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# Preface

The annual EGOV conference assesses the state of the art in e-government/ e-governance and provides guidance for research, development and application in this fast-moving field. EGOV 2005 in Copenhagen built on the achievements of the preceding conferences (EGOV 2004 in Zaragoza, EGOV 2003 in Prague, EGOV 2002 in Aix-en-Provence). The EGOV conferences have become a reunion for academics and professionals worldwide. In that way, EGOV conferences provide both an exchange on the state of affairs concerning e-government developments and a basis for networking and building the community.

EGOV 2005 brought some changes in the outline and structure of the conference. In line with the growing number of submissions the conference was more structured and the reviewing process was more formalized, adopting a double-blind peer-review procedure.

The new design of EGOV safeguards the scientific quality and guarantees up-to-date information together with a discussion of the state of the art and of emerging themes in the field. Hence EGOV 2005 had both research sections and a workshop part. It comprised completed research and research in progress, workshop and poster presentations, and a PhD student colloquium. The proceedings volume published by Springer, Heidelberg includes the papers presented in the conference part. The volume published by Trauner, Linz contains the EGOV workshop and poster contributions.

This year's conference bore the message: *E-government is Both a Vision and a Construction Site*. Consequently, a considerable set of themes was covered in several streams:

- Visions, challenges and frameworks
- Policies and strategies
- Methods and tools
- Technologies
- Design aspects
- Interoperability and standards
- Knowledge management and semantic modelling
- E-participation
- Electronic services
- GIS (geographical information systems)
- Monitoring and performance indicators

Many people worked to form the conference and to prepare the program and the proceedings. So the members of the Program Committee and Gabriela Wagner who headed the DEXA organization deserve acknowledgement. In particular, the editors express thanks to Gerti Orthofer and Michael Leitner;their

exceptionally engaged assistance in preparing both the program and the proceedings was decisive for success.

Vienna, Linz, Ørebrø, Copenhagen
August 2005

Maria A. Wimmer
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# Organization

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# Organizational Transformation Through E-Government: Myth or Reality?

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**Abstract.** The field of e-Government (e-Gov) is still in the phase of finding and defining its research agenda and its accepted research standards and methods. How does e-Gov research differ from traditional public management information systems (PMIS) research? Also, to what extent does e-Gov represent a new tradition of research in terms of the subject area and the research paradigm? To what extent does government change through e-Gov? While one group of e-Gov researchers emphasizes the transformational impact of e-Gov on the business of government, others have squarely questioned this assertion. This paper contributes to the debate and to the definition of the research agenda by discussing various dimensions of organizational transformation, and how they relate to the phenomenon of e-Gov. It suggest that e-Gov, at least in the short term, has the capacity to transform the business of government in mode rather than in nature.

## 1 Introduction

Traditional PMIS research has studied the use and impact of information technology (IT), now commonly referred to as information and communication technology (ICT), in government for decades (for example [4], [5], [7], [8], [43]). Accounts of fundamental transformation in government through the use of traditional PMIS are in short supply. By and large, PMIS it appears had just an incremental effect on the business of government through automating ("manumating", [31]) or computer-aiding existing processes and procedures, while processes and structures basically remained unchanged.

In a larger, sector-unspecific context, the capacity of ICT for bringing about organizational change, and in its wake also more fundamental organizational transformation, has been questioned altogether [48]. As the authors point out the magic trick assumption, according to which the introduction of new ICT systems deterministically induces organizational change lacks empirical support. Several recent empirical accounts seem to suggest similar low-impact outcomes for e-Gov projects [24], [27], [32], [33], while others observe and document change in government business processes [16], [45], [46], [47]. Hence, the extent of e-Gov induced transformation, if any, is unclear. However, should further empirical evidence confirm the non-transformational impact, then the fledgling academic field of electronic Government would lose its claim to originality and relevance

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as a discipline in its own right. At best, e-Gov would be considered a sub-department of existing PMIS research, amounting to little "more than good practice in ICT-enabled change" [27].

This paper discusses the elements, indicators, and dimensions of organizational transformation in general and develops a framework, which helps distinguish the transformational dimensions in government through e-Gov projects and practice. By so doing, it also paves the way for further debate on the foundations, methods, and the research agenda of e-Government as a discipline. The paper is organized as follows: First, the concepts of organizational transformation in the literature are discussed. Then, those concepts are related to ICT-enabled change as observed in e-Gov practice. Finally, propositions for empirical testing are proposed, and suggestions for an e-Gov-related research agenda on organizational transformation are made.

## 2 Organizational Transformation (OT)

While the traditional organizational literature influenced by the Weberian research stream sees the organization as a nexus of structure, standard routines, and procedures geared to greatly reduce internal and external uncertainty, provide stability, and organizational self-perpetuation independent from individual human agents [35], newer contributions portray the organization as a locus of and a means for orchestrated and controlled adaptation [44], [52]. In this latter tradition, change is interpreted as a continuous process over time ("becoming") based on an inherent property of human organization to facilitate and breed change, whereas the former research tradition views the phenomenon of change as either a planned and carefully executed sequence of steps from a former state to a more desired state, or as a series of discrete, cataclysmic, and mostly external perturbations, which, at the risk of total disintegration, drive an organizations away from a state of equilibrium, while it undergoes a transitional process from a former to a later homeostatic state.

Most literature on organizational transformation implicitly follows the traditional assumption, although the notion of "loosely coupled elements" ready for re-alignment and re-grouping [54] might be viewed as bridge between the two interpretations of the nature of organization. In this vein, the individual gestalt of organizations has been recognized as influential in organizational transformation, since it consists not only of structural properties but also of overarching patterns rooted in human agents' values, beliefs, and assumptions, which become engrained in structures and systems as an interpretive scheme [20].

Smith distinguishes the dimensions of *morphostasis* and *morphogenesis* in organizational transformation [49]. According to the author, morphostatic changes can either be of only superficial character, that is, no essential change occurs; or, they take on the form of "a natural expression of the developmental sequence" [49], as found, for example, in maturation or saturation processes. In other words, no fundamental change in essence takes place. In sharp contrast, morphogenetic changes are deep, permanent, and irreversible altering the "very

essence" [49] of the organization. Those two dimensions of organizational transformation have also been referred to as "first-" and "second-order" changes [53], the former of which are incremental and planned reaching for "minor improvements and adjustments," while the latter extend to a "multi-dimensional, multi-level, qualitative, discontinuous, radical organizational change involving a paradigmatic shift" [28]. Planned change initiatives as proposed and studied in the Organizational Development (OD) literature [1], [3], [12], [17], [29], hence, mostly fall in the category of first-order change, whereas business reengineering efforts [9], [13], [14], [21], [22] would be geared for second-order change.

The aforementioned newer school in organization theory advocates lending "theoretical priority to *microscopic* change" brought about "by adaptation, variations, rest-less expansion, and opportunistic conquests" [52]. Unlike the traditional structure- and routine-focused view, the process view of the organization as a journey of "becoming" appears to have much in common with first-order, morphostatic change as a maturation and aging process as developed in the earlier organizational transformation literature.

Empirical research on organizational transformation in government has found evidence for successful and effective first-order change [18], [40], [41]. Practical attempts of applying rapid second-order change in the private sector via Hammer-style reengineering have proven mostly unsuccessful [21]. For the public sector such accounts are missing or inconclusive (for example [15]). Systemically, radical and disruptive change in context of the intentional and effective division and distribution of powers as it is characteristic for the public sector seems to be highly unlikely, in other words, the missing of true-to-label reengineering accounts from the public sector is unsurprising.

Second-order change in the public sector, hence, may come about only over long periods of time along with a gradually changing interpretive scheme [20] as for example indicated through the growing influence of principles lent from *New Public Management* (NPM) [25], [38], [39] and according legislation (for example, the Government Performance and Reform Act of 1993 in the US) over those from traditional public ad-ministration (PA) (cf., also [19]). In summary, organizational transformation in the public sector is of comparatively slow pace and is mostly first-order change oriented. Organizational "drift", "spread", "slippage," and "creep" [52], that is, evolutionary transformation, are the much more likely drivers and embodiments of change in the public sector than second-order or revolutionary transformations.

## 3 Information Technology and Organizational Transformation

MIS scholars have long attempted to demonstrate that ICT is a guarantor of performance improvements as well as other desirable outcomes in OT to the effect that

$$o = f(i) \tag{1}$$

with $o$ as organizational outcome and $i$ as the ICT input.

In other words, the desired organizational outcome would simply be a function of the ICT input in a straightforward deterministic fashion [30]. In recent years, this perspective has increasingly been challenged both empirically and theoretically [26], [42], [48], as it became obvious that the same inputs would also lead to different outcomes, or, even different inputs would yield the same outcomes including no change or even detrimental impacts. The effect of ICT on OT is "contradictory" [42] at best. Human agents, organizational systems, and ICT are linked in a circular fashion [34], [37], such that "information technologies are produced by the very social structures that they promise to transform" [42].

Inasmuch as ICT can play an enabling role in one given context of OT, it can also assume the role of a disabler and inhibitor in another OT context. Overall, ICT can be viewed as an "ingredient in a more complex process of social change, in which forces for transformation are frequently offset by forces for persistence" [42]. In government, the role of ICT cannot be assumed different. In fact, accounts of ICT-related OT problems have been well documented leading to legislation intended to correct the problems [2]. However, even after those interventions, federal ICT policies were still found in conflict and competition (ibid.). Electronic Government, on the other hand, has been praised as "good governance in the information society" based on advanced ICT leading to a "change in culture" and becoming a "way of life" that reaches far beyond the first-order change aims of NPM [51]. E-Government would lead to the modernization and restructuring of public organization by means of re-engineering [50]. In other words, e-Gov is expected to bring about nothing less than second-order change.

From what has been presented so far, it follows that e-Gov resides in an organizational, political, and social context, which is highly guarded against swift and radical change. Moreover, the interpretive scheme in the e-Gov-related context structures and systems is held in place via powerful constitutional, statutory, and regulatory measures, which add to the systemic resistance to change. For a radically new interpretive scheme of e-Gov as outlined above, hence, it is hard to imagine that it would ever develop quickly and without tremendous friction.

Finally, with ICT as just an indeterminate ingredient of e-Gov rather than a driver and enabler, one could conclude that the prospects for the Traunmüller/Wimmer vision of e-Gov are bleak, or even unreasonably speculative, and justifiably reject the scientific relevance and foundation of the nascent field altogether. However, the line of reasoning laid out in the following section leads to a different conclusion.

## 4 A Neo-Hegelian Foundation for E-Government Research

In his famous publications on American industrial history, Alfred Chandler analyzes and portrays the growth and spread of industrial organizations in the 19th century [10], [11]. In his assessment, the two enabling technologies of rail-way and telegraph were instrumental for the genesis and rise of large, nationwide-

operating, and managerial firms, which were able to significantly increase both the speed and the volume of industrial production. Although the technologies did not "cause" the rise of the large managerial firm, the rapidly emerging infrastructures made possible and required large-scale integration and control, and vice versa. The role of the enabling technologies was necessary, however, not sufficient. Without an entrepreneurial and managerial vision and without the identification of the economic opportunity on the part of human agents, "big business" would not have emerged. The rise of big business reinforced the rapid emergence of a modern transportation and communication infrastructure, while, in turn, the emerging infrastructure reinforced the rise of big business. At a certain point, when a critical mass was reached, the new interpretive scheme and its structure superseded and marginalized the earlier one, and a new dominant type of industrial organization had established itself. A second-order transformation had occurred.

A similar development has been observed in the context of the Internet and the Worldwide Web. While a few hundred military and educational institutions used the Net and the Web in the early 1990s, its commercialization brought about an avalanche of new uses, new business opportunities, and new information practices, which changed the structure of organizations and industries. In contrast, the "manumation" [31] of processes through traditional MIS never facilitated such rapid change in strategy and structure.

It is also noteworthy to mention that no single account exists that predicted the exponential diffusion of the Net and the Web ex ante. As in the case discussed before, it was not the technology that "caused" the transformation. Human agents, again, began seizing the business opportunity, which reinforced the spread of the technology, and vice versa. However, there is more to this development than the notion of the reinforcing feedback loop.

As Hegel observes, a change in quantity leads to a change in quality, and vice versa ([23], §108). Tsoukas & Chia's small steps, creeps, and spreads may account for little, however, when accumulating over time, a new quality emerges. In other words, a long series of first-order changes results in a second-order change. Further, once the rate of change in quantity increases, then also increases the rate of change in quality. Paradoxically, the change in quality occurs even though essential elements remain unchanged. For example, the aircraft carrier is still a seagoing naval vessel, which leaves port and crosses the oceans much like any other vessel. However, at the same time, it has the quality of a fully functional airbase. Moreover, it has changed the nature of naval warfare, once and forever. It obliterated the concept of the battle ship. The carrier launches and lands aircraft while underway.

From a different perspective, the mounting of an airbase on top of a ship has also significantly changed the quality (and the roles) of a military airbase, although the routines of operating a ship-mounted airbase are not fundamentally different from a land-based one. The concept of the aircraft carrier transforms both the concepts of airbase and naval vessel. Moreover, it transforms the nature of (naval) warfare.

Technology re-combination and diffusion over time changes its utility (quality), which reinforces human agents' seeking for opportunity leading to an expansion of technology-enabled structure (quantity), and vice versa. These quantity/quality transformations are facilitated and shaped within the triangular relationship between human agents, institutional system, and information technology [34], [36], [37]. When using these lines of reasoning in the context of electronic government research as discussed in this and the previous sections, one arrives at the following propositions:

*Proposition #1:* Successful first-order changes through electronic Government reinforce e-Government diffusion.

*Proposition #2:* E-Government diffusion reinforces government's seeking of opportunities for successful first-order changes.

*Proposition #3:* First-order transformation through electronic Government can be observed more frequently in the earlier stages of its development rather than in the later stages.

*Proposition #4:* Second-order transformation through electronic Government can be observed more frequently in the later stages of its development rather than in the earlier stages.

*Proposition #5:* Second-order transformation through electronic Government can result from a long sequence of first-order changes.

*Proposition #6:* Second-order transformation through electronic Government can also result from a high rate of first-order changes.

*Proposition #7:* Second-order transformation through electronic Government occurs more frequently as a consequence of a long sequence of first-order changes rather than from a high rate of first-order changes.

*Proposition #8:* E-Gov research is likely to yield contradictory and indeterminate results when studying the efficacy of technology-enabled interventions on government practice in a deterministic fashion.

*Proposition #9:* E-Gov research is more likely to uncover the drivers and dynamics of the complex social processes yielding first-order and second-order organizational transformation induced by e-Government practice when employing a multi- and interdisciplinary perspective rather than when employing a single-disciplinary perspective.

Further, so far, empirical research has predominantly focused on the most visible occurrences and artifacts of e-Government such as public government websites as well as publicly observable transactions between governments and private-sector businesses. Hence, the two dimensions of e-Government, to which much, if not a majority of research has been dedicated, are those of government-to-citizen (G2C) and government-to-business (G2B). However, the other dimensions of e-Government, that is, government-to-government (G2G), government-to-employees (G2E), and internal effectiveness and efficiency (IEE), have attracted much less empirical research. Paradoxically, it is those latter dimensions, to which much of the attention of government practitioners and notably much of the tax dollars are directed [6]. In other words, it seems not unlikely that the dimensions of (1) highest activity and (b) highest potential internal impact in terms of both first- and second-order change in government, that is, G2G, IEE, and G2E, have remained grossly understudied, at least in proportion. Current e-Government research might possibly suffer from the iceberg phenomenon (see figure 1), where most attention is dedicated to the above surface phenomena, while "sub-surface" phenomena not readily available to scientific scrutiny have been spared. Consequently, many behind-the-scenes first-order changes might have escaped the radar screen of e-Government research. Research concerned with the nature and extent of organizational transformation through e-Government, this paper suggests, needs to expand into those dimensions of G2G, IEE, and G2E. Changes, if any, might not become widely visible within short, which is why longitudinal research needs to establish points of departure and reference as soon as possible.

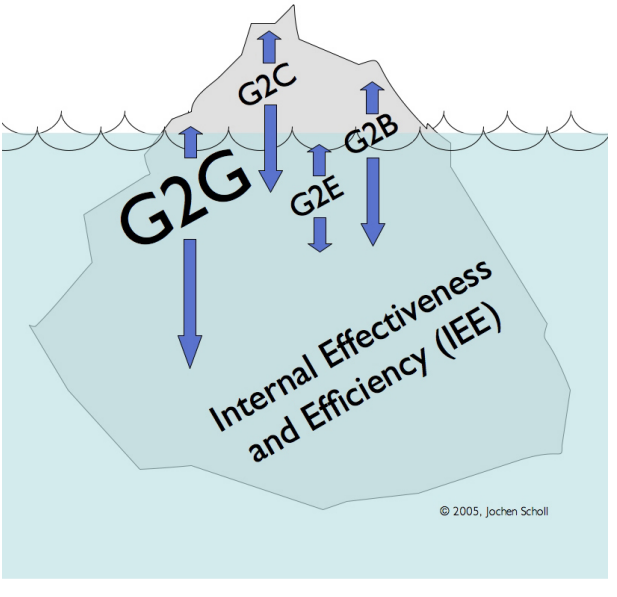


**Fig. 1.** The Iceberg Phenomenon of e-Gov Research

*Proposition #10:* E-Gov research is more likely to uncover first-order and second-order organizational transformation induced by e-Government practice when focusing on the dimensions of G2G, IEE, and G2E rather than when confining itself to the publicly visible portions of G2B and G2C.

## 5 Concluding Remarks

In this paper, I have reviewed the OT and the OT-related ICT literatures and linked them to the theory and practice of e-Government research. The paper has clarified the terminology regarding organizational transformation and preliminarily assessed the transformational capacity of electronic Government on the business of government.

It charts out a research agenda for the study of organizational transformation though electronic Government. It also proposes that research in this area requires the employment of multi- and interdisciplinary perspectives in order to cope with the complexities of the social and political process.

The paper further suggests focusing on the G2G, IEE, G2E rather than G2B and G2C dimensions when researching the transformational impacts and outcomes of e-Government practice. Such transformations might become visible only over time, which is why longitudinal research projects to this extent need to be launched as soon as possible, in order to establish the status quo ante. Longitudinal studies to that end have the capacity to trace both the actual process and the effect of organizational transformation through e-Government, which ex post might become untraceable in sufficient detail.

Finally, by presenting testable propositions in the context of charting out a research agenda for the transformational effects of e-Government practice, this paper asserts the capacity of e-Government research as a field of study in its own right.

## References

1. Argyris, C. (1971). Management and organizational development; the path from xa to yb. New York: McGraw-Hill.
2. Beachboard, J. C., & McClure, C. R. (1996). Managing federal information technology: Conflicting policies and competing philosophies. Government Informa-tion Quarterly, 13(1), 15-33.
3. Beckhard, R., & Harris, R. T. (1987). Organizational transitions: Managing complex change (2nd ed.). Reading, Mass.: Addison-Wesley Pub. Co.
4. Bozeman, B., & Bretschneider, S. (1986). Public management information systems: Theory and prescriptions. Public Administration Review, 46(November (spe-cial issue)), 475-489.
5. Bretschneider, S. (1990). Management information systems in public and private or-ganization: An empirical test. Public Administration Review, 50(September/October), 536-545.

6. Bush, G. W. (2002). e-Gov: The official web site of the president's e-Government initiatives. Retrieved 10/23/, 2003, from http://www.whitehouse.gov/omb/egov/
7. Caudle, S. L. (1994). Reengineering for results: Keys to success from government experience. Washington, D.C.: Center for Information Management, Na-tional Academy of Public Administration.
8. Caudle, S. L., Gorr, W. L., & Newcomer, K. E. (1991). Key information systems management issues for the public sector. MIS Quarterly, 15(2), 171-188.
9. Champy, J. (1995). Reengineering management: The mandate for new leadership (1st ed.). New York: HarperBusiness.
10. Chandler, A. D. (1962). Strategy and structure: Chapters in the history of the indus-trial enterprise. Cambridge: M.I.T. Press.
11. Chandler, A. D. (1977). The visible hand: The managerial revolution in American business. Cambridge, Mass.: Belknap Press.
12. Cummings, T. G., & Worley, C. G. (2005). Organization development and change (8th ed.). Mason, Ohio: Thomson/South-Western.
13. Davenport, T. H., & Short, J. E. (1990). The new industrial reengineering: Information technology and business process redesign. Sloan Management Review, 31(Summer), 11-27.
14. Davenport, T. H., & Stoddard, D. B. (1994). Reengineering: Business change of mythic proportions? MIS Quarterly, 18(2), 121-127.
15. Dudley, L., & Raymer, M. (2001). Inside organizational change: Puzzling across permeable boundaries. Public Administration Review, 61(5), 620-624.
16. Fountain, J. E. (2001). Building the virtual state: Information technology and institu-tional change. Washington, D.C.: Brookings Institution Press.
17. Golembiewski, R. T. (1990). Ironies in organizational development. New Brunswick, N.J., U.S.A.: Transaction Publishers.
18. Golembiewski, R. T., Proehl, C. W., & Sink, D. (1981). Success of OD applications in the public sector: Toting up the score for a decade, more or less. Public Administration Review, 41(6), 679-682.
19. Gow, J. I., & Dufour, C. (2000). Is the new public management a paradigm? Does it matter? International Review of Administrative Sciences, 66(4), 573-597.
20. Greenwood, R., & Hinnings, C. R. (1993). Understanding strategic change: The con-tribution of archetypes. Academy of Management Journal, 36(5), 1052-1081.
21. Hammer, M. (1996). Beyond reengineering: How the process-centered organization is changing our work and our lives (1st ed.). New York: HarperBusiness.
22. Hammer, M., & Champy, J. (1993). Reengineering the corporation: A manifesto for business revolution (1st ed.). New York, NY: HarperBusiness.
23. Hegel, G. W. F. (1986). Wissenschaft der Logik. Hamburg: F. Meiner.
24. Holden, S. H., Norris, D. F., & Fletcher, P. D. (2003, January, 5-8). Electronic gov-ernment at the grass roots: Contemporary evidence and future trends. Paper presented at the 36th Hawaiian International Conference on System Sci-ences, Waikoloa, Big Island, HI.
25. Hood, C. (1995). The "new public management" in the 1980s: Variations on a theme. Accounting, Organization and Society, 20(2/3), 93-109.
26. Huber, G. P. (1990). A theory of the effects of advanced information technologies on organizational design, intelligence, and decision making. In J. Fulk & C. W. Steinfield (Eds.), Organizations and communication technology (pp. 237-274). Newbury Park, Calif.: Sage Publications.
27. Kawalek, P., & Wastall, D. (2005). Pursuing radical transformation in information age government: Cases studies using the sprint methodology. Journal of Global Information Management, 13(1), 79-101.

28. Levy, A., & Merry, U. (1986). Organizational transformation: Approaches, strategies, theories. New York: Praeger.
29. Margulies, N., & Raia, A. P. (1971). Organizational development; values, process, and technology. New York: McGraw-Hill.
30. Markus, M. L., & Benjamin, R. I. (1997). The magic bullet theory in it-enabled trans-formation. Sloan Management Review, 38(2), 55-68.
31. Mohan, L., & Holstein, W. K. (1998). Decision support systems: An applications per-spective. Albany: Unpublished draft.
32. Norris, D. F. (2004, Aug 30 to Sep 3). E-Government impacts at the American grass-roots: An initial assessment. Paper presented at the Third International Conference, EGOV 2004, Zaragoza, Spain.
33. Norris, D. F. (2005, January, 5-8). E-Government at the American grassroots: Future trajectory. Paper presented at the 38th Hawaiian International Conference on System Sciences, Waikoloa, Big Island, HI.
34. Orlikowski, W. J. (1992). The duality of technology: Rethinking the concept of tech-nology in organizations. Organization Science, 3(3), 398-427.
35. Orlikowski, W. J. (1996). Improvising organizational transformation over time: A situated change perspective. Information Systems Research, 7(1), 63-92.
36. Orlikowski, W. J., & Barley, S. R. (2001). Technology and institutions: What can research on information technology and research on organizations learn from each other? MIS Quarterly, 25(2), 145-165.
37. Orlikowski, W. J., & Robey, D. (1991). Information technology and structuring of organizations. Information Systems Research, 2(2), 143-169.
38. Osborne, D., & Gaebler, T. (1992). Reinventing government: How the entrepreneurial spirit is transforming the public sector. Reading, Mass.: Addison-Wesley Pub. Co.
39. Peters, B. G., & Savoie, D. J. (1995). Governance in a changing environment. [Ottawa]; Montreal; Buffalo: Canadian Centre for Management Development; McGill-Queen's University Press.
40. Peters, B. G., Savoie, D. J., & Canadian Centre for Management Development. (1998). Taking stock: Assessing public sector reforms. Montreal; London; Buffalo: McGill-Queen's University Press.
41. Robertson, P. J., & Seneviratne, S. J. (1995). Outcomes of planned organizational change in the public sector: A meta-comparison to the private sector. Public Administration Review, 55(6), 547-558.
42. Robey, D., & Boudreau, M.-C. (1999). Accounting for the contradictory organizational consequences of information technology: Theoretical directions and methodological implications. Information Systems Research, 10(2), 167-185.
43. Rubin, B. M. (1986). Information systems for public management: Design and im-plementation. Public Administration Review, 46(Special Issue), 540-552.
44. Sarason, S. B. (1972). The creation of settings and the future societies ([1st ed.). San Francisco: Jossey-Bass.
45. Scholl, H. J. (2004). The dimensions of business process change in electronic government. In W. Huang, K. Siau & K. K. Wei (Eds.), Electronic government strategies and implementation (pp. 44-67). Hershey PA.: Idea Group Pub.
46. Scholl, H. J. (2005a). E-government-induced business process change (BPC): An em-pirical study of current practices. International Journal of Electronic Government Research, 1(2), 25-47.
47. Scholl, H. J. (2005b). Motives, strategic approach, objectives & focal areas in e-Gov-induced change. International Journal of Electronic Government Research, 1(1), 58-77.

48. Schwarz, G. M., & Brock, D. M. (1998). Waving hello or waving good-bye? Organizational change in the information age. International Journal of Organiza-tional Analysis, 6(1), 65-86.
49. Smith, K. K. (1982). Philosophical problems in thinking about organizational change. In P. S. Goodman (Ed.), Change in organizations: New perspectives on the-ory, research, and practice (1st ed., pp. 316-374). San Francisco: Jossey-Bass.
50. Traunmueller, R., & Wimmer, M. A. (2003, Sep 1 to 5). E-Government at a decisive moment: Sketching a roadmap to excellence. Paper presented at the EGOV 2003, Prague, The Czech Republic.
51. Traunmueller, R., & Wimmer, M. A. (2004, Aug 30 to Sep 3). E-Government: The challenges ahead. Paper presented at the EGOV 2004, Zaragoza, Spain.
52. Tsoukas, H., & Chia, R. (2002). On organizational becoming: Rethinking organizational change. Organization Science, 13(5), 567-582.
53. Watzlawick, P., Weakland, J. H., & Fisch, R. (1974). Change; principles of problem formation and problem resolution ([1st ed.). New York: Norton.
54. Weick, K. E. (1982). Management of organizational change among loosely coupled elements. In P. S. Goodman (Ed.), Change in organizations: New perspec-tives on theory, research, and practice (1st ed., pp. 375-429). San Francisco: Jossey-Bass.

# The Governance of Back Office Integration in E-Government: Some Dutch Experiences

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**Abstract.** Should back office integration in e-government seen as a top down project management problem, emphasising strong leadership, or as a governance problem, focusing on organizing cooperation between information domains? A comparison of four Dutch case studies, shows that successful back office integration is being perceived as managing a process of creating a shared understanding between actors. Although project management methods identify risks in several environments, these environments are not neutral but loosely and closely related arenas with competing rationalities. Essential is the mutual recognition of core values and the interdependency between them (win-win). Interdependency can only be recognized, if actors focus on the nature of the problem and not on the allocation of competences and costs and benefits. Trust and external pressure are favouring cooperation. Moreover, it is important to anticipate on a changing political agenda. Project management methods are not obsolete, but they operate well in a stabilized environment.

## 1 Introduction

A bottleneck in electronic government is the co-operation between front office and back office and between back offices, which obstructs the seamless exchange of information. However, one can question the integration approach that is proposed in some writings .Top down project management, vertical integration of government layers, and strong leadership have been seen as necessary conditions for back office integration, which is primarily defined as a (project and information) management problem, as a problem of redesigning the machinery of government (OECD, 2003).

Will such a vertical orientation on back office integration be effective, if we look at the rather horizontal nature of the exchange relationships between these offices? Does it recognize that information itself is a powerful resource that is used to protect specific interests? From this perspective back office integration can also be seen as a governance problem, as a co-operation problem between quasi-autonomous information domains.

In this article we present the results of a comparative case study, in which four back office integration projects in the Netherlands have been studied. Our goal has been to identify critical factors which account for the success of ICT-driven

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back office integration projects. In each case study we have asked stakeholders to give us the main reasons, why the integration of the involved offices has been successful, looking at the complex mixture of co-operation and conflict between them. And, what do these findings tell us about the way back office integration should be organized? Is this primarily as management or a governance challenge?

In section two some interoperability problems of back office integration have been elaborated. In section three we have presented some theoretical notions which have been used to define back office integration as a co-operation problem between information domains. These notions have been translated in an empirical research strategy (section four). Some research results will be presented in section five. In section six several conclusions have been drafted.

## 2 Interoperability Problems and E-Government

Narrowly defined, e-government refers to the production and delivery of government (information, interaction and transaction) services through the use of ICT [15]. Traditionally, a citizen is confronted with many offices, which perform different tasks in relation to a specific public service. ICT enables government to organize their service delivery in a customer-friendlier, integrated and responsive way. Due to the integration of services interoperability problems will arise (see next table).

**Table 1.** Types of interoperability problems [16]

| Types of interoperability problems | Elaboration |
|---|---|
| Administrative interoperability | Conflicting and overlapping formal tasks and competences of offices; Diversity and plurality of offices due to complexity and differentiation of public administration. |
| Operational interoperability | Unclear which office should handle a specific case. Absence of integral case management and integrated working procedures |
| Multi-channel interoperability | No mutual adjustment between communication channels procedures and routines of offices as well as no updated content of the information provided |
| Technical interoperability | Incompatibility of specific 'legacy' ICT-infrastructure (hard and software) |
| Semantic interoperability | Absent ontology of services, absence of common identifiers of target groups and absence of common data definitions |
| Legal interoperability | Legal obligations obstruct gathering additional information or combining existing information which comes from other offices |
| Cultural interoperability | Conflicting organizational cultures and grown practices |

Interoperability problems are often put forward to obstruct collaboration between back offices. Simultaneously integration models, which try to create a shared information domain in order to manage interorganizational interdependency, are being introduced to overcome these problems ([14]; [13]).

The first way is to re-engineer the service delivery process through the introduction of a virtual front office, in which several agencies work together and which provides information and contact/interaction services. Sometimes a common information domain portal is created on top of the existing back offices – a internet portal – which provides a single entry-point.

The second option is the integration of back offices through centralization. One super-ordinated back office is created which uses the communication and transaction channels of other organizations in order to provide equivalent services. These organizations use a common, 'pooled' information source.

When back offices operate as sequential links in the same service delivery chain, another option is to improve the exchange of information within the chain through the introduction of workflow and supply chain information management. A common information domain is being created, when a specific case is handed over from one part to another part in the chain. Back office integration, as a product of sequential interdependency, implies the management of the information interfaces between the links in the chain.

However, it is also possible to use an intermediary information service, which operates as an information broker or clearing house. This broker facilitates the exchange of information between the demand for and supply of information within the chain. One can speak about procedural integration: developing standardized interorganizational exchange procedures that respect the intra-organizational autonomy of the offices involved [1].

A fourth model reaches even further. The distinction between front office and back offices gets blurred, when these offices use the same database, consisting unique information, which identifies the status of a person or object. The data is collected at one administrative point, in relation with one administrative procedure, and is used and re-used by several other agencies in relation to other services. One can speak about substantial integration: developing shared data definitions in a network of front and back offices which is based on reciprocal interdependency [1].

Back office integration implies that the 'raison d'etre' of existing information domains is being challenged, which can lead to a complex mix of obstruction and collaboration. How can we understand this?

## 3 The Integration of Information Domains

Typical for many back office integration projects are the rather horizontal relationships between them. No back office organization is able unilaterally to enforce its will. One the one hand back offices are rather autonomous organizations which try to protect their own interests; on the other hand they are part of the same logistic and administrative chain (or even network) of activities in

which each back office fulfils a specific task in de handling of certain cases, requests, assessments etc. Each office controls specific resources – like information, knowledge, experiences, authority, money, competences – but at the same time it is also dependent of resources which are controlled by other offices [17].

Each back office has its own information domain. This is a unique sphere of influence, ownership and control over information – its specification, format, exploitation and interpretation [2]. An information domain can be said to exist where significant control over access has been established, so that information is withheld or surrendered on terms, or in a form, negotiated by dominant actors. Thus, the existence of an information domain is signalled by a) a break in flows of information, b) compartmentalisation of information resources, c) idiosyncrasy of information specifications and d) the hegemony of specific discourses that shape information and influence in its creation and interpretation [3].

The introduction of e-government implies that established information domains are being challenged. The boundaries between them begin to blur, or even new domains emerge, which can lead to a complex mixture of conflict and cooperation ([14]; [1]; [9]). According to the resource dependency-theory, the strategic behaviour of these back offices, in terms of conflict, competition, exchange, negotiation and co-operation, can be understood in terms of, how stakeholders perceive the nature and degree of the uncertainties and dependencies which resolve from a more intensive and coordinated exchange of information between them ([17]). They are willing to set up information systems that cross organizational boundaries, if they are able to minimise their dependency on other organizations or are to maximise the dependence of other organizations on them ([4]; [1]). This will lead to shifts in power, because they touch upon culturally or professionally accepted procedures that may not be given up easily. They may even result in back offices losing their reasons to exist. ([14]; [3]) Therefore, back office integration should be understood in terms of 'information politicking' [10]. How can we accept information politicking on the one hand, while on the other hand collective action is needed? Two perspectives can be discerned ([7]; [9]).

The first perspective is the information management perspective, in which project management techniques are dominant. In this approach centralization of competences is seen as a prerequisite for the definition of a super-ordinated goal in order to overcome the variety of interests. A proper implementation of ICT, which is seen as a neutral set of tools, can only be managed through the centralisation of power. Command and control is used to overcome resistance. The horizontal character of back office relations can re-designed through the introduction of a temporary hierarchy. A temporary endeavor is undertaken in order to create an decomposed information and system architecture (including standardized data formats, terms of use and uniform information handling procedures) as the backbone of the information exchange between back offices. Goals are fixed and formalized, and implementation is carried out in a step-by-step manner, which enables a rather easier and speedier identification of interim and end results within specific time periods. This enhances the controllability of the project.

In advanced project management methods, the identification of risks, related to factors in different (political, technological, organizational and legal) environment has been perceived as crucial in safeguarding the project's progress ([7]; [8]). Disturbances are also related to organizational characteristics, like the organizational structure and culture, staffing and skills, organizational processes, management style or the existing ICT infrastructure [8]. The awareness of potential risks, through a risk-analysis at forehand, enables a project manager to anticipate on these risks and, due to the power he has, he can act in order to secure the accomplishment of the desired goals. Hence, command and control are important.

In the second approach, the network character of the relationships between the back offices and their information domains is accepted as well as the fact that ICT and information are powerful resources which can be used strategically ([14]; [7]). Back office integration is defined as a governance challenge, as a challenge of process management instead of project management ([3]; [2]). Governance can be described as the process of horizontal coordination, in which different actors are involved in creating a shared understanding and definition of the problems they are confronted with, and of measures to be taken ([11]; [12]). From this perspective back office integration can be seen as the co-production of a common e-government practice through interaction, communication, negotiation and exchange in a self-organizing network of back offices [18]. This common practice, or common information domain, is formulated in several rounds and in several – closely and loosely linked – negotiation arenas, in which actors try to define a dynamic balance between (qualitative and quantitative) costs and benefits (in the short but also in the long run), so that a 'win-win' situation emerges, which is based on the recognition of interdependency.

From a process management perspective ([5]; [12]) the creation of a shared understanding about the necessity of back office integration, is influenced by respecting the core values and interests of the back offices involved. At the same time is important to define, how these stakeholders are mutually dependent from each other in the realization of their core values. Moreover, changing circumstances can make it necessary to re-define this shared understanding, while at the same time trust seems to be important to (re-)define interdependency. Are these notions recognized in the practice of back office integration?

## 4 Research Strategy

We have asked key-figures who have been involved in four back office integration projects, which factors have contributed to their success and what does this imply for the further development of e-government? Should we define back office integration as a management or governance challenge?

In order to guarantee the comparison of the cases we have used a semi-standardized format which consists of the following items: a) an analysis of the involved back offices and their core values; b) an analysis of the perceived

**Table 2.** Case characteristics

| Case\ Characteristics | Redesign housing subsidy (EOS) | Clearing house social security (RINIS) | Municipal Citizen's Residential Information Register (GBA) | New Vehicle License Register (NKR) |
|---|---|---|---|---|
| Goal of back office integration | Efficiency improvement through process redesign | Fraud detection of social benefits and quality service delivery | Modernizing local registry offices; later on public service delivery and fraud detection | Traffic safety by increasing the effectiveness of the liability of vehicle (used car) ownership |
| Actors involved | Ministry of Housing (initiator), municipalities, housing associations, private rental agencies, more than 1.000.000 recipients | Variety of organizations which give unemployment benefits and other social security compensations (bottum-up initiative) | Ministry of the Interior (initiator), more than 500 municipalities and 300 public and private users like the Tax and Customs Administration, regional health (vaccination) agencies but also pension and insurance companies | Ministry of Traffic (initiator), Vehicle Licence Register Agency, garages, post offices and the police |
| Type of dependency and integration model | Pooled interdependency through the sharing of a common database. Centralisation of the back office | Procedural integration: Information broker and shared exchange procedures which facilitates the exchange of information demand and supply between sequential interdependent organizations. Is evolving into a networked interdependency between sequential chains. | Reciprocal or networked interdependency as well as substantial integration through a standardized registration model, which facilitates the exchange of common data as well as development of a common exchange network | Substantial integration and centralization of back offices through a common pool database which facilitates (a network) of several service delivery chains of front offices |
| Ownership | Ministry of Housing | The participating organizations | Residential information by the municipalities; network by Ministry of the Interior | The Vehicle License Register Agency |

| | | | | |
|---|---|---|---|---|
| Dominant interoperability Problems | Administrative, operational, multi-channel, technical, semantic, legal and cultural interoperability problems | Administrative, technical, semantic and legal interoperability problems | Administrative, operational, technical, semantic, legal and cultural interoperability problems | Administrative, operational, multi-channel, technical, semantic, legal and cultural interoperability problems |

resource dependency between the involved back offices; c) an analysis of the factors which contributed to the definition of a shared information domain; and d) an analysis of the circumstances under which a project management and/or process management approach contributes to the effective integration of back offices.

We have selected four successful back integration projects, based on a) the reputation of the project and b) on a match with the described integration models. We did not look for a case that matches the portal model of integration, because comparatively to the other models the interoperability problems are less. In the table 2 several characteristics of the projects have been described.

## 5 The Practice of Back Office Integration

In this section we have described the major lessons learned, based on a comparison of the four cases.

### 5.1 Managing Multi-rationality in Different Arenas

The first lesson shows that attention should be paid to the management of different rationalities that compete with each other and that have a legitimacy of their own. Each rationality stresses the importance of specific core values and specific interoperability problems which are not always complementary. The following rationalities have been put forward: the political, legal, organisational, economic and the (information) technological rationality. In table 3 we show which core values have been competing.

**Table 3.** Competing core values

| | Housing subsidy system | Clearing house social security | Municipal Residence Information Register | Vehicle License Register |
|---|---|---|---|---|
| Core values | Efficiency versus income redistribution versus organizational change | Efficiency and efficacy of law enforcement (fraud) versus organizational autonomy | Local autonomy versus privacy versus technological innovation | Public safety versus privacy versus organizational change |

In the Municipal Residents Information Register (in Dutch: GBA) several rationalities competed which each other. From the political rationality the autonomy of the municipalities should be respected, which implied that a central register was not a discussible option. Another argument, based on the legal rationality, was that centralization was perceived as a threat for the privacy of the citizen ('Big Brother is watching you syndrome' in combination with bad experiences during World War II). That is why a decentralized storage of residential information has been worked out. The integration of back offices was established through the creation of a standardized information model, which, through an EDI-network, could be exchanged between the municipalities themselves as well with other public and private organizations. There was also a tension between the political, legal and technological rationality. At the beginning of the 1990's EDI-network technology was not a proven technology in Dutch public administration, which could only function properly, if a standardized data format was used. However, this format required very specific data definitions, which asked for a very specified (binary) drafting of the law which was needed for the system's implementation. An approach was developed in which the informational requirements were translated in suitable legal requirements, and not vice versa which is the common practice. The political discussion in the Parliament was also forced to comply with the requirements that enabled system developers to do their job.

This example shows that it is also important to distinguish several closely or loosely linked arenas. The parallel development of legislation and system development implies that at least three (the legal, technical and political) arenas have been closely linked. Moreover two implementation arena's could be distinguished. One consisted of more than 500 (large, medium and small-sized) municipalities which should reorganize their registry offices, another arena consisted of more than 300 potential users in the public and private sector, all with their own routines, procedures and specific residential information registers. In the linking of these arenas different 'ambassadors' and 'advocates' have plaid an important role.

At least three competing rationalities plaid an important role in Vehicle License Register (NKR). A law, in which the privacy of the car owner also had to be protected, should be drafted in such a way that it could be translated in a workable information system. Within the Vehicle License Agency and within thousands of garages, in which the actual safety examination took places, the new system challenged, grown practices, routines and procedures. Moreover, also between the agency and the garages specific information exchange procedures had to be developed, because the garages add new information about the quality of the to the register.

Given these competing core values, why did actors which were involved in these four integration projects give up their autonomy and co-operate?

### 5.2 The Ongoing Recognition of Interdependency

Research shows that successful back office integration depends on the definition of a common goal, based on creating a 'win-win' situation in which each of the

involved parties could benefit or could minimize potential costs. In table 4 the nature of these win-win situations has been described. Essential is how these back offices define their dependencies, which also implies an exchange between interests and resources within and between several arenas. In the case of RINIS, the information broker in Dutch social security, several agencies struggled with their legitimacy, because they were not able to effectively attack the misuse of social benefits as well as to provide tailor-made services. A better exchange of information was needed, but simultaneously this could threaten the informational autonomy of the organizations involved. The integration focussed on the standardization of the information exchange between the participating organizations, while their intra-organizational informational autonomy was not challenged.

In the case of the Housing Subsidy (EOS), the ministry was able to increase the efficiency of the working and information processes by redesigning them, realizing more than 400.000 billion euro. However, this would imply that the housing associations and municipalities would loose some, rather time consuming, tasks. However, they would also benefit from these efficiency advantages. Finally, the cut back operation did not challenge the amount of subsidies which could be spent; only the operational costs were the object of the cut back operation. For all parties involved this was politically acceptable.

Because back office integration is a long lasting adventure, it is important that the fellow-travelling organizations continuously reconfirm the earlier defined interdependencies, while at the same time new, emerging problems should be defined as new interdependencies which asks for the new compromises and new commitments. Back office integration can be defined as an ongoing incremental, goal searching process, always looking for structural or ad hoc commitment. For instance, the GBA started with clear boundaries between the activities that should be done by the Dutch municipalities, and the activities that should be done by the project organisation at the national level. The project organisation should focus on the exchange network as well as on the definition of the data

**Table 4.** Nature of interdependency and win-win situation

| | Housing subsidy system | Clearing house social security | Municipal Residence Information Register | Vehicle License Register |
|---|---|---|---|---|
| Win-win | Efficiency gains for each organization. Preventing the worst case scenario: saving operational costs rather than on the amount of subsidies given | Fight against fraud through a better information exchange without given up the intra-organizational autonomy | Protection of municipalities' autonomy and privacy through a the distributed data base | Improving public safety of vehicles in relation to money earning activities of garages without fundamentally challenging their informational autonomy by the use of 'third party' network |

format, while the municipalities should focus on the implementation of the GBA application at the local level and the improvement of the quality of the local residential information. A first test showed that quality of data at the local source was poor and that necessary knowledge to use the new applications was insufficient. Still, both parties had a common interest: a prosperous implementation of the system, which was related to a legally fixed deadline. The municipalities accepted the help of the project organisation to improve the quality of the information and accepted the necessary education given by the project organisation.

However, it is possible that actors do not recognize new interdependencies, because they are focussed on those interdependencies which have contributed to the 'vested' compromises. Research shows that, during the development of the GBA and the NKR, external audits, contra expertises and additional research has plaid an important role in 'unfreezing' blockades in specific arenas.

### 5.3 It Is the Content That Unifies: Trust and External Pressure as Lubricant

When are back offices able to define their relationships in terms of interdependency? How to formulate complementary interests? Our research shows that the content of the problem to be tackled has been perceived as the major incentive to explore the need for cooperation. Legitimacy problems were an important incentive in RINIS. In the GBA and EOS case, it was the content of the solution to be provided that brought the parties together. At the same time these three cases show that it has been important to work with rather open goals, like improving efficiency and client friendliness, that gradually could be translated into more concrete objectives.

Research also shows that starting a discussion about back office integration with a debate about the competences and jurisdictions of the offices involved, will frustrate consensus building. In the RINIS case, the jurisdiction of each back office has been respect, which is expressed by the principle that each office is still autonomous in organizing its own ICT. Contra-productive discussions also originate, if one starts with a debate about the allocation of costs and benefits about the participants. That is why the Social Security Bank has offered to pay for the initial costs in order to establishment RINIS. Later on a more detailed arrangement has been worked out.

However, an analysis of the problem's content, can show relevant interdependencies, but sometimes back offices and their representatives are unable to see them, because their perception is blurred by negative experiences from the past. Hence, a minimum of trust is a necessary condition to create a shared understanding about the added value of back office integration. The minimum of trust which existed between the parties which were involved in the redesign of the housing subsidy, enabled them to commit themselves to an risky ICT and organizational redesign process. In the case of the NKR, the garages trusted the agency because the agency was willing to use a exchange network that was owned by the association of garages (RAI). Trust has been generated by adopting a 'neutral', third party – network. Moreover, the agency's management has

recognized that is was important that its own employees could trust them by recognizing that the project was not primarily an ICT-project, but an organisation development project. So, the management gave key people, who knew the culture of the organisation and were respected by the organisation, a place in the project organisation rather then selecting people based on their professional (ICT and legal) knowledge.

Another incentive which brings back office together, is external political and legal pressure. The plans for a possible redesign of the housing subsidy were already developed in 1995, but were put in a drawer. In 1999, when a new cabinet took office, all the parties were confronted with a major cut back operation. The pressure to come up with alternatives, forced them to unify themselves around the idea of business redesign. In the case of the GBA, a legally fixed deadline date has been inserted in the accompanying law, which confronted the municipalities with the obligation to get connected to the new system.

### 5.4 Managing the Political Agenda

Back office integration takes several years. The original consensus can fade away, due to a changing of the political and societal agenda. Our research shows that it is essential to look for new arguments that could legitimise the necessity of back office integration, which could also implies the emergence of new coalitions.

At the start of the GBA, privacy was an important issue, but during its development, the political agenda changed and the pursuit of fraud and the improvement of service delivery has altered the view on the added value of the GBA. The development of RINIS shows that other arguments have been produced to legitimise its further growth. The concept was linked to the development of a more robust government wide information infrastructure. At the start of EOS, efficiency has been a major argument to legitimise the concept, but later on, during the e-government hype of 1999-2001, the project has also been sold as an innovative e-government project.

Managing the political agenda involves stakeholder-management, because the neglect of the wishes of specific stakeholders can create turbulence in the project's political environment. During the implementation of the GBA the attention has been primarily focussed on the back office problems of the municipalities, while the complaints of the more than 300 users were not sufficiently heard. The resulting rumour reached Parliament and questions were asked about the 'lagging' progress of the system. In a major modernization of the same register, starting in 2000 after its launch in 1995, the same mistake was made. The Ministry of Internal Affairs was accused of listening insufficiently to the wishes and needs of several users groups.

In managing the political environment, personal commitment of the responsible minister has also been viewed as a major contribution to the success of the GBA, NKR and EOS-system. Not only to defend the proposed concept and the necessary funds, but also defend the project at those moments, when major implementation problems occurred and the political and societal pressure increased.

### 5.5 The Dynamic Allocation of Costs and Benefits

The research shows that the unfair distribution of costs and benefits, which could lead to a concentration of the costs at one party while another party receives most benefits, can tremendously obstruct back office integration. Costs and benefits should be in balance, but the emergence of new circumstance can make it necessary to look for a new balance. This ongoing balancing act can be achieved, if one is able to look for other ways of compensation than financial compensation. Each of the involved rationalities produces its own costs and benefits. Not only financial costs and benefits should be considered; it is important to include qualitative (legal, political and organizational) costs and benefits as well. In the GBA case there was, originally, a distortion between the costs and investments that the municipalities had to make and the major benefits and rather small investments of the organizations that would receive the data, like the Tax and Customs Administration. Resistance was the result, because the municipalities had to install new information systems, had to improve the quality of data, had to procedures and routines and had to improve the necessary skills. However, during the implementation, the municipalities have realized themselves that the register could be a major incentive to improve the quality and modernization of their public service delivery and the pursuit of fraud, which led to a qualitative reassessment of costs and benefits.

### 5.6 Managing Openness and Closure: The Balance Between Project and Process Management

Our research shows that key figures define the ongoing process of consensus-building more important to end back office integration successfully, than the aiming to accomplish rather well-defined and ambitious goals through a planned sequence of activities. However, the differences between project and process management approaches of back office integration should not be exaggerated. Once consensus has been established, it is possible to use a more project management-oriented approach and to work in out in more specified project plans. However, consensus will not last forever. Positions can change, new issues can emerge, which requires a process oriented management approach. Hence, process and project management approaches alternate. This problem can also be described as a managing the tension between openness and closure. If we look at the history of the GBA, EOS and the NKR Register we see that in stabilized times the project was rather closed and the project management techniques were used to accomplish specific goals, while due to implementation problems or the emergence of new demands, it was necessary to re-define the existing consensus about the nature of integration.

Moreover, the tension between process and project management is also made visible in another way. In many project management methods the identification of risks, related to several factors in different project environments (like the political, technological or legal environment) is crucial. The awareness of potential risks, through a risk-analysis at forehand, enables a project manager to anticipate on these risks. When they occur, he can respond quickly, because he had

thought about the actions to be taken. Moreover, he has the authority to act in order to secure its projects goals. Our research shows that risk analysis has been important in terms of awareness. Our respondents define these risks as changing perceptions of relevant interests in different arenas. Hence, the different project environments should be seen as arenas in stead of neutral environments. The effective management of environmental disturbances has been rather perceived as developing strategic behaviour in order to create new trustworthy conditions for consensus-building in stead of showing who is the boss.

Many project management approaches stresses the importance of rather autonomous subprojects, which relate to each other to a minimum in order to reduce mutual disturbances. Our research shows that it is important to connect subprojects (and thus arenas and rationalities) and to create linking pins. This had led the Dutch civil service to development of training program for 'weavers' in order to improve back office integration in order to create open relationships.

## 6 Conclusion

Our research shows that one can question the back office integration approach that is put forward in some writings on e-government (OECD, 2003). 'Top down' project management, vertical integration between government layers, and strong leadership have been defined as necessary conditions for integration. It has been primarily defined as a (project and information) management problem, as a problem of redesigning the machinery of government. Does such vertical orientation on back office integration, recognizes the network (thus: horizontal) character of the exchange relationships between the information domains of these back offices as well as the fact that information itself is a powerful resource which is used to protect specific positions and interests? According to our research, back office integration should, therefore, be seen as a governance problem, as a problem of organizing rather horizontal co-operation between relatively autonomous information domains. How can a shared understanding about the necessity of ICT-driven integration within a network of back offices be obtained? The following lessons have been put forward. Although many project management methods identify risks in several project environments or domains, it is important to define these rather neutral environments as loosely and closely related arenas. Within and between these arenas a minimum of consensus between the relevant stakeholders should be created in order to guarantee successful back office integration. Essential is the mutual recognition of the core values which are at stake as well as the interdependency between them. Interdependency can be only recognized, if the relevant parties concentrate their discussion on the content of the problem. Discussion about competences or the allocation of costs and benefits is contraproductive. Trust is seen as another necessary condition for defining 'win-win' situations, while at the same time external pressure can also be a stimulating force. Moreover, it is important to recognize the dynamics of consensus building. New issues, like implementation problems or the emergence of new items of the societal and political agenda, and the entering of new actors in the arena could

make it necessary to redefine this consensus. These lessons do not imply that project management methods are obsolete, but they can only work when the environment of the integration project is rather stable.

## References


1. Bekkers, V.: Wiring Public Organizations and Changing Organizational Jurisdictions, In: Snellen, I., van de Donk, W. (eds): Public Administration in the Information Age IOS, Amsterdam (1998) 57-78
2. Bellamy, C., Taylor, J.: Governing in the Information Age, Open University Press, Buckingham (1998)
3. Bellamy, Ch.: ICTs and Governance. Beyond Policy Networks? The Case of the Criminal Justice System, In: Snellen, I., van de Donk, W. (eds.): Public Administration in the Information Age. IOS, Amsterdam (1998) 293-306.
4. Beynon-Davies, P.: Information Management in the British National Health Service: The Pragmatics of Strategic Data Planning. International Journal of Information Management, Vol. 14, No: 2, (1994) 84-94
5. de Bruijn, H., ten Heuvelhof, E., In 't Veld, R.J.: Process Management (Why Project Management Fails in Complex Decision Making Processes), Kluwer, Boston (2002)
6. Davenport, T.H., Eccles, R.G., Prusak, L.: Information Politics, In: Sloan Management Review, Vol. 34, No: 1, (1992) 53-65
7. Davenport, T.H.: Information Ecology: Mastering the information and knowledge environment. Oxford University Press, Oxford (1997)
8. Heeks, R. (ed.): Reinventing Government in the Information Age. Routlegde, London New York (1999)
9. Homburg, V. (1999): The Political Economy of Information Management, SOM, Groningen (1999)
10. Knights, D., Murray, F.: Politics and Pain in Managing Information Technology: A Case Study in Insurance. In: Organization Studies, Vol. 13, No: 2, (1992) 211-228
11. Kooiman, J. (ed.): Modern governance, Sage, London (1993)
12. Koppenjan, J, Klijn, E-H: Managing Uncertainties in Networks, Routlegde. London (2004)
13. Kubicek, H.: The Relationship Between Government and Citizens: Key Policy and Research Issues. Paper prepared for the IPTS/EU workshop on E-Government in the EU in 2010: Key policy and research challenges, IPTS Seville (Spain), 4-5 March 2004.
14. Kumar, K., van Dissel, H.: Sustainable Collaboration: Managing Conflict and Collaboration in Interorganizational Information Systems. In: MIS Quarterly, Vol. 20, No: 3, (1996) 279-300
15. Moon, M.: The Evolution of E-Government Among Municipalities: Rhetoric or Reality?, In: Public Administration Review, Vol. 62, No:4 (2002) 424-433.
16. van Venrooij, A..: Nieuwe Vormen van Interorganisationele Publieke Dienstverlening, Ph.D. Thesis, TU Delft, Delft (2002)
17. Pfeffer, J., Salancik, G: The external control of organizations. Harper & Row, New York (1978)
18. Rhodes, R.: Understanding Governance, Open University Press, Maidenhead (1997)

# E-Government Systems in Developing Countries: Stakeholders and Conflict

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**Abstract.** With the widespread deployment of e-government systems in developing countries, and also their high failure rates, it is important to understand the complex processes that underlie successful implementations of large-scale information systems. MIS theory has explicated the nature of conflict in the design of information systems and the reasons why systems are resisted by stakeholders. In this context, it is important to have a nuanced reading of stakeholders in the e-government systems domain to understand the origin of conflict and resistance to such systems. This paper develops a framework for stakeholder groups and uses this to analyze conflict and resistance in four case examples of implemented e-government systems in India.

## 1 Introduction

E-government systems in developing countries represent vast public interventions. These are high technology interventions where the population that is targeted for these services is usually not well versed with the technology or with the new methods of acquiring government services. Most e-government systems in developing countries fail. In November 2004, Robert Schware, Lead Informatics Specialist at the World Bank, remarked that about 85% of the e-government systems that were implemented in developing countries turned out to be either total (35%) or partial (50%) failures.

While looking for the causes of these failures, many points are cited, ranging from the lack of sustained high-level governmental support to the corruption at the lower-levels that prevents the normal functioning of the system to technical flaws in the design or implementation. What is usually overlooked are the issues of conflict and active resistance to systems that emerge from groups of people who are responsible for both the delivery and the consumption of the services. Issues of resistance and conflict, though well researched in the Information Systems discipline, are often not used for understanding or theorizing about e-government systems. The objective of this paper is to highlight the value that understanding conflict and resistance by stakeholder groups can bring to the theory of e-government systems. In particular, in developing countries, these phenomena play a crucial role because existing institutional mechanisms cannot address the deep issues of disruption and disintermediation raised by e-government systems.

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### 1.1 Methodology

This paper relies on the case-study method to support the issues of stakeholders and conflict. Four independent e-government initiatives from India are used as the case studies. Data about the cases is obtained from interviews (primary data), published papers, published reports and media reports. One case example forms the primary basis for assessing the hypothesis whereas the others provide additional support.

In the rest of this paper we begin with a review of the theories of conflict (or potential for conflict) that have been addressed in the Information Systems literature. A review of the subtle notions of stakeholders and their relevance for this analysis is then presented. The next section highlights the specific issues of conflict that arise in the e-government systems being studied in this paper. The last, concluding, section outlines the theoretical contributions of this research and points to future work.

## 2 Literature Review

External e-government systems or government-to-citizen systems in developing countries are embedded in public spaces and deliver services that are demanded by a significant and diverse population. Their implementation success is based on neither their technical merits alone (the systems view) nor on the aspects of change management and user acceptance alone (the user view). Such systems are embedded in a web of relations or in a web of interactions within a particular socio-economic context and their design and implementation requires an understanding of this context [1]. When viewed out of this context, particularly as a tool (to achieve a specific goal of, say, increased speed of processing), or as a proxy (as a surrogate for some economic criteria, say development), or simply as a nominal object (simply a name for some other object or action, say human development), e-government systems may suffer an endemic and hard-to-pinpoint problem of rationale, that is, why were they conceived and what was their goal [2]. This paper considers the "ensemble" view of information systems as the most relevant for the understanding of e-government systems and explores issues related to conflict, resistance and the role and motivations of stakeholders and their implications for the system that they have to interact with.

### 2.1 Conflict and Resistance

In a classic paper Hirshheim and Klein (1989) used the notions of conflict and order as a priori and ontological realizations of meaning by systems designers and users to derive four paradigms of systems development. Conflict, as opposed to order, as an ontological commitment entails assuming that objectives and goals of systems development will be opposed and contested by various groups concerned with the system. Conflict is related to change, disintegration and coercion. Hirshheim and Klein contended that most systems development efforts

fall under the functionalist paradigm where the basic working assumptions are of objectivity and order. The other three dimensions that include subjectivity or conflict are rarely, explicitly deployed by systems developers. The fundamental assumption of the functionalist paradigm is that all the groups or individuals involved in a project share common, objective and well-defined goals for the project and despite differing on the means of achieving the goals the ends are the same. One consequence of this paradigm is that it makes the issues of power, conflict and resistance outside the domain of the developer, enabling the focus on rationally defined objectives. The main drawback of this paradigm emerges from this denial, as agreement upon ends is rarely achieved in situations where there is a contestation of goals.

In another classic paper, Markus (1983) identified the roots of resistance to information systems as being in the interactions that new information systems had with people who were to use the systems. The principal issue, in retrospect, that Markus raised was that of the sustainability of the system. The most popular reasons advanced for the abandonment or overhaul of expensive information systems projects were those of technical problems with the system, lack of top management support, lack of "user-friendly" features in the system, a generic resistance to change from users, and a resistance to change deriving from perceived excess costs of systems that outweigh the benefits. However, Markus showed that simply the systems features, internal to the system, were not responsible for resistance to the system and neither were factors of resistance from people, inherent resistance, resistance to innovation etc. The interaction between people and systems was the basis of resistance, where resistance is understood as an active stance by an individual or a group to prevent the system's objectives from being achieved, as opposed to either or both theories outlined above. This interaction is best understood as a political process where systems are resisted (or not) if they redistributed or altered the basis of power within the organization. One important consequence of this theory is that it can explain why in certain cases people welcome a new system whereas in others they strongly oppose the same system; it all depends on the interactions they have with the system.

The political variant of this theory posits that information systems frequently redistribute power among key actors of organization where power is broadly understood as an individual or group's ability to cope with uncertainty and have their way in the face of resistance. Redistribution of power occurs when certain information, relevant and necessary for doing work, is made available by the new system to those who did not have this access before. The task of examining power relations is based on the assumptions that the intentions (derived from the specifications) of the system are known and that there is a particular structure of the organization in which the system is being used.

### 2.2 Stakeholders

The idea of stakeholders was developed in the literature in Organization Theory where the essence of a corporation's survival and success depends upon the ability of its management to create sufficient wealth, value, or satisfaction for all its

primary stakeholder groups [5]. In the field of Information Systems a stakeholder is a person or group who is able to have an impact on the eventual system in a practical sense [6]. By this definition one has to include all parties who can affect a system, whether their traditional roles and responsibilities are enhanced by the system or depreciated. The information systems literature has subtle variations on the notion of a stakeholder [7]. One difference is that most researchers consider a stakeholder to be one (individual or group) who is affected by a system. After a review of the extensive literature on stakeholders, Scholl (2001) concluded that the concept of stakeholders was necessary and important for public sector management also owing to the need for 'inclusion and management of constituencies.'

Owing to the nature of e-government interventions it is important to include within the research ambit the questions of resistance, conflict and complex stakeholder relations. A review of the extant e-government literature reveals that such a viewpoint is lacking owing to an excessive emphasis on descriptive case studies and technology solutions discussions [9].

## 3 Demand-Side and Supply-Side Stakeholders

It is useful to view the stakeholders that impact the eventual success of a system as belonging to either the demand-side, those who will consume the services of the system, or to the supply-side, those who fund, design, implement and maintain the system. Individuals, groups and organizations belong to either stakeholder group according to their relationship to the system. These categories are not water-tight, that is, there could be individuals or groups who belong to both categories. This categorization enables a richer understanding of the e-government implementation process. It will be observed that most e-government systems implementations in developing countries are driven by the supply-side, who design the services, the processes and the architecture of the system without consulting any demand-side stakeholders. Supply-side stakeholders dominate the implementation process and are mostly informed by their own ideological commitments or by the technological imperatives of their commercial partners. They have control over all the resources and deploy them according to their understanding of demand-side needs.

Demand-side stakeholders consume the services of the e-government system and, on occasion, provide the revenues that sustain the systems. There are instances where demand-side stakeholders such as citizens' groups and civil society groups have demanded that they be included in the implementation process but this is rarely achieved. They influence the eventual success of the system through use or non-use and are directly impacted by the service efficiencies achieved.

To understand the different stakeholder groups let us consider a particular e-government system, the Bhoomi system, that was implemented in the state of Karnataka in South India, and was launched in all districts of the state in 2001. It essentially allows farmers to receive a record of their land holdings at a reasonable price and also enter requests for mutations (changes in the land

record resulting from sale or inheritance) into the system. Land records are maintained electronically and details about crops are updated thrice a year. The main product of the system is a Record of Rights, Tenancy and Crop (RTC) certificate that is provided for a nominal price of Rs 15 (about $0.33). This system replaced a manual system that was maintained by village accountants and was reportedly hard to access owing to corruption and red tape.

Neither demand-side nor supply-side stakeholders form a contiguous group, and there are further divisions of the stakeholders depending on their distance from the system (see Figure 1). For the demand side the primary users are the farmers who have records in the system and who use the system extensively. Till October 2004, over 22 million farmers had accessed the system since inception. Farmers use the certificates mostly to apply for loans from banks, along with using it as a surety in courts, for checking the details of their data, and for use in selling or mutation. With the advent of a faster process of obtaining the certificates, banks have an increased possibility of doing business (of giving loans to farmers) and they are the secondary demand-side users. Other secondary users are courts, police stations, and other financial institutions. Those institutions that benefit from the increased service in banks and courts are the tertiary demand-side users. On the supply side the primary users are the kiosk-operators

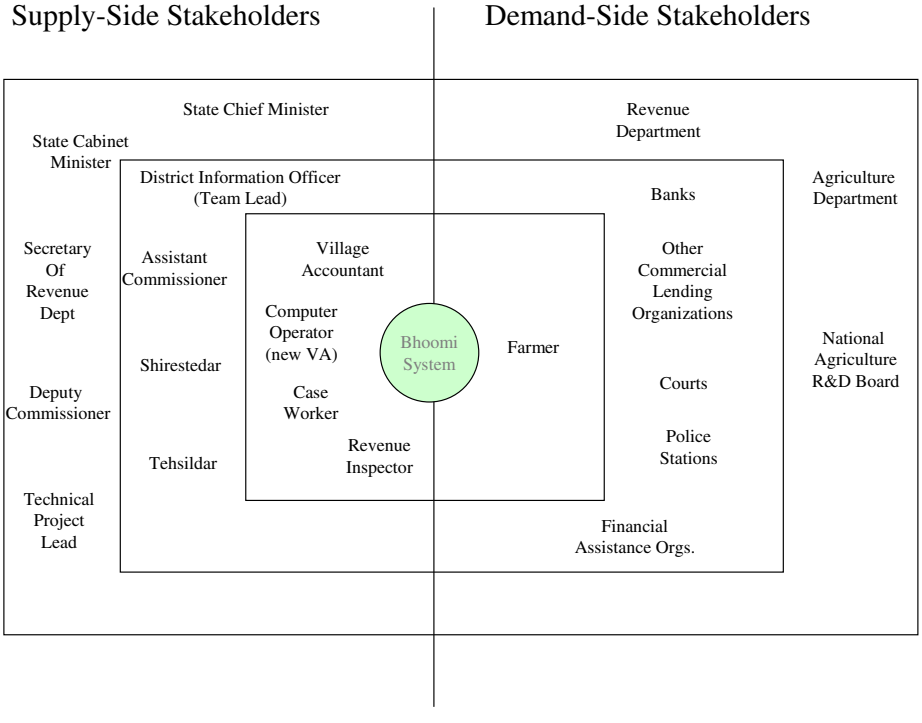


**Fig. 1.** Stakeholder Diagram - Bhoomi Example

(new village accountants) who run and maintain the system at the local level, the old village accountants who provide update data, case workers who assist farmers and revenue inspectors who are required for mutations of records. At the secondary level are district information officers, Tehsildars and Shirestedars (district officials) who also participate in the mutation process but not directly. They receive reports from the system that assists (or impedes) their work. At the tertiary level are the owners of the system such as the Secretary of the Revenue department, the Chief Minister of the state and others who are the top management that championed the project and whose work is indirectly assisted by the system.

## 4 Analysis

Using the framework of stakeholders and the issues of conflict and resistance that arise within e-government systems implementation we examine a number of e-government case studies. The case studies provide data and insights into various aspects of conflict and resistance. Data for the case studies was obtained mainly from secondary sources such as published reports and papers, and in the case of Bhoomi data was also obtained through primary means such as interviews and surveys. A brief description of the cases is provided in Table 1.

Table 2 outlines the conflict that arises in the expectations of demand-side and supply-side stakeholders. These conflicts may be viewed as goals, formally stated or informally understood, that stakeholder groups had of the system during its design or implementation. The figure outlines broad goal conflicts amongst groups, however there are subtle issues within each side that need to be highlighted. The fourth column identifies the resistance that results when there is a presence of conflict. In many cases of conflict there is not explicit resistance to the system that is manifest. There is no claim being made here that there is a directly observed and measured act of resistance here to a particular conflict. The observed phenomena in the case is best explained by the categories of conflict and resistance as attributed.

Conflict in the Bhoomi system is evident along the following points:

1. Historically, land records in Karnataka state were maintained in five different languages and the formats for the records were in the hundreds. In one particular region each land-owner practically had his own land record format. The issue of conflict here is that when computerization was attempted there was an expectation that the details available in the various formats and languages would be preserved in the new format (in Kannada, the official language of Karnataka). However, in many cases this was not done and much of the details were lost in the current data format. In some cases, lawsuits have been filed to rectify the suppression of data during computerization.
2. In the manual system the village accountant (or *patwari* in Karnataka) maintained all the records and there was a certain protection of privacy as he would allow only the concerned farmers to see their records. There was abuse of this power as corrupt accountants could show the records to anybody for a price.

**Table 1.** Description of E-Government Projects

| E-Gov Project | Description |
|---|---|
| Bhoomi | Land records digitization project in the state of Karnataka, India, where 20 million land records were digitized and maintained in databases. The system provides access to farmers via kiosks located at taluk (part of district) headquarters where for a nominal sum farmers may obtain certification of their land holding and cropping, as also submit applications for mutation. In 2001 the Bhoomi system was legally vested and all manual records were made illegal. Sources: [10,11,12]. |
| CARD | Another land records project implemented in the state of Andhra Pradesh in over 200 centers. The goal of the system was to introduce transparency and efficiency in the land registration process. The system was legally secured by amendment of laws but the manual process existed simultaneously. Sources: [13] |
| CRISP | A planning tool for development projects promoted by the Government of India. The tool assisted in data collection in rural areas, divided into blocks, and helped with analyzing the data for awarding bank loans to those who had been identified as needy and eligible as such by the survey. Pilot tests were successful and the systems were deployed in several blocks. After some time the systems fell into non-use and were subsequently abandoned. Sources: [14]. |
| Gyandoot | Envisaged as a low-cost, community-owned, rural Intranet project, it was initiated in the remote Dhar district of the state of Madhya Pradesh. Twenty villages opted to set up information kiosks, with their own money, that were networked in an Intranet and served a population of about 20-30000. Youth from the villages were trained to man these kiosks as self-sustaining ventures. Each Gyandoot kiosk offered services such as: prices of agricultural produce at various auction centers in the state; copies of the record of rights to land at a nominal price; online application for revenue, caste or domicile certificates etc. Gyandoot facilities were used by up to 40,000 village users in the first few months of its deployment, with usage ranging from auctioning cows to seeking brides. The system was unsuccessful and was abandoned. |

In the computerized system, the objective was to make all records 'transparent' at the taluk level. As such anybody can pay the minimal fee and access any record in the system by simply using the record number. The supply-side rationale for this transparency was to expose any possibility of corruption, such as changes made to records without the knowledge of owners. This conflict has subtle variations, where some demand-side stakeholders welcome the ability to view the land holdings of other owners, ostensibly to detect illegal acquisitions. On the down side, some land for which taxes have not been paid, in cases where owners cannot afford the tax, become targets for land sharks. They are able to obtain details about such land easily and target the owners.

3. An express intention of the supply-side designers was to exclude the traditional village accountants from having sole control over managing the land records. This was to avoid corruption as well as provide the state govern-

**Table 2.** Stakeholders and Conflict

| Project | Demand-Side Stakeholder | Supply-Side Stakeholder | Resistance |
|---|---|---|---|
| Bhoomi | Multiple languages and formats for land records | Single format in one language for all records | Cases filed in court |
| | Privacy of land records | Open availability of land records to all, transparency | |
| | Inclusion of village accountant; an access to power | Removal of traditional village accountant; all transactions now at the taluk level | Resistance to system from old village accountants |
| | Address inequities of land records | Not a matter for e-governance to resolve | |
| | Inclusion of cadastral maps on digital records | Cadastral maps would slow down the implementation process | Cases filed in court for map updation |
| | Reduction of officials in processing | Inclusion of Tehsildar in mutation process | Objection expressed by farmers |
| CARD | Reduction in intermediaries in registration office | Retention of all functionaries in registration office | Continued usage of document writers for registration |
| CRISP | Variety of needs for which loans to be sanctioned | Limited needs for which loans to be sanctioned | |
| | Inclusion of local leaders and bank officials | Inclusion of only planning personnel | Bank officials stopped using the recommendations of the system |
| Gyandoot | Permanent access to higher level officials via the system | Temporary access to high officials | |

ment better and updated information about cropping patterns and land issues. With Bhoomi installed the village accountants could no longer issue the land certificates to farmers to obtain loans for seeds and fertilizers. They were also not able to entertain applications for mutation of the records to adjust for sales and partitions. For many farmers this was a loss of their access to a power base. The village accountant was an easily accessible government functionary within the village with whom the farmers could maintain a long-term relationship. With the new system the power had shifted half a day's journey away to the taluk headquarters and new functionaries were in charge. The old village accountants actively resisted the computerization process and they had to be removed by bringing in about 1000 new village accountants who were trained to man the kiosks.

4. One of the strongest demands of the farmers of the land records management system was that it address the huge inequities and problems that had

cropped up in the land records over the years. According to a McKinsey report over 90% of the land parcels in India were disputed [15]. The practice in the British colonial period was to re-survey the land every 30 years and then resolve the ownership issues arising out of divisions and consolidations and sale etc without having to go through court [16]. Such a practice has declined in independent India as for most states land revenue constitutes a small fraction of its tax revenue, for example, in Karnataka, in 1990, the land revenue was only 0.8% of the state's tax revenue. Karnataka has not undergone a land survey and revision since 1978 and when the computerization effort was initiated in the 90s the problem of inequities was exacerbated. The stand of the supply-side stakeholders was resolute on this issue, they were not able to make any changes in land records as they did not have the legal mandate to do so and besides it was a highly time-consuming activity that would delay the computerization process.

5. The issue of cadastral maps is related to the above point. Since a survey had not been conducted, the maps were also outdated. Rather than digitize outdated maps the Bhoomi management decided to exclude them from the entire land management system.
6. In the Bhoomi system the district-level official, the Tehsildar, was introduced in the land record mutation process whereas in the prior manual system this official only had to consider escalation cases. This aggregates control and power at the level of the Tehsildar at the district-level, reducing the power of revenue inspectors, village accountants and Shireshtedars. Farmers are opposed to such a change as it increases the official review time and, in some cases, increases the corruption levels because of the increase in red tape for mutation.

The CARD system of Andhra Pradesh (a neighboring state of Karnataka) is similar in concept as the Bhoomi system but underwent a somewhat different trajectory. One of its key design goals was to maintain the number and scope of officials in the registration office as demanded by the employees. This was incorporated in the design of the system but was later objected to by the demand-side stakeholders as it retained the levels of corruption in the system. One act of resistance was that citizens went back to using document writers, or agents, who would act as intermediaries for them for a price. The expressed objective of the CARD system was to remove such intermediaries and hence to reduce corruption [13].

The CRISP system reported by Madon (1992) provides a clear example of stakeholder conflict. One of the reasons why farmers sought loans was to buy dairy cows. Loans were approved for this purpose. In a situation where there was a lack of a market for milk, farmers tried to process and sell clarified butter (*ghee*) but this was objected to by the lending authorities and their activity was stopped. The entire loan processing system in CRISP was highly politicized where demand-side stakeholders were interested in subverting the system as it did not allow them control over the loan disbursal process. Corrupt officials who were influenced by the local politicians about the planned loan dispersal process stopped using the system allowing it to fall into disuse.

In the Gyandoot system, which has subsequently been abandoned, one of the main differences in the perceptions of the demand-side and supply-side stakeholders was the duration of the engagement of government officials. From the documents it appears that the initial design by the supply-side was to set up a facility with e-governance services included but it was to become an independent service kiosk by itself, economically surviving by providing digital services to the local population. The demand-side stakeholders on the other hand were expecting the increased access they had to senior district officials via email and other means to continue but this did not happen. Further, the economic and administrative support that the government had initiated was also pulled away, against the expectations of the village residents. The Gyandoot system was not actively resisted by anyone but fell into disuse and failed. This is in sharp contrast to its initial promise, when it won the Stockholm Challenge Award in 2000.

## 5 Conclusion and Future Work

In the light of the large number of failures of e-government systems in developing countries it is important to consider issues other than the usual ones that derive from a functionalist paradigm of systems development. Developers of e-government systems have to contend with politics, power struggle, and conflict, although the literature that deals with this is sparse. This paper develops a framework of stakeholders that allows a nuanced reading of the conflict and resistance inherent in e-government systems. Stakeholders are understood to belong to either demand-side or supply-side groups where their role and relationship to the e-government system is understood from the ultimate benefits (or costs) they derive from the system. For supply-side stakeholders, e-government systems help to improve efficiency, transparency and effectiveness of services. These are the proclaimed benefits. More realistically, the systems often serve to enhance their power base in the public context, improve their standing with local politicians, help them with their career growth, etc. Demand-side stakeholders are rarely included in the design or implementation of e-government systems and as such there is hardly any record of their motivations for supporting e-government systems. Post hoc surveys, after the systems have been implemented, show that they benefit from speedier services and less corruption. But in most cases the benefits are marginal and have few externalities.

A review of four implemented e-government systems in India revealed that the framework of stakeholders is adequate to explain the conflicts and resistance that arise. Several issues raised in this context have to be addressed by future work: a) The stakeholder theory presented in this paper is normative and helps to explain some of the complex phenomena observed in the case studies, however it would be more useful in the instrumental sense where specific prescriptions could be made regarding design of e-government systems. b) The theory as presented seems to imply that resistance arises from conflict and not the other way around. This could be understood better by empirical work that examines the genealogy of events in the life cycle of an e-government system. c) Existing lit-

erature [17] shows that stakeholder importance and needs vary according to the life cycle stage an organization is in. The argument can be extended to show that stakeholder roles and importance also vary with the stages of an e-government project, from initiation to maturity. These roles are dependent on the nature of the stakeholder's interaction with the system with impacts of the system being felt as first order, second order or higher order effects. Stakeholders who initially benefit from the system will correspondingly impact others who will derive economic benefits from the first order beneficiaries. (The impact of the system could be negative also.) This web of dependence would determine the impact and outcomes of the system as it matures. This would have to be examined theoretically as well as empirically.

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## References

1. Sein, M., Harindranath, G.: Conceptualizing the ICT artifact: Toward understanding the role of ICT in national development. The Information Society **20** (2004) 15–24
2. Orlikowski, W.J., Iacono, C.: Research commentary: Desperately seeking the "IT" in IT research - A call to theorizing the IT artifact. Information Systems Research **12** (2001) 121–134
3. Hirschheim, R., Klein, H.K.: Four paradigms of information systems development. Communications of the ACM **32** (1989) 1199–1216
4. Markus, M.L.: Power, politics, and MIS implementation. Communications of the ACM **26** (1983) 430–444
5. Clarkson, M.: A stakeholder framework for analyzing and evaluating corporate social performance. Academy of Management Review **20** (1995) 92–117 Stakeholder Theory.
6. Coakes, E., Elliman, T.: Focus issue on legacy information systems and business process engineering: the role of stakeholders in managing change. Communications of AIS **2** (1999)
7. Alter, S.: Same words, different meanings: are basic IS/IT concepts our self-imposed tower of babel? Communication of the AIS **3** (2000)
8. Scholl, H.: Applying stakeholder theory to e-government: Benefits and limits. In: Proceedings of the Internation Federation of Information Professionals Conference. (2001)
9. Gronlund, A.: State of the art in e-gov research – a survey. In Traunmuller, M., ed.: Proceedings of the Third International Conference, EGOV 2004. Lecture Notes in Computer Science, Springer-Verlag (2004) 178–185
10. Chawla, R.: Roll out of successful e-governance projects: Bhoomi - a case study. Technical report (2003)
11. Lobo, A., Balakrishnan: Report card on service of Bhoomi kiosks: An assessment of benefits by users of the computerized land records system in Karnataka. Technical report, Public Affairs Centre, Bangalore (2002)
12. Acharya, K.: The case of Bhoomi. Deccan Herald (2003)
13. Caseley, R.: Public sector reform and corruption: CARD facade in Andhra Pradesh. Economic and Political Weekly (2004) 1151–1156

14. Madon, S.: Computer-based information systems for decentralized rural development administration: A case study in India. Journal of Information Technology **7** (1992) 20–29
15. Hanlon, C.: On the road to Shanghai: India. Technical report, World Bank (2004)
16. Saxena, N.: Updating land records: Is computerisation sufficient? Economic and Political Weekly (2005)
17. Jawahar, I., McLaughlin, G.: Toward a descriptive stakeholder theory: An organizational life cycle approach. Academy of Management Review **26** (2001) 397–414

# Intelligent Measuring and Improving Model for Customer Satisfaction Level in e-Government

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**Abstract.** E-government is defined as an application of IT to government services and it is a global phenomenon and public servants around the world are adopting novel ways to leverage IT to better serve their constituents. In this paper, we proposed a g-CSI model that has two major contributions to overcome the weakness of the existing CSI models that not suitable for the e-government. First, the g-CSI model that measures customer satisfaction for government should have a difference in that for private sectors, and the e-government operates on the Internet environment. We suggest the g-CSI model for e-government suitable to the Internet environment. Next, using a feature weighting and a feature positioning, we can extract the improvement points to enhance the level of customer satisfaction.

## 1 Introduction

E-government is defined as an application of IT to government services. E-government is a global phenomenon and public servants around the world are adopting novel ways to leverage IT to better serve their constituents. Since the word 'electronic government' appears in the United States in 1993, many nations have pushed on establishing an e-government as a means of innovation of society and a government.

The purposes of constructing e-government are 'providing citizen with service quickly and accurately', 'effectiveness of government work', 'innovation by redesign work process', and 'raising national competitiveness by improving productivity' [1].

The final goal of e-government makes citizen more easiness to access government. So, the future direction of implementing e-government has to improve customer satisfaction. The services related to customer such as operating a call center and investigating customer satisfaction must be developed and progressed [2].

Customer satisfaction has taken on a national and an international significance with the development of national satisfaction barometers and indices in Sweden (1992), the US (1996) and Norway (1998). Indices have also been pilot tested in New Zealand, Austria, Korea and the European Union. It remains to be seen whether these indices will develop on a global level and, importantly, in

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what form. Of critical importance to the validity and reliability of such indices is that the models and methods used to measure customer satisfaction and related constructs continue to learn, adapt, and improve over time [3].

First of all, the model that measures customer satisfaction for government must have differentiation from that for private sectors. Therefore, American Customer Satisfaction model for government [4] is developed. This model, however, has the problem which it does not consider the Internet environment. The 'Accessibility' that is the critical factor in the Internet environment should be reflected to customer satisfaction model for government for accurate measuring.

Therefore, we suggest the new model to measure customer satisfaction in e-government and configure for the reasons. First, the proposed model had to evaluate the level of customer satisfaction. On the basis of analyzing the existing ACSI and NCSI model (National Customer Satisfaction Index model in Korea) adapted with private sectors, the measuring model reflected to the characteristics of e-government organization must be made, and used for standardized model comparing between government agencies. Second, it is required to expand the mind of management for satisfying customers and offers customer-oriented services. The accurate measuring of customer satisfaction enables assess a government organization objectively, and contribute to make the management of customer satisfaction better. Third, the government agencies are faced with improving a competitive service quality. The results of standardized measuring for customer satisfaction about government organization are helpful to find out the weakness area of their services and extract the direction of improvement.

The existing methodology for measuring customer satisfaction is limited to show only the level of satisfaction. Its results are not continued to take a chance of improvement for government services. Our proposed system will be able to enhance the usability of the results. With a feature weighting and a feature selection, important variables, critical success factors to improve government services, are found out.

If the government applies our g-CSI model, and analyzes and executes the results to improve e-government service, the customer satisfaction level will be raised. The efforts for reducing primary complain factors could increase the satisfaction level of customer as well as government organization. And, the government can realize customer-participated e-government. The customer does not only receive services from a government, but also can give the suggestion about problems to government.

The purpose of our paper is to suggest the new measuring model for customer satisfaction in e-government. This paper consists of 5 sections. In section 2, we introduce the weakness of the existing customer satisfaction models in the e-government environment. And, the section 3 presents a customer satisfaction to-be model for e-government. Next, we provide the methodology that makes government agencies improve using a feature weighting and selection in section 4. Finally, we summarize this paper.

## 2 Existing Customer Satisfaction Models & Suggested Model for e-Government

### 2.1 National Customer Satisfaction Index (NCSI) in Korea

The NCSI model was developed to be suitable for the environment of Korea by a National Quality Research Center at Michigan University and Korea Productivity Center.

The NCSI model presents a cause and effect relationship model that measures a customer satisfaction level. The 'Customer Expectations' index before purchasing and the 'Perceived Service Quality' and 'Perceived Product Quality' index after purchasing are effect to 'Customer Satisfaction'. Also, the 'Customer Satisfaction' is ahead to 'Complaint' and the results of 'Loyalty'. Repurchasing or retention of customers that influence organization sales is important variables for measuring 'Customer's Loyalty'.

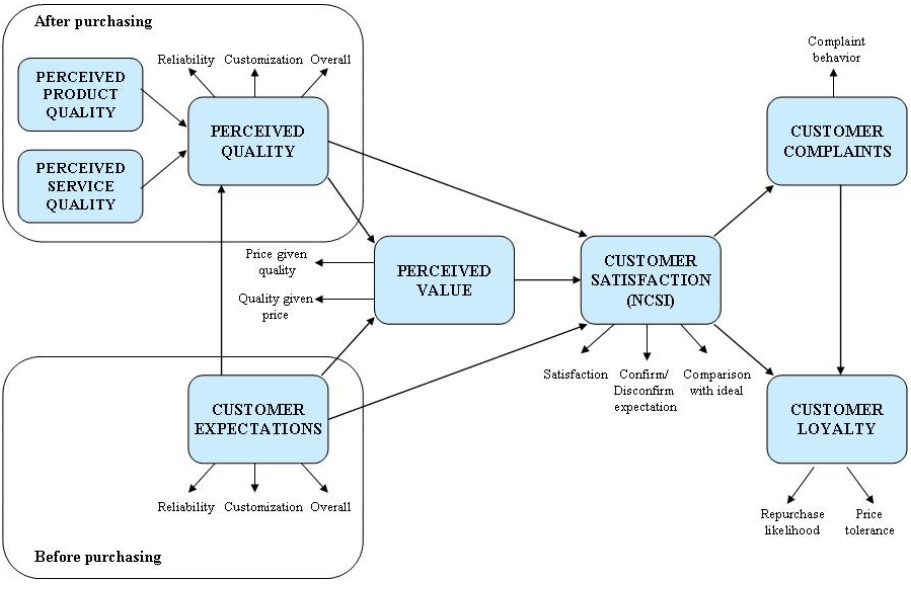


**Fig. 1.** National Customer Satisfaction Index (NCSI) model in Korea

### 2.2 American Customer Satisfaction Index (ACSI) for Government

The ACSI was developed in 1994 following several years of development and pre-testing. It is produced through a partnership of the University of Michigan Business School, American Society for Quality (ASQ) and Arthur Andersen. The National Quality Research Center (NQRC) at the University of Michigan Business School is responsible for researching and producing the ACSI. The ACSI follows the general modeling and the survey methodology for Swedish Customer

Satisfaction Barometer (SCSB) adapted in the distinct characteristics of the US economy and it can be considered as an effort to develop an index similar to the national consumer price index (US Consumer Price Index) [5]. The ACSI for government model was developed to measure the customer satisfaction of US Federal Government in 1999 [4].

### 2.3 Improving the Existing CSI Models for e-Government (g-CSI)

As we mentioned before, the NCSI model which is suitable to private sectors should be modified to g-CSI model that reflects characteristics of e-government. The existing model designed for private cooperates has some measuring factors that are not fit to characteristics of government. For example, 'Price' or 'Repurchase' factors are not evaluated to a government organization. The NCSI model is needed to reflect ACSI model for government agencies that measures property of them.

Next, the standard model for measuring customer satisfaction is needed to compare with government organizations in another country. The overall assessment steps that evaluate government agencies are composed of customer satisfaction, organization management, and president management. The scale and weight among these assessments are different. The proposed model makes it possible to compare with other government agencies in any country as well as in a local country.

## 3 Customer Satisfaction Index Model for e-Government (g-CSI)

As depicted Fig. 2, we suggest the g-CSI (Customer Satisfaction Index for e-government) integrated model. This model solves the problems that the existing CSI model does not fit to government but private organizations.

The proposed model that evaluates customer satisfaction for e-government is different from NCSI model and suitable for characteristics of government organization.

The 'Perceived Value' and 'Customer Loyalty' are omitted or changed from NCSI model to apply for the government's property. The 'Perceived Quality' is linked to several governments related to their activities.

For the perspective of private organizations, 'Loyalty' is closely related to the increasing sales or reusing service is the important factors which are more effective to customer satisfaction. However, for the perspective of government organizations, 'Outcomes' such as 'Trust' or 'Compliance' is more important factor than 'Loyalty' (Government Performance & Result Act). With these reasons, the customer satisfaction model for e-government has to be designed as follows.

The g-CSI model does not consider some variables related to price. That is, the 'Perceived Value' factor that measures price given quality and quality given price in NCSI model is not mandatory.

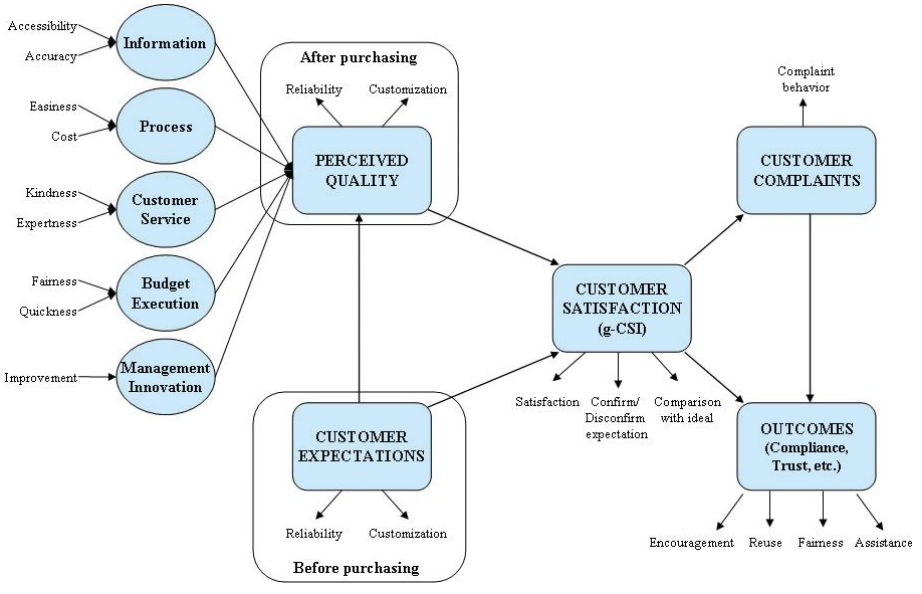


**Fig. 2.** Customer Satisfaction Model for e-Government

**Table 1.** Activities for g-CSI model

| Service target | Agency examples | Activity |
|---|---|---|
| Customer | District Heating Corp., Electrical Safety Corp., Science Foundation, etc. | Information, Process, Customer Service |
| Customer including financial service | National Health Insurance Corp., National Pension Corp., Teachers Pension Corp., etc. | Information, Process, Customer Service, Budget Execution |
| Other organizations | Testing Laboratory, Energy Management Corp., Gas Safety Corp., etc. | Information, Process, Customer Service, Budget Execution, Management Innovation |

In the ACSI model for government agencies, the 'Perceived Quality' factor is composed of several Activities. They consist of information, process, and service. The measurements of information are accessibility to information, accuracy of information, etc., the measurements of process are easiness, costs, etc., and the measurements of customer service are expertness, kindness, and so on.

The 'Loyalty' factor that consist of permitted limit of increasing price, decreasing price at other cooperates in NCSI model has to be changed to 'Outcome' factor such as 'Trust' or 'Compliance'. The units like reusability, assistance, justice, encouragement are measured and evaluated.

Second, our proposed models are divided by characteristics of government agencies. One is the measuring model without financial service against customer, another is the measuring model with financial service against customer, and the other is the measuring model against other organizations. The Activities connected to 'Perceived Quality' are differently designed for each other. The Table 1 shows activities and government agencies for each service target in Korea.

## 4 Finding Out Improvement Points Using Feature Weighting and Selection

Traditional CSI only survey customer's satisfaction level and simply compare two levels. Therefore, it may not provide information about improvement factors. Also, because government makes an effort to improve satisfaction degree of a large majority, they can not improve satisfaction degree of a minority. So, there is always room for improvement.

Therefore, we should analyze and improve many factors to fit characteristics of each customer group extracted by customer segmentation. As a result of this analysis, government can promote satisfaction level of whole customers.

To compare and analyze important improvement factors in organization and to find improvement direction and improvement effects, the new method for choosing improvement factors and an output image is needed.

The framework as depicted Fig. 3 shows processes to choose improvement factors in government and public office.

The framework consists of 5 processes - a feature weighting using trained neural network, a feature selection using the feature weights evaluated feature weighting process, an evaluating degree of importance, an evaluating degree of contribution, and positioning using degree of importance and degree of contribution.

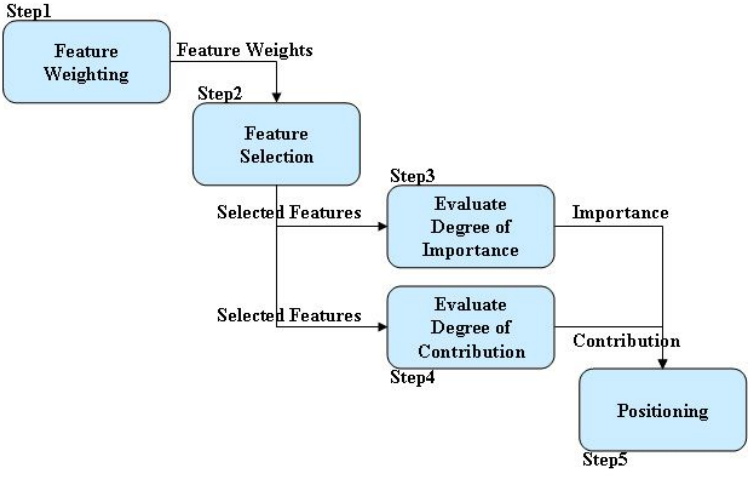


**Fig. 3.** Framework for choosing improvement factors

### 4.1 Feature Weighting

The presented features are not equally important in CSI for government. That is, some features should be treated more important than other features. Many feature weighting methods have been proposed to assign higher weights to the more relevant features. Shin et al. proposed a hybrid approach of neural network (NN) and CBR named as MANN (Memory And Neural Network based learning) [6]. In this paper, we adapt the Shin's hybrid approach.

In the hybrid approach of MANN, the feature weight set, which is calculated from the trained neural network, plays the core role in connecting both learning strategies and the explanation for prediction, which can be given by obtaining and presenting the important factors. Those methods gave large weight value to important features. And four feature weighting methods are suggested – Sensitivity, Activity, Saliency, Relevance. Each of four feature weighting methods has a different characteristic. So, we must select a feature weighting method for selecting features and evaluating degree of importance.

### 4.2 Feature Selection

As a result of feature weighting process, we can obtain feature weight values. Because the feature weighting method assigns higher weights to the important features, we can select important features. Feature selection make analysis of CSI very simple. That is, feature selection has the effect of data reduction.

We use Sensitivity as measure for the feature selection because a measure of sensitivity of input feature is the difference of the error when the feature is removed and when it is left in place. That is, if input feature is important, the measure of sensitivity of an input feature is high and we must select the input feature.

Table 2 shows example of feature selection. As a result of feature selection, seven features (questionnaires) are selected and three features which have a shadow are not selected.

**Table 2.** Feature selection

| **Feature** | **Sensitivity** |
|---|---|
| TotalQualityIndex_Q1_Process | 0.2077 |
| TotalQualityIndex_Q2_Process | 0.1433 |
| CustomerExpectationIndex_Q1_Process | 0.1724 |
| CustomerSatisfactionIndex_Q1_Process | 0.0692 |
| TotalQualityIndex_Q3_Service | 0.1578 |
| CustomerExpectationIndex_Q2_Service | 0.4624 |
| Complain_Q1_Service | 0.1034 |
| CustomerSatisfactionIndex_Q2_Information | 0.3357 |
| Complain_Q1_Information | 0.2189 |
| Outcomes_Q2_Information | 0.0573 |

### 4.3 Evaluating Degree of Importance

Degree of importance shows degree of related strength between specific dependent variable – such as whole satisfaction – and features (questionnaires) selected by the feature selection. The higher degree of importance between a dependent variable A and an independent feature B is, the closer relation between the feature A and the feature B is. We use Activity as measure for feature selection because Activity of a node is measured by the variance of activation level for the training data. When activation value of a node varies large according to its input value, the activity of the node is high. That is, the higher degree of importance between a dependent variable and an input feature is, the higher measure of activity of an input feature is. So, we can know degree of importance of the input feature according to measure of activity of an input feature.

The key features have a higher value of degree of importance. We will perform analysis with priority given to the key features. Table 3 shows degree of importance of the independent features – questionnaires.

**Table 3.** Degree of importance of the features selected by feature selection process

| **Feature** | **Degree of Importance** |
|---|---|
| TotalQualityIndex_Q1_Process | 0.2357 |
| TotalQualityIndex_Q2_Process | 0.1834 |
| CustomerExpectationIndex_Q1_Process | 0.1224 |
| TotalQualityIndex_Q3_Service | 0.1328 |
| CustomerExpectationIndex_Q2_Service | 0.3224 |
| CustomerSatisfactionIndex_Q2_Information | 0.4327 |
| Complain_Q1_Information | 0.1132 |

We can find the three key features – TotalQualityIndex_Q1_Process, CustomerExpectationIndex_Q2_Service, CustomerSatisfactionIndex_Q2_Information – based on degree of importance among many features. Because the three key features move to direction of the dependent variable, we can evaluate how much the dependent variable is influenced by the key feature. We call it a degree of contribution.

### 4.4 Evaluating Degree of Contribution

If the dependent variable is improved very much when a specific independent feature is improved, degree of contribution of the specific independent variable is high. That is, degree of contribution is the measure that shows degree of improvement of the dependent variable caused by a specific independent feature.

With a graph, we can display change of degree of contribution. As depicted Fig. 4, shapes of the graph can be classified with three types. The first graph has an exponential shape and the second graph has a linear shape, and shape of the third graph is a logarithm shape.

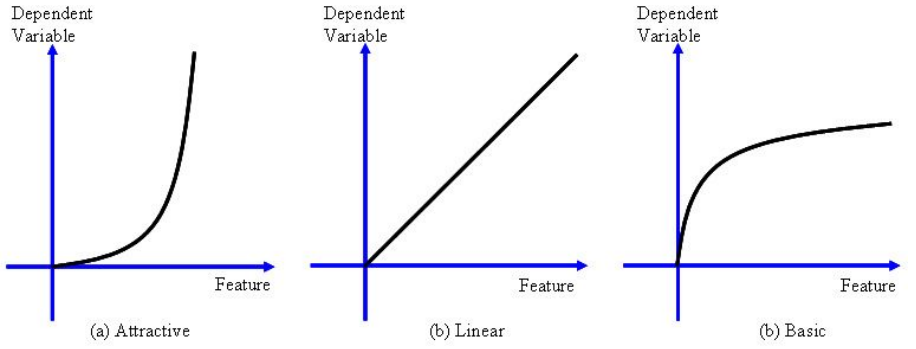


**Fig. 4.** Three types of the graph of contribution

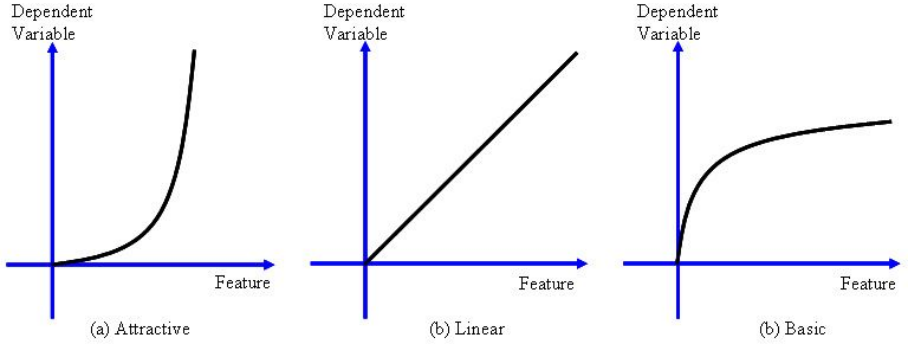


**Fig. 5.** Graph of contribution degree

The feature in case (a) is an attractive feature because increasing degree of contribution is the most, and the feature in case (c) is a basic feature because increasing degree of contribution is the least.

In Fig. 5, degree of contribution of Q2_Information is the highest and degree of contribution of Q2_Service is the lowest.

### 4.5 Positioning

The degree of importance shows a correlation between the dependent variable and the independent variable in a whole scale and the degree of contribution shows a capable degree of improvement of the dependent variable when each independent variable is improved. Positioning display graphs of many variables on a coordinates plane of which the horizontal and the vertical axis of coordinates shows are the degree of importance and contribution.

The coordinates can be divided into four areas. The first area contains variables having the high degree of importance and the high degree of contribution. The second area contains variables having the high degree of importance and

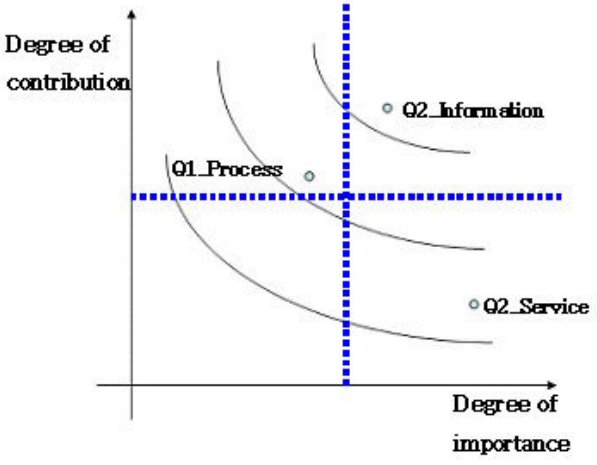


**Fig. 6.** Positioning

the low degree of contribution. The third area contains variables having the low degree of importance and the high degree of contribution. The fourth area contains variables having the low degree of importance and the low degree of contribution.

We must manage variables different according as which piece variable locates in. Fig. 6 shows example of positioning. Q2_Information variable lies in the first piece and Q1_process is on the second piece, and Q2_Service locates in the third piece. We must manage Q2_Information very well because Q2_Information have the high degree of importance and contribution.

## 5 Conclusions

The boom of Customer Relationship Management influences government agencies as well as private sectors. The government agencies try to understand the needs of citizen and raise the level of citizen's satisfaction. The common methodology of finding out the needs of customer is to measure the Customer Satisfaction Index.

In this paper, we propose the g-CSI model that has two major contributions to overcome the weakness of the existing CSI models that not suitable for e-government.

First, the model that measures customer satisfaction for government must have differentiation from that for private sectors. The American Customer Satisfaction model for government was developed, however, it has the problem which it does not consider the Internet environment. We suggest the g-CSI model for e-government suitable to internet environment.

Next, using the feature weighting and the feature positioning, we can extract the improvement points to enhance the level of customer satisfaction. The existing methodology for measuring customer satisfaction is limited to show only

the level of satisfaction. Its result is not continued to take a chance of improvement for government services. Our proposed system will be able to maximize the usability of the results.

## References

1. Jung A Lee and Jin Woo Jung. Strategy for Implementing High Level e-Government based on Customer Relationship Management. Korean National Computeriazation Agency. 2004. 5.
2. Jung Yeon Oh. e-Government Service Improvement Initiative. Korean National Computeriazation Agency. 2003. 8.
3. M. D. Johnson, A. Gustafsson, T.W. Andreassen, L. Lervik and J. Cha. The evolution and future of national customer satisfaction index models. Journal of Economic Psychology. 2001. Vol.22
4. http://www.theacsi.org/government/govt-model.html
5. E. Grigoroudis and Y. Siskos, A survey of customer satisfaction barometers: Some results from the transportation-communications sector. European Journal of Operational Research. 2004. Vol.152.
6. C.K. Shin, U.T Yun, H.K. Kim and S.C. Park. A Hybrid Approach of Neural Network and Memory-Based Learning to Data Mining. Int J IEEE Trans. on Neural Networks. 2000. Vol.11, No.3

# Accountability of Electronic Cross-Agency Service-Delivery Processes

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**Abstract.** Due to the fragmented nature of governments, governmental services are delivered by cross-agency service-delivery processes. Accountability for these cross-agency service-delivery processes is especially challenging, as it is unclear who is accountable for the whole cross-agency process. Unclear accountability relationships lead to untransparent processes. In this paper, we investigate literature on accountability, derive a framework for accountability of cross-agency service-delivery processes, and propose several initial mechanisms and guidelines for ensuring accountability of these processes.

## 1 Introduction

Governmental service-delivery processes can take many different forms, ranging from relatively simple processes for basic services such as issuing a parking-license, to highly complex processes for services such as issuing the environmental permits for a chemical plant. As governments are fragmented into many different (semi)autonomous agencies and departments (e.g.[1]) and an increasing number of processes are contracted out to private parties [2] and shared service-centers [3], many governmental processes are executed by multiple autonomous agencies or organizations, making them cross-agency service-delivery processes.

Accountability is an important requirement throughout the whole public sector. Accountability is a relationship between two parties, in which an individual or agency is held to answer for a performance that involves some delegation of authority to act [4]. Accountability is a very broad concept, reaching from overall governmental accountability to the accountability of a single civil servant for the performance of a certain task.

As the number of agencies that are involved in a particular service-delivery process increases, coordinating these processes on an agency-to agency, bilateral basis becomes infeasible, and the need to orchestrate these processes arises. Figure 1 shows a cross-agency service-delivery process that is executed by three different agencies. In this example, agency A is a one-stop-shop, and consequently has to orchestrate the process, by invoking a subprocess to be performed by agency B. Several semi-autonomous agencies working together to reach a common goal, in this case deliver a service, is also called 'joined-up government' [5, 6].

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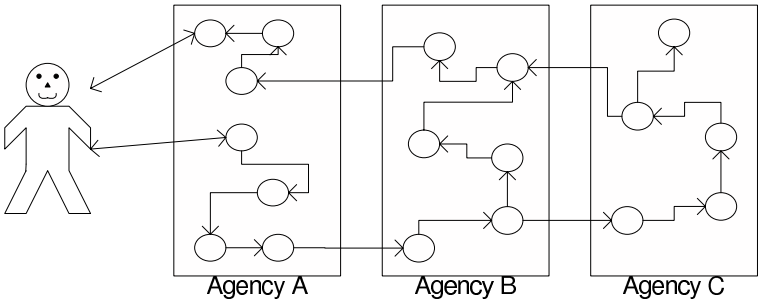


**Fig. 1.** Cross-agency Service-Delivery Process

Ling [5] states that although there have always been accountability dilemmas in the public sector, mainly about the tension between delivering responsive local services while maintaining central coordination, 'joined-up government' gives this tension a new inflexion, and, arguably makes it less easy to manage [5]. Haque [2] comes to the same conclusion, as he observes that, as public administrations are more and more adopting the business-like 'customer model', there is diminishing publicness about public services . "In order to ensure public accountability, there is a need for redesigning the existing accountability measures and introducing new ones" [2, p. 76].

This paper presents the first results of research aimed at developing mechanisms for keeping electronic cross-agency processes accountable. In the next section, a literature study into the concept of accountability is presented. Section three synthesises the findings of this literature study into an accountability framework, and section four presents some preliminary ideas on a set of guidelines and mechanisms for accountable cross-agency service-delivery processes.

## 2 Literature Study on Accountability

White and Hollingsworth state that "accountability always involves an actor with the duty to render an account and another actor with the power to judge or impose sanctions" [7]. When compared to the definition by [4] from the previous section, this 'duty to render an account' corresponds with the 'delegation of authority to act', and 'held to answer' implicitly assumes that one party has the power to judge the performance of the other party. This relationship can also be seen as a principal-agent relationship [8, 9, 10] with the agent as the party who has to account for its performance, and the principal judging and sanctioning. In an accountability-relationship, the agent can be called the 'accountor', and the principal the 'accountee' [8, 11].

As the definitions of accountability are quite broadly defined, many different accountability relationships exist within governments. This is also reflected in literature on accountability in the public sector. Many 'frameworks' aimed at categorizing different types of accountability-relationships exist. A particularly

popular distinction between different types of accountability is based on the difference in accountee.

Sinclair identifies five forms of accountability, based on interviews among 15 chief executives in the public sector [12]: (1) political (or democratic) accountability: a minister is accountable for the actions of its civil servants; (2) public accountability: more informal than political accountability, the civil servant is directly accountable to the public; (3) managerial accountability: based on a persons location in the hierarchy, focusses on monitoring inputs and outputs or outcomes; (4) professional accountability: invokes the sense of duty that one has as a member of a professional or expert group; (5) personal accountability: fidelity to personal conscience in basic values such as respect for human dignity.

Romzek and Dubnick discern four types of accountability, based on two dimensions: whether the accountee is internal or external to the organisation, and whether the degree of control over agency actions is low or high [13]: (1) bureaucratic accountability: high degree of control, accountee internal to agency; (2) legal accountability: high control, external; (3) professional accountability: low control, internal; (4) political accountability: low control, external.

Bovens calls the distinction in accountee "the problem of the many eyes", and identifies five forms of accountability [11]: (1) organizational accountability: superiors, both administrative and political; (2) political accountability: elected representatives and political parties; (3) legal accountability: courts; (4) administrative accountability: auditors, inspectors and controllers; (5) professional accountability: professional peers.

Bovens also presents another way of categorizing the different forms of accountability. He calls it "the problem of the many hands", or who is to be held accountable? Is it the organization who is the accountor, are the individuals within the organisation themselves accountable, or both? In the latter case, a distinction can be made between hierarchical accountability ('one-for-all'), collective accountability ('all for one'), and individual accountability ('each for himself') [11].

Kearns [14] reconfigures the dimensions of [13] into whether the mandate for control is explicit ('de jure'), or implicit ('de facto'), and whether the response of management is tactical or strategic [15, 16]. This difference in explicitness corresponds with what [11, 17] call formal and informal types of accountability. This depends on the relationship between the accountor and the accountee, whether the obligation of the accountor to inform the accountee about its conduct is formal or informal [11].

Tactical and strategic responses to the expectations of the accountee can also be called reactive and proactive [16]. Reactive accountability processes are initiated by a trigger, an event that triggers the accountability process [18]; For example the explosion of the space shuttle Challenger [13]. When using proactive accountability, the accountor does not wait on a trigger to account for its actions. An example is 'Accountability by Dialogue', as is discussed in [17].

Another distinction between different types of accountability can be made based on the subject of the accountability-relationship, or 'accountability for what' [11]. A framework to classify accountability based on the subject of the

accountability relationship is offered by the American National Performance Review, which identifies three types of accountability [17]: (1) direction-based accountability: checks whether objectives are established in accordance with aims; (2) performance-based accountability: specifies and measures output and outcomes; (3) procedure-based accountability: specifies laws and rules of conduct.

An accountor can be held accountable for the objectives of its agency, its performance, and for correct following of procedures. A trend in public sector accountability is that due to recent governmental reforms, mainly under the influence of the New Public Management (NPM) paradigm [19], the focus of governmental accountability shifts from accountability for process (procedure) to accountability for performance (product) [20, 21].

Ospina et al. [22] give three different levels on which performance can be measured: macro or policy level, meso or organizational level, and micro or individual level. These levels can also be applied to the subject of the accountability-relationship; not only to accountability for performance, but also for accountability for process, where an accountor can be asked to account for each step in every instance of a specific process, or can be held accountable for the finances or fairness of the general process.

## 3 Framework for Accountability in Cross-Agency Processes

As the accountor in an accountability-process can be an organization, an individual, or both, the term 'accountable process' is semantically incorrect. When looking at accountability and business processes, we look at the capability of the accountor to account for a specific process. An "accountable process" would enable the accountor to account for every relevant part of the process, whereas in a process that is less or not accountable, information about (parts of) the process is lacking, or accounting for the process is in an other way unsatisfactory.

We synthesized the different categorizations of accountability from literature, together with their interrelationships, into a framework for accountability in cross-agency-service-delivery processes. This framework is shown in figure 2. The text from the figure in boldface corresponds with a further description in the list below. As all of these distinctions have been explained in the previous section, the descriptions have been kept concise.

1. *Accountee*: Who is the accountee: the public, customers, managers, politicians, auditors, professional peers, or (the conscience of) the accountor himself?
2. *Accountor*: who is the accountor: the 'corporation', the person, or both? And who is accountable in the case of a cross-agency process?;
3. *Type of Accountability Process*: proactive (giving account) or reactive (being held accountable) accountability; and accountability during the execution of the process (operational accountability) or accountability afterwards?
4. *Level of Aggregation*: accountable for an instance of a process, for a process, a single task, or for multiple processes in agency/department?

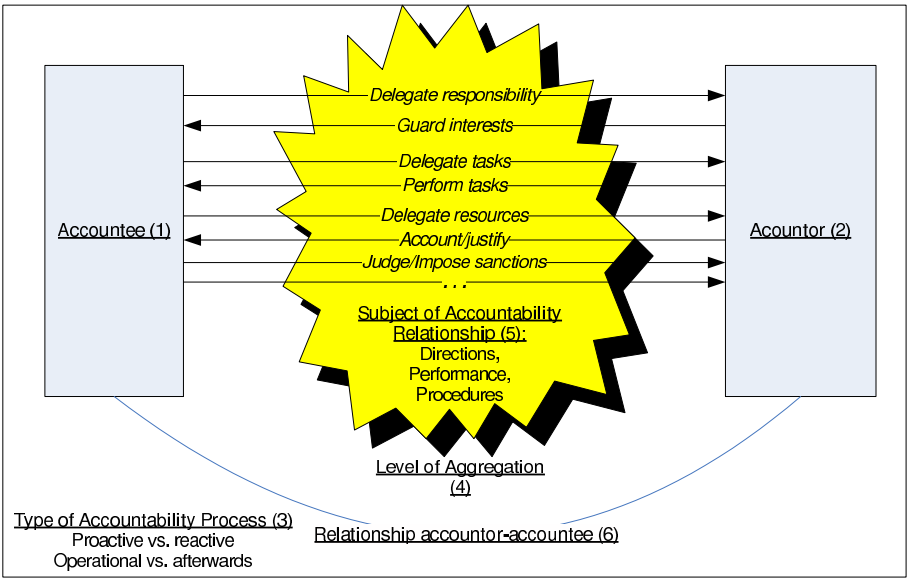


**Fig. 2.** Different Categorizations of Accountability

5. *Subject of Accountability Relationship*: Accountable for the aims of the agency, for the fairness of the process, or for performance?
6. *Relationship Accountor-Accountee*: relationship between principal and agent determines formal(explicit), or informal(implicit), and external or internal accountability.

For analysing the problem of accountability in cross-agency service-delivery processes, the framework can be filled in as follows. The customer of the service and the citizens are the main accountees of the process, but public managers and politicians are also important as accountees. To reduce administrative burdens and increase the transparency of government, it is necessary to make one agency accountable for the whole cross-agency service-delivery process. Direction-based, performance-based, and procedure-based accountability need to be considered, but the main focus will be on accountability for performance at the level of aggregation of specific process-instances. Furthermore, both proactive and reactive forms of accountability, and both accountability during the process and accountability after the service has been delivered need to be considered.

## 4 Towards Accountable Cross-Agency Service-Delivery Processes

In the literature on accountability we studied, mainly drawn from the public-administration field, little was found about mechanisms to ensure accountability of a process. This section will take a first step towards guidelines and mechanisms for accountable cross-agency business processes.

From the previous sections can be concluded that it is important to have one single accountor, i.e. to have one singe agency accountable for and orchestrating the whole cross-agency process. In function of the service that is to be delivered, it requests sub-services to be performed by the involved agencies in the right sequence, and forwards, aggregates and sends the outcomes of these sub-services to other sub-services, and finally to the service-requester. As accountability is currently typically only organized within the own hierarchy, making one agency responsible for the whole cross-agency process may require the re-allocation of responsibilities among the different governmental agencies. To accomplish this, law changes may also be necessary.

One way of ensuring accountability of orchestrated cross-agency service-delivery processes to let agencies provide, next to the service-interface by which it is called to perform its tasks, an *accountability-interface* by which it provides -upon request- the information that is needed to account for the overall process. By offering this 'accountability-interface', each participating agency is in itself 'inherently accountable'. This means that each agency should take care of documenting their actions for accountability-purposes.

When the agencies store this accountability-information themselves, and provide access to it using a specific 'accountability-interface', (reactive) accountability after execution of the process can be ensured. An accountability-interface can, however, also be used for accountability during the process. When the agency that is accountable for the whole process for example receives a request for the status of a particular process-instance, it can call the status-service on the accountability-interfaces of the agencies who it has asked to perform a subtask, and it can use this information to respond to the status-request. Accountability to the citizens can also be satisfied with information about the execution of the process, the documents, and the responsibilities associated with the process.

An initial set of information that agencies need to be save to be able to account for their processes are:

**Save Processes.** For accountability after the execution of the process, it is necessary to know how processes were actually executed; it must be possible to 'replay' the process. As processes can change over time, it is especially important that not only the deviations from standard process-execution are saved, but that the whole process is saved;

**Save Documents.** Almost every service-delivery process involves documents. For example the information filled in by the applicant of a building-license highly influences the tasks that are performed in the process that is executed and have therefore to be stored. Other, different types of documents that have to be stored are policy documents, especially documents that translate law into policies and actual processes. By saving these documents it can also be seen why a process was changed, or why it was not changed.

**Save Responsibilities.** Every task has an associated actor who is responsible for it. It is important that these responsibilities are also stored. If, for example, one of the tasks that has to be performed by an agency is to make a decision

about whether to grant a building-license or not, it is important to know who performed this task. When the task is by default allocated to one specific civil servant, but was reallocated to a less experiences colleague due to a vacation or illness, then this is important information for the accountability-process.

One of our steps of further research will be the elaboration on the above set of initial requirements by studying literature from the fields of (EDP-)auditing and electronic records management.

## 5 Conclusions

The goal of this paper is to investigate the accountability of electronic cross-agency service-delivery processes. A literature study on accountability showed that this goal is semantically incorrect, as accountability is always about a relationship between an accountor and an accountee. Many different views on accountability exist, and we synthesized them into a framework to analyze the types of accountability that are needed for establishing accountable cross-agency service-delivery processes. This framework consists of six elements: accountee, accountor, type of accountability process, level of aggregation, subject of the accountability relationship, and relationship accountor-accountee.

The paper shows that accountability of cross-agency processes may require the re-allocation of responsibilities and changes in laws in order to create clear accountability relationships. Accountability of this agency for the different sub-processes that make up the overall process can be accomplished by means of an accountability-interface, by which the other agencies provide the relevant information that is needed to account for their part of the overall process. Further research will focus on the mechanisms for ensuring accountability in cross-agency processes.

## References

[1] Maria A. Wimmer. An european perspective towards online one-stop government: the egov project. *Electronic Commerce Research and Applications*, 1(1):92–103, 2002.

[2] M. Shamsul Haque. Public service. the diminishing publicness of public service under the current mode of governance. *Public Administration Review*, 61(1):65–83, 2001.

[3] Marijn Janssen and René Wagenaar. An analysis of a shared service centre in e-government. In *Hawaii International Conference on System Sciences*, Big Island, Hawaii, 2004. IEEE.

[4] B.S. Romzek. Where the buck stops. accountability in reformed public organizations. In P.W. Ingraham, J.R. Thompson, and R.S. Sanders, editors, *Transforming Government. Lessons from the Reinvention laboratories*, pages 192–219. Jossey-Bass, San Fransisco, 1998.

[5] Tom Ling. Delivering joined-up government in the uk: Dimensions, issues and problems. *Public Administration*, 80(4):615–642, 2002.

[6] Christopher Pollitt. Joined-up government: a survey. *Political Studies Review*, 1(1):34–49, 2003.
[7] Fidelma White and Kathryn Hollingsworth. *Audit, Accountability and Government*. Oxford Univ Press, Oxford, 1999.
[8] Andrew Gray and Bill Jenkins. Codes of accountability in the new public sector. *Accounting, Auditing and Accountability Journal*, 6(3):52–67, 1993.
[9] David Mayston. Principals, agents and the economics of accountability in the new public sector. *Accounting, Auditing and Accountability Journal*, 6(3):68–96, 1993.
[10] Jane Broadbent, Michael Dietrich, and Richard Laughlin. The development of principal-agent, contracting and accountability relationships in the public sector: Conceptual and cultural problems. *Critical Perspectives on Accounting*, 7(3):259–284, 1996.
[11] Mark Bovens. Public accountability. In E. Ferlie, L.Lynne, and C. Pollit, editors, *The Oxford Handbook of Public Management*. Oxford University Press, Oxford, 2004.
[12] Amanda Sinclair. The chameleon of accountability: Forms and discourses. *Accounting, Organizations and Society*, 20(2-3):219–237, 1995.
[13] B.S. Romzek and M.J. Dubnick. Accountability in the public sector: Lessons from the challenger tragedy. *Public Administration Review*, 47(3):227–238, 1987.
[14] K. Kearns. *Managing for Accountability: Preserving the Public Trust in Public and Non-profit Organisations*. Jossey-Bass, San Fransisco, 1996.
[15] Gary M. Cunningham and Jean E. Harris. A heuristic framework for accountability of governmental subunits. *Public Management Review*, 3(2):145–166, 2001.
[16] Enamul Choudhury and Shamima Ahmed. The shifting meaning of governance: Public accountability of third sector organizations in an emergent global regime. *International Journal of Public Administration*, 25(4):561–581, 2002.
[17] Nancy Roberts. Keeping public officials accountable through dialogue: Resolving the accountability paradox. *Public Administration Review*, 62(2):658–669, 2002.
[18] Albert Meijer. Electronic records management and public accountability - beyond an instrumental approach. *The Information Society*, 17(4):259–270, 2001.
[19] C. Hood. A public management for all seasons? *Public Administration*, 69(Spring):3–19, 1991.
[20] Robert D. Behn. The new public management paradigm and the search for democratic accountability. *International Public Management Journal*, 1(2):131–164, 1998.
[21] George Boyne, Julian Gould-Williams, Jennifer Law, and Richard Walker. Plans, performance information and accountability: the case of best value. *Public Administration*, 80(4):691–710, 2002.
[22] Sonia Ospina, Nuria Cunill Grau, and Ariel Zaltsman. Performance evaluation, public management improvement and democratic accountability. *Public Management Review*, 6(2):229–252, 2004.

# Citizen Relationship Management and E-Government

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**Abstract.** Recent policy initiatives have advocated a Citizen Relationship Management (CzRM) strategy in conjunction with e-government to respond to the challenges facing public agencies. CzRM promises higher service quality at lower costs. CzRM was originally a private sector business strategy, part of the "entrepreneurial" paradigm that was applied to the public sector in the mid-1990s. This paper deals with four concerns: the assertion that transformation of citizens into customers has damaging effects on democratic governance and public administration; the existence of digital divides; accountability-issues; and the role of consultants as intermediaries. Finally, the change in citizens' wants and views about government may be caused by more fundamental changes happening in the American society. Despite the mentioned concerns, CzRM is feasible, but it should occur with an awareness of the raison d'être of the public sector, and that government has a role in securing both the quality and equality of government services.

## 1 Definitions of E-Government and CzRM

### 1.1 Different Approaches to E-Government

E-government is a growth industry. Not just in Europe and the United States but worldwide. In 2001, an AltaVista search on "Electronic Government" found 44,979 html documents [1]. A similar search by the authors in fall 2004 resulted in 12,200,000 – an enormous increase of 2,172% [2].

E-government is defined in the E-Government Act of 2002 as: *"the use by the government of Web-based Internet applications and other information technologies, combined with processes that implement these technologies, to – (A) enhance the access to and delivery of government information and services to the public, other agencies, and other government entities; or (B) bring about improvements in government to operations that may include effectiveness, efficiency, service quality, or transformation" [3].* Another definition of E-government emphasizes

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that E-government differs from traditional public service delivery, because: it is electronic, not paper based; it is available to citizen/customers 24 hours a day, seven days a week; and it provides information and service delivery of various types and degrees of complexity [4].

These two definitions are concordant in the sense that they both indicate that one of the important aspects of e-government is the use the World Wide Web and other electronic devices to provide citizens with information and deliver services. They also diverge because the latter definition also includes the activities between agencies and other units and also explicitly mentions e-government as a way to improve efficiency, effectiveness and transformation. This deviation calls for a distinction of e-government between an internal perspective and an external perspective.

**External and Internal Operations.** According to Åke Grönlund, e-government is about changes in both internal government operations (the internal side of e-government) and external government operations (the external side of e-government). The internal operations refer to the use of IT for automation, cooperation and integration among agencies, and e-government in this sense has now existed for a couple of decades. The use of e-government in terms of external operations is on the other hand new and occurs when government agencies use the internet to provide information and deliver services to citizens [5]. The primary area of interest in this paper, when examining the CzRM perspective within e-government, is the external side of e-government.

### 1.2 The Transformation of CRM into CzRM

Customer Relationship Management (CRM) is a profit-driven business strategy, which helps companies to better serve customers and improve their understanding of customers' wants and needs. In the private sector an evolution and transformation of customers took place during the last decades of the 20th Century [6]. Customers went from being regarded as passive buyers with predetermined consumption to be seen as partners, co-creators of business value, and co-developers of personalized experiences [7]. This has changed how companies provide information, deliver services, and interact with their customers. From the CRM perspective, the customer is an individual with a unique set of interests and needs; he/she has the right to customized, quick and convenient service [8]. Self-service technologies gives today's customers the option of having their needs met at their leisure through, e.g. online banking or e-commerce.

As customers experience an increase in service, access, and involvement in private sectors, they now demand the same from the public sector. Citizens today expect government service to be as good as or better than that received by private providers. Meanwhile governments all over the world are pressured by population growth and demographic change, a technological and knowledge explosion, and by citizens' increasing expectations combined with their tax reluctance. As a result, governments are beginning to adopt CRM practices in order to respond to the demands of citizens. They refer to it as Citizen Relationship Management CzRM [9].

### 1.3 The Elements of CzRM

At the core, CzRM focuses on providing citizens with timely, consistent, responsive access to government information and services using the channel that the citizen prefers. CzRM promises to strengthen the links and cooperation between government and its citizens, realizing operational and financial efficiencies, and building an environment that encourages innovation within government. Accordingly, CzRM strategies should be multi-channel, developed from a 360° view of the citizen, and oriented around the citizen's needs, not those of the organization [10].

All possible services needed by citizens should be provided in integrated solutions, such as websites, call-centers, or one-stop-shops. From Internet and email, over text messages and telephone, to appearing in person, people will have multiple modes of access to government. Furthermore, a multi-channel integrated service increases the possibility of self service. It reduces cost and improves the level of public service. Citizens filling out forms on websites reduce the need for manpower.

Increasingly, governments recognize the advantages of having a single website as a portal, where citizens can find information about services, contact information on public offices etc. A call-center can provide one single telephone number to public offices, thus making it easier for people to know to how to get in contact with government entities. One-stop-shops provide citizens with a single place to meet with public servants for routine business such as relocation reporting, tax filling or social security number applications.

Implementing CzRM within government organizations requires a shift in culture and a re-orientation by public authorities. Services provided by the public sector should be oriented toward citizens needs, not administrative and bureaucratic processes. CzRM facilitates government becoming *citizen-centric*. Hence, an attitudinal change within public servants is required [11].

## 2 Policy Initiatives in the US

The implementation of CzRM practices in the US is visible through various policy initiatives. Although some of them do not refer to the specific term CzRM, they include perspectives and require implementation of CzRM practices. The development of a more citizen-centric, service-oriented government originated with the Clinton administration's effort to reform the federal government, the National Performance Review (NPR) in 1993.

### 2.1 NPR and NPRG

NPR lasted from 1993 until 2001, and established nearly 4,000 customer service standards in 570 federal organizations. In 1997, NPR was renamed National Partnership for Reinventing Government, and attached with the slogan "America@Its Best" for an emphasis of the commitment to greater public access to government information and services through expanded use of IT and the internet. The establishment of customer service standards was one of NPR's key

achievements. An important factor was the Executive Order 12862 – "Setting Customer Standards" (E.O. 12862), issued by President Clinton in 1993 [12]. The order emphasized that the quality of government services should equal or exceed the best service available in the private sector. In order to reach that goal it described actions that needed to be taken by the agencies. Each agency was required to identify its customers, their wants, and the current level of satisfaction with services. Moreover, agencies were obliged to publish service standards, measure achieved results, and benchmark them against the best in business.

### 2.2 The President's Management Agenda

Despite changes in administrations the focus on CzRM practices has not lessened after the Republican win in 2000. President George W. Bush's management agenda (PMA) for the fiscal year 2002 focused on five government-wide initiatives. Here, we deal with the initiatives concerning expanded electronic government. These initiatives aim to provide high quality customer service regardless of whether the citizen contacts the agency by phone, in person or on the Web. In addition, they aim to cut government operating costs, provide citizens with easy access to government services, and make government more transparent and accountable [13].

The reform principles announced in the PMA initiative on expanded e-government were followed by legislative action, when the "E-Government Act of 2002" was signed into law. Among other things this legislation included an effort to expand the use of the internet and computer resources to deliver government services and to make government citizen-centred, result-oriented, and market-based [14].

Hence, Democrats and Republicans alike see CzRM practices as key to dealing with some of the contemporary paradoxes within government. The NPR / NPRG and PMA are clear examples of this, and the E-government Act gives legislative support to the implementation of CzRM practices.

## 3 General Services Administration – USA Services

USA Services, an element of the PMA, is managed by the US General Services Administration's (GSA) Office of Citizen Services and Communications (OSCS). USA Services is citizen-centred and provides people with a choice between different mediums: the internet, email, telephone, fax, or by mail and gives them timely information in both English and Spanish. USA Services provides quality customer service for citizens. During FY2003, the unit handled 209 million citizen contacts. Most of these took place through the 1-800-FEDINFO call center and the FirstGov.gov website (`www.FirstGov.gov`). The toll free national contact number is manned by specially trained staff, able to answer all questions about federal government issues between 8 a.m. and 8 p.m. Monday through Friday.[15] The FirstGov.gov website constitutes a "front door" to government information, services and transactions. It contains information from 180 million

federal, state, and local government web pages, or gives directories to these government websites 24/7. Via the FirstGov.gov website citizens may also apply for benefits, such as Social Security and student financial assistance and receive applications for passports.

The 1-800-FEDINFO call center and the FirstGov.gov website are only two among numerous analogous initiatives, e.g. Pueblo.gsa.gov, GovBenefits.gov, GoLearn.gov and Recreation.gov that have already realized CzRM practices. The huge amount of contacts that USA Services in general receives exemplifies that Americans embrace these new forms of contact.

## 4 Implications for Citizens

The previous sections have illustrated the evolution of the CzRM strategy in the US government, and we have seen a change in how government interacts with people. The following sections deal with the implications of this change.

### 4.1 Improved Service Delivery at Lower Costs

The cost and quality of service are not proportional. Multi-channel service within CRM provides a higher quality of service at a lower cost [16]. The adoption of the CzRM approach within the public sector therefore enables citizens to receive a higher level of service at a lower cost. The argument is that personal assistance types of service like face-to-face contact or telephone are expensive, whereas self-service on a website is less expensive. Thus, the best and most in-expensive quality of service is provided by a combination of the two. This relationship is illustrated in figure 1.

Several different elements are worth noticing when making this argument. First, a multi-channel contact center allows people to access government services and information around the hour. With FirstGov.gov and 1-800-FEDINFO's extended accessibility citizens receive better customer service than most governments offer. In the past, finding information could be time-consuming and hard to fit into a working schedule. Undoubtedly, CzRM makes it easier for people to receive information about government services and apply for benefits.

Secondly, FirstGov.gov is organized from a citizen-centric perspective. The website is a virtual one-stop-shop to services and information. Previously citizens would need to contact each individual office to apply for and obtain information about government benefits. The one-stop-shops, whether virtual or physical of nature, represent a shift from department-task organization to citizen-oriented organization.

Third, cheaper, yet improved, service follows from the less costly nature of internet transactions over manual transactions, as found by Cohen and Eimicke. In addition, CzRM also gives way for the possibility of self-service [17]. Grönlund reached a similar conclusion when studying the case of ServiceArizona – a website where people themselves can renew their vehicle registrations. Each internet

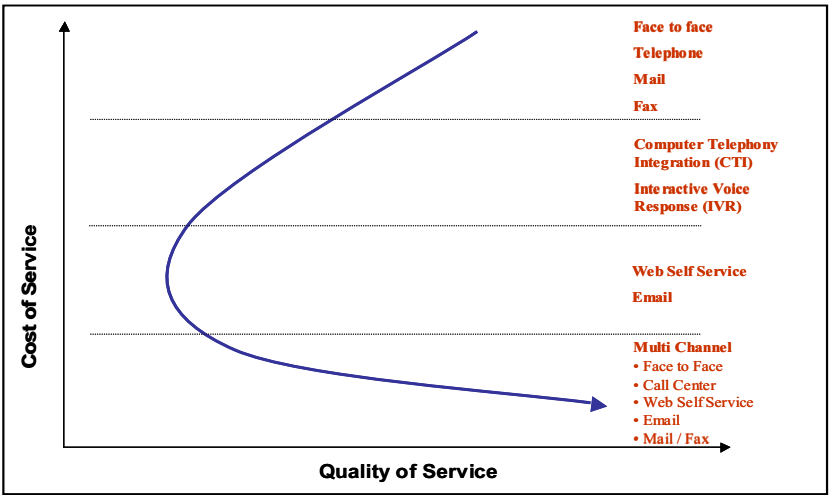


**Fig. 1.** Relationship between cost and quality. Source: Coleman C.: Citizen Relationship Management. US General Services Administration Newsletter, issue 14 (2004) 6–8.

transaction carries a cost for government of $1.60 compared to previous manual transaction cost of $6.60 [18]. These studies show the potential for reduced expenditures on service delivery.

Thus, CzRM does give way for a higher level of quality in service at lower costs. This being said, clearly, implementing a CzRM system does not come without expenses. Investment in computers, communication infrastructure, software, web design, expert staff, and training of employees is indispensable. Reduced costs are not achieved overnight and the benefits of the reduced service costs will tend to occur in a different fiscal year from the year the investment was made [19]. The overall implication of the implementation of a CzRM strategy for citizens is better quality of service at lower costs.

### 4.2 Citizens Not Customers?

CzRM practices and policy initiatives such as the NPR and the PMA are all part of a recent trend in public administration termed "Reinventing Government" or "New Public Management". Surfacing in the 1990s this trend influenced the Clinton Administration. Reinventing government applies market-based and customer service quality principles to government. In light of an inherent frustration with government reinventing it appears attractive. People commonly view government and the bureaucracy as producers of poor service quality, treating people impersonally, and in some cases even incompetently.

An example of citizens turning customers is the fact that more local government services are becoming fee-for-service based. Citizens in general also now demand improved levels of quality in service on par with the private sector.

Critics would argue that since reinventing government is based on a specific set of private sector values they do not apply to the public sector. Adopting the "entrepreneurial" paradigm in favour of the "administrative management" paradigm that had prevailed in the public sector since the late 1800s may have yet unknown long-term consequences.

**The New Public Service vs. Reinventing Government.** A contemporary criticism of the entrepreneurial paradigm is that: *"Public servants do not deliver customer service; they deliver democracy"* [20]. Denhardt and Denhardt call for a refocus on words like democracy, citizenship, and pride when talking about government and governmental actions, instead of the reinventing government keywords market, competition and customer. The New Public Service is based upon democratic theory and believes that the public interest should be a result of dialogue and deliberation about shared values. The interest of citizens is *integrative*. Public servants' motivational basis is seen as the desire to contribute to society and they must attend to law, community values, political norms, professional standards and citizen interests.

Reinventing government, on the other hand, presumes that public servants have an entrepreneurial spirit. The primary theoretical foundation of reinventing government is from economic theory, and it is very much influenced by the rationalist perspectives of public choice theory and principal agent theory. It presumes a notion of humans as being self-interested with ego-centric goals. The public interest is seen as the *aggregation* of the individual interest of every citizen. Like customers in the private market each "citizen" chooses for itself on narrow individual interests.

Denhardt and Denhardt argue that there is and has to be a distinction between customers and citizens, because the former chooses between products in the market, whereas the latter decides what is so important that the government has to do it at public expense. They stress that: *"Citizens are described as bearers of rights and duties within the context of a wider community. Customers are different in that they do not share common purposes but rather seek to optimize their own individual benefits"* [21].

In essence, citizens are an integral part of the governmental system, and not only a consumer of government services. In their role as customers, citizens do not need to think about others' interest. Thus, the public interest disappears when citizens are transformed into customers with damaging effects on democratic governance and public administration. Note that one of the public sectors original raison-d'être was to correct the imperfections of the market. The New Public Service therefore emphasizes that there may be consequences for the overall values in the public sector and within public administration, if citizens are transformed into merely customers with egoistic interests. Arguably this happens with the implementation of CzRM.

**Overcoming Digital Divides.** Another important facet when examining the implementation of CzRM is the existence of *digital divides*. The apprehension about digital divides is that unequal access to the internet is based on tradi-

tional social divides in society [22]. Uneducated citizens do not have the same opportunity to benefit from the improved quality of service because the internet is out of their reach.

The tremendous increase in use of the internet for government services and information (as seen with USA Services) indicate a risk of government services being more accessible to some than others based on the existing inequalities in society. The FirstGov.gov website is a good example of how only those citizens with access to the internet are able to benefit from the improvements in the quality of service that the website provides, even though all taxpayers are contributing to its budget. One might say that the e-government initiatives thereby result in a type of "negative redistribution". Especially if the new forms of transactions become fee-based there is a risk of a widened digital gap. Citizens would have to "pay and go on-line, or get in line" as opposed to traditional government service – at the Social Security office everyone has to stand in line.

Thus, in addition to physical accessibility for all online and accessible government must go hand in hand with development of the public's skills in how to utilize the new offerings. Especially if one believes that the responsibility of government is more than merely responding to the aggregate interests of citizens.

### 4.3 Accountability

Accountability is a core value within public administration. In its most narrow sense accountability means holding the politicians answerable for their actions by some form of external control, and may be specified as political accountability. Today, as government becomes increasingly complex, so does the issue of accountability.

Reinventing government and the New Public Service represents two views that give different emphases to aspects of accountability. Reinventing government stresses results. Administrative executives have discretion to be creative and innovative when carrying out government policies. Accountability becomes a matter of satisfying the preferences of individual customers of governmental services. The New Public Service pays more attention to process and policy. Agencies and officials have to be accountable to citizens, not customers. These two approaches originate from a different perception of the relationship between the political system and the administrative system. Differences in political and administrative values are illustrated in table 1.

Reinventing government and CzRM concentrate on the administrative values. Both represent a perception of a clear distinction between the political and administrative system by imposing the entrepreneurial and more technical paradigm to public administration practices. The New Public Service on the other hand represents another view. Here, the political and administrative should not be regarded as two separate systems with completely distinct values: *"Ultimately, those in government must recognize that public service is not an economic construct, but a political one. That means that issues of service improvement need to be attentive to not only the demands of "customers" but also to the distribution of power in society. Ultimately, in the New Public Ser-*

**Table 1.** Political vs. administrative values. Source: Milakovich, M. E., Gordon, G. E.: Public Administration in America. Wasworth California (2004) 52-53.

| Political Values | Administrative Values |
|---|---|
| Accountability | Efficiency |
| Responsiveness | Effectiveness |
| Representativeness | Representation |
| Participation | Rationality |
| Democracy | Professionalism |
| Citizenship | Discretion |

*vice, providing quality service is a first step in the direction of widening public involvement and extending democratic citizenship [23]."*

Thus, public service is seen as a continuation of the political system, and therefore representative of the same basic values. The incorporated entrepreneurial paradigm in public administration may have consequences for how we define the basic political values of citizenship, participation, accountability, responsiveness and democracy in the United States.

In sum, whether or not the citizen can be regarded as a customer originates from a different understanding of the relationship between the political and the administrative systems, their values, and the issue of accountability.

### 4.4 Intermediaries

In the private sector, numerous consultant companies offer expertise on Customer Relationship Management. While the private sector today is generally influenced by CRM practices, a new market is developing for these consultancies as the practices are disseminated to the public sector. They possess the specialized knowledge that government entities now find useful in order to deal with their present challenges such as a decreasing tax base due to a low economy combined with citizens' tax reluctance and higher demands. Yet, most consultant companies are experts in CRM, not CzRM. They are familiar with implementing CRM strategies to enhance commercial drivers such as increasing revenue and sales, but seldom government drivers such as improve quality of service within a shrinking budget *combined* with public sector responsibilities.

## 5 Give Citizens What They Want

The former discussion concerned problems related to the change happening in contemporary public administration. As we mentioned in the beginning of this paper, the initial reason for implementing CzRM is that people want it. They want increased quality of service as experienced in the private sector, while keeping taxes low. Furthermore, emphasis is on the ego-centric interest of individual citizens rather than on the public interest. Changes in citizens' demands and views of government may occur as a result of more fundamental and complex

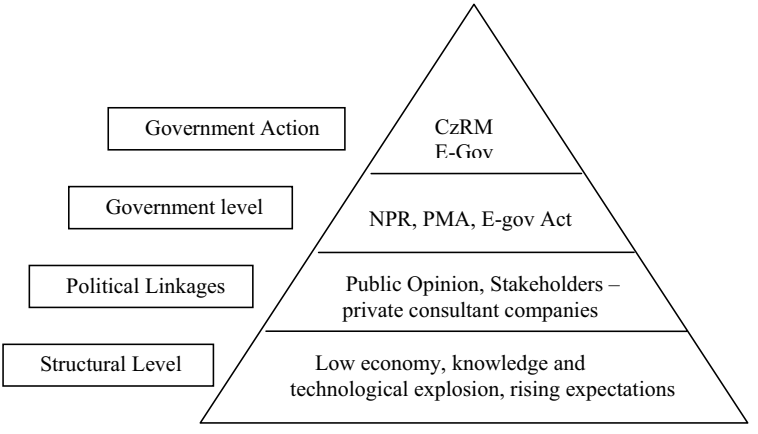


**Fig. 2.** E-government and CzRM in relation to structural changes in the American society

changes in American society. Figure 2 illustrates four different levels related to the rise of e-government and CzRM practices.

At the economic side of the structural level the American and the global economy in general have been low. The low private economy has resulted in an absolute shrinkage of tax bases, which combined with citizens tax reluctance puts a chronic fiscal stress on governments. A knowledge and technological explosion have taken place in especially Western industrial nations the last decades, which have given rise to the use of communication and electronic techniques in government. At the cultural side of the structural level there has been a revolution of rising expectations since World War II. Citizens expect economic development, higher productivity, more leisure time, more material possessions and increased standard of living. They have also developed an "I want mine" attitude towards government services. People want government to satisfy their individual demands and expect government to protect them from dangers, but they do not have great confidence in the execution of service delivery, and in general they regard government with hostility.

At the political linkages level these structural level tendencies have resulted in a general negative public opinion in the US towards government. The public opinion has been that government does not perform well enough and resources are not used effectively. The private consultant companies may play a role at this level, due to their interest in the opening of a new and huge market for their services. Politicians are affected by the public opinion, because it reflects the interests of a majority of the citizens.

To respond to the demands expressed through the public opinion different programs and laws are enacted at the governmental level. In the case of e-government and CzRM, the NPR/NPRG with E. O.12862, the PMA and the E-government Act of 2002 are examples of this.

Finally, at the governmental action level programs and laws have resulted in implementing e-government and CzRM practices in the national government, e.g. the FirstGov.gov website and the 1-800-FEDINFO.

Thus, the rise of e-government and CzRM practices and the transformation of the citizen into a customer may be seen as results of structural changes of society.

## 6 Conclusion – Is CzRM Feasible?

Citizen Relationship Management provides more effective and improved service quality for citizens at lower cost, and organized according to the need of the citizens. Already implemented initiatives show that CzRM indeed is feasible in the public sector. From a strictly functional service delivery focus, implementing CzRM practices improves the level of customer service and accessibility to government services at lower cost to taxpayers. However, from an academic and theoretical perspective this transition raises more fundamental implications for the overall understanding of government-citizen relations.

This paper has discussed both the possible advantages as well as disadvantages of implementing CzRM. Four concerns linger when this originally private sector strategy is introduced to the public sector. Public administrators have to keep in mind that those they deal with are citizens and not customers. The improved service quality must not take place on the expense of the fundamental values and drivers of the public sector. Furthermore, the adoption of CzRM in the public sector must recognize the existence of digital divides. The race for a more convenient and internet augmented government should therefore be combined with a concern for ensuring skills, abilities, and possibilities for all citizens to go online.

Reinventing government and the New Public Service represents two views on accountability. This is caused by different perceptions of the relationship between the political system and the administrative system. Thus, a discussion of the relationship between these two systems is just as relevant today as it was more than a century ago. The relationship has consequences for the overall actions of government.

Increasingly, government relies on external expert knowledge and the adoption of CzRM is not exception. This cooperation with private sector companies has great benefits for government, but at the same time public officials have to be aware that the private sector consultants are experts on CRM, not CzRM.

Finally, the action by politicians and public administrators alike to implement CzRM occurs as a response to structural changes in the American society. It is inherently problematical to predict the precise future structural development of the American society. Nonetheless, nothing indicates a decrease in CzRM initiatives. In fact, the opposite seems more likely.

No matter which direction of development we will witness, there is a continuous need for a discussion of government's role and how public administration takes part in securing the quality and equality of government services.

## References


1. Grönlund, Å.: Electronic Government: Design, Applications and Management. Idea Group Publishing London (2002) 1
2. www.altavista.com/web/results?itag=wrx&q=Electronic+government&kgs=0&kls=0. 10/19/04
3. United States' House of Representatives.:The E-Government Act of 2002. H. R. 2458. Washington (2003) 4 http://csrc.nist.gov/policies/HR2458-final.pdf. 9/3/05
4. Holden, S., Norris, D., Fletcher, P.:"E-government at the local". Public Performance & Management Review, Vol. 26 No. 4 (2003) 327
5. Grönlund, op. cit. 2
6. Prahalad, C. K., Ramaswamy, V.: Co-opting Customer Competence. Harvard Business Review. Customer Relationship Management. HBS Press Boston (2001) 4
7. Milakovich, M.E.: Balancing Public Service Expectations with Political Accountability. International Public Management Review, Vol. 4 No. 2, (2003) 61-82
8. Nasif, T.: Using Customer Relationship Management to Serve Citizens. U. S. General Services Administration, Newsletter issue 14 (2004) 1 www.gsa.gov. 12/6/04
9. Coleman, C.: Citizen Relationship Management. U. S. General Services Administration, Newsletter issue 14 (2004) 6
10. Xavier, Dr. M.. J.: Citizen Relationship Management - Concepts, tools. 6th Research Conference on Relationship Management in Atlanta, Georgia (2002) 3
11. Milakovich, M. E.,Gordon, G. J.: Public Administration in America Wadsworth California 8th Ed (2004) 429
12. The White House.: Executive Order 12862: Setting Customer Standards. Office of the Press Secretary (1993) http://govinfo.library.unt.edu/npr/library/direct/orders/2222.html. 12/6/04
13. Office of Management and Budget.:The President's Management Agenda. (2002) www.whitehouse.gov/omb/budintegration/pma_index.html, 24-25. 12/6/04
14. United States' House of Representatives, op. cit.
15. "1-800 FED INFO" www.pueblo.gsa.gov/call/ncc.htm. 12/6/04
16. Coleman, op. cit, 6-7.
17. Cohen, S., Eimicke, W.: The Use of Internet in Government Service Delivery. The PricewaterhouseCoopers Endowment for The Business of Government (2001) 7
18. Grönlund (2002) 31
19. Cohen and Eimicke (2001) 8
20. Denhardt, J. V., Denhardt, R. B.: The New Public Service. M. E. Sharpe, Inc. New York (2002) ix
21. Denhardt, Denhardt (2002) 60
22. Grönlund (2002), p. 39.
23. Denhardt and Denhardt (2002) 62

# DSS in a Local Government Context – How to Support Decisions Nobody Wants to Make?

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**Abstract.** This paper reports and analyses a case where a Decision Support System (DSS) was used in a local government for the purpose of arriving at a decision on a complicated and politically infected issue the City Council despite years of effort had failed to sort out. It was assumed that a strict and open method would make the grounds for the decision clearer, and that people would accept a clearly motivated decision even though they personally preferred another solution. The project was also intended as a test of new methods for potential adoption into normal practices. The analysis shows mixed understanding of, and mixed belief in, the method. While generally happy with the project work, also this time the Council failed to make a decision as constituency concerns eventually overruled the rationality of the arguments in the decision making council. The case raises issues of both the potential for DSS in a political context and the nature of political decision making. In particular we conclude that DSS use has to be carefully crafted but swiftly executed, and more than a one-off effort as a change process is involved.

## 1 Introduction

The City of Nacka is part of the Greater Stockholm Area, situated partially in the Stockholm archipelago. Some of the islands are inhabited, and on those that are easily reached by car or boat summer houses have evolved into permanent residents. The proximity to Stockholm has made property prices surge, so on the islands of Älgö and Gåsö expensive houses owned by well-off newcomers are now neighbouring older houses inhabited by residents since generations. This immigration and upgrading of the areas has raised demands for public services such as roads, water supply, and sewers, and also marinas for commuting to the islands. During the previous "summer house era" such facilities were run cooperatively by the inhabitants, but permanent residential areas in Sweden require the municipality to take over responsibility (although not necessarily operation), both by public demand and by law (not the marinas). For the past decade the issue of whether the above-mentioned services should remain private or run by the municipality has been discussed. Inhabitants at Älgö are divided into two groups with opposite views on the road, water and sewers issue, but they are united in a dispute with Gåsö inhabitants over the issue of the location of a commuting marina. All groups have lobbied politicians for years.

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There are political parties in the local council to support both fractions at Älgö. The Green party generally supports "local solutions", meaning private care, while the social democrats typically prefer municipal systems. The conservatives and the liberals – the coalition in power – do indeed like private entrepreneurship, but they are torn in this case as they have also made economic calculations showing that a publicly owned system would in the long run be more economical. The Social Democrats are by default in favour of municipal ownership. All parties have voters on the islands. The scene is set for a political drama.

After having failed for years to reach a decision, a new option appeared. In 2003 the leading civil servant at the City Planning Office came across a decision support system (DSS) at a fair (the system and the method used in Nacka are described in [1] and [2]). He was inspired by the clarity of the method and thought it would be a good idea to test it at the "Älgö case". During Fall 2003 the DSS was used in a new attempt to solve the long-standing problem. A consultant was hired to manage the process of having the project group work with the DSS. It was envisioned that the process would be finished by Christmas 2003, but there were delays. In May 2004 a decision was finally made regarding the marina. Plans were to make decisions on the road and water/sewage issues in June, but as one of the leading politicians at a late stage changed his mind this did not happen. As of this writing – February 2005 – no clear decision is yet made. Both alternatives are still up for discussion, this time without the DSS.

The question for this research is if, or to what extent DSS can be used in issues where opinions are truly mixed, something which is typically the case in politics. One of the ideas with a DSS is that clarity and transparency make the case. Enlightenment succeeds over private concerns, not only by a vote, but also in people's minds – people accept rational decisions. In the Älgö case, it was indeed assumed that a strict and open method would make the grounds for the decision clearer, and that people would accept a clearly motivated decision even though they personally preferred another solution. In this case no decisions were made on the trickiest issues. Instead political struggle, fired by underlying antagonism among inhabitants, continued. However, many people in the project group still believe the method has advantages. As a research problem this is interesting. DSS have been used over many years, often successfully, but this has been in not so public contexts. Are the experiences transferable– *how, and under what circumstances, can DSS support decisions in a political context?* Also the outcome may be challenged – was the failure to make a decision in June 2004 in fact a success? Did the project lead to a more enlightened understanding that the problems were indeed political and hence only solvable politically? Was it perhaps exactly what the political system needed in order to better fulfil its role – to make decisions where compatibility among all views is impossible and economic calculations do not speak strongly in favour of any proposed solution? [3]

The paper proceeds as follows: Next section describes the setup and method. Section 3 presents the results of the interviews. Section 4 analyses the results

and discusses the role of the DSS in this case and the implications for further research and use of DSS in political contexts.

## 2 Research Questions and Method

The issue of *how, and under what circumstances DSS can support decisions* is not new, but the application of DSS in a *political context* is, and this poses new challenges [3]. Not only are political contexts less controllable than business decision making as the public is involved more directly. Also, political decision making procedures are usually more built on representing and compromising among interests rather than striving for objectively rational decisions. Further, more than in business, social values are involved. Nevertheless – or precisely for these reasons – rational decision support might be very useful as it could help sort out many technical issues involved in assessing numerous criteria and at least make the grounds for decisions more clear to everyone involved or affected. The purpose of this study was to understand how decision makers involved in the Älgö project understood the DSS they used, and how they perceived this way of making decisions. Could a DSS find a place within, and improve, the existing political decision making procedures? Is a DSS useful, and what can we learn from this case regarding the design and use of it? All these questions were asked to begin inquiry into the more general question of if, how, and under what circumstances, DSS can support decisions in a political context.

Interviews were made with the participants in the project group – 4 politicians – three civil servants at the City Planning Office (*Stadsbyggnadskontoret*) adjunct to the group, and leading officers in four groups organizing citizen interests in the issues involved. Interviews were made by telephone. They were semi-structured by key themes, and lasted 45-90 minutes each. Notes were taken, spelled out more clearly with inclusion of my interpretations immediately afterwards and emailed to the interviewees for approval and corrections. Some people made minor clarifications, usually by moderating formulations they used in the interview and by detailing some technical issue.

The key themes investigated were:

1. How the interviewee viewed the *process*, including the contacts between decision makers and the public, the cooperation within the project group, the role of the consultant, and the influence of the method /the DSS/ used.
2. The *work* of the individual. Time spent, the view of the different steps such as coming up with decision criteria, weighing of criteria, assessing alternatives, and finding and disseminating information.
3. The *method* itself. Requirements for time spent, ease of use and understanding, cost, and added value, and if there were suggestions for improvement.
4. The *result*. What was the most positive with the method? The most negative? Was the outcome different than it would have been using the traditional method, and if so, how? How, if in any way, was the planning process affected?
5. The *role of politicians* is of course crucial. Did that change in any way?

The first three themes are grounded in the extensive DSS literature. There have been a large number of studies on DSS and use of DSS in various contexts. Traditionally, DSS are thought of as a technical system representing knowledge in some way and applying inference mechanisms to that knowledge. Using the Bayesian model, also opinions are represented quantitatively by assigning weights to parameters representing people's views. Holsapple [4] provides a modernized definition more in accordance with IS views discussing "human decision support systems" (HDSSs) and defines DSS as "computer-based systems, including those that support individual or multiparticipant decision makers". This definition illustrates the evolution of the DSS concept and applications as it also includes the idea of multiple people involved. It also puts the emphasis on the DSS' "ability to hold and process knowledge that is of benefit to the decision maker as he/she drives toward creating knowledge about what to do [4]. This is, a DSS is not applicable just to some decision point but is, or should be, a process support. The political context is new to DSS use and means both that decision makers are in a different position as compared to the traditional DSS settings in business environments – elected politicians have a fragile position – and new actors are closely involved if not actually making decisions, the public. Therefore, themes 4 and 5 are brought up for the purpose of understanding how the method fits into political decision making as understood by the actors in that field [3].

## 3 Findings

Let us now briefly present our findings by the five themes presented above. (In the following, quotes are coded by CS for civil servant, P for politician, and C for citizen)

The project was somewhat controversial from the outset. The official motivation was that "[T]he situation was so complicated with strong antagonism. We had already used the usual methods but had not succeeded in arriving at a solution" (CS1). Another motivation, less prominent but clearly present, was to test new methods; "this is not the only time something is complicated [and this project should serve] as a pilot test for the future" (P3). To the contrary, all citizen groups thought enough was already known (although their interpretations of the information were diametrically opposed), the only thing missing was the political decision. They considered the new project a political move to gain time, not motivated by any information need. "Unnecessary! [The project means] the same information is collected once more" (C1).

Technically there were two main new ingredients in the project. One was the DSS used as the core of the work method. The other was extensive use of the Web; all documents were published there, both background information and outcomes of the process such as minutes from meetings and information from interest groups. The interviews show that everyone was positive to the web publication. All agree that it enhanced openness. Not only was City information made more easily accessible (even in traditional procedures it is always public, only more complicated to find), but also did the local interest groups have to

substantiate their views by facts. "When we put all information on the Web the debate become more orderly"

(P3). It also saved considerable time for the politicians in power, as there were fewer phone calls and less need for long oral explanations. The web also served well as an information source for politicians in the processes. One of the citizen groups is a bit critical to the quality of some information on the web, in particular that stemming from other interest groups, "any off the cuff idea was published" (C4). But this is a minor problem, in general all see this as increased openness. Behind these statement is a suspicion that other actors hide information: "Earlier the civil servants have tried to affect the information provided to the politicians. Perhaps they have not hidden stuff, but they have not listen to [our] views" (C1).

This generally positive view of the web information leads us to in the following concentrate on the use of the DSS as this is a controversial matter.

**1. THE PROCESS.** Everyone at the City considers the work in the project as being "different". Most have positive things to say, even though most are also critical both towards the way the work was done and the result. "This was different, makes the discussion clearer. More stringent" (CS2).

As for the contact between citizens and authorities, the use of a consultant meant that new information could be collected. Due to distrust, previously citizens did not pass on certain information to the City Planning Office but preferred to lobby politicians. This tended to create information imbalance – different actors had different information.

A general view of the process, expressed by everyone but valued differently, is that it has led to more focus on facts because values were contained in the criteria and weights early on. "We made values clear quickly and then we could better discuss the matter at hand. And then when the result came out people were pretty much in agreement that this was actually the way we perceived things" (CS1). That is, people were generally happy with the values they had assigned early on and felt the result was in agreement with their views. But the positive view of the process was diluted as it dragged on beyond the initial schedule, and it finally became clear that no decision could be reached. People felt they were "back to the normal procedure" again, political discussions as usual. By the time of my interviews noone would recommend any other city to use the method, and neither would they reuse it themselves. At least so they say, but as our findings indicate there may be circumstances under which they in fact would.

**2. WORK OF THE INDIVIDUAL.** An important issue in municipal decision making is resources spent, and staff time is the most important resource. One promise of DSS is to reduce time spent as part of the assessment of alternatives can be made automatically. On the other hand, DSS use may mean new information has to be collected and organized. Assessing time spent in this case is hard as this was the first time a DSS was used, which obviously means initial learning efforts. I tried to differentiate between time spent on learning and using

the method and time used gathering and understanding information, but this distinction was not clear to everyone. Most participants say that working with the method – setting up and weighing criteria – was not that time consuming. There is, however, a marked difference among groups. The part-time politicians have experienced the work much more complicated and time consuming than the full time ones. The latter find learning the method a "bonus" as part of struggling with understanding the alternatives. Nevertheless, too much time spent on the project is what everybody complains about.

**3. THE METHOD.** Another crucial point is the credibility and the usability of the method – do people understand the process of assigning decision criteria and weighing them, and do they trust the outcome of the calculations to truly reflect their opinions? The answers to these questions vary considerably.

Everyone who participated in the weighing say they are satisfied with the criteria and the weights they have assigned to them. They claim to still stand by those (the interviews were made more than six months after the initial workshops), but this claim could not be subject to a hard test during interviews. Some had forgotten what weights they actually assigned, but on the other hand during the – lengthy – process they have not had reason to change them. This gives some support for claiming that the result the method produced has indeed solid ground in the politicians' minds. On the other hand, two politicians (who declared they still stand by their numbers) and all four citizens say they basically doubt this way of working and claimed views cannot be expressed in exact numbers. This raises another critical point, how well the criteria and weights express the underlying opinions. Responses to the question "was it hard to assign weights" vary. "[Weighing was] pretty hard. Not that necessary. Very much about opinion. The method poses for scientific but each step is a matter of opinion. We arrived at very different criteria" (P2). "Some wanted more than 100 %" (P3). Some politicians put serious effort into the process, but not all. One part time politician avoided going through the process claiming the work was "Hard, takes time. Must read more, consider every word" (P1). A compromise was made by having the consultant enter numbers which he arrived at based on his interpretation of her expressed views; "I don't know how he did it" (P1).

The view that this way of making decisions may not be that good coincides with the opinion on the issue at hand. Those in favour of the main alternative [municipal takeover] are positive, those against are negative. "I'm not impressed by the method. Common sense, collect as much information you can. It is always about values at the end of the day. Can't make this a science" (P2, against). Those who were positive saw increased rigor not just in the process but also in their own thinking. "Very useful having to categorize [information], take a stand" (P3, for). "Useful. Fascinating to make an intuitive decision process more rational. We are used to make decisions quicker and not in this systematic way. We usually weigh intuitively" (P4, for until the last minute).

At the citizen organizations, people are not that familiar with the details of the method. There was no explanation made by the City, but some people have made investigations and learned about at least the principles of the method.

All are sceptical: "People do not make decisions that way. You can't separate and individually rank 10 different aspects. You rather think 'I'll consider these 10 aspects and then you blend them in your head into an opinion. That's the human way of making decisions" (C2, knowledgeable about the method). "The City sometimes considers unimportant things and disregards important ones [...] The important thing is which parameters they use. In the end they made a political decision anyway [by ignoring the majority for the "local" alternative that C2 claims exists]. That must be viewed as a rejection of the method" (C2)

There is a marked distinction about views about "how humans think" and should think among the "pro" politicians group and the citizens. The distinction is about whether the human brain's inability to explicitly calculate a large number of factors is an advantage that makes it "human" or a disadvantage that could be remedied by computer support to arrive at better decisions. Whether intuition or modelling and calculation is the best way to improve decision quality. This question could be nuanced to say, how much of our thinking should be formalized? This issue is expressly brought up by several interviewees. "Collecting data, assigning weights to parameters, and out comes a figure. Seems to me like a weird decision making method. If something is assigned a weight of 90% it could just as well be 85 or 95. The politicians' task is to decide in matters that really can not be put into a mathematical formula" (C1). C1 does not criticize the model, only its application to these kinds of issues: "This kind of method is not bad [...] But you shouldn't go too far so everything becomes a formula". The judgement of what is too far differs considerably among the interviewees. Leading politicians say this project is not going too far, some politicians and all citizen representatives say it is. The factor distinguishing between yes and no-sayers is their original opinion about the matter at hand.

While the work of assigning weights invoked mixed feelings from a theoretical point of view, the work with assessing alternatives was not contested in principle by politicians but more practically challenging. Assessing alternatives is a new method step for the politicians. This work is traditionally done by the civil servants, politicians are usually given only one new alternative to accept or reject (rejection often meaning maintaining an existing alternative). "Some in the group were apparently surprised that this took so much time. Some lowered the level of ambition when they realized how much concentration it took to complete the task" (P4).

Another critical issue for the method is whether the weights well enough represent the opinions of the politicians or whether they were produced ad hoc. This is not easy to find out. We did make a test using weights results from the first and second workshop to see if the changes would have made any difference in terms of outcome. It turned out they would not, the same alternative would still have come out as winner. But this does not make weights totally reliable. First, the politicians did this for the first time. Even though they did get quite a lot of time at two occasions to assign and discuss weights, it is not a standard way of thinking for them. It cannot be assumed they thoroughly understand the link between criteria weights and outcome. Second, groupthink may occur

during the meetings. Third, people may change their views over time, so even if weights were indeed representative at the time they were set they may not be so six months later. People's own opinion is very clearly that they are happy with their weights in retrospect. They say they would assign the same weights again given the same situation. "I think so, but I also think I got some impressions from the process" (P4). But there is some uncertainty: "The values were not stable [...] [the consultant] should have put more time on this" (C4). It appears people did indeed change their view during discussions, but they also claim that this was normal, just like any political discussion, it was not groupthink. "I think I was influenced by what the others said during the discussion, but I did not change [the weights] afterwards. The criteria can be interpreted in different ways. I think I changed both the meaning and the weights of the criteria during the discussion" (P2). P2 says his political assessment remains but he is not sure that this is correctly reflected in the method, that is, that it is correctly interpreted in the ensuing calculations. "We had good discussions. Issues have been investigated continuously, new information has appeared that has made the situation gradually clearer" (P1).

In conclusion, many people are uncertain about just what the weights mean for the following work, and they are not entirely comfortable with them. There seems to be a need for some practice with the method. Sensitivity analysis was used to give understanding about the robustness of the outcome. Perhaps also simulation techniques should be used to give a feeling for the importance of each criterion used. In any case, one try is not enough to become comfortable with the method.

**4. THE RESULT.** There was huge confusion about the result. The first interviews were made in May, when only one of the three issues at hand had been decided upon (the marina, the least controversial issue). At that point people still had good hope that also the other two issues would be resolved in accordance with the project outcome. This did not happen, and when I made the last interview in August there was clear disappointment with the fact that one politician had in the last minute changed his mind, which made the political assembly unable to make the expected decision.

But even in May there were clear indications of disappointment with the method. The project group had come to a decision (not to be confused with the formal political decision which was not made) but this decision was the same that the ruling coalition had advocated a year ago, and none of the actors involved had changed their mind during the project. Those in favour or the municipal takeover alternative felt the process had made their case clearer by means of better data and clear decision criteria. Those against did not accept this. This led even the positive politicians to question the method's ability to resolve conflicts. "Initially I had a naïve belief that this [complicated conflict] could be resolved and [the method would] make the parties come closer to each other. We did not succeed with that" (P5). P5 is happy with the process and thinks both he himself and the political decision process have benefited, but the

antagonism among citizen groups was not mitigated and his initial belief that facts would make things clear to everyone was shattered.

It might seem as something of a paradox that what is felt like a negative outcome can instead be seen as something positive in a somewhat longer perspective. According to several interviewees, the method made it more clear what was the role of the politicians- mitigating civil conflicts – and what was not (collecting data). Anecdotally, a citizen from Älgö called me twice after learning I was working on this report. He was affected by the marina decision, the one that the project actually delivered. We had long conversations revealing that he now – as opposed to earlier – was quite clear about just why the politicians made this particular decision. This was because they hade made the criteria "safety for boat commuters" very important, i.e. the politicians had indeed been clear as to their decision criteria. The citizen just did not think this criterion should have that much a weight. In other words, he had other values than the majority of politicians. But isn't that what politics is about? Arbitrating among incompatible values, as opposed to choosing among alternatives that objectively can be ranked? The citizen and I agreed on that principle issue, but not on the decision ;-) And here, I believe, lies the crux with DSS use in a context like this – how much detail of decisions do politicians want to discuss with citizens? The debate on "e-democracy" a couple of years ago showed, if nothing else, that the idea of a more "direct" democracy – more citizen involvement – was not well received by politicians.

A fair summary of the perceived added value brought by the method is the following: "We were pretty confused when we saw the result – was this what we spent 6 months on, to learn that the social democrats were for the municipal takeover alternative [which was well known before]. But it was more nuanced now [...] a higher level of insight. There was no unambiguous recommendation coming out of the system" (P4). P4 claims the model was not "guiding" strong enough: "As time goes by [and the method] is used in practice – compromises, deviations [from the method] – you lose respect gradually [for the method]. Eventually you're back in the usual [political discussion]" (P4).

**4b: WOULD YOU DO IT AGAIN?** As a hard test on their views, respondents were asked if they would use the method again or advice some other city to use it. Everyone are negative, although some less so. This is mainly related to the amount of time they spent. "We need to speed up the planning processes, and this is only faster when the normal procedures [do not get us there]". Even the positive politicians would not do it in a "normal" case but perhaps in a modified way in a complicated case. Those who are negative also claim that the quality of the decision is not improved. The positive ones say it might be under certain circumstances, candidate cases would be "[when things are] pretty complex, many stakeholders, many world views [and] hard-to-handle conflicts of different kinds" (P3). "When we get stuck" (P1). P1 claims this does not happen that often, "perhaps once a year".

The answers show that people tend to mix up the decision model and the DSS with this particular project. They also show that time is a critical issue and

that any further attempt to use a similar model must be arranged in a manner that is quicker. This said, at least some of the positive politicians felt learning the actual method was not time consuming but "a bonus from our work with the planning project" (P3). This raises another issue, that of part-time politicians. In the political debate the problem of having politicians that do not really have the time to get into complicated issues enough has long been on the agenda. The risk with that, it is said, is that it this increases the power of the full time politicians and decreases the reputation of politics in general as it becomes less of a popular activity and more of a profession. In this case the DSS has served to increase the gulf between those who have time and those who have not, but more interestingly is probably to consider whether in a longer perspective scenario when DSS use is standard procedure part time politicians might in fact save time by being able to understand well structured information by applying decision criteria.

The civil servant most involved with the project thinks that parts of the method might be incorporated with standard procedures, in particular the idea of assessing several alternatives, not just one. This is normally done informally in contacts between the administration and interest groups, but in this case politicians were involved which led to the procedure being "more correct and less talk" (CS2). CS2 also thinks less time would be needed next time as new principles for data collection, measurements etc. would have been agreed upon. This time new data had to be collected "on the fly". CS2 believes this could be a way to a more effective standard procedure.

**5. THE ROLE OF POLITICIANS.** The civil servants conclude that by adopting this new work model politicians have challenged their own role, or at least their work traditions: "We were surprised that the politicians were so open [...] They have been unusually unbound by traditional political division lines" (CS2). They also claim politicians through participating in this processes have become more knowledgeable about the problem about which they are to decide. "The weighing [has forced them to] educate themselves about the problem. They usually don't do that. They tend to listen more to groups of citizens than consider the facts of the matter [...] this work has given them a basic knowledge on issues like this (CS2)". Many issues raised here are not specific to this project [...] this can be useful in other projects [...] This is confirmed by some politicians: "This was a more thorough review than we normally do" (P1).

There were clearly two groups of politicians, one that spent quite some time understanding the method and applying it to the problem and one that did not. Those who did have come to the conclusion that the method requires a new take on evaluating the information. This raises the question of how an issue like this should be handled. In that sense, the project has served as a tool for critical examination of existing methods. Politicians have found both pros and cons. They claim the clear structuring of information has meant "a more objective scrutiny" (P5), and "better insights in the matter at hand" (P4). On the other hand they had to put much more time into this project than into a standard procedure. Not only did they have to learn about more alternatives, it also took

considerable time to understand what ingredients in the information should be noticed and evaluated (but this knowledge is to some extent reusable).

As we have seen above, there are different views of the pros and cons of the method. Trying to grasp the overall process, did the decision process as a whole change in any fundamental way? One issue presented both as a promise and a threat is that by using structured decision making methods politics will become more scientific and less about "opinions". The interviewees bring up some interesting points to feed that debate. Nobody wants to point to the method as the source for the more thorough knowledge everyone claim they now have. This is partly because they cannot clearly distinguish between the method and the project, partly because they feel factual arguments, not methodological, should be used. Still, "It is interesting that in the marina issue it became very clear that the assessment of facts [which was enforced by the method] was important" (P3).

Even those positive to the method say it did not suffice to resolve the problems that really mattered: "The well-structured and systematic design was not pursued [...] I feel the method didn't have any effect whatsoever. Now we are in a familiar situation – meetings where we discuss how to evaluate arguments, without method support [...] we have put the method aside" (P4). Some have put this more strongly: "[The method] does not solve the problem we wanted to solve [...] it does not lead to consensus [or to] resolve conflicts" (P5).

Everyone agrees on one thing, it is good to rely on the method in contacts with the public: "Now we know well where we stand!" And standing united is important to them. On the other hand, there is some doubt about how the DSS and the web publications go together. There is some conflict between openness to the public and the internal discussions about criteria. Some, e.g. P4, claim there should have been some separation in time so the processes do not interfere with each other.

Civil servants claim the method has contributed to neutralizing ideologies: "extreme opinions, like some environmental issue or some economic [one] the method has in fact neutralized that" (T1). Politicians, unsurprisingly, do not see neutralization but rather a more viable political debate. They feel the ideologies rather stand more strongly as they are now manifest in the criteria and weights "I am frustrated that there is traditionally so little debate in politics [and this time it was better]" (P5). "We are supposed to supply values, not facts [so it was good the method helped in collecting and sorting facts]" (P3).

## 4 Conclusions

In summary the interviewees provide answers that make up a mixed picture:

- In general there are mixed views about the usefulness of the method. Views are correlated with opinion on the planning issue at stake, but some issues can be discerned irrespective of that bias. In short, the method provided better information, but no clear outcome.
- Everyone appreciates the increased openness and clarity that web publishing and ordering of information according to decision criteria have meant.

- People often did not distinguish the method from the project. Nobody claims to understand fully just how the DSS arrives at a solution.
- The project took too long time to be practical as a general method, but some believe that some components might be used regularly.
- Some people have put effort into understanding the method, and they appreciate it.
- Civil servants as well as full time politicians claim the role of politicians have been made clearer, and different. More independent of political pressure as of civil servants, more factually clarifying as of politicians.
- Many claim the process has been more clarifying than the standard procedure, both as concerns the matter at hand and the political debate.
- The citizens consistently claim that the project did not make any difference in the factual matter. And because they claim politicians had a hidden agenda they do not feel there has been more clarity this time.
- Even though formalization and good organization of information are generally acclaimed, there is also the view that precisely this formalization may also mean you miss things that normally appear in the informal consultations among civil servants and citizens.

In conclusion, this investigation has showed that DSS may indeed have a future in the complicated and often infected environment of local politics, but the role has to be carefully crafted. The critical issue is not technical use of DSS– however non-trivial – but the way it changes the role of the politicians. Such a change has to be made in a conscious manner, and to be able to understand changes DSS use has to be tested in a more conclusively. This project has showed that this calls for two main requirements to be met:

- It has to be done more than once. It takes more than one effort for people to understand how a DSS works and how they should relate to it. People involved in this particular project now have developed a relation to the new kind of processes made possible, but they need to reinforce it based on these new insights and understandings.
- Application of the method has to be swift. People need to feel they save time, not just make "better decisions". Politics needs to be effective.

## References

1. Danielson, M. and Ekenberg, L. (2004) A Method for Decision Support in e-Democracy, Proceedings of e-Challenges 2004, Vienna, October, 2004.
2. Danielson, M. (2004) A Method for Public Decision Support, ICIS SIG DSS Workshop, International Conference on Information Systems, Washington DC, December 2004.
3. Grönlund, Å. (2003) eDemocracy: in search of tools and methods for effective participation. Journal of Multicriteria Decision Analysis.
4. Holsapple, C. (2005) Big Picture about DSS. http://dssresources.com/interviews/holsapple/holsapple02112005.html

# Monitoring and Updating Regulations and Policies for Government Services

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**Abstract.** One of the challenges citizens and businesses face in interacting with governments for entitled services or compliance services is to find the right set of regulations and rules that are applicable for them. Very often the regulations and policies that determine the applicability of specific services are implemented and provided by separate government agencies, thus scattered in different Web sites and documents and are hard to be identified. In addition, the regulatory rules and government policies change often, making it harder to maintain the applicable services. In this paper, we present an integrated *policy ontology* of distributed regulatory rules and policies to support the discovery of applicable regulations and services. We present an ontology-guided annotation and extraction of policy rules from Web source documents. To support the dynamic changes in regulatory and policy rules, we developed a method of *automatic updating* the policy ontology by monitoring the source text documents. We describe a prototype eligibility verification system that verifies eligibility for various welfare government services. The eligibility rules and policies are extracted from different government websites to enrich the policy ontology. The eligibility rules and policies are monitored, and automatically updated, should any changes occur.

## 1 Introduction

The explosive growth of the Internet has changed the way the world does business. Government agencies have been no exception. Many government agencies have put up websites with tremendous amounts of information to facilitate access to various government services. Citizens or business entities are now faced with information overload and often get lost in cyberspace with hyperlinks pointing everywhere. In addition, the services they are entitled to are multi-agency services composed from individual agency's services, requiring the citizens to interact with multiple agencies independently. For example, welfare applicants need to go through document after document on the Web, searching for the appropriate rules and regulations to figure out eligibilities for several services [1]. There are over a dozen welfare programs that are available in New Jersey, ranging from low-income family food stamps to the well being of women and children. These programs are provided by dozens of divisions within one agency (New Jersey Department of Human Services) [2].

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Identifying services and eligibilities is time consuming and often confusing. A system that can provide an integrated and customized view of the needed information and services is highly useful for citizens as well as government officials who are evaluating the eligibilities. To address this issue, we use an integrated ontology of regulatory and business policies from different government agencies. The policies are presented as rules that are arranged with semantic categories of concepts and sub-concepts.

To inform an applicant of their eligibility for government services may seem like a trivial task. One could simply hardcode the eligibility criteria into a program. However, any system like that would require a human to constantly monitor these government websites, and update the code as necessary when one of the eligibility criteria changes. This is costly, creates inconsistent data due to human error and delays processing, limiting the timely availability of current rules and policies for determining eligibilities for services. This also hinders the successful inter-organizational (inter-agency) business integration, where the business policies and rules may change frequently to meet the organizational strategic goals. We address the issue of automated identification of changes and updates of regulatory and business policies. These changes are monitored and immediately available. We use a text-based approach for tracking the policy changes that are reflected in the policy ontology.

This paper thus addresses the following issues and provides our solutions for each: (1) how to model regulatory and business policies is addressed by developing a policy ontology, (2) how to identify a set of eligible services is addressed by reasoning capabilities using the policy ontology, and (3) how to monitor and update the policy rule changes by tracking source text pattern changes tied to the policy ontology.

The paper is organized in the following manner. Section 2 describes the background and motivation of this research. Section 3 presents the system overview and Section 4 introduces the ontology modeling of regulatory and business policies, followed by ontology-driven policy rule extraction from Web sources. In Section 5, we introduce the monitoring and update issues and approach. In Section 6, we present the prototype system architecture and its components, followed by related work and conclusions in sections 7 and 8 respectively.

## 2 Business Rules, Regulations and Eligibility Rules

Business rules or legal (regulatory) rules are embedded in textual documents in many different Web sites. Thus, a company Web site might describe the rules under which a customer may get a refund for a product. A government Web site might describe what kinds of benefits a person is eligible for under which circumstances. A club or organization might describe rules for a person that wants to become a member. A person would need to read the rules, and apply them mentally to a given situation, e.g., the date when an item was purchased, or the

current income of an applicant, and make a determination of eligibility or of the steps to be taken. For example, government welfare service eligibility policies can be seen in sites of the New Jersey Department of Human Services [3], NJ Family Care [4], and NJ Supplemental Nutrition Program for Women, Infants and Children [5]. The citizens will have to visit each site and decide whether the rules are applicable to determine their eligibility for these programs.

Rule-based systems have long been used to incorporate legal or business rules into software systems, which then may make a determination for a given situation based on input data [10], [11]. Such rule-based systems are normally implemented on top of an Expert System Shell such as OPS83, JESS or CLIPS [6], [8], [9]. However, the process of coding and implementing the rules is as difficult as any other programming task and requires a knowledge engineer's proficiency to understand the English language rules first, before translating them into a system of expert rules. These rule-based systems have one additional complication. Published rules often undergo regular changes. Thus, a maximum salary that is allowed while receiving state government child support may change every year to take inflation into account. Thus, the result of building a rule-based system on the basis of the information in a Web page may become invalidated at any time and without notice to the system builder.

What is needed, then, are policy rules that can be automatically extracted from Web documents to build a knowledge repository that can be used as part of a system. Furthermore, this system should continuously (or at least periodically) monitor the original Web documents with the policy rules and automatically incorporate every change of the English text into the system, without any service interruption. For instance, a welfare eligibility determination system should "read" Web documents and automatically construct policy rules from them, then link those rules into a working eligibility determination system. Thus, a person would enter personal data into the eligibility determination system and be told whether or not he/she can still get a refund for a product or whether he/she can get food stamps. When the rules for food stamps change, the eligibility determination system automatically incorporates the changes.

However, natural language extraction of rules from text documents has not advanced to the point where it can be fully automated and reliably used in sensitive areas such as government operations. Any mistake of such a system could make the government liable to law suits. Thus, we extract rules from Web text in a semi-automated fashion, first by a system that uses semantic and syntactic clues to annotate portions of the text, and then by human who validates the annotated text. The system then parses the annotated text based on linguistic keywords, and builds the linguistic knowledge used in expressing the policies that is then used for subsequent annotations for new documents by the system. The extracted rules are semantically annotated using the ontology's concepts and relations. The automatic monitoring and updating of rules is achieved by linking sections of text to the rules that they gave rise to and monitoring those sections of text for changes.

## 3 System Architecture

We have developed a system, which brings together various government resources into one place. Our system runs based on a regulatory and business policy ontology, which represents the eligibility criteria from several government services. The system monitors the eligibility criteria on these government Websites and updates the rules if necessary. A Web form is provided to collect an applicant's information. This information is then run against the rules and the applicant is notified of his/her eligibility status. The system consists of the following components: A Web interface to collect information from the applicant is used as a front end; the ontology, which holds the rules; and a back end, which processes the form against the rules and informs the applicant of her/his eligibility. The policy rule annotation and extraction mechanisms identify policy statements in a text, guided by the concepts in the ontology, and extract the rules and enrich the ontology with policy rules. This component has a human verification part to validate whether the identified text fragments are indeed policy statements and whether the extracted rules are valid. A monitoring component is used to monitor the Web site with the English text of the rules, and to update the ontology.

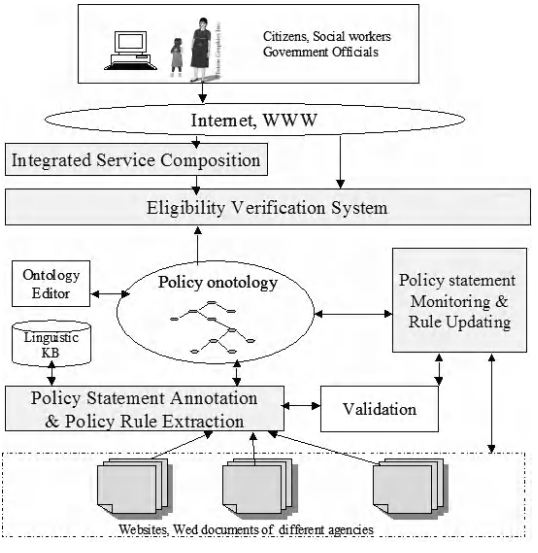


**Fig. 1.** System architecture

## 4 Policy Ontology

The eligibility policy ontology for the New Jersey (NJ) welfare services has been created as shown in Figure 2. The ontology describes the concepts and their relationships from four NJ welfare programs, namely Special Supplemental Nutrition Program for Women, Infants and Children (WIC), Work First New Jersey

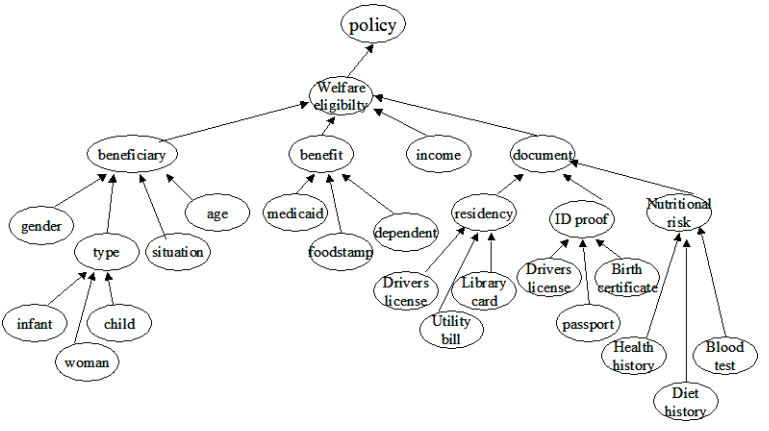


**Fig. 2.** Welfare Eligibility Policy Ontology

(WFNJ), NJ FamilyCare and NJ Fostercare. The welfare eligibility policies include rules on family size, income, beneficiary, benefit types, residency, health history, age, citizenship, drug treatment, year limits, and drug uses. Each welfare program (service) requires a subset of these policy classes (categories), and can specify the rules associated with each class. This ontology was built using Protégé-2000 (Figure 3)[7], where the concepts and their relationships in a welfare service domain are defined and organized.

**Policy Ontology-Driven Rule Extraction:** Given the policy ontology of concepts, each policy rule needs to be extracted from text documents. Our approach is to use the concepts defined in the policy ontology to identify and annotate the candidate policy statements in the text. Similar to the Crystal IE system [18], each concept is defined with a concept node (CN) with linguistic and text patterns/cues and semantic constraints. For instance, NJFamilycare has as one of its policy statements that "Foster parents must be at least 21 years old." This statement is identified as a candidate policy rule related to the concept "age." We use synonyms of the concept and/or frequently associated phrases with the concept, such as "years old." The semantics of a concept in the policy ontology and a set of linguistic clues such as deontic verbs, "must, should, ought to, is obliged to, is subject to" that are often used in policy statements are employed to identify a policy statement in a text. Once the fragment of text is considered a policy statement, it is treated as a policy rule candidate statement and is tagged with the related concept. For instance, the above text is annotated as: <age> Foster parents must be at least 21 years old. </age>

The candidate policy statements are extracted and validated by a human, discarding extracted statements that are not considered policy rules.

**Policy Rule Representation:** After the validation step, each statement is parsed and converted to a rule formula in JESS [1]. For example, the statement "Foster parents must be at least 21 years old." is mapped to a JESS rule (defrule rule => (store RESULT (> X 21))). In general, a rule has two parts: the LHS of

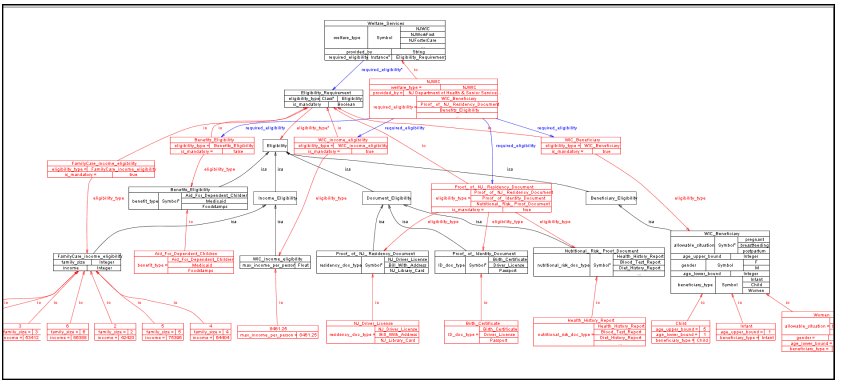

**Fig. 3.** Protege Implementation of Welfare Eligibility Policy Ontology

a rule consists of patterns, which are used to match facts in the knowledge base, while the RHS contains actions and function calls. In this example, the LHS does not contain any patterns, so the RHS is evaluated immediately. Defrule is a JESS construct, which is used to define a rule. In the RHS, RESULT and X are variables. Before the rule is executed X will be replaced with a value from the user input. The RHS of the example says that when X is greater than 21, it stores the result in variable RESULT with the value to be either true or false, depending on whether the condition was satisfied. A JESS rule is similar to an if... then statement in a procedural language such as JAVA or C++, but it is not used in a procedural way. While if... then statements are evaluated in a specific order, a rule stored in JESS executes the RHS whenever the LHS is satisfied. Rules that are hard-coded in a programming language are very difficult to change. JESS offers a higher degree of flexibility. We have devised an algorithm to recognize the policy statement according to the semantic concepts in the policy ontology and to extract the rules in JESS format. The policy ontology now can be populated with policy instances corresponding to specific rules extracted from the text. The class defines the topic of each rule attached to it. For the previous example, the class is age, because it is a rule having to do with age. The class relates the rule to our form. For example, when creating the form, we have a text box for the user to enter her/his birth date. Birth date relates to age. So we can now calculate the user's age. Each policy class in the ontology can have slots to represent the policy rule information as shown in Figure 4. For each welfare agency we maintain a set of policy rule classes.

- **Policy Statement:** This is the text of the policy rule statement. For example, "Children 15 and younger may apply for the program."
- **Url:** This is the URL of the Web page where the rule text is located.
- **JessRule** – This is the policy rule in executable JESS format. For example, the rule "Children 15 and younger may apply for the program," is represented as follows: (defrule rule => (store RESULT (< X 15)))

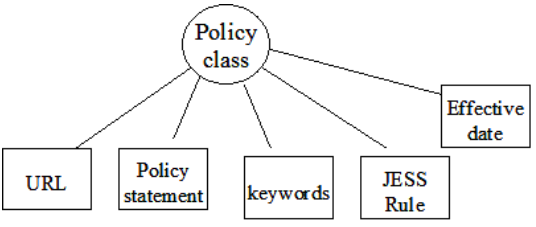


**Fig. 4.** Policy Rule Representation

- **Critical Keywords** – This describes critical sections in the rule text that need to be monitored. For example, in the rule "You must be 18 or older to be eligible for this program." 18 is the critical section. When the age 18 changes, the update of the policy rule is triggered accordingly.
- **Effective Period:** The rule can be effective from a start date to an end date.

## 5 Rule Monitor and Updater

In order to handle any changes of the text of policy rules, we use a rule monitor that automatically rescans the Web text at regular intervals. Whenever the source text for a policy rule is changed on the Web, this change is automatically propagated to that rule, which is immediately updated. This is done as a hot-swap, so that the eligibility determination system immediately changes its behavior. This is achieved as follows.

Given the rule class and instance in the policy ontology, and the policy's text statement the system knows exactly which text to monitor. For example, "Children 15 and younger may apply for the program." From the URL slot of the rule, the system knows which Web page the statement is from. Rule changes are detected when either a critical part of the rule that is being monitored is changed or an entire policy statement text has changed. When changes occur in the critical part of a rule, for example, "21 years old" in "Foster parents must be at least 21 years old," is changed to 18 years old, then the change is detected. This results in changes in the corresponding JESS rule. In our example, it is changed from (defrule rule => (store RESULT (> X 21))) to (defrule rule => (store RESULT (> X 18))).

If the entire text of a rule is not found, the system checks for the closest match to that sentence. Should our rule change too much, for example if it should change to "Foster parents must be between 18 and 50," the system needs to determine the semantic category of the new policy and parse the text to generate the new rule. If it is a different semantic category, then it is necessary to create a new rule. If it is the same semantic category, e.g. age, then the system

has to revise the existing rule according to the newly parsed rule text. In case of a new rule, human verification is required.

The algorithm 1 detects when a policy rule in a Web page has changed. In step 5 we apply a heuristic to decide whether the text has changed to a degree that can be analyzed automatically, or whether human intervention is necessary. We are going from the assumption that if the number of critical sections has stayed the same or has been reduced, we are dealing with parametric changes of the critical sections, such as a change of an age. On the other hand, if new critical sections have been added, the text will need to be reprocessed and presented to a human for approval.

**Algorithm 1: Rule Monitoring and Updater**

1. FOR (each class $C$ in the ontology)
   FOR (each rule $i$ at $C$)
   Extract the URL $C_{Ui}$, the text rule $C_{Ti}$ and the JESS rule $C_{Ji}$;
2. Load the page text $T(C_{Ui})$ and remove its HTML tags;
3. match $T(C_{Ui})$ against $C_{Ti}$
4. IF *issubstring*($C_{Ti}$ ,$T(C_{Ui})$)
   THEN done; /*Rule has not changed.*/
5. ELSE FOR (each critical section $S_{ij}$ of $C_{Ti}$ )
   match $S_{ij}$ against $T(C_{Ui})$
   IF the difference between the old rule and new rule ≤ the number of critical sections
   THEN update the old rule $C_{Ji}$ with new critical sections
   ELSE report to the user: TOO MANY CHANGES

## 6 Prototype Implementation

*The Welfare Eligibility system* was built with four simulated government Websites for experimental use in the Welfare project. For instance, the simulated NJFamilycare site covers all the services the real site offers. This includes the eligibility requirements, the services covered, and a detailed description of the applicable policies.

*Online Application Form:* One major issue for an eligibility verification system is that it should minimize the information that a user has to enter. A user should be spared entering and reentering her/his personal information over and over again. Rather, he/she should enter all pertinent information once, and the eligibility verification system should route the correct required sections of that information to each government Web site. Our simulated system completely implements this principle. Thus, we maintain a central entry point, the universal application form that routes its inputs automatically to the four (simulated) NJ Government Web sites. Only the required sections of the universal application form are passed on to each government Web site.

*Web Interface:* To determine eligibility for the various government services, welfare applicants fill out one online application form. This online application form

includes the questions that will be needed for all four NJ welfare programs that we are supporting. As our system has all the pertinent information, it can make an initial determination whether an applicant is eligible for a welfare service. While this response is not given as a legally binding determination, it is much faster than the government response and can help the applicant by pointing her/him to documents that might have to be obtained for a successful application. When welfare applicants click the SUBMIT button, the Rule Processing Bean will be activated to run the rules and conduct the eligibility verification process.

*The Java Server Page* is responsible for forwarding the form contents from the User Interface to the Rule Processing Bean. It is also responsible for displaying the results from the Rule Processing Bean to the user.

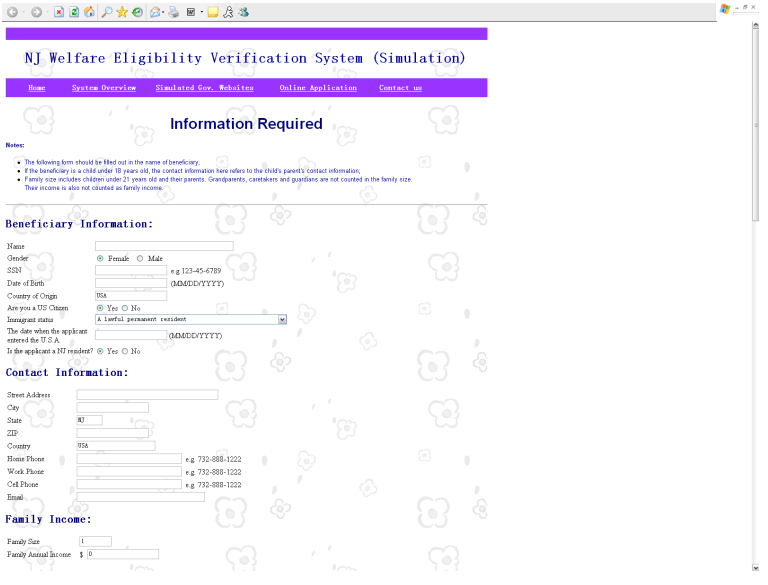


**Fig. 5.** Eligibility Verification Web Form

*The Rule Processing Bean* takes the form input and matches it against the rule types in the ontology. It then runs the rules using the form contents as input, and displays back to the user which eligibility requirements they have met and which eligibility requirements they have not met.

*Ontology Construction with Protégé*: Protégé is an ontology editor. It is an interface to the ontology and can be used to add new policies for government services and programs. Although the rules in the ontology are updated automatically,

the system administrator has to add new eligibility policy concepts when new government services become available.

*Policy Rule Extractor:* A Java program that converts the Web document into a text format. It applies semantic knowledge (concepts from ontology) and linguistic knowledge (such as key phrases, synonyms, associated or collocated phrases) to extract the candidate policy statements, and converts them into policy rules, which are inserted back into the ontology.

*Policy Rule Monitor and Updater:* This component monitors the various rules on the various simulated government websites. When a change is detected this component notifies the system administrator by outputting to the screen the time the change occurred, the old rule text, and the new rule text. This component then updates the JessRule and stores it in the ontology accordingly. The administrator can now check that the rule change was changed correctly, as major changes to the eligibility requirements on the government Web sites would possibly generate an incorrect rule.

The interface to the Rule Monitor and Updater allows the administrator to enter the time intervals when s/he wants the rule monitor to run and check for changes in the Web pages, for example every 5 seconds.

The prototype system has been tested successfully with the simulated Welfare sites' documents and policy rules. Even though our goal is to extract and monitor rules fully automatically, the prototype system can only monitor and update text representations of already identified rules. When the system administrator is notified of a rule change he/she must check to see that the correct rule was generated and improve it if necessary. We are working on algorithms for improved policy annotation and extraction to utilize the linguistic clues gathered from text updates.

## 7 Related Work

With the variety of document types available on the Internet, change detection algorithms for structured and semi-structured documents have been proposed, such as for XML [12], [15]. A format independent change detection algorithm would solve the problem of different document types [15]. There are companies that provide change detection services. For a nominal fee they will monitor websites of one's choice and notify you if they change [13]. Unlike these approaches, we use a continuous (or user-controlled frequency) monitoring approach where the changes are monitored in a flexible time period, and targeted to specific areas in the document, e.g. policy statements.

Approaches for information extraction from Web documents include wrapper induction methods [16], [17], which automatically generate procedures to learn the rules for extraction and use automata to recognize the extractable elements. In [14], a document's structure and layout information (document object model) are used to identify relevant information to be extracted from texts. In contrast, our approach to identifying and extracting policy statements is based on the concepts in the policy ontology.

Attempts have been made to make legal text available on the Web by marking it up with standardized XML tags [19]. In our approach we use concept labels as XML tags. The automated analysis of legal texts for the purpose of summarization has been described in [20]. Legal text analysis and an automated concept extractor, which allows a computer to identify the different concepts that exist in a given legal text, were briefly described in [21].

## 8 Conclusions and Future Work

In this paper, we have presented an approach to extracting regulatory and business policies from Web documents and to monitoring and updating the changes and modifications in policy rules of different organizations. To identify and extract policy statements from a Web document, a policy ontology that includes concepts and relationships is utilized as well as a linguistic knowledge base. To detect and update the policy rule changes, we monitor policy rule statements in a textual format in a user specified frequency, and automatically extract new rules. To utilize our methods, we have built the service eligibility verification prototype system for various government welfare programs. The policy rules are represented in textual as well as JESS expert system rules so that they can be used to trigger actions in case that the rules satisfy the user input.

We are currently improving our system to handle changes in adding and deleting new and obsolete policies. Our approach for identifying and extracting rules depends on the semantic classes in the policy ontology, thus a new rule that is not in the existing semantic categories is not recognized. We are also looking at the potential uses of Web thesauri and dictionaries for related terms and synonyms. The feedback loop from corrections in the policy statements is being considered. Currently we are looking into the Web source text documents from where the original policy rules are extracted. Often legal changes are posted in separate documents. We will consider extending monitoring of the policy changes by including not only source text documents but also other documents that point to the source text documents. The effective dates for rules should be considered for obsolete versus currently active policies, and the user requests should be logged and dated. For example, if a user turns 21 three months after applying, he/she is now eligible for the Workfirst program and he/she should be informed of that fact.

## References

1. Njhelps.org, `http://www.njhelps.org/go`, 2002
2. New Jersey Department of Human Services, `http://www.state.nj.us/humanservices/index.shtml`
3. New Jersey Department of Human Services `http://www.state.nj.us/humanservices/workfirstnj.html`
4. NJ Family Care `http://www.njfamilycare.org/`
5. NJ Supplemental Nutrition Program for Women, Infants and Children, `http://www.state.nj.us/health/fhs/wic/index.shtml`

6. JESS 6.1 Manual. Sandia National Laboratories. 2004 http://herzberg.ca.sandia. gov/jess/docs/index.shtml
7. Holger Knublauch, An AI tool for the real world: Knowledge modeling with Protégé, http:// www.javaworld.com/javaworld/jw-06-2003/jw-0620-protege.html.
8. OPS83, 12/1/04 http://www-2.cs.cmu.edu/afs/cs.cmu.edu/project/ai-repository/ai/0.html
9. CLIPS, A Tool for Building Expert Systems, 12/1/04 http://www.ghg.net/clips/CLIPS.html
10. Vision Corporation, VTECH* BRDS (Business Rule Development System), http://www.visionca.com/English/Products/Vtech.htm
11. Grosof, Benjamin, Rouvellou, Isabelle, Degenaro, Lou, Chan, Hoi, Rasmus, Kevin, Ehne-buske, Dave, McKee, Barbara, Combining Different Business Rules Technologies, A Rationalization, Proc. Of the OOPSLA 2000 Workshop on Best-practices in Business Rule Design and Implementation, October 15, 2000.
12. Yuan Wang, David J. DeWitt, Jin-Yi Cai, X-Diff: An Effective Change Detection Algo-rithm for XML Documents, 19th ICDE, 2003.
13. http://www.changedetection.com/
14. Thomas M. Breuel, Information Extraction from HTML Documents by Structural Match-ing, PARC, Inc., Palo Alto, CA, USA
15. Latifur Khan, Lei Wang and Yan Rao, Change Detection of XML Documents Using Sig-natures, University of Texas at Dallas
16. N. Kushmerick. Wrapper induction: Efficiency and expressiveness. Artificial Intelligence, 118, Number 1-2, 2000, pp 15-68.
17. V. Crescenzi, G. Mecca, and P. Merialdo. Roadrunner, Towards automatic data extraction from large web sites. In 27th International Conference on Very Large Databases (VLDB2001), 2001.
18. S. Soderland, D. Fisher, J. Aseltine, W. Lehnert, Crystal: Inducing a conceptual diction ary, Proceedings of the 14th IJCAI, 1995.
19. Biagioli C., Francesconi E., Spinosa P.L., Taddei M., The NIR Project. Standards and tools for legislative drafting and legal document Web publication, Proceedings of the International Conference of Artificial Intelligence and Law, Edinburgh, June 24, 2003.
20. Ben Hachey and Claire Grover (2005). Automatic Legal Text Summarisation: Experiments with Summary Structuring. Proceedings of the 10th International Conference on Artificial Intelligence and Law (ICAIL 2005), Bologna, Italy.
21. Emile de Maat and Tom M. van Engers, Mission Impossible?: Automated Norm Analysis of Legal Texts, Legal Knowledge and Information Systems, Jurix 2003: The Sixteenth Annual Conference, edited by Daniele Bourcier, 2003.

# Service Take-Up and Impacts of E-Government in Austria

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**Abstract.** Austria has made a great leap forward with e-government into the top group in Europe over the past three years. The paper examines how far the usage of services keeps pace and what kinds of impacts are observable. It finds that in Austria the take-up of services among enterprises has made enormous progress to one of the highest in the EU. Usage growth is strongest in advanced, transaction-related services, although there is still much potential to raise the usage among citizens in a socially balanced way. Impacts are identified in quantitative as well as qualitative terms: they include cost savings, increased efficiency and accelerated processing times of case handlings (exemplified among others by win-win situations in the finance and foreign trade sector), improved service and information quality, but also some adaptation problems and reorganization needs.

## 1 Introduction

Spurred by ambitious goals, the priorities in implementing e-government as well as in related research activities were on the supply side for years. Much less attention has been paid, until recently, to the demand side of e-government. In 2004, one of the reports devoting itself to the study of usage and benefits stated that "... there are still remarkably few statistics on the usage of the individual e-services compared to services offered off-line. There is also very little information about the benefits gained by the citizens and business using the services" [1]. This neglect could no longer be held up when more and more signals of deficits in service take up and usage began to show up throughout Europe: e.g. in the UK [2], [3]; in Germany[1]; Switzerland[2] [4]; Denmark [5]; as well as beyond these countries [6]. On the other hand, there are also examples of extraordinary successful take-up more recently, such as the e-tax service in France [7].

[1] "Studie: E-Government-Dienste in Deutschland wenig genutzt", available at: http://www.golem.de/0312/28833.html

[2] "Der Blick durchs Guichet virtuel ist (zu) vielen noch unbekannt", available at: http://www.unisg.ch/org/idt/pmce.nsf/0/525b8f1a89e03682c1256db700472de5?OpenDocument

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Austria has made a great leap forward in the implementation of e-government services especially over the past three years and has caught up with the top group in Europe. The latest EU wide benchmarking of 20 basic public online services for citizens and businesses resulted in lead positions for the country (close to Sweden as front-runner), with both indicators: online sophistication and full availability online. The growth rate over the three years before was the strongest among all countries surveyed [8]. Additional evidence for Austria's progress in e-government comes from various other studies: outstanding good practice examples in back office reorganisation for online services such as tax services, customs declaration, public procurement of schoolbooks, registration of residence and central population register [9]; further back office and infrastructural achievements such as the completed implementation of an electronic record management system in all federal ministries ('ELAK'), a fully electronic law making process, the provision and promotion of digital signatures, electronic health insurance cards ('e-card'), as well as significant progress also on regional and local government levels [10]; last not least, top ratings for individual online services (social insurance and business registration) in qualitative assessments of public web offerings [11].

Compared to the progressing implementation the extent of usage and impacts of e-government services is still largely a white spot. The paper devotes itself to these under-researched issues and also attempts to explain the revealed picture. It first analyzes the amount and structure of service take-up by citizens and businesses, including comparisons with other EU countries, before it proceeds to investigate available evidence on impacts at various levels for the main stakeholders, i.e. public administration, citizens and businesses. The analysis of service-take-up is based on data from special national surveys as well as from EU-wide surveys on 'ICT usage in households' and on 'E-commerce' carried out under the coordination by Eurostat, while the impact assessment mainly makes use of evidence from studies of specific e-government projects in Austria.

## 2 Usage of E-Government Services by Individuals

In 2004, two surveys on e-government have been undertaken in Austria by order of the strategic e-government unit at the Federal Chancellery. Both were carried out by FESSEL-GfK, one in February, the other in September. The results are representative for the attitudes and usage patterns of the Austrian population from 15 years of age onwards with access to the Internet. According to the Austrian Internet Monitor[3] the population so defined with connection to the Internet either from home, work or any other way accounted for nearly two thirds (64%) of the overall population by end of September 2004. The surveys by FESSEL-GfK [12] yielded a rather positive picture of general attitudes towards e-government as well as of awareness and understanding of it. In the September survey, about two thirds stated to be informed or well informed about

[3] Available at: `http://mediaresearch.orf.at/index2.htm?internet/internet_aim.htm`

e-government; the same quantity saw it as the enabling of electronic interactions via Internet by the public administration to make lives easier for citizens. The vast majority of respondents (93%) turned out to be open-minded about e-government, whereas only a minority of 4% explicitly preferred personal contacts. Some 40% reported unpleasant feelings when transmitting personal data online; however, this proportion decreased to 28% in the case of transmissions to public institutions. Despite these overall positive results there were also some other findings to reflect on, e.g. indications of a demand for more information about e-government, and a somewhat mixed perspective for the spread of so-called citizen cards for electronic signatures and secure transactions: when the question included a detailed description of associated costs, readiness to purchase one dropped to 14% with a clear "yes" and 44% "yes, perhaps", which turns the development of costs into a crucial factor. The extent of practical usage experience with e-government in Austria is displayed in Fig. 1.

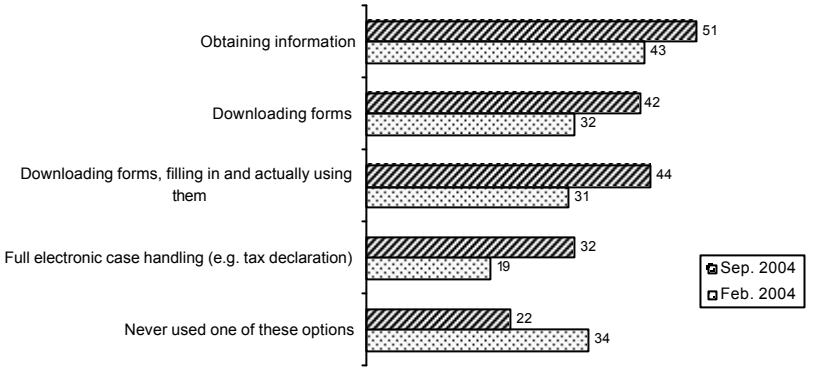


**Fig. 1.** Experience with e-government services among the population in Austria (in % of Internet users). Source: [12].

The diagram shows above all two things: (1) characteristic differences of experience with individual forms of usage, depending on the complexity of services: already 51% of the Internet users in Austria have experienced the more simple form of e-government service, accessing information online, whereas the corresponding percentage goes down to 32% when it comes to full electronic case handling; (2) the level of usage experience has increased considerably across all forms over the seven months between the first and second survey; correspondingly the proportion of non-users decreased to about one fifth. Further analysis showed that the proportion of non-users is less a matter of age than of educational attainment, and is still somewhat higher among women. Respondents have also been asked for their relative preferences of interacting in certain dealings with public agencies via Internet as compared to conventional forms (via telephone, fax, mail or personally). The results presented in Fig. 2 are surprising insofar as the interest in carrying out activities online seems to be highest for categories which serve to prepare contacts with public agencies (obtaining forms,

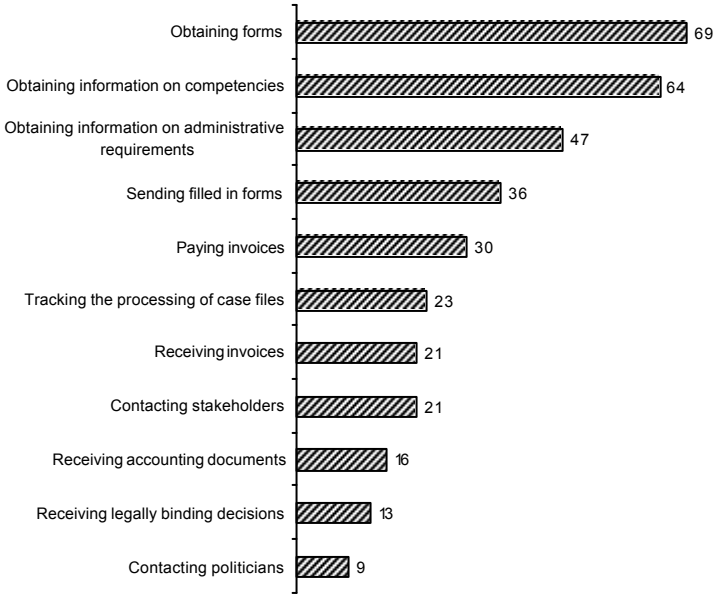


**Fig. 2.** Preferences for interactions with public institutions via Internet (Sep. survey); in % of Internet users. Source: [12].

information): they are preferred by up to nearly 70%. This is in contrast to much lower preferences for online interactions in activities which stand for complete transactions or contacts with stakeholders, while sending filled in forms take an intermediate position. The proportion of respondents who prefer the Internet for processes such as paying or receiving invoices or receiving notifications and decisions which conclude an administrative case is much lower, and getting in contact with politicians online is only appreciated by a minority (9%). Even the option to get online insight in the state of processing of one's case is only preferred by less than a quarter of the respondents. An explanation for this pattern would require further information and can therefore only be attempted tentatively.

To some extent the preference pattern corresponds to a similar paradoxical one revealed in an international study, although carried out about two years earlier [13]: while the Internet users in Austria – next to Finland – stated the highest preference for online contacts to public authorities, the actual usage among the group with online preference reached a comparatively modest level. At that point of time the discrepancy may have had to do with a still insufficiently developed supply of e-government services. But in the present case this factor could hardly play a similar role: first, because of the evidence of a now more mature array of e-government services and, second, because it is the preferences themselves which are somewhat surprising. One cannot exclude that a perceived lack of user-friendliness of transaction services may impact on preferences. Another possible explanation could be a kind of "cultural lag" phenomenon behind the preferences for simpler activities as objects of online interactions with public authorities: it could well be so that in this early stage of more mature e-government services the

majority of Internet users still needs some time of getting mentally accustomed to using also more complex and hitherto unknown online services before this is reflected in preferences. A different view on the development of service take-up among citizens in Austria is possible with results of the Community surveys on ICT usage in households undertaken annually since 2002 (and in enterprises since 2003)[4]. Though limited to measuring various forms of usage, these data offer the advantage to allow for analyzing trends and direct international comparisons. In contrast to the FESSEL-GfK surveys which ask for usage experience without temporal limitation the Community surveys in households interrogate usage only during a period of three months before the time of the interview. Fig. 3 shows the extent of e-government usage by citizens in Austria in different forms as well as changes over three years.

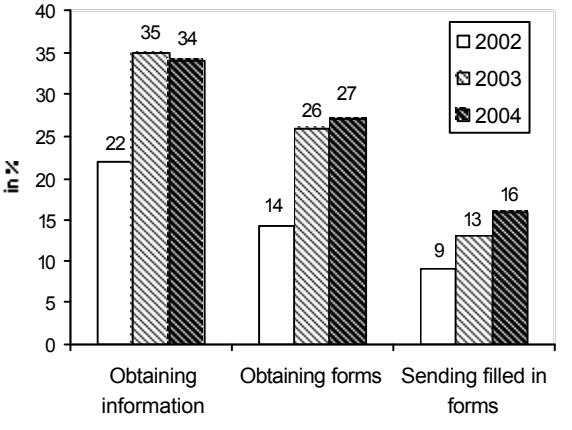


**Fig. 3.** Evolution of the usage of e-government services in Austria (in % of individuals who have used the Internet during the past three months). Source: Eurostat.

Between 2002 and 2004, usage of e-government services by individuals has significantly increased in Austria. This holds true for all three forms of services, although there is still much potential for raising the absolute level of usage. Interestingly, obtaining information online has not grown over the last period whereas the more transaction-oriented forms show more continuous growth and nearly 100% growth rates between 2002 and 2004. Further analysis showed that the usage rates of the youngest (16-24) and oldest (65-74) age groups, of the lowest level of educational attainment as well as of those who are not gainfully employed are significantly below the average. When compared with other EU Member States, Austria comes off quite well as can be seen from the diagram for the most recent survey results displayed in Fig. 4. Generally, the take-up of e-government services among citizens in Europe still seems to be in its infancy, especially as concerns transaction-oriented applications. However, the usage of

[4] Source: Eurostat, Community survey on ICT usage in households, online database available at: `http://epp.eurostat.cec.eu.int`. The diagrams following below are based on data from this source (path: Science and technology/Information society statistics/Policy indicators/e-government).

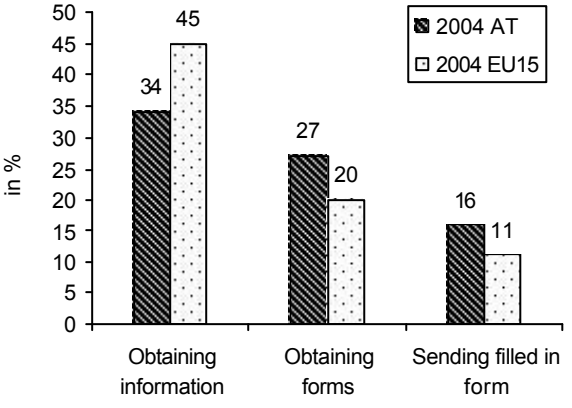


**Fig. 4.** Usage of e-government services: Austria compared to EU-15 average (excluding: BE, FR, IE, NL; in % of individuals who have used the Internet during the past three months). Source: Eurostat.

the more mature forms (i.e. more transaction-oriented) in Austria is clearly above the EU-15 average, both in the case of downloading forms and in the case of sending filled in forms. In contrast to this, the majority of the other EU-15 states make more use of information services in e-government. A breakdown by countries showed rather surprisingly that even the Northern countries in Europe do not stand out with high usage rates in the transaction-oriented forms either (the front-runner in sending filled in forms online is Luxemburg with 32%). This result does to some extent qualify the high usage rates found for Denmark, Norway and Finland in global surveys such as TNS [14].

## 3 Usage of E-Government Services by Enterprises

Among enterprises e-government usage has already reached markedly higher penetration than among citizens. Especially medium and larger enterprises are more active in this respect. According to the latest e-Commerce survey in Austria, 74% of all enterprises with 10 or more employees make use of e-government services in one or the other way [15]. In the financial and insurance sectors the penetration has practically reached 100%. Moreover, sectors with special IT affinity such as business services, R&D and media are characterized by a significantly higher level of maturity of e-government usage. This is indicated by above 50% rates of enterprises reporting full electronic case handling in contacts with public agencies. In contrast to the household surveys this form of e-government service has been interrogated separately in the enterprise surveys as follows: "Does the enterprise use the Internet for interaction with public authorities? (Filter question): a) for obtaining information, b) for obtaining forms, e.g. tax forms, c) for returning filled in forms, e.g. provision of statistical information to public authorities, d) for full electronic case handling, e.g. return filled tax form and

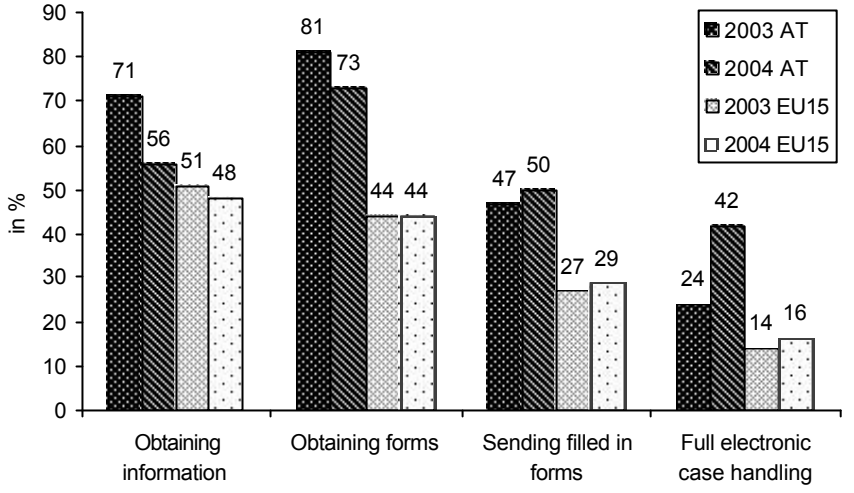


**Fig. 5.** Usage of e-government services by enterprises: Austria compared with EU-15 (excluding: BE, FR, IE, NL; in % of enterprises with access to the Internet). Source: Eurostat.

include electronic payment"[5]. A rather complex picture of results is summarized in Fig. 5. The diagram includes usage data for Austria compared to the EU-15 average on the four different forms of e-government service. Moreover it does so for two points in time to observe the nature of change at least with the so far available data for 2003 and 2004.

According to these data the usage of e-government by enterprises in Austria is in all forms consistently and clearly above the corresponding EU-15 average. The distance between the two usage levels is most pronounced in the case of full electronic case handling in the most recent survey, i.e. in 2004: 42% of the enterprises with Internet access practice this advanced form of e-government service in Austria, whereas the EU-15 average is only 16%. The other transaction-oriented service forms also show the usage figures in Austria clearly ahead. What is also noticeable is the significantly stronger usage growth of the two most advanced service forms, full electronic case handling and sending filled in forms, between 2003 and 2004 in Austria. Only when it comes to information services the difference is less pronounced and in Austria as well as at EU level the significance of this usage type seems to have decreased. Such a shift towards transaction services would be quite plausible as an effect of a maturing service supply. In sum, these results could be interpreted in favour of Austria's special e-government maturity in the enterprise sector. Additional usage impulses can be expected from legal obligations for enterprises to transmit tax statements online (advance turnover tax return statements since April 2003, annual declarations for income, corporate

[5] Source: Eurostat, Community survey on e-Commerce, questionnaire, available at: `http://epp.eurostat.cec.eu.int`electronic case handling in their questionnaires. The data for the following diagram is available from the same source at the corresponding database.

and turnover taxes since May 2004). However, the present results would need to be confirmed in further surveys as two measurements over time are still a too low number to ascertain stable trends. Especially the data on full electronic case handling needs to be treated with caution because of rather inconsistent results at the level of individual countries. One reason could be that not all countries included an exact definition of full electronic case handling in their questionnaires.[6] It remains to be seen whether the results of the coming 2005 survey will be more consistent so as to provide a clearer picture.

## 4 Impacts

The analysis of impacts of e-government is still largely in its infancy. On the other hand, with progressing implementation the interest in measurable effects and benefits has become an important issue. Comprehensive and methodologically sound assessment frameworks for measuring e-government effects are not yet at hand. However, they are the object of ongoing projects such as eGEP[7] funded by the European Commission as well as similar efforts at the OECD. Existing studies mainly focus on case-specific evidence and partial, predominantly positive effects. For instance, a US report by IAB [16] offers numerous examples of "high-payoff" e-government programs from various countries, demonstrating multiple forms of benefits such as financial (reduced costs, increased revenues), economic development, reduced redundancy, enhanced democracy and improved service. In Europe, Capgemini/TNO [17] provide a qualitative study with a similar approach based on eight selected case studies of e-government services from different EU Member States, with a focus on returns on investment. Case material is used to illustrate seven types of benefits: improved quality of information and information supply, reduction of process time, reduction of administrative burdens, cost reduction, improved service level, increased efficiency and increased customer satisfaction. Main outcomes are that public authorities profit more from e-government than citizens and businesses; that savings are rarely quantified; that at least some back office reorganization is necessary to reap benefits; and that institutional cooperation is also crucial. An interesting quantitative approach to assess the economic effects of individual e-government services is the "eGOV-calculator" developed and applied by IAO in Stuttgart [18]. An assessment of six e-government services in the city of Stuttgart yielded a total savings effect of € 530.000 per year and a win-win situation for the city administration as well as the users in four out of the six services. Although the calculation depends on various assumptions and may not include all cost aspects, it is transparent and can offer some guidance when applied with care. For Austria a more comprehensive evaluation of e-government impacts is still

[6] Personal communication from Eurostat. It should also be noted that the lack of a common understanding of "government", together with different forms of public and private organization of functions in individual countries may affect international comparability.

[7] `http://www.rso.it/eGep/asp/E_Home.asp`

lacking. However, from a number of case studies in [19] including evidence on individual services from published sources as well as administrative documents from an ongoing project [10] a variety of effects can be identified. Only some exemplary aspects can be summarized here briefly:

### 4.1 Reduced Process Times

The introduction of online services has led to significant and quantifiable savings in cycle times of administrative processes in a number of areas. A clear example is the online service of the 'paperless foreign trade administration' (PAWA), a system for the issuing of import licenses for goods regulated by EU quota, including a function for customs declaration. Instead of five days on average the issuing process has been reduced to three hours at most. The transformation to a fully electronic law making process with the 'e-Recht' project for creating legislation, from initial drafts to the final passing of laws and publishing exclusively over the Internet has speeded up the distribution of bills from weeks to a matter of a few days. Fully electronic tax declarations via the 'FinanzOnline' service together with a reorganization of work processes have speeded up the delivery of decisions and payments enormously.

### 4.2 Improved Service

'HELP', the central online portal, offers its users better and more flexible access to information on Austrian authorities and services 24 hours, seven days per week, saving citizens as well as businesses time and money. The expansion of online information systems such as on law information has also improved information access. The publishing of law gazettes over the Internet with the option of receiving automatic online notification offers the information to a larger part of the population in a more comfortable way than before. For importing enterprises the 'PAWA' online system brought a much faster issuing of licenses, less workload, a corresponding reduction of storage times, significantly shorter 'time to market' for the goods concerned, and in sum a competitive advantage.

### 4.3 Reduced Administrative Burden

Online tax declarations have reduced administrative manipulations both for the authorities and clients, through intelligent online forms and online help, improved data quality and automatic control routines. The electronic record management system 'ELAK' led to a significant reduction of transport-, search-, storage- and access efforts in the handling of records in all ministries.

### 4.4 Increased Efficiency

'FinanzOnline' has made the work of tax offices more efficient: an assessment of time savings amounts to a total of 381 person years per year. 'ELAK' raised

efficiency based on logistical improvements and on average a 15%-20% faster handling of individual files. The 'PAWA' system brought efficiency gains which allowed redeploying some staff for other tasks. Online accesses to the central population register and further digitized registers allow for significantly more efficient and automated information management of the public administration.

### 4.5 Adaptation Problems and Reorganization

The transformation to 'ELAK' meant a culture shock to most employees in the ministries and caused significant adaptation problems initially. To reap the benefits required substantial learning investments as well as reorganizing work tasks, roles and responsibilities. Central support functions were partly abolished and 'team assistants' introduced as a new role. The head office of the Austrian Parliament has to cope with a significant higher workload to support 700 instead of 450 working places, due to the introduction of the electronic law making process.

### 4.6 Cost Reductions and Enhanced Revenues

The PAWA online system has safeguarded revenues generated by customs duties and interest on import turnover tax as major importers of textiles and clothing had threatened to stop importing goods for the Austrian market and the EU through Austria. The safeguarded amount for the Austrian state was assessed at about € 3.5 million only for the year 2003. Savings of printing costs of € 1 million annually in the parliament's printing house are a direct benefit of electronic law making. The more efficient record management through 'ELAK' together with a reduction of support staff in the Federal Chancellery means a cost reduction. Information retrievals from the population register by business partners who are liable to pay costs bring at least € 2.5 million per year.

## 5 Summary

The results show that Austria has not only made a great leap forward into the top league with its supply of e-government services over the past three years but also experiences increasing popularity of these services. Especially the take-up of services by businesses in Austria is making enormous progress and is in all forms consistently and clearly above the corresponding EU average. Moreover, both among businesses and citizens the growth in using e-government services is strongest in transaction-related services. In the business sector the usage of advanced e-government services, particularly in the form of full electronic transactions is, according to available data for 2004, clearly ahead of most other EU Member States. Nevertheless there is still much potential to raise the usage level, especially among citizens, and to achieve a socially more balanced e-government practice. As far as impacts are concerned, quantifiable cost savings and accelerated processing times of case handlings are in the foreground as exemplified

among others by positive effects in the financial and foreign trade sector of the public administration. When attempting to explain the positive development of service take-up in Austria, among the factors which seem to have contributed most are an advantageous institutional framework of coordination and cooperation (e.g. establishment of structural and procedural instruments, including cooperative institutions integrating different levels of government), a fairly advanced level of Internet penetration, early progress in back-office integration and standardization, last not least an e-government programme spurred by EU initiatives and national top level political backing [10].

## References


1. Ramboll Management: Top of the Web. User Satisfaction and Usage Survey of eGovernment Services. Prepared for the eGovernment Unit, DG Information Society, European Commission, (2004) http://europa.eu.int/information_society/activities/egovernment_research/doc/top_of_the_web_report_2004.pdf
2. Tempest, M.: Official websites leave public cold. In: The Guardian. Monday, December 30, London (2002)
3. Leam, D.: Log on, switch off. In: The Guardian. Thursday, January 16, London (2003)
4. IDABC: Swiss e-government still below expectations, survey reveals. eGovernment Observatory. eGovernment News, 22 March (2005) http://europa.eu.int/idabc/en/document/4025/5791
5. IDABC: Danes still prefer using public services offline, finds survey. IDABC eGovernment Observatory. eGovernment News, 14 April (2005) http://europa.eu.int/idabc/en/document/4099/5800
6. Lowe, C.: Take-up of eGovernment in Europe. e-Forum Working Group on Take-up and Benefits. e-Forum Association (2003) http://www.eu-forum.org/summit/docs/Take-up%20of%20eGovernment%20in%20Europe%20-%20eSummit%20paper.doc
7. IDABC: French e-tax service victim of its own success. IDABC eGovernment Observatory. eGovernment News, 22 April (2005) http://europa.eu.int/idabc/en/document/4186/5800
8. Capgemini: Online Availability of Public Services: How is Europe Progressing? Web Based Survey on Electronic Public Services. Report of the Fifth Measurement, October 2004 (2005) http://europa.eu.int/information_society/soccul/egov/egov_benchmarking_2005.pdf
9. Millard, J., et al.: Reorganisation of government back-offices for better electronic public services - European good practices. Vol. 1: Main report. European Commission, Brussels (2004)
10. Aichholzer, G. and M. Spitzenberger: E-Government in Österreich: Entwicklungsstand, Nutzung und Modellprojekte. Bericht 1: Stand des Diensteangebots. Studie im Auftrag des Bundeskanzleramtes. ITA, Österreichische Akademie der Wissenschaften, Wien (2004)
11. PLS Ramboll/eWorx: Top of the Web. Survey on quality and usage of public e-services (2003) http://www.topoftheweb.net/docs/Final_report_2003_quality_and_usage.pdf

12. FESSEL-GfK: Lifestyle Online 2004: E-Government. Executive Summary, Bundeskanzleramt. Wien (2004)
13. RAND Europe: Benchmarking e-Goverment in Europe and the US. SIBIS Statistical Indicators, Benchmarking the Information Society. empirica, Bonn (2003) http://www.rand.org/publications/MR/MR1733/MR1733.pdf
14. TNS: Government Online: An international perspective - Global summary (2003) http://www.tns-global.com/corporate/Doc/0/JF206RCSIND4H7QIOVKUGST011/0
15. Statistik Austria: Europäische Erhebung über E-Commerce 2003/2004. Wien (2004)
16. IAB: High Payoff in Electronic Government: Measuring the Return on E-Government Investments. Office of Intergovernmental Solutions; GSA Office of Citizen Services and Communications, Washington, D.C. (2003) www.gsa.gov/intergov
17. Capgemini/TNO: Does E-Government pay off? Study on the effective use of ICT in the public sector in Europe, in search for European exemplary public services - EUREXEMPs, Final Report. (2004) http://www.eupan.org/cms/repository/document/Does_e_gov_pay_off.zip
18. IAO: Ermittlung der Wirtschaftlichkeitspotenziale von eGovernment Stuttgart. IAO, Stuttgart (2004)
19. Aichholzer, G.: Nutzungs- und Wirkungsindikatoren von E-Government in Österreich. In: Wimmer, M.A. (ed.): E-Government 2005: Knowledge Transfer und Status. Oesterreichische Computer Gesellschaft, Wien (2005) 375-386

# Evaluation of a Risk-Modelling Tool at the Business Case of eService Projects – Results from a Workshop in the UK

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**Abstract.** It is accepted that public administrations may benefit from eGovernment initiatives. Unfortunately, for various reasons recent reports show that eService projects fail on a grand scale. Potentially speaking, proper risk-modelling techniques could be employed to assist in this situation. A current doctorate research programme looks at the relevance of a risk-modelling tool engaged at the pre-proposal phase of eGovernment projects in the UK. This article describes a research strategy that is found on scenario-guided focus group workshops that aims to supply the doctorate's questions with adequate answers. One such workshop recently took place in the UK, where eGovernment practitioners working at the Edinburgh City Council participated. The paper presents the fruitful results from that workshop, which were about the relevance of a risk-modelling tool at the business case stage of a potential eService project for the local government. It is hoped that this research document may contribute and assist parties involved in the development and research of eServices for the government.

## 1 Introduction

Here is a perplexing contrast. Globally, public administrations are investing heavily into the concept of electronic government. Fundamentally, this is due to the expected benefits that could be reaped from it, such like increased efficiency, cost-effectiveness and increased accessibility, to name a few (*for more on that, read* [1], [2]). On the other hand, reports [3], [4] show that several high profile eGovernment projects in the UK fail to conclude satisfactorily. Research [5], [6] revealed that there are many diverse risk-generating areas that may affect the course of any eGovernment implementation. And indeed, ICT projects – in general – can fail if prompt and proper analysis of risk elements does not occur at the early stages of the project development [7]. Within that context, a current doctoral research programme is trying to reply to the following question: "How relevant is a qualitative multi-perspective risk modelling tool at the pre-proposal phase of eService projects for the government?" To assist in that, a research workshop has recently taken place in Edinburgh, Scotland. The workshop procedure and its results are presented in the next sections of this paper. But before delving into that, let us have a brief look at the research instrument.

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This risk-modelling tool (*for more, read* [8], [9]) comprises two main components. First, there is a high-level framework called FRAMES and second, the other module is the eService Risk Taxonomy. FRAMES may be used to: (i) *provide a holistic view of the risk areas associated with an eService;* (ii) *support risk assessment during the pre-proposal phase (in this instance, the business case) of the project;* and (iii) *generally enhance consistency in the decision-making process.* On the other hand, the main benefits of the eService Risk Taxonomy are to: (i) *express and put an order to potential risk factor generating areas;* (ii) *enhance communication amongst decision-makers;* and (iii) *act as the basis upon which risk assessment may happen.*

## 2 Research Methodology

The nature of the research programme and its fundamental question could be characterised as exploratory with a rather experimental hint. And this is so, because a research instrument is to be used in order to provide a satisfactory response to the research questions set in a rather new area, where little or no research has occurred so far. Therefore, the methods used had to be able to accommodate such research temperament, as well as ensure that there was also a fair amount of representativeness and a way of improving the research instrument.

This paper presents a mixed research strategy based on a selection of well-known methods that complemented each other in order to answer the question described earlier in this document. Overall, this research methodology may be termed as 'scenario-based focus group workshop', which aimed to simulate an instance of a real-life event and observe the participants using the research instrument. Scenarios have been used extensively in the HCI field in order to elicit design requirements [10]. Quite recently, such method has been successfully used in eDemocracy contexts [11], whereby it posed a simple way of representing ICT prototype tools in an easy to follow non-technical format. Moreover, to achieve representativeness and gather multiple expert opinions on the research instrument, the well-established method of focus group has been employed. According to Bryman [12] focus group can bring – amongst others – three main benefits that are relevant to this research. Firstly, it is a technique that shows why people feel the way they do about a topic, as well as allows these people bring in front issues that they think to be significant; and thirdly, focus group participants will often argue with each other and challenge each other's views [13]. Moreover, 'focus groups often mix requests for evaluations with the elicitation of descriptions' [14], which was one of the research requisites.

The scenario-based focus group workshop research strategy could be discriminated into methods used to collect data for a 'before-use' appraisal and an 'after-use' evaluation of the research instrument. In order to allow the researcher explore what the participants' first impressions with the tool were, they were all given the diagrams of the tool and were asked to express their viewpoint on the sheets provided to them, also allowing them to freely modify/update anything

they wanted. In a way, it resembled a projective technique as it 'supplemented the data collection and posed a useful way of revealing the participants' inclinations, and general worldview' [15].

On the other hand and for the 'after-use' appraisal of the prototype tool, various structured and unstructured research methods were exploited. One such method was a unstructured interview with all the participants in the form of an open discussion that followed a series of pre-planned open-ended probes [16]. In such a way, the participants were free to discuss on the topics from their own perspective [17], which potentially could pave the way – due to the group's dynamics – for change on the discussion focus to more important topics [18]. To complement representativeness [19] the method of structured written questionnaires was also used. This well-known method was also used to supplement the open-focus group discussion, mainly for two reasons [20]; i) to avoid any potential interviewer (the researcher acting as moderator) bias, and ii) to provide greater feeling of anonymity (since in the open focus group discussion the participants could be more cautious in expressing their opinion freely). And finally, a novel way of retrieving and organising swiftly and in a consistent manner was also employed. Basically, a grid-based method posed a 'two-dimensional' structured survey and it was asking for the brief comments (after specific questions) of each focus group member. Such comments were placed by the participants in a table that had rows representing questions and columns that represented a certain context of inquiry. The main strength of this method was to have a feedback blitz, saving time and cost. On the downside, if not explained adequately, it could confuse participants and influence the resulting data. In effect, it was a method that carried strengths and weaknesses of structured questionnaire surveys, and visually, it looked very much like a repertory grid [21], though not identical.

## 3 The Workshop

The members, selected for this workshop, were all employed at the City of Edinburgh Council. The actual number of participants that attended the workshop was five and they were all working at the eGovernment Unit within the city council. The participants were all actively engaged in the eService project development and management, and their positions varied; three were eGovernment consultants, one was a senior eGovernment consultant, and one was an eGovernment change manager. The focus group workshop was structured around three phases, each of which is described below. These were the i) *presentation*, ii) *interaction*, and iii) *discussion*. During the interaction phase the researcher took notes to record the behaviour and any potential points raised by workshop members. Also, whilst at the interaction and discussion phases, the participants were video and audio taped, so as to capture as much data as possible throughout the workshop.

*Presentation.* The first phase of the workshop lasted for about 30 minutes and encompassed the following segments: i) Introduction to the project aims and the

role of the research; ii) ground rules for how the focus group could help and the filling of the agreement forms; iii) rationale behind the research instrument and its potential benefits, including a presentation of its main purposes; and iv) introduction to the scenario, the criteria that the participants should use to assess the research instrument, and the method of applying them.

*Interaction.* At the second phase of the workshop, the participants had 45 minutes to use the research instrument, bearing in mind that they were in a situation as described by the scenario. In the beginning of the session, and for about 8 minutes, each participant had the opportunity to familiarise him/herself with the two components of the research tool. During that stage, the participants were asked to alter/update the components in a manner that felt more suitable. Following that, the remaining session involved the members using the tool and creating output (risk statements) recorded on a supplied form (risk assessment blank forms). Due to the restricting time limitations of the workshop, the researcher, who was asking the partakers to use different parts of the research instrument at finite intervals, guided the session. At the end of the session, the participants were allowed time to express their comments about the research tool on sticky notes, following the guidelines presented to them with the scenario. Basically, it was asked whether the research instrument fulfilled the following purposes: i) To provide a common high-level understanding of eService projects, and ii) to provide a standardised process of identifying specific risks for eService projects. The participants had to assess whether the instrument could satisfy the above purposes, and in order to judge that the following criteria would be used: i) Does it identify likely issues?, ii) Does it identify areas that could be overlooked?, iii) How useful is it?, iv) How usable is it?, and v) How complete is it?

*Discussion.* The third and last phase of the workshop involved two different feedback-gathering elements; a structured questionnaire, and an open-ended discussion. First, the members were asked to provide, in written form, comments on their experience with the research tool. They had to fill in a questionnaire, which comprised 11 questions, all examining the tool from different angles. The participants were given approximately 20 minutes for the task. After that, an open-ended discussion followed, where all the participants could express their views openly in regards to the research tool and the research topic in general. The researcher was involved by guiding the discussion, using the following general questions: i) How relevant is this tool to the business case of your eService project?, ii) Does it provide a process of identifying risks?, iii) What would you like to see in this tool?, and iv) Do you use any risk tools at the business case?

## 4 Criteria-Based Findings

The first criterion to be assessed was whether the research instrument identified likely issues. The response was mixed; the FRAMES component appeared to fail in the identifying of likely issues, and on the other hand, the feedback received

for the eService Risk Taxonomy was overwhelmingly positive. Overall, as a tool it could in fact identify likely issues and was suggested that it also 'formulates' or 'categorises' risks. Another angle from which the research instrument was explored was to ask if it identified areas that could be overlooked. In this case, the feedback was not extremely rich, probably due to the nature of the question that sounded similar to the criterion described earlier. It seemed that potentially the risk-modelling tool could help in identifying areas that could be overlooked with the eService Taxonomy receiving more positive feedback, though again it was evident that the FRAMES represented the weak point. But how useful was that risk-modelling tool at the business case of an eService project? Most of the related partaker replies appeared to be quite encouraging in that respect. In regards to FRAMES, it may be said that overall it looked like a useful model, and as one participant pointed, it 'provides an overview of those involved with eServices'. On the other hand, the eService Risk Taxonomy, received positive comments and was perceived as useful overall. In a nutshell, this tool was found useful for the following six reasons: i) can dissect systems, ii) analyses contained risks, iii) focuses on the key areas, iv) breaks down risk to more details compared to the PRINCE2 methodology, v) forms the basis for risk discussion, and vi) can be a very powerful brainstorming tool. The fourth criterion, used to assess the research instrument, was examining the usability of the tool at the business case of the eService project. Overall, the taxonomy part of the decision support device was found to be usable to a satisfactory level. On the other hand, it was apparent that the FRAMES component failed to convince on its usability. The reasons for that failure were mainly two; improper/insufficient terminology that led to misinterpretations or no comprehension, and lack of complexity. The final assessment criterion was asking how complete the tool appeared to be. The response here seemed mixed, as it was evident that the taxonomy part of the tool was found to be complete to a satisfactory extent. On the other hand, FRAMES did not impress the participants, who found it quite incomplete.

## 5 Purpose-Based Findings

Broadly speaking, the research instrument appeared to provide high-level understanding, though there has been no suggestion/proof that such understanding was common. As a whole, the tool could provide towards the understanding of risk and help to avoid project failures, as one participant put it. To another one, the eService Risk Modelling Tool provided an overview of those involved in eServices. At a more specific level, the FRAMES part of the tool achieved to portray high-level understanding as some participants found it to provide a way of conceptualising process breakdown. FRAMES (and hence the tool) achieved 'a high level' of understanding as it was expressed that FRAMES is good enough for a presentation. Moreover it was generic enough to be used across different implementations. Having said that, some participants stated that FRAMES should become better and be redesigned. That was, because FRAMES did not resemble relationships in an eProject, it could be misinterpreted, and one noted that

FRAMES did not reflect reality. The main strength of the tool in providing the practitioners with high-level understanding seemed to be the taxonomy. Though, it was stressed that such high level understanding would probably be more appropriate at the feasibility study stage and not the business case stage, where issues need to be more specific. Such high-level understanding was perceived as a good checklist that provided input into areas covered by the business case, as well as helped to focus on key areas. The second purpose that the eService Risk Modelling Tool aimed to achieve was 'to provide a standardised process of identifying specific risks for eService projects'. On the whole, the findings suggested that it did actually identify risks, though it did not appear to provide steps to make it a 'process'; it was seen more as a tool. Though, it paved the way towards such a process, and it would be better if FRAMES was more accurate and integrated with the taxonomy. To be seen as a process it had to be better presented. Finally, it was pointed out that, despite the fact that it portrayed a good risk identification tool, it could be more appropriate for the feasibility study stage as at the business case more is needed.

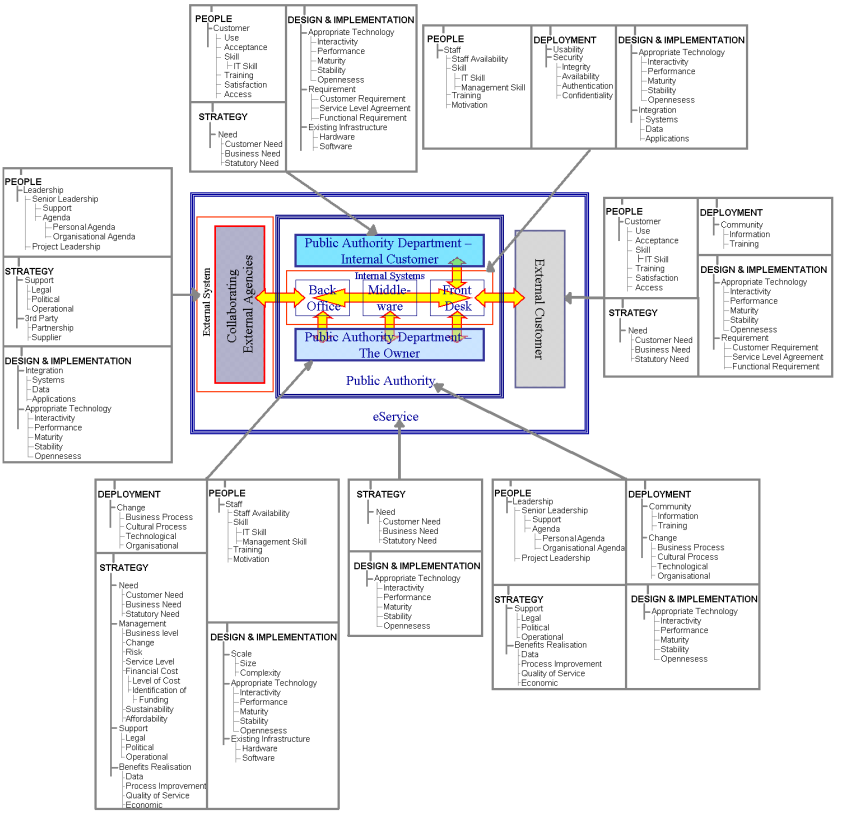


**Fig. 1.** Integrated Risk Modelling Tool

## 6 The Updated Risk Modelling Tool

It is evident from the afore-presented discussion in the paper that the research instrument did indeed need some modifications in order to become more applicable at the business case stage of eService project development. In a summarised form four main remarks were made in order to better the tool, which are: i) the whole tool needs to be more integrated, ii) FRAMES needs redesign, iii) some taxonomy categories need renaming, and iv) some new taxonomy categories are needed. All these remarks have been taken into consideration and both parts of the tool have been updated accordingly. The picture above (*figure 1*) shows the integrated version of the tool, which of course entails in itself the updated parts as well.

## 7 Conclusions

This paper elaborated on the results of a recent workshop done in the UK. The workshop's main aim was to explore the relevance of a risk-modelling tool for the business case stage of eService project development at a local authority. Apart from an extended talk on the research methodology, the workshop's procedure and results were looked upon. Part of the results, prompted for further exploration of the relevance of the instrument at the earlier stage of project development, the feasibility study stage. Such research is currently ongoing and its outcomes will be published soon as part of a doctoral research programme in the area.

## References

1. Traunmüller, R. and Lenk, K. Electronic Government: the Innovating Power of E-commerce. Proceedings of the XVI IFIP World Computer Congress, Bejing, China, (2000), August 21-25.
2. Howard, M. E-Government Across the Globe: How Will 'e' Change Government? Government Finance Review, (2001), issue August, pp 6-9.
3. Arnott, S. £1.5bn Squandered on Government IT, Computing, (2003), March 13, 2003, p.1.
4. Arnott, S. Report Shows How Libra Courted Disaster, Computing, (2003), Nov. 12, 2003
5. Akomode, J., Taleb-Bendiab, A., Evangelidis, A., Taylor, M. UML Approach to Risk Assessment Modelling for eGovernment, Proceedings of the European Conference on E-Government, St. Catherine's College Oxford, UK 1-2 October (2002), pp395-402.
6. Evangelidis, A., Akomode, J., Taleb-Bendiab, A., Taylor, M. Risk Assessment & Success Factors for eGovernment in a UK Establishment. In Proceedings of the First International Conference on Electronic Government, EGOV 2002, Aix-en-Provence, France, (2002).
7. Avison, D. and Shah, H. The Information Systems Development Life Cycle: a First Course in Information Systems. (1997) McGraw-Hill.

8. Evangelidis, A. and Macintosh, A. Introduction to FRAMES - An eGovernment Risk Modelling Framework. 3rd European Conference on E-Government, Trinity College, Dublin, Ireland (2003).
9. Evangelidis, A., Macintosh, A., Davenport, E. FRAMES Towards Risk Modelling in eGovernment Services: a UK perspective. Third International Conference on Electronic Government, EGOV 2004, Zaragoza, Spain (2004).
10. Carroll, J.M. and Rosson, M.B. Getting Round the Task-Artefact Cycle: How to Make Claims and Design by Scenario. ACM Transactions on Information Systems, (1992) vol.10 pp 181-212
11. Whyte, A. and Macintosh, A. Representational Politics in Virtual Places. Journal of Environment and Planning (2003) vol.35 pp 1607-1627
12. Bryman, A. Social Research Methods (2001) Oxford University Press.
13. Vaughn, S., Schumm, J.S., Sinagub, J. Focus Group Interviews in Education and Psychology (1996) Sage Publications.
14. Puchta, C. and Potter, J. Focus Group Practice (2004) Sage Publications.
15. Fetterman, D. M. Ethnography In (eds.) Bickman, L. and Rog, D.J. Handbook of Applied Social Research Methods (1998) Sage Publications.
16. Anderson, T. and Kanuka, H. e-Research: Methods, Strategies, and Issues (2003) Pearson Education.
17. May, T. Social Research: Issues, Methods, and Process (1993) Open University Press.
18. Robson, C. Real World Research (2002) Blackwell Publishing.
19. Fetterman, D. M. Ethnography In (eds.) Bickman, L. and Rog, D.J. Handbook of Applied Social Research Methods (1998) Sage Publications.
20. Kidder, L. and Judd, C. Research Methods in Social Relations (1987) HRW International Editions, 5th Edition.
21. Fransella, F., Bell, R., Bannister, D. A Manual for Repertory Grid Technique (2004) Wiley, 2nd Edition.

# Achieving Administrative Transparency Through Information Systems: A Case Study in the Seoul Metropolitan Government

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**Abstract.** Information systems have been mostly used to enhance the efficiency of administrative procedures in the local government sector as well as the central government sector. Information systems also help to improve transparency of civil affairs. The OPEN (Online Procedures Enhancement from civil application) system in the Seoul metropolitan government of South Korea has helped to achieve transparency in the civil administration by preventing unnecessary delays and unjust handling of civil affairs on the part of civil servants. The focus of this study is an administrative informatization at the level of the local government, not at the level of the central government. This paper, therefore, examines the success factors of the OPEN system, i.e., the powerful leadership of the city government, the development of Information and Communication Technology (ICT), and citizens' attitudes. In addition, this paper analyzes some barriers to the development of the OPEN system and its existing problems.

## 1 Introduction

With the development of ICT, has come an infrastructure for accessing information in a more convenient manner, and many government offices have started to utilize it in their administrative tasks. Especially, the larger the size of the government organizations become, the more the information system is necessary. Many countries have focused on initializing the information system and on using it with ease, and the Korean local government is one of them. Although a number of countries have invested a huge amount of their budget in administrative information systems, there are few instances in which they have made real successes. With this in mind, the Seoul metropolitan government has achieved great performance using the OPEN (Online Procedures Enhancement from civil application) system in its electronic civil affair system.

The OPEN system was first introduced in 1999. It provides online services for approximately 54 kinds of administrative procedures in 10 areas such as sanitary problem, building construction, etc. Citizens can check their civil affairs on the Internet. In other words, they can know administrative processes at each

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step in real time. Not only focusing on realizing the process of civil affairs online, but also unveiling their all steps which had been notoriously haunted by injustice and corruption, the OPEN system has showed a great success in achieving administrative transparency. In addition, another success can be found in that the OPEN system was established with a relatively small budget and scale of a local government, which is totally different from the previous one where the Korean central government poured large budget and manpower.

The performance of the OPEN system had, however, been in question at the initial stage of the development. Moreover, civil servants of the Seoul metropolitan government were not in favor with that system because it was suspected that the new system would limit their discretion and increase the amount of their work. In this paper, we will answer the following questions:

- How has the OPEN system been planned and developed?
- Does this system add more convenience in both administrative and technical perspectives, how does it have an effect on lowering the corruption level of civil affairs?
- What are the problems pointed out from the developing stages of the OPEN system, and what are the possible solutions to them?
- What factors have led the OPEN system to success?

In the next chapter, this paper addresses the conceptual background of corruption and transparency in administrative procedures. In the following chapter, the OPEN system will be introduced, and its impact will be investigated. Finally, this paper will analyze the problems of the OPEN system and suggest possible future issues.

## 2 Theoretical Background

He, Z pointed out that the concept of corruption is a negative phenomena and unhealthy tendency within the party and government departments and that this concept has three features [1]. The first feature is that the core element of corruption is not abuse or misuse of public power but the very use of public power for private benefit. The second feature is the ambiguity of the term "private interest" in contrast to "public interest". In other words, sometimes, private benefits include not only personal gains but also the public interest. The last feature is the question of the subject of corruption. It often refers to public bodies and their leaders, as well as individual public officials.

From the viewpoint of the first feature, how can public power be used for private benefit? It can be explained by the theory of principal-agent relationships. Becker and Stigler first introduced a principal-agent model of corruption. After the introduction of a principal-agent model, many researchers have extended that theory [2]. Tirole [3], [4] and Laffont [5] extended the classic principal-agent framework to include chains of principal-agent relationships. According to Smith and Bertozzi [6], the relationship between governments and citizens can be explained by principal-agent theory, i.e., citizens are principals and, in

contrast, governments are agents, who work for citizens. Under this relationship, the principal has the right to know about administrative process, flow, and output. Although the principal (citizen) pays its agent (government) for the work, the principal (citizen) has difficulty in knowing the agent's (government) performance. So information asymmetry occurs, where the agent (government) has more information than the principal (citizen). For that reason, the agent would have the possibility of facing corruption or a moral hazard. Therefore, the citizen needs to monitor the government's work in order to decrease the information gap between the principal (citizen) and the agent (government) [6], [7].

Klitggard [8] developed the concept of corruption briefly described as

$$\text{Corruption} = \text{Monopoly} + \text{Discretion} - \text{Accountability}$$

He emphasized that governments monopolized information, and therefore, they could have the power of discretion. In other words, if we want to decrease the corruption, we would decrease the monopoly on information and increase the accountability of government. Vishwanath and Kaufmann have pointed out that more openness and information sharing, which enable the public to make informed political decisions can improve the accountability of governments and reduce the scope for corruption [9]. They also emphasized devising regulatory policies made to facilitate the collection and sharing of information that are critical to the design of various institutions and policies, and to limit the abuse of power by bureaucrats by enabling a system of monitoring and incentives that promote openness and accountability.

In the meantime, although the term of transparency has been used widely, its rigorous definition has been poorly discussed. Florini pointed out that in politics, transparency enables citizens to learn what governments are up to through information provided by the government [10]. Vishwanath and Kaufmann identified the attributes of transparency such as accessibility, comprehensiveness, relevance, quality, and reliability [9]. In accessibility, it can be explained that the citizen can obtain government information widely, easily, and equitably. Because of the accessibility of the information, the citizen can collect information easily and accomplish the citizen's right to know.

At this point, regarding the enhancement of accessibility for the citizen, information and communication technology (ICT) can be referred to as effective methodology. Kauvar argued that an electronic government could execute transparency through IT (information technology) faster and more easily [11]. Perritt and Henry pointed out that the Internet offers the potential to provide freedom of information at low cost [12]. In addition, the Internet is the most effective channel for accessing the administrative information for citizens in their homes without having to visit the offices. Accessibility includes the following three principles: First, the channels should be widely open, various, and near to the citizens. Second, procedures should be easy and simple for citizens to understand. Last, the method of providing administrative information should be official and direct [9]. For these reasons, many governments use ICT to conduct electronic government for enhancing accessibility for citizens, and hence, administrative transparency can be increased.

## 3 Overview of the OPEN System

When Kun Goh was inaugurated as the second elected mayor of the Seoul metropolitan government, Seoul had been, unfortunately, facing a big crisis due to the consecutive scandals of corruption. In order to break through this crisis, Goh took resolute steps forward, launching a variety of reformative contingency plans by declaring "the War against Corruption". Under his powerful leadership, the Seoul metropolitan government has accordingly proposed the introduction of the OPEN system and set forth its subsequent development.

The OPEN system is an online system to open the administrative procedures, which are likely to be closely related to corruption, to citizen through the Internet in various public service sectors such as housing and construction, sanitation, building, etc. It was first developed on April 15, 1999 to achieve transparency in the civil administration by preventing unnecessary delays or unjust handling of civil affairs on the part of civil servants.

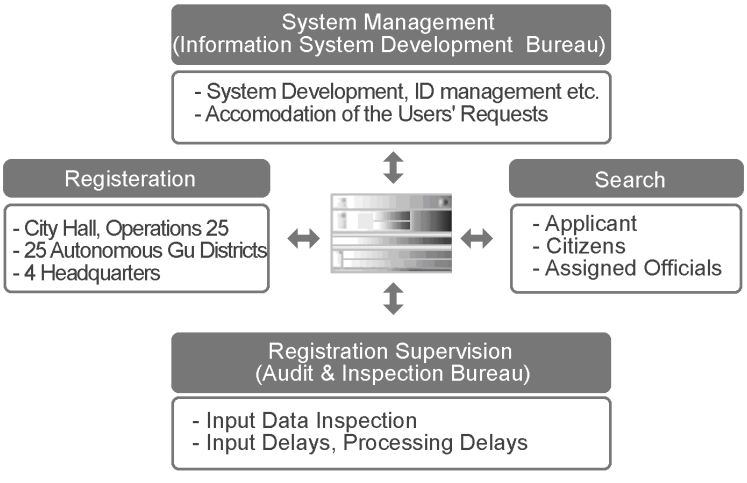


**Fig. 1.** Architecture of the OPEN system

For example, if a citizen wants to get permission for construction after submitting the application and related information, the citizen doesn't need to meet or call the officer in charge. Instead, the officer will post the details of the received application on the OPEN site. Using any computer connected to the Internet, whether at home, work, or at the nearest district or ward office, the citizen can learn in real time whether the application has been received properly, who is currently handling and reviewing the case, when the permit is expected to be granted, and whether it has been returned and for what reasons. Although many similar systems have been introduced for the purpose of conducting administrative procedures both domestically and overseas, they have provided only information related to the final decision through the Internet. The OPEN system,

however, is a more dynamic system where a citizen is able to track all necessary information from the beginning to the completion of the citizen's application without waiting for responses.

The steps for the development of the OPEN system are as follows: First, the Seoul metropolitan government announced the development plan of the OPEN system. Actually, the OPEN system was planned by Goh, who had announced that the Seoul metropolitan government would make a great effort to prevent corruption and to guarantee citizens' rights to access information for ensuring transparency through the disclosure of administrative procedures.

Second, a department was selected that would be in charge of the development and operation of the OPEN system. The Information System Planning Bureau in the Seoul metropolitan government was originally appointed as the main office to administrate the OPEN system. However, due to having only a short time for developing the OPEN system and insufficient authorities and skills to control the related departments, the organization adopted a dual-typed system. The Audit and Inspection Bureau took the responsibility for controlling the overall development process, and the Information System Planning Bureau was changed to play the role to support the OPEN system development.

Third, the services for the OPEN system were selected. In the beginning stages of developing the OPEN system, a review team composed of well-seasoned staffs in Audit and Inspection Bureau focused on selecting the services, which had the high possibility to relate corruption. With this in mind, they selected the services considering following perspectives: (1) they had been deeply involved in corruption, (2) they got into trouble from citizens because their processes were complex, (3) when the processes of these services opened, they could prevent the officers from taking bribes, and (4) they could influence many citizens when their processes opened. As a result, 26 parts in 10 fields for civil application were finally selected to publish on the Web, and they were extended to 54 parts later as shown on Table 1.

**Table 1.** 10 Fields of Civil Applications to be Made Public (Source: Seoul metropolitan government, [13])

| | |
|---|---|
| Housing and Construction | Housing construction project and 6 services |
| Transportation | Assessment of influence on traffic and 10 services |
| Culture and Tourism | Review of compulsory installment of art objects for building and 6 services |
| Urban Planning | Approval for acts of changing topography and soil and 2 services |
| Administration | Purchase of government supplies |
| Construction Work | Compensation and 5 services |
| Environment | Purchase of land for parks and 7 services |
| Industry and Economy | Adjustment of city gas consumer rates and 6 services |
| Sanitation and Welfare | Contact for social welfare facilities operation and 1 service |
| Firefighting | Inspection on completion of fire-fighting facilities and 1 service |

Then, the Seoul metropolitan government analyzed the processes of the selected services for applying to the OPEN system and developed the system. The development team was formed: three task analysts with much experience in the Audit and Inspection Bureau, two members in the Information System Planning Bureau, and eight professional computer programmers in the private company. They met the relevant officers of 26 departments, and these officers brought all the related records and presented the details including the characteristics and objectives of the processes. After discussion, the team analyzed all of the processes, decided on the detailed processes to make public on the Web, and standardized this information to apply to the OPEN system. According to analyzed processes of each step, programmers designed the flow chart and developed the standardization for the OPEN system.

At last, the Seoul metropolitan government prepared for the launch of the OPEN system. After developing the OPEN system, data were inputted and Seoul metropolitan government officials were trained to operate and maintain the system.

## 4 The Results of the OPEN System

From the introduction of the OPEN system on 15 April 1999 to January 2003, more than 3.418 million citizens had visited the system. The number of business registrations was more than 194,000 and the number of document registrations was more than 1,072,000. Moreover, in 2003 the number of daily visitors to the site increased to 3,500 from about 1,000 at the beginning of its operation, showing a growing interest of the citizens. All 8,200 officials in 770 departments were busy with data input at this time. As a result of these remarkable achievements, the OPEN system was accelerated toward the extension of services, and 15 services in March 2000 and 13 services in July 2000 were added to the system in comparison with 26 services when it started. Then the OPEN system was accessible to the public with a total number of 54 services, including nearly all services that are prone to improprieties. Details of the services to be made public are as follows:

### 4.1 Positive Impacts – Administrative Perspective

**Increasing the Transparency.** First of all, the most remarkable effect of the OPEN system is the increase of administrative transparency with access to real-time information on details of handling civil applications, procedure of approval, etc.

After the introduction of the OPEN system in 1999, the number of the castigation considerably decreased from 114 in 1999 to 65 in 2001. Because the Seoul metropolitan government has executed various anti-corruption strategies, these results cannot be completely attributed to the OPEN system.

However, other empirical evidence shows that the OPEN system increased administrative transparency (TI-Korea, Gallup). Findings from a survey of 1,245

citizens showed that 84.3% (984 out of 1,167 persons) replied that the OPEN system contributed to achieving transparency, and 72.3% (762 out of 1,055 persons) said that it satisfied their interests. The OPEN system's performances achieved transparency of working habits in terms of corruption.

**Increasing the Efficiency.** After the introduction of the OPEN system, detailed procedures and document forms of 54 kinds of civil affairs were standardized. Through the online system, the 657 detailed procedures of 54 kinds of services were defined and were categorized into the approval and non-approval ones. The document forms of the 358 procedures, which were linked to the existing system in the Seoul metropolitan government, were also standardized for common use for the all government organizations. Also, short message services (SMS) and email services were added for citizens.

Telephone interviews of 250 employees in 125 divisions (five divisions per "Gu" office of Seoul) were conducted after the implementation of the OPEN system. 152 respondents (61%) said that the number of telephone inquiries had decreased, 58 respondents (23%) said they were similar as before, 22 respondents (9%) said they had increased, and 18 respondents (7%) were not sure. The interviews also revealed that the number of personal visits by applicants had decreased (132 respondents, 53%), stayed similar (60, 24%), increased (27, 11%), and were not sure (30, 12%), indicating that the system is successfully responding to citizens' requirements.

### 4.2 Positive Impacts – User Perspective

**Easy to Access.** Citizens usually used to visit the city hall and wait for a long time to conduct their civil affairs. After the introduction of the OPEN system, however, citizens can browse all the details just by "clicking their mouse" at home. Furthermore, the OPEN system shows the current status of the process, and so citizens can check necessary information with ease without visiting or calling the office.

**Increase the Trust.** 657 procedures are revealed in the standardized forms in the OPEN system. This guarantees the equity and objectivity of the administrative officer. The OPEN system opens every detailed procedure of the services, and so, helps to increase the trust between the civil officers and citizens.

### 4.3 Valuations of the OPEN System

Kofi Annan, U.N. Secretary-General, and Goh, the Mayor of Seoul, made an agreement to offer the OPEN system of the Seoul metropolitan government to 180 member nations of the U.N. The Seoul government prepared the manual of the OPEN system in 6 languages, and jointly with U.N., held a symposium on anti-corruption in Seoul in 2001. International organizations such as International Transparency Organization, OECD, and World Bank have encouraged related countries to use the OPEN system of Seoul.

The OPEN system was recognized by the central government of Korea as a successful model for an innovative management system in the public sector. Citizens, public administration specialists, and government employees also voted the OPEN system as the Most Valuable Policy of Seoul in 1999 and 2000.

### 4.4 Problems of the OPEN System

**Two Directing Bodies for one Policy.** Seoul appointed the Information System Planning Bureau, according to custom, at first as the major office responsible for developing the OPEN system. But it came to be recognized that the development of the OPEN system would be impossible without sufficient integration and support from all concerned departments of the Seoul metropolitan government since they had been tightly related with a variety of autonomous units and project-based offices. Accordingly, it came to empower the Audit and Inspection Bureau, already armored with a strong directing and planning power, as the main office and let the Information System Planning Bureau cooperate with and support it. With these two different bodies for directing one policy, there was more room for incongruity and conflicts between them, and there actually arose some inevitable collisions.

**Lack of Liaison with Another Systems.** In the initial stage of the OPEN system, the Seoul metropolitan government already had an electronic approval system as a particularly dedicated network to handle some important approvals. Since the OPEN system ran separately through the Internet, the civil officials could not avoid an additional workload from doing the same job twice through the OPEN system and through the existing electronic system. Fortunately, after the amendment of the OPEN system, where the electronic approval system was linked, this problem was solved

**Limited Resources.** The OPEN system had taken only 10 weeks to be developed and had been directed by 13 persons with a small budget of about 57,000 US dollars. So there had been difficulties, and support was not enough. Even after its establishment, it has come to be confronted with speed decreases and instability as data increases.

**Non-cooperative Officials.** Real-time opening throughout the whole administrative process, which is an important feature of the OPEN system, would impose a heavy load on the civil officials and decrease their authority. Accordingly, its introduction could not help but cause resistance and objections from the civil officials concerned.

## 5 The Implications of the OPEN System

### 5.1 Success Factors

In spite of insufficient budgets and short development time of the OPEN system, it set a good example as a success of the informatization policy conducted by

the local government. Now, it is meaningful to figure out what factors can lead the OPEN system to be successful.

**The Powerful Leadership of the City Government.** The first success factor is powerful leadership by the city government toward corruption eradication. The newly elected Seoul metropolitan city Mayor, Kun Goh, declared the war against corruption as his top priority and much effort by would be put forth. Unlike previous failure cases, he chose this task as one of the primary cases, which should be conducted during his time and he would take an integrated and systematic approach to solve it. Bardach emphasizes the role of the fixer as "the third mediator'" or "project manager" in order to resolve various conflicts and obstacles, which can occur in the course of the policy implementation [14].

**The Advanced ICT.** The second success factor is the function of two-way, real time communication channels between citizens and the Seoul metropolitan government by utilizing ICT, especially, the Internet. The increase of the Internet users and the development of the ICT infrastructure enabled both sides (citizens and the local government) not only to communicate with each other more frequently, but also to spur the exploitation of the OPEN system. As Sabatier and Mazmanian proposed for the sake of the successful implementation of the government policies, appropriate technologies should be chosen and developed to solve policy problems [15].

The established research regarding administrative information and e-government emphasizes small size and simplicity of the information systems embedded in organizations [16]. In other words, the less complex the technique is, and the smaller the size of ICT is, the more the possibility that a successful administrative policy implementation exists. In this respect, although the OPEN system had been developed with insufficient budgets and on a small scale, that condition made it more suitable to carry out administrative informatization. Both the technological progress of ICT and the increase of Internet users have been perceived as technical factors enabling the successful implementation of administrative informatization under the name of preventing corruption. Also, the small scale of the information systems makes it possible to work effectively.

**Citizen's Attitudes.** The citizens' attitudes and understanding toward administrative services can be the third success factor of the OPEN system. The bureaucratic, top-down way of administrative services has been increasingly transformed into more customer-oriented ones [17]. Citizens should pay much attention to their administrative services if they expect transparent and rapid administrative services, broken from the prevailed stale corruption. Changes of citizens' attitudes toward administrative services inevitably caused them to be reformed. The OPEN system might have remained one of the useless administrative informatization cases if not for the high concern and active participation of citizens. In this sense, it can be undeniable that a change of citizens' attitudes and perceptions toward administrative services played a crucial role in the successful implementation of the OPEN system.

### 5.2 Future Issues

**Link of the Other Administrative Systems.** The OPEN system should be connected with other existing systems for improving work efficiency on one side and with citizen-related systems for sharing more data on the other. In addition, it also needs to be reconfigured with standardization into a system nationally implemented over all of the provincial areas and attract more active participation by citizens with consistent public relations.

**Continuous Propulsion of Non-corruption Strategy.** The purpose of the OPEN system is to increase administrative transparency. The second mayor, Goh, who took a resolute action to launch a variety of anti-corruption strategies, introduced this system. Currently, the mayor of the Seoul metropolitan government has changed, and the third mayor plans to introduce another new strategy. The frequent change of mayors weakens consistency between the established administrative strategy and the new one. Therefore, it is important to constantly make an effort to enhance the existing administrative transparency strategy.

**Reduce of the Ineffective Administrative Procedure.** Even if the OPEN system contributes to the efficiency of many of administrative procedures, naturally the administrative procedure has a tendency toward complexity, and it takes so long time to complete a civil affair. The purpose of administrative informatization is not to introduce the information system but to downsize the dimension of the government. Therefore, government officials should first reduce the ineffective administrative procedures substantially and make them simple, and introduce the information system later.

## 6 Conclusions

In this paper, we found that the OPEN (Online Procedures ENhancement from civil application) system in the Seoul metropolitan government of South Korea has helped to achieve transparency in the civil administration by preventing unnecessary delays and unjust handling of civil affairs on the part of civil servants. The case of the OPEN system confirms the role of information systems for enhancing the administrative transparency in the local government level.

This paper has several limitations including lack of proper quantitative analysis. In addition, since this paper only focuses on a Korean case, it would be recommended for further studies to examine similar cases in other countries. Moreover, the results of the OPEN system may need to be studied by a longitudinal approach.

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## References

1. He, Z. (2000), "Corruption and anti-corruption in reform China", Communist and Post-Communist Studies, Vol 33 No 2, pp.243-270
2. Becker, G. and Stigler, G. (1997), "Law enforcement, malfeasance compensation of enforcers", International Library of Critical Writings in Economics, Vol 81 No 2, pp.505-522
3. Tirole, J. (1986), "Hierarchies and bureaucracies: On the role of collusion in organizations", Journal of Law, Economics and Organization, Vol 2, pp.181-214
4. Tirole, J. (1992), Collusion and the theory of organizations: In advances in economic theory, University Press, Cambridge
5. Laffont, J. (1990), "Analysis of hidden gaming in a three level hierarchy", Journal of Law, Economics and Organization, Vol 6, pp.301-324
6. Smith, R. and Bertozzi, M. (1998), "Principals and agents: An explanatory model for public budgeting", Journal of Public Budgeting, Accounting &â Financial Management, Vol 10 No3, pp.325-353
7. Strausz, R. (1997), "Delegation of monitoring in a principal-agent relationship", The Review of Economic Studies, Vol 64 No 3, pp.337-357
8. Klitggard, R. (1997), Controlling Corruption, Institute for International Economics Pub, Washington DC.
9. Vishwanath, T. and Kaufmann, D. (1999), "Towards transparency in finance and governance", The World Bank Draft, pp.1-30
10. Florini, A. (2000), "Does the invisible hand need a transparent glove? The politics of transparency", World Banks Annual Conference on Development Economics, pp.163-184
11. Kauvar, G. (1998), "Electronic Government: Concepts, Visions, and Strategies", The KAPAs International Symposium on Electronic Goverrnment: Visions and Strategies, Seoul, Korea.
12. Perritt, H. (1997), "Open government", Government Information Quarterly, Vol 14 No 4, pp.397-406
13. Seoul Metropolitan Government `http://www.seoul.go.kr`
14. Bardach, E. (1977), Implementation Game: What Happens After a Bill Becomes a Law, MIT Press, Cambridge.
15. Sabatier, P. and Mazmanian, D. (1980), "The Implementation of Public Policy: A framework of Analysis", Policy Studies Journal, Vol 8, pp.538-560
16. Heeks, R. (2001), Reinventing Government in the Information Age: International Practice in IT-enabled Public Sector Reform, Routledge, New York.
17. Ho, A. (2002), "Reinventing Local Governments and the E-Government Initiative", Public Administration Review, Vol 62 No 4, pp.434-444

# eGovernment and Structural Reform on Bornholm: A Case Study

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**Abstract.** In Denmark a major eGovernment project is on its way. By January 2007 a structural reform of government will reorganize all counties and municipalities. More than 1 million employees will be affected, and all public IT systems will have to change. In 2003 a kind of pilot study for this upcoming structural reform including both eGovernment and organisational change was undertaken. Five municipalities and a county on the Island of Bornholm merged. In this paper I report from an in-depth interview study of the merging process. My analysis focuses on organizational change and the implications for eGovernment. I conclude by identifying three main hindrances. Finally the implications and learning for the upcoming structural reform is discussed.

## 1 Introduction

Recently a bill was passed in the Danish parliament that will result in a total reorganization of the county and municipal levels of government. The idea is to decentralize more government responsibility which requires local units that has a size to take on the added responsibility. By 1 January 2007 it is expected that the existing 271 municipalities will be merged into approximately 100 larger municipalities, and the current 14 counties will be merged into five regions. We believe that the management of organizational change, diffusion of Information Technology (IT), and the use of IT in government (eGovernment) will become key issues for the Danish Government in the near future.

A kind of pilot project for the structural reform was undertaken in 2003 on the Danish island of Bornholm with the merging of five municipalities and one county into the Regional Municipality of Bornholm. With regards to the structural reform in Denmark, we believe that a lot can be learned about organizational change, IT-diffusion and eGovernment from the process that Bornholm recently went through.

In this paper we report results from an interview-based case-study that we did on Bornholm. We emphasize learning that can be used in the reorganization of the Danish municipalities decided for 2007. We relate our findings and measures to the literature on organizational change, eGovernment and IT diffusion.

The remainder of this paper is laid out as follows. Section 2 of this paper discusses relevant theory on change and IT diffusion. Section 3 introduces the

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Bornholm case. Section 4 lays out our research method. Section 5 details our findings from analyzing our findings and section 6 discuss and conclude on our case findings.

## 2 Organizational Change and eGovernment

To analyze our case about the merging of five municipalities on the island of Bornholm we need a theoretical framework. On the one hand the merging of the municipalities is an *organizational change* process. And as a major part of the change process was about IT, and since that is where we put our emphasis in our field study, it is reasonable to look at *IT diffusion* and at how the *eGovernment*, interpreted as IT-enabled and -related parts of government, works in the new larger organisation?.

Organizational change and diffusion are two concepts very close to each other. Rogers [1] defines the diffusion process as one "which is the spread of a new idea from its source of invention or creation to its ultimate users or adopters". So if you study a single case then diffusion will look like organizational change.

### 2.1 Organizational Change

By and large the upcoming structural reform in Denmark is a story about a major organisational change. Organizational change in relation to IT is still attracting considerable attention. Dunphy [2] have studied organizational change in corporate settings and finds that any theory of change should incorporate at least five components:

- A basic metaphor of the nature of the organization
- An analytic framework or diagnostic model to understand the organizational change process
- An ideal model of an effectively functioning organization that specifies both the direction of change and values used in assessing the success of a change intervention
- An intervention theory that specifies when, where, and how to intervene to move the organization closer to the ideal
- A definition of the role of change agents

In the literature three different schools of organizational thinking have provided metaphors of the nature of the organization. The oldest approach to organizational design and change descends back to the end of the nineteenth century where Frederick Taylor, Henri Fayol and Max Weber were key figures. Taylor invented "Scientific Management" including the key belief that "it is possible and desirable to establish, through methodological study and the application of scientific principles, the one best way of carrying out any job." (Here cited from [3], page 28). The metaphor in this perspective is that an organization is like a production system where it is possible to optimize the systems efficiency

and effectiveness. Thus organizational change is about optimizing planning and optimizing through observation, experimentation, calculation and analysis.

In the 1930s and 1940s the classical view of organizations were challenged and a new perspective was born. In relation to change this perspective is characterized by [3], [4] the belief that organizations are cooperative, social systems rather than mechanical ones, where people seek to meet their emotional needs. So the metaphor for an organization is a (large) group of people with an organisational culture and visible communication and interaction processes between them.

The third school of thought has been called the political-emergent perspective [3], [4]. It is characterized by the belief that organizations and change is shaped by the interests and commitments of individuals. And by the belief that decisions often arise from power-struggles between special-interest groups or coalitions. "Organizations are not machines, even though some of those running them would dearly like them to be so. They are communities of people, and therefore behave just like other communities. They compete amongst themselves for power and resources, there are differences of opinion and of values, conflicts of priorities and of goals" [5].

It is possible to combine tools and techniques from the three different perspectives. John P. Kotter [6], a Harvard professor, for example recommends eight stages in leading a change process: (1) Establish a sense of urgency, (2) Build support, (3) Develop a change vision, (4) Communicate the change vision, (5) Empower and enable action, (6) Generate short-term wins, (7) Consolidate and revitalize change, and finally (8) Anchor new approach in culture. Stage 1, 3 and 4 is close to the view of an organization as a production system, whereas stages 2, 6 and 8 clearly show the organization as a social system. And then stage 2 and 5 are taking power and special interests into account (see also [7]).

Organizational change processes can rarely be considered a linear function [8], and often the best change strategy is to keep as much stable around the change as possible simply to allow enough energy and attention of the people changing behaviour.

Beer & Nohria [9] have analyzed change literature and found two schools of thinking that he called theory E and theory O. Theory E focus on changing tangible structures and work processes (hardware) first, while theory O seeks to revitalize culture, beliefs and social relations (software) first. This view of organizational change is used by Huy [10] to identify four ideal types of interventions. He distinguishes between episodic and continuous change. So if one wants to change formal structures then it is an episodic change of something tangible. Thus the ideal type of change will be commanding. In figure 1 you find the four ideal types according to Huy [10].

When one type of intervention best is, is a natural question to figure 1. Huy's answer is that every ideal type is relatively more effective that the other ideal types in changing certain specific organizational parts. For example the engineering intervention is relatively best at changing work processes.

Organizational change processes can rarely be considered a linear function [8], and often the best change strategy is to keep as much stable around the change

| Tangibility of content | Episodic change | Continuous change |
|---|---|---|
| **Tangible (theory E)** | Formal structures *(changed through commanding)* | Work processes *(changed through engineering)* |
| **Intangible (theory O)** | Beliefs *(changed through teaching)* | Social relations *(changed through socialization)* |

**Fig. 1.** Four change approaches according to Huy [10]

as possible simply to allow enough energy and attention of the people changing behaviour.

### 2.2 IT Diffusion

Diffusion of innovation is essential to the successful adoption of new information technology (IT) by people in organizations. The innovation process cannot be isolated among those who originally developed the IT. Innovation is also practiced by those who adopt an innovative new IT in the way that they use the IT in their own work lives.

An innovation is an idea, practice, or object that is perceived as new to an individual or other unit of adoption [1]. Diffusion of innovation is the process by which an innovation is communicated through certain channels, over time, among the members of a social system. The innovation is naturally evolutionary in the sense that each member of the social system innovates in adopting and adapting the communicated innovation to their own settings

### 2.3 eGovernment

eGovernment is the efficient delivery of government services using information and communication technologies (ICTs). Recently the rapid diffusion of the Internet and Web has resulted in a proliferation of applications that for example provide the necessary instructions and forms for public specific services so citizens can interact directly.

Some definitions restrict eGovernment to include only these recent Internet and Web-enabled applications. Another restricted definition is to focus only on interactions between government and people outside. In this paper we will use a broad definition, thus all computer-based information and communication technologies are included.

A recent study [11] shows that governmental online service sophistication and citizen readiness are at a very high level in Northern Europe. "Our benchmark of eGovernment ... shows ... Northern European countries in particular reaching high levels of sophistication, while at the same time having a population that is ready to embrace the services"

## 3 Case Bornholm

Bornholm is a smaller Danish island with 45.000 inhabitants situated in the Baltic Sea. In January 2001 the Mayors from the five municipalities on Bornholm, met. The result of their meeting was a suggestion for a local election about the amalgamation of the five existing municipalities on the island.

The background for this suggestion was a local debate that had been going on for some time. It was often claimed that having five very small municipalities in such a limited geographical area led to both economic and democratic ineffectiveness.

The five city councils supported the election with great majority and a local election was held in May 2001. A total of 74% of the island's population voted yes to an amalgamation of the five municipalities. Hereafter it was decided that a new regional municipality of Bornholm should be effective from January 2003.

## 4 Research Method

A little more than a year after the merger the first round of an in-depth interview study focusing on the outcome of the Bornholm merger was conducted. Six months later a second round of interviews we carried out. The purpose of the interview study was to reconstruct and understand the complex merging process in order to identify lessons to be learned.

For the study it was decided to interview users and IT-professionals from Bornholm as well as developers from KMD, the semi-public provider of IT. To capture both management and employee perspectives representatives from all three groups were interviewed. In total 14 people was interviewed. Ten of them were from Bornholm of which half of them were IT-people and the remainder was IT users primarily from the "one-stop shops", single points of access to the citizen services that were introduced and placed at the former town halls as part of the change process. One-stop shops deal with more or less any issue a citizen may come with.

The remaining four people interviewed were three from KMD and one from the Danish Federation of Municipalities. In Table 1 an overview is given of our interviewees together with a short description of their role.

**Table 1.** Overview of interviewees. All names anonymous per request from the people interviewed. Pseudonyms derived from names of cities at Bornholm.

| **Name (Pseudonym)** | **Organization and role** |
|---|---|
| Anne Arnager | Work in one-stop kiosk in Rønne – the largest city on Bornholm |
| Berit Balka | Work in one-stop kiosk in Nexø – 2nd largest city on Bornholm. |
| Diana Dueodde | Headed the steering committee on behalf of KMD |
| Gaya Gudhjem | Chair of group looking at debtor it-systems for money collection |
| Heidi Hasle | Employed since 1976. Works with property tax collection |
| Kurt Knudsker | IT person in both the old and new organization. |
| Lars Langeskanse | Manager at the regional level. Responsible for main parts of the organisational change process in relation to the merger. |
| Mikael Myreby | CIO for all IT in the new regional municipality. |
| Nils Nylars | Responsible for all IT-development in new regional municipality. |
| Ole Olsker | Senior Consultant from the Danish Federation of Municipalities. |
| Ron Rutsker & Soren Sandvig | Employed with KMD. Responsible for estate and taxing systems. |
| Teo Tejn | Works with debtor systems and tax collection in Rønne. |
| Viggo Vang | Employed in the IT department. Refers to Mikael Myreby. |

In the interviews the interviewees were asked to reflect on their experiences with the merger. The interviews by examining artefacts – documents, presentations, and newspaper clippings – from before and after the merger. Subsequently all the interviews were tape-recorded, and central parts from each interview were transcribed and summarized for detailed data analysis. Formally the research method can be described as an in-depth case study relying on data triangulation [12].

The interview notes including the transcribed parts were then analyzed in an iterative hermeneutic process. This revealed a number of interesting lessons.

## 5 Analysing the Bornholm Case

This section first takes the top-down perspective looking at the organizational change process that took place at Bornholm.

Because the politicians on Bornholm prioritized a rather long period for political discussions about the organizational setup of the new regional municipality the execution phase for the IT part of the merger was very short. During the planning phase after the election in May 2001, 22 working groups were formed – one of them was focusing on IT. But the working groups were only supposed to map out, describe and identify problem areas. They were told not to make any major decisions with regards to the future organization of the IT-organization

in the new regional municipality of Bornholm because this was seen as a political decision. But it was cumbersome to make decisions. Every decision had to be approved by six political councils, one for each municipality plus the county council. Lars Langeskanse was still happy that "*the politicians as a whole were positive*" although "*to have decisions made it required a lot of spadework*". Seen by people outside this process, however, it was experienced as decision avoidance. Ron Rutsker and Soren Sandvig, from KMD, experienced this as a lack of decision power. They said: "*We experienced a kind of decisional vacuum. Nobody knew who was to answer what?*"

Another related problem was ignorance of how much a change process actually implies. For example it requires a lot of extra time, but that time wasn't allocated. Gaya Gudhjem told. "*No time were set aside specifically for the development work. Thus we didn't have time to really advance as we should have. There were things that just hobbled along.*"

By January 1, 2003 the merger had materialized and only one regional municipality existed on Bornholm. But in fact a lot happened right after that New Year 2002/03. For example in the local tax administration they came to sending out property tax bills twice. And some people actually paid twice we were told. It required a lot of work redoing the property tax collection manually. Anna Arnager told us about another example where a person called in very mystified that he shouldn't pay tax: "*We had a case where a person called because he hadn't paid property tax. We checked it in the system, but his tax was actually paid. Then we looked more deeply into it and found that the tax was paid through an Internet bank. The man declined that he had paid via Internet and when we checked we found that a total stranger had paid the tax for this man using his old debtor number. From that we learned never to reuse debtor numbers.*"


**Fig. 2.** Time Line for the merger at Bornholm

To give you an overview of the change process at Bornholm I have made figure 2.

### 5.1 Too Much Uncertainty – Too Few Decisions on IT

The election for the new Bornholm city council took place in May 2002 and after the summer the contract between Bornholm and KMD was finally signed. Then the work in the 22 working groups restarted – it had been stalled for a long period due to the request for not making decisions. However, many of the people participating in the working groups still hesitated in making decisions because they didn't know their own role in the future. Viggo Vang told: "*The users were not involved in the whole merging process. The reason being that it was not decided where each individual would be [geographically and job wise] after the merger*".

The only thing the employees knew at this point was that everything would change: the organization, their job, and probably the geographical place (to another town most likely). This caused a lot of uncertainty and a lack of willingness to make important decisions. Nils Nylars said: "*At this time we did not know our future organization; neither did we know what goals to pursue. That is the reason why most of the work came down to discussing the conversion of data. We didn't know who was going to work with the systems. And we didn't know anything about the interfaces [between people and systems]. For example we did not know whether there would be a one-stop citizen service in the new regional municipality*".

Users were expected to take responsibility for the restructuring. But in reality KMD took over the design of the new systems because the working groups were not able to make decisions. We asked Lars Langeskanse how that could be and his answer was that he believed "it was a good negotiation" because "*we had nothing to bring to the table. We just had six small IT departments . . . and the largest consisted of 3 and a half person*".

The workers in the different working groups had been empowered to map out the existing processes. Berit Balka, who had a job in the information desk before the merger, told: "*Before the merger we met every 3 months and tried to unify and standardize our work processes. So we meet and we told what pictures [referring to screens] we needed. These meetings continued until Christmas at which point we were told which job we were going to have.*"

So the first result of our analysis of the interview data is that the IT-system users were expected to take responsibility for the restructuring. But in reality KMD were setting the agenda. So the 'empowered users' lacked flexibility to imagine something for others than themselves. They were not willing to use the power that were given them.

### 5.2 Too Much Change at the Same Time

As we said above the working groups were not able to make actual IT-decisions before the end of 2002. In fact the initiation of the new merged IT function hap-

pened in October 2002, but the first couple of months they turned inwards and concentrated on defining an IT strategy. "*We used all of October and November to write the IT strategy*" told Viggo Vang.

Mikael Myreby emphasized that the late establishment of the new IT organization created huge problems. "*The reason being that everything from IT systems to Intranet was new*". Thus it seems that the lack of time for the execution phase dramatically increased the cost of the merger.

Another problem identified in our analysis was that it was expected that savings from the merger would materialize more or less immediately. Unfortunately that was not the case. Diana Dueodde told: "*Bornholm did not harvest any savings in the beginning. You don't do that from day one*". Never the less Lars Langeskanse told us that today 7,5% have been saved. The first year 2,5% was spared and the second year after the merger another 5%. On top of that close to 1 million Euro per year in savings came from having fewer politicians to pay allowance to than before.

The official figure for the costs associated with the Bornholm merger was more than seven million Euro. A closer look at the data behind this figure revealed that it only included money for IT investments and some of the working time before and after the merger took effect on 1. January 2003.

However, the interviewees clearly told us that considerable time was invested in the change process after the merger, i.e. to define and agree on how to work in the new organization. Formally this wasn't accounted for as extra time but in fact it was time that was not used to service the people on Bornholm. Even when visiting the island 18 months after the merger there were still new processes related to the merger that were being discussed. The best estimate I can give based on analysis of the data collected is that the merger may have had costs up to 50% more than is shown in the official figures.

It was not that people were not trying to cope with the many changes. The head of IT development Nils Nylars told us: "You have to prioritize the changes. You only have limited energy. We reached a point here where the employees said NO, now we cannot take any more change. We need a project stop."

I believe that the real problem was that too much was happening in the same very short time period. Gaya Gudhjem told how she experienced the merging process: "*It was not the merging of the systems that was worst. It was the merging of cultures. And it was whether I got the table?*" [here referring to whom was getting which job after the merger]. And she continued: "*The biggest change from before to now is the culture. And the people that worked alone before had the worst experience. Suddenly they needed to cooperate.*"

So the second result from analyzing the data is that too much uncoordinated change at the same time dramatically increased the cost of the merger.

### 5.3 No Clear Vision for eGovernment

Though there existed a clear vision of how to organize the new regional municipality so every organizational unit became an independent company, ICT was discussed surprisingly late in the merging process. Even though the merger was

agreed upon almost two years in advance, the ICT part of the merger was only seriously considered half a year before the actual merger and executed in the last couple of months in 2002.

After the clear public support in the ballot for the merger, the legal foundation for the new regional municipality was negotiated with central government, and later accepted by the Danish national parliament with the introduction of a new law on the merger. The local preparations for the merger started mid-2001. At a meeting on August 29, 2001 between the Ministry of the Interior and representatives from Bornholm the cost of the merger is estimated. However, in this cost figure IT was estimated as zero! It was simply thought that "one could just put the IT systems together" as Lars Langeskanse remembered it. Thus neither in the central negotiations between the Ministry and Bornholm nor in the local preparation work on Bornholm was the IT-costs taken seriously before the beginning of 2002. At this point, however, the cost of both local and central government system was estimated. I.e. the cost of changing central governmental systems was estimated at 3 million Euros.

One of the largest problems in the Bornholm merger was that the ICT-related changes were perceived as a simple data conversion task. Maybe because all of the five existing municipalities were primarily using IT-systems provided by KMD they did not perceive the IT-integration challenges to be very large. Furthermore IT-challenges were considered a problem for the IT-provider and consequentially not a large issue in the merger. Mikael Myreby told: "*All the five municipalities on Bornholm were KMD customers, and from the beginning there was a belief that everybody could just use the systems from Rønne [the largest of the 5 municipalities]. However, it turned out that all the municipalities have had different organizational structures and as a result of that; used the KMD-systems differently*". And Ron Rutsker and Soren Sandvig, from the IT supplier KMD, told: "*In the user tests we clearly experienced that there were different ways of doing things [in the five municipalities]. Especially the BGS-system [used to identify a specific estate in a building file] was used differently. Some used a three-digit number [for referring to a building] while others just referred to a name such as Meadow Farm*".

One problem that came out very clearly in the analysis was that the carefully described processes didn't work out. The head of IT development in the new organization Nils Nylars told: "*At the point in time where we created the workflow descriptions people perceived things as they were in the old system. As of today [August 2004] we haven't had time to envision a unified way to work. The first year after the merger was just pure survival.*"

Another problem was that energy was used for the wrong things in the new organization. Nils Nylars told: "As a manager you have to remember that the employees are used to collecting money. They know how to do that. They just do it different ways [in different municipalities]. So we have learned that we should have focused much earlier on the new way of doing things – the vision for how to cooperate in the future. That lesson surprised us, but it is very clear for us today."

According to Kotter [6] a vision is needed in a change process to motivate, to show direction, and to help in coordinating and integrating action. Thus the third result of the data analysis is that a clear and communicated vision for eGovernment stating how to integrate the differing work procedures and the deployment of ICT was lacking in the Bornholm merger.

## 6 Discussion and Conclusion

The analysis above leads to a number of conclusions. From a change management point of view I found that the empowered employees never the less were unwilling to use the power they were given. I found that too much (uncoordinated) change at the same time dramatically increased the cost of the merger. And I found a lack of a clear and communicated eGovernment and ICT vision.

As the problem analysis differs, the remedies that can be identified differ as well: The increase in cost and time because of too much change at the same time can be countered by careful planning allowing enough room for one change at a time [8].

The estimate I gave earlier that the real cost may be up to 50% higher than the cost of the merger officially accounted for can be found in the book "The Mind of the Maker" [13] where it is given as a rule of Thumb that it takes one third of the effort to imagine a new IT system. It takes one third of the effort to build the new system. And it takes the last third of the effort for the users to understand and use the system. In this perspective I believe it is that last third of the cost that was overlooked in the official accounts from the merger at Bornholm.

Would it have helped at Bornholm if the change process had been spread over for example 6 months? That is a good question. Here there are two schools of thinking. One is to put as much change in the same time frame as possible. When a system is "unfrozen" you should use the opportunity to move it as much as possible (and needed). An opposing school of thought is that introducing change is a "foreign element" that will create "chaos" for the individual [7] at least for a period of time. And adding chaos to already existing chaos – equal to adding to change to change – will only lengthen the chaotic period. In this school of thinking you finish one change at a time.

What is the answer to the question then? My data indicates that it was not a good idea to pile all the changes together in December 2002. I believe a lot could have been achieved in a more efficient way if the change decision had been made and communicated 3-4 months before the actual change. That would have made it possible for the individual to perceive and adapt to the change needed before it physically took place by January 1. I.e. a lot of employees would have liked more time to organize how to get to work in a new city, how to work with new colleagues, how to sat goodbye to the old colleagues, and last but not least how to cope with new ICT.

Another discussion is whether the right change approach was used according to Huy [9]? The change content was quite tangible at Bornholm but what were to

be changed were both formal structures and work processes. Huy claims that formal processes are best changed through commanding eventually followed up by some of the other change approaches. And that was more or less what happened. But also work processes were to be changed for example around the one-stop shops (or kiosks as they are often called). Here Huy recommends engineering and that did not happen in any significant way at Bornholm. So that may be the learning here, that one should realise the type of change and carefully apply the best change approaches.

The way to cope with empowered employees unwilling to use the power they are given could be to build an environment for the individuals that lead them to take responsibility also for defining and discussing tasks and workflows that they themselves will not have responsibility for after the change.

The lack of a clear and communicated eGovernment and ICT vision is of course to define and communicate a vision and make expectations clear from day one [6].

### 6.1 Implications for the Structural Reform of Government in Denmark

The interesting thing about the Bornholm case is that it is a kind of pilot for up to 100s of similar projects going to take place in Denmark from 1 January 2007. So a highly relevant question is; what can be done to avoid the problems we identified at Bornholm? Based on my analysis I propose the following:

- Actively integrate the re-organization of the Danish municipalities with the design and development of an eGovernment infrastructure.
- Start early to have time for the above and to be able to decide on changes in due time
- Develop an eGovernment and an ICT vision that can be used to coordinate and integrate work in different sectors.

The central politicians in Denmark have publicly declared that they expect a leap forward – the Minister of the Interior even called it a "tiger leap" – in the use of IT in government as a result of the Danish structural reform.

One of our interviewees Diana Dueodde commented: "*There may be a tiger leap waiting in the future, but it will not come at the same time as the structural reform*".

My analysis seems to propose that Diana Dueodde is right in making this statement. Small efficiency gains like the 7,5% achieved on Bornholm in the first two years may be achievable. But the "tiger leap" is far ahead.

## Acknowledgements

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## References

1. Rogers, Everett M.: Diffusion of Innovations 5th Edition. The Free Press, New York (2003)
2. Dunphy, D.: Organisational change in corporate settings. Human Relations 49 (1996) 541-552.
3. Burnes, B.: Managing Change. 2nd Edition. Financial Times, Pitman Publishing (1996)
4. Borum, F.: Strategier for organisationsændring ("Strategies for organizational change"). Handelshøjskolens Forlag, Copenhagen (1995)
5. Handy, C.: Understanding Organizations. 4th Edition. Penguin Global (2005)
6. Kotter, John P.: Leading Change. Harvard Business School Press, Boston (1996)
7. Kotter, John P. & Cohen, Dan S.: The Heart of Change: Real-Life Stories of How People Change Their Organizations. Harvard Business School Press, Boston (2002)
8. Weinberg, G.M.: Quality Software Management, Volume 4, Anticipating Change. Dorset House. (1997)
9. Beer, M. & Nohria, N. (Eds.): Breaking the code of change. Harvard Business School Press, Boston, Massachusetts (2000)
10. Huy, Q.N.: Time, Temporal Capability, and Planned Change. Academy of Management Review, Vol. 26, No. 4 (2001) 601-623
11. IDC Report: European eGovernment Services - Country Benchmarking and Market Fore-casts, 2003-2008. December 20, 2004. 24 Pages. Publication ID: IDC1073350 (2004)
12. Yin R.K.: Case Study Research. Design and Methods. 3rd Edition. Sage Publications Lon-don (2002)
13. Sayers, D.L. The Mind of the Maker. Harper, San Francisco (1987)

# When Technology Meets the Mind: A Comparative Study of the Technology Acceptance Model

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**Abstract.** Issues related to technology, including diffusion, acceptance, adoption, and adaptation, have been the focus of research for different disciplines including Information Systems (IS), System Dynamics, Psychology, and Management Science. Of all research conducted and models developed to study technology related issues, the Technology Acceptance Model (TAM) stands out as most prominent, particularly in the field of IS. However, technology acceptance research has been relatively limited in its application to the public sector. Therefore, there is a concurrent need to develop and gain empirical support for models of technology acceptance within the public sector, and to examine technology acceptance and utilization issues among public employees to improve the success of IS implementation in this arena. In this paper we present a more comprehensive, yet parsimonious model of technology acceptance and suggest testing it both in public and private sectors to help understand the similarities and differences (if any) between the two sectors.

## 1 Introduction

In the last decade, a considerable amount of financial resources have been allocated to the implementation of e-Government projects. In the early years, projects primarily had a technological focus. This was due to the belief that organizations' behaviour and performance could be changed and improved by simply infusing technology. Over the years, the high rate of IT project failures prompted many to acknowledge the limits of this approach. The interaction between people and technology is a complex phenomenon involving rational as well as emotional factors. Failing to acknowledge the importance of understanding the underlying attributes of human-computer interaction may jeopardize the success of IT projects in e-Government. Recently, both academicians and practitioners have turned their attention to the organizational aspects of IT projects. And while the process of technology acceptance has been widely studied in the private sector, it has been relatively overlooked in the e-Government field. This

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paper attempts to fill a gap in the literature by deepening the understanding related to technological acceptance issues among public sector employees.

## 2 Objectives

The main objective of the study is to investigate the process of technology acceptance in the public sector, which will help both policy makers and practitioners gain a better understanding of the key factors driving the diffusion of information and communication technologies among public organizations. The long-term goal of our study is to contribute and improve the design of the policies aimed at fostering the adoption, acceptance and usage of Internet based technologies at all levels of public administration.

We will present the results stemming from the first phase of the study in this paper. In particular, we will propose an extended version of the TAM accounting for a wider range of contextual and individual factors.

In the second phase of the study, the application of the suggested model to both public and private context will highlight the similarities and differences of the technology acceptance process. The results of the research will allow stimulating discussion on whether and how public employees differ from private employees in their behaviour toward technology acceptance and usage.

## 3 Literature Review

In 1986, Fred Davis developed the TAM foundation to explain how and when users decide to accept and use a technology. The main elements of Davis's TAM model are "perceived usefulness" and "perceived ease of use." The model suggests that when users are presented with a new software package, "perceived usefulness" and "perceived ease of use" influence their decisions about how and when they will use the new software. Recently, numerous studies have been conducted using the original TAM-or an extended version of TAM-to examine the usage of IT. For example, Davis, Bagozzi, and Warshaw [3] examined an intention model called the Theory of Reasoned Action (TRA) with TAM to discover "synthesizing elements of the two models in order to arrive at a more complete view of the determinants of user acceptance." Taylor and Todd [11] extended, integrated, and compared the TAM model with two variations of the Theory of Planned Behaviour (TBP) to determine which model is the most helpful in understanding the technology usage. Venkatesh, Morris, Davis, and Davis [13] extended TAM, building a new model called Unified Theory of Acceptance and Use of Technology (UTAUT), which helps managers assess the likelihood of technology success as well as understand the drivers of technology acceptance.

The literature review shows that there are many attempts to evaluate, integrate, and extend different models and approaches for analyzing the implications of the TAM theory. Different researchers have adopted different measures for technology in order to understand its usage. The different measurement criteria for evaluating technology usage included looking at technology as an en-

tertainment tool (online games), a task-oriented tool (software for increasing organization productivity), a learning tool (software for school purposes), and an information-seeking tool (Internet). The unit of analysis in most of these studies was individual users, and their usage of technology was based mainly on individual motivations and individual decision-making processes. These past studies are deductive in nature, as they are all based on an existing TAM theory and pre-established research hypotheses. Most of the past studies adopted quantitative research to test the hypotheses and evaluate the TAM theory. The contribution of the past research studies are the revisions and extensions of TAM theory to explain the usage of different technological tools. The main limitation of these studies is that the sample of the research does not allow generalizing the findings to broad sectors of technology users in general and public sector employees in particular.

## 4 The Research Study

The proposed research model draws its theoretical premises from TAM [2], [3] and UTAUT [13], and adopts the technology acceptance framework proposed by Hu et al. [6] and Chau and Hu [1].

Hu et al. (1999) stated that technology acceptance should be examined in three different contexts: individual, technological, and implementation. Therefore, an individual's acceptance behaviour is influenced by factors pertaining to the individual context, the technological context, and the implementation context [1]. Individual context refers to the characteristics of individual end-users; the technological context refers to the characteristics of the technology such as functionality and user-friendliness, among others; and implementation context refers to the user's professional environment. Chau and Hu's [1] multi-contextual framework is adapted for this research because of its applicability to technology acceptance within both the public and private sectors.

The proposed research will study the impact of the following factors on employees' attitudes toward technology acceptance motivation, usage intention, and actual usage: (1) technology performance expectancy, (2) technology effort expectancy, (3) compatibility, (4) social influences, (5) organizational facilitating conditions, (6) computer attitude, and (7) computer anxiety. The significance of this study is that it is a comparative study using a research model that includes a sample of both private and public sector employees, to extend technology acceptance research into the public sector. In addition, the study sample will consist of both public and private employees representing two different industries: education and health. The results of this study will have both practical and theoretical applications for stakeholders involved in public and private sectors.

### 4.1 The Modified Research Model

The research model for the proposed study is based on the modification and extension of TAM and UTAUT (see Figure 1 below for the proposed research

model diagram). The research model was pilot-tested and based on interviews of ten New York State government employees representing different industries, including health and education. The research model was finalized based on pilot study results.

As shown in Figure 1 below, the research model incorporates Chau and Hu's [1] three dimensions. As the research model diagram shows, the technological context includes two determinants – performance expectancy and effort expectancy. Previous studies of technology acceptance show that performance expectancy is a strong predictor of technology acceptance intentions [4], [11], [12], [13]. Although the Venkatesh et al. [13] study shows that effort expectancy does not have significant impact on behavioural intentions; it is included in the model to empirically validate the significance of effort expectancy on technology usage intentions.

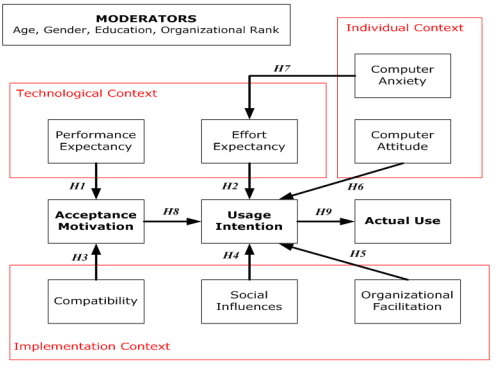


**Fig. 1.** Research Model

The implementation context includes three determinants – compatibility, social influence, and organizational facilitation. Compatibility is not included as a separate determinant of technology acceptance and usage either in TAM or UTAUT. However, compatibility has been included as a separate measurement for the technology acceptance study conducted by Chau and Hu [1], where the authors found a significant relationship between compatibility and perceived usefulness of technology. This study will test the impact of compatibility on technology acceptance motivation. Social influence is included as a separate determinant in the UTAUT, as previous technology acceptance studies found a direct impact of social influence on behavioural intentions [8], [12]. We will test the impact of effort expectancy on technology usage intentions. The empirical results from UTAUT show that organizational facilitating conditions do not play a significant role in predicting behavioural intentions, but there is a statistically significant relationship between the organizational facilitating conditions and the actual usage of technology [13]. The organizational facilitating conditions construct is included in the proposed study to test the significance of organizational facilitating conditions.

Individual context includes two determinants: computer attitude and computer anxiety. Chau and Hu's [1] study shows that the attitude toward computers plays a significant role in the technology acceptance decisions. As supported by UTAUT, computer anxiety has a direct effect on effort expectancy. The proposed study will empirically validate the impact of computer attitude on technology usage intentions, as well as test the relationship between the computer anxiety and effort expectancy.

### 4.2 Research Hypotheses

The following hypothesized relationships will be tested:

**H1:** The higher the perceived performance expectancy of technology, the more motivated the employees are to accept technology.
**H2:** The higher the perceived effort expectancy of technology, the lower the employees' technology usage intentions are.
**H3:** The higher the technology compatibility level within the agency, the more motivated the employees are to accept technology.
**H4:** The stronger the social influences in a government agency, the higher the employees' technology usage intentions are.
**H5:** The stronger the organizational facilitating conditions, the higher the employees' technology usage intentions are.
**H6:** Computer attitude will have a positive effect on technology usage intention.
**H7:** Computer anxiety will have a positive impact on effort expectancy.
**H8:** There will be a positive relationship between technology acceptance motivation and usage intentions.
**H9:** There will be a positive relationship between the usage intentions and actual usage of technology.

### 4.3 Conceptualization of Variables

The measurement criteria for evaluating acceptance motivation and usage intention of technology will view technology as a communication tool for increasing organization productivity. Technology acceptance motivation and usage intention will be employed as two dependent variables for this study. Acceptance motivation is the degree to which a person believes that using particular software will be rewarding in terms of professional productivity (job performance) and promotions. Usage intention is measured based on the purpose of using particular software. The independent variables for this study will be the performance expectancy, effort expectancy, compatibility, social influence, organizational facilitating conditions, computer attitude, and computer anxiety. Performance expectancy is defined as the degree to which an employee believes that using technology will help him or her to achieve better job performance (adopted from Venkatesh et al. [13]). Effort expectancy is defined as the degree of ease of technology use (adopted from Venkatesh et al. [13]). Compatibility is the degree to which technology is perceived as being consistent with the existing practices,

values, norms, needs, and experiences of the employees (adapted from Chau and Hu [1]). Social influence is the degree to which an employee perceives that others (e.g., coworkers) believe he or she should use a technology. Organizational facilitating conditions measure the degree to which an employee perceives that an organizational and technical infrastructure exists to support use of the technology (adapted from Venkatesh et al. [13]). Computer attitude is defined by the degree to which individuals like and feel comfortable when using computers. Previous studies developed the Computer Attitude Scale [9], which is adapted to study attitudes toward statistical software. Computer anxiety is the degree of fear or apprehension felt by individuals when they use computers, or when they consider the possibility of computer utilization [5]. This definition is based on Simonson, Maurer, Montag-Torardi, and Whitaker's [10] development of the Computer Anxiety Index. Four control variables will be included in this study: age, gender, educational background, and organizational rank (state grade) of the employees.

## 5 Research Methodology

During the second phase of the research, a multi-method technique will be employed to collect substantial qualitative, quantitative, and longitudinal data to study technology acceptance and utilization in public and private sector employees. Qualitative research methods are noticeably infrequent in technology acceptance research. Thus, the combination of both quantitative and qualitative methods, as opposed to only quantitative, is a significant methodology consideration [7]. Qualitative data underline the importance of context, people, and organizational issues in technology use and acceptance, and provide a deeper understanding of what is actually happening. Moreover, qualitative data help to understand the dynamic interaction between the constructs, which may change over time.

We will evaluate the acceptance motivation, usage intention, and Intranet use among public and private sector employees. For this study we chose the Intranet rather than other software applications, as its use is appropriate and equally applicable to the private and public sectors, as well as the health and education industries. In addition, the Intranet is a powerful tool that allows the obtaining and sharing of documents, web pages, and calendars, scheduling meetings, managing and delegating action items and project tasks, all of which are important and necessary for effective and efficient communication among employees. Moreover, as virtual work becomes increasingly more widespread, it is crucial that employees are able to utilize the Intranet.

Employees are the unit of analysis for this study. . Our research will be based on the triangulation of multiple data sources and data analysis methods, including semi-structured interviews and an online survey questionnaire. Although the survey will serve as the primary data collection method, the interviews will provide complementary data and will help to refine the research model and hypotheses.

We will collect data in three phases. In the first phase we will collect qualitative data through semi-structured interviews, which will help to revise the research model and survey questionnaire. In the second phase, we will collect quantitative data that will help to study the acceptance motivation and usage intentions of Intranet among employees at different agencies. Finally, in the third phase we will employ a longitudinal multi-method study to evaluate the actual usage of the Intranet. The proposed timeframe for data collection will span a one-year period, with two months for phase one interviews, three months for phase two surveys, and seven months for longitudinal study.

## 6 Limitations

There are a number of limitations for this research study. First, the study sample consists of employees representing two major industries: education and health. This sample group limits the generalization ability of the results to agencies in other industries. The second limitation is the limited measurement criteria for assessing the usage of technology as a communication tool only (usage of Intranet). However, the research could be expanded by assessing technology usage as a task-oriented, information seeking tool, and interactive task management tool.

## 7 Conclusions and Expected Results

In this paper we presented the first phase of the project, which is aimed at studying and comparing the process of technology acceptance in public and private sectors. An analysis of the literature heretofore published showed that despite previous studies to evaluate, integrate, and extend different models and approaches for analyzing the implications of the TAM theory, employees of public sector agencies have seldom been the unit of analysis. Business managers and students have been the traditional subjects of technology acceptance and usage research. The strength of the proposed study is that its subjects comprise both public and private sector employees, allowing a comparative analysis of research results. Most of the past studies are deductive in nature and based on an existing TAM theory. They adopt quantitative research to test pre-established research hypotheses and evaluate the TAM theory. Therefore, the collection of qualitative and quantitative data will increase the robustness of results by permitting data triangulation and providing a deeper understanding of what the driving force is for technology acceptance and usage among state government agencies, as well as private agencies. The study will also allow comparing and contrasting technology acceptance and usage practices across two different industries, i.e., education and health, which have different missions.

An extension of TAM has also been proposed. In the new formulation of the model, a wider range of contextual and individual factors has been included. The extension is intended to provide a more comprehensive representation of the phenomenon studied without compromising the model's cost-effectiveness.

In conclusion, our study will attempt to fill an important gap currently present in e-Government literature. Gaining a deeper understanding of how the government employees differ from those in the private sector-in terms of acceptance and adoption of technology-could result in a faster and more efficient diffusion of e-Government activities. The ability to design ad hoc policies, taking into account the specificities present among public employees surely represents a step forward toward improving the low success rates currently experienced by e-Government public managers worldwide.

## References

1. Chau, P. and Hu, P.: Examining a Model of Information Technology Acceptance by Individual Professionals: An Exploratory Study. Journal of Management Information Systems, Vol. 18. (2002) 191-229
2. Davis F.: Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. MIS Quarterly, Vol. 13. (1989) 318-341
3. Davis F., Bagozzi R., and Warshaw P.: User Acceptance of Computer Technology: A Comparison of Two Theoretical Models. Management Science, Vol. 8. (1989) 982-1003
4. Davis F., Bagozzi R., and Warshaw P.: Extrinsic and Intrinsic Motivation to Use Computer in the Workplace. Journal of Applied Social Psychology, Vol. 22. (1992) 1111-1132
5. Henerson, M., Morris, L., and Fitz-Gibbons, C.: How to Measure Attitudes. Sage Publications Inc, Thousand Oaks, CA (1978)
6. Hu, P., Chau, P., Liu Sheng, O. R. and Tam, K.: Examining the Technology Acceptance Model Using Physician Acceptance of Telemedicine Technology. Journal of Management Information Systems, Vol. 16. (1999) 91-112
7. Kaplan, B. and Duchon, D.: Combining Qualitative and Quantitative Methods in Information Systems Research: A Case Study. MIS Quarterly, Vol. 12. (1988) 570-586
8. Karahanna, E., Straub, D. and Chervany, N. L.: Information Technology Adoption Across Time: A Cross-sectional Comparison of Pre-adoption and Post-adoption Beliefs. MIS Quarterly, Vol. 23. (1999) 83-204
9. Loyd, B., and Gressard, C.: Reliability and Factorial Validity of Computer Attitude Scales. Educational and Psychological Measurement, Vol. 44. (1984) 501-505
10. Simonson, M., Maurer, M., Montag-Torardi, M., and Whitaker, M.: Development of a Standardized Test of Computer Literacy and A Computer Anxiety Index. Journal of Educational Computing Research, Vol. 3. (1984) 231-247
11. Taylor, S. and Todd, P.: Understanding Information Technology Usage: A Test of Competing Models. Information Systems Research, Vol. 6. (2001) 144-176
12. Venkatesh, V. and Davis, F.: A Theoretical Extension of the Technology Acceptance Model. Management Science, Vol. 46. (2000) 186-204
13. Venkatesh, V., Morris M., Davis G., and Davis F.: User Acceptance of Information Technology: Toward a Unified View. MIS Quarterly, Vol. 27. (2003) 425-479

# E-Government Practice: What One Country Could Learn from Other

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**Abstract.** E-government changed the way government thinks and functions. All over the world, government tried to get the benefits of e-government. Some of the efforts were successful and some failed. The paper made a comparative study between policy and practice of e-government in Bangladesh and India. The paper identified the causes of success in India and failure in Bangladesh. At the end, suggestion has been provided, so that Bangladesh could learn from the experience of India.

## 1 Introduction

Use of Information and Communication Technology (ICT) for government activity is common phenomena now. One of the most common applications of ICT in government activities is e-government. It is the process of reform in the way Government works, shares information and delivers services to external and internal clients [1]. E-government serves variety of objectives but at the end it reduces cost and corruption, increased transparency and greater convenience [2].

In this paper ICT policies and subsequent e-government projects of two countries has been compared. So that the less advance country could learn from the advance country. There are many examples in other fields where one country's successful case is replicated in other countries. For example the micro-finance program of Grameen Bank of Bangladesh is now successfully implemented in around 58 countries [3]. So an attempt has been made to look at the possible learning curve for e-government. For the study, Bangladesh and India has been chosen. According to United Nations Bangladesh has a deficient e-government capacity (an index of 0.9) [4]. In global e-readiness survey Bangladesh is languishing in 159th position for the last two consecutive years [5], [6]. For development in e-government policy/practice, India could be an example for Bangladesh due to sociocultural and economic similarity. India is in the next rung of e-government capacity (minimal e-government capacity with an index of 1.39) than Bangladesh [7]. But also improved its position on e-readiness from 2003 to 2004 [8], [9]. So, Bangladesh could take the Indian path for the development of e-government. But for most of the citizen service, Indians are dependent on state government. So it is appropriate to compare e-government policy and practice of

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a state with Bangladesh. Andhra Pradesh (AP) has long been considered as the most advance state in the field of e-government in India [10], [11]. So Andhra Pradesh has been chosen as the case study state.

## 2 Status of ICT in India

From the very beginning government of India realized the enormous power of ICT. In 1954, computer was introduced in India, though, use was limited. However all this changed in the 1980s when economic liberalization policy and government patronization made India a global player in ICT sector. One of the reasons for India's success is government is very much aware on the rapidly developing scenario in ICT and accordingly developed her policy. With this approach India has dramatically increased its tele-density from 0.5% in 1993 to 8.79% in 2003 [12], [13] India has a comprehensive ICT policy stated by her IT action plan. The plan charted the short and long term path for ICT in India. The recommended actions of the plan would make the government more transparent, effective, simplify service delivery, reduce duplication and improve the level and speed of service [14]. The policy also provides ample opportunities for the state government to implement their own ideas.

## 3 ICT Policy and E-Government Practice of Andhra Pradesh

Andhra Pradesh (AP) initiated its own ICT policy with strong emphasis on e-government riding on the opportunities provided in IT action plan. The sensible approaches of the ICT policy of AP make it as one of the best examples of e-government practice in developing world. AP's various e-government projects become model for e-government in developing world [15]. Some of AP e-government initiatives like *Mandals Online, VOICE*, have been mentioned as best practices of e-government by World Bank [16]. Mandals Online project reduced the delivery time of revenue certificate [17]. The VOICE project delivers municipal services to the citizen of Vijaywada municipality [18]. These projects face some very common implementation challenges like resistances within the organization, data inadequacy, data redundancy, shortage of skilled manpower to implement and operate the systems [19], [20]. But due to firm policy support and strong government commitment to the cause of e-government, the projects overcome all these. In its policy statement Government of AP declared that it believes e-government is one of the edifices of IT and e-government is one of the major vehicles for reaching the goal of good governance [21] A high speed fiber optic backbone network, APSWAN (Andhra Pradesh State Wide Area Network) is developed to government offices to support various e-government initiatives of AP government [22]. Government realizes that for successful e-governance all the departments should be computerized. But due to lack of resource, government developed the system of prioritization of computerization of departments, to

achieve the optimum use of resources. For the successful delivery of the services government adopts telegu, the mother tongue of the citizen of AP as medium of computerization and service delivery for e-government projects. Government planned to setup kiosks all over the state to access e-government facility from any part of the state within 2006. Government put the framework by which projects can generate its own money without compromising the quality of service and cost effective for the user, so that projects are self sufficient [23].

## 4 Status of ICT in Bangladesh

Computers were introduced in Bangladesh in the late 1960s, but use of computers is still low [24]. At the beginning government was quite inactive and apprehensive about the development of ICT sector. There are many examples of this. For example, in 1988 and in 1994 government refused to join the world wide data communication network by submarine cable under the pretext of protecting classified state information [25]. So private sector took the initiative. But due to little government support use of ICT was costly and limited [26]. However from 1996 government view regarding ICT changed. In 1996, ICT has been declared as thrust sector. An IT taskforce headed by prime minister has been formed. There were other steps which removed some of the barriers for ICT development. In 2001 ICT policy was declared. It aimed at building an ICT driven nation by the year 2006 [27]. Government's aim and strategy regarding e-government is stated in a section titled e-government/e-governance. However, e-government registers a low priority on policy agenda of Bangladesh government [28]. At present, Bangladesh government's official web page provides only basic information. It has link with 31 out of 41 ministries and their associated organizations [29]. Unfortunately even most of the information provided is outdated. For example, the web page of national data bank was last updated on December 2002. *National Data Bank* (NDB) is one of the first attempts of e-governance in Bangladesh. The project was initiated to provide a broad range of data and information support to stakeholders. It intended to address the shortcoming of official data, their inconsistency, inadequacy, lack of timeliness and to provide the information online [30]. But after spending more than US$ 440,000 the project seems to be abandoned [31]. But all the e-government projects did not failed in Bangladesh. One of the projects *EBRIS* (Electronic Birth Registration Information System) is largely successful [32]. The project registers birth, provides basic citizen identity, schedule and track immunization in the city of Rajshai [33]. The project is running in a restricted LAN format without any web presence, but it is successful and sustainable. The project is successful because it takes into consideration off all the stakeholders, has user friendly interface in bangla (the mother tongue of Bangladeshis). It is sustainable, because it has been integrated within the setup of host organization and gained acceptability to its all possible antagonists. Comparison of these two projects would provide an inside view of e-government practice in Bangladesh. NDB was a huge government project initiated by the government and with financial support from

government and donor agencies. But the objectives of the project were against the self interest of the government officials who are reluctant in publishing data. As publishing data would serve against their self-interests and would diminish their powerbase. So either it needed a strong leadership to have data available or specific guideline to the officers to provide data. Unfortunately the project had none. It was compounded with political appointment of personnel [34]. So from the very beginning the project was destined for failure. Contrary to that in EBRIS project, has very little government support. However the lack of government support was compensated by the strong leadership, strong support from the stakeholders – the health workers, managerial staffs and the citizen. So it succeeded.

## 5 Comparison of Policies of India, Andhra Pradesh and Bangladesh

LAN base e-government project may be successful, but to reap the full benefit of e-government project should be web base. An affordable and broadly accessible ICT infrastructure is needed for the success of web base project. In this regard telecom policy come into fore. The telecom policy of Bangladesh was declared in 1998 with 18 diverse objectives. The policy considered telephone is the only telecommunication medium [35]. But telecommunication is not only telephone but also internet, cable television and any other form that could be used for communicating [36]. More over with the exception of teledensity none of the target set in the policy is quantifiable [37]. Telecommunication infrastructure is also poor. So government has taken steps to improve the infrastructure. Nation wide fiber optic backbone line has already established and digital data network and broad band internet covers 41 out of 64 districts [38].

The Indian Telecom policy of 1999 included every activity that deals with communication and frequency distribution. So the policy considered telephony (fixed, mobile, IP, satellite) and other communication medium as form of telecommunication [39]. The suggested approach of the policy led to a rapid development of ICT infrastructure in India, which in turn increased the phone and internet users. In the last five years India has an internet user growth rate of 269.6% well above the world average of 123%. At present India is 11th largest user base of the world [40].

## 6 Lessons Bangladesh Can Learn from India

So for effective e-government Bangladesh has to take a long journey. There are many things Bangladesh can learn from India particularly from AP. First of all policy has to be *ambitious and pragmatic*. Both ICT and Telecom Bangladesh policy tried to do too many things in too little time. So though they are ambitious, they failed to deliver. The second lesson is policy target should be quantifiable. If the targets are *quantifiable* it is easy to achieve. The first Indian

telecom policy had five quantifiable objectives while in Bangladesh only one objective is quantifiable. The third lesson is to make policy *flexible* and amendable whenever necessary. The first telecom policy of India was updated within five years to meet the global changing state of ICT. Government of India is already planning for new policy [41]. The ICT policy of Andhra Pradesh is time specific (2002-2005). So that AP government could chart its path to meet the demand of ICT. The draft ICT policy for 2005-2010 has already been approved by the AP cabinet [42] Bangladesh should learn to think *big but start small*. For example in Mandal Online project a pilot project was run for 91 mandals before the project for all the 1124 mondals were implemented [43]. Beside all theses policy must be *comprehensive*. In the ICT policy of AP not only government stated the desire for good governance but also to the strategy to achieve it. It tried to identify potential pitfall and stated the strategy to overcome those. It considered technical, financial and economical aspects. In Bangladesh case, none of these is mentioned in the policy paper.

## 7 Conclusion

Bangladesh recognized the importance of the role of technology plays and has embarked on e-government program. At present government lacks many aspects necessary for establishing a successful e-government practice. Bangladesh can look at Grameen Bank experience. It is now been replicated in 223 countries and all are successful [44]. There are other examples where one country's strategy work for other. So one could conclude that Bangladesh could learn from the experience of India for policy and projects of e-government.

## References

1. Bhatnagar S, Egovernment: lessons from implementing in Develo-ping Country in Regional Development Dialogue, Vol 24, UNCRD, Nagoya (2002)
2. World Bank, (2005) `http://www1.worldbank.org/publicsector/egov/` (accessed on 21st Feb, 2005)
3. South Asian Com, (2005) `http://www.the-south-asian.com/Feb2001/Tech-poverty1.htm` (accessed on 12th May 2005)
4. UN, Bench marking e-government, New York, (2001)
5. UN, Global e-government Survey 2003, New York (2003)
6. UN, Global e-government Readiness Report 2004, New York (2004)
7. UN, Bench marking e-government
8. UN, Global e-government Survey 2003
9. UN, Global e-government Readiness Report 2004
10. The Hindu, Karnataka among 4 states with e-readiness (2003) `http://www.hinduonnet.com/thehindu/thscrip/print.pl?file=2003070702640400.htm&date=2003/07/07/&prd=th&` (accessed on 18th Feb, 2005)
11. The Hindu, UNDP Officials lauds e-seva (2003) `http://www.hinduonnet.com/thehindu/thscrip/print.pl?file=2003111404440400.htm&date=2003/11/14/&prd=th&` (accessed on 18th Feb, 2005)

12. Government of India, Telecommunication Policy, Delhi (1994)
13. BSNL Portal, The Significance of Tele-density (2005) http://www.bsnl.in/Telecomguide.asp?intNewsId=47510&strNewsMore=more (accessed on 12th May, 2005)
14. Government of India, IT Action Plan, Delhi (1998)
15. The Hindu, Karnataka among 4 states with e-readiness
16. World Bank
17. Bhatnagar S, Mandals online in Andhra Pradesh (2001) http://www1.worldbank.org/publicsector/egov/apmandalscs.htm (ac-cessed on 22nd Feb, 2005)
18. Kumar A and Bhatnagar S, Voice: Online Delivery of Municipal Services in Vijaywada, India (2001) http://www1.worldbank.org/publicsector/egov/voice_cs.htm (accessed on 22nd Feb, 2005)
19. ibid
20. Bhatnagar S, Mandals online in Andhra Pradesh
21. Government of Andhra Pradesh, ICT Policy, Hyderabad (2002)
22. ibid
23. ibid
24. Hasan S, Introducing e-government in Bangladesh in International Social Science Review, Fall -winter, Winfields (2003)
25. ibid
26. ibid
27. Government of Bangladesh, National Information and Communication Policy, Dhaka (2001)
28. UN, Bench marking e-government
29. Government of Bangladesh, (2005) http://www.bangladeshgov.org (accessed on 12th May, 2005)
30. Government of Bangladesh, Project Concept Paper for National Data Bank, Dhaka (1992)
31. Himmelsbach V, Bangladesh e-government failures offer as many lessons as do other success in Technology in Government Vol. 10 No 9, Toronto (2003)
32. Ahmed M, Electronic Birth Registration in Rajshai, Bangladesh (2002) http://www.egov4dev.org/rajshahi.htm#title (accessed on 18th Feb, 2005)
33. ibid
34. Himmelsbach V, Bangladesh e-government failures offer as many lessons as do other success
35. Government of Bangladesh, National Telecommunication Policy, Dhaka (1998)
36. ATIS, http://www.atis.org/tg2k/ (accessed on 1stJanuary 2005)
37. Government of Bangladesh, National Telecommunication Policy
38. Government of India, Telecommunication Policy, Delhi (1999)
39. BTTB (2005), http://www.bttb.net/ (accessed on 18th Feb, 2005)
40. Internet world Stat, (2005) http://www.internetworldstats.com/top20.htm (accessed on 28th Feb, 2005)
41. India Telecom News, (2005) http://www.indiatelecomnews.com/ (accessed on 22nd Feb, 2005)
42. Times of India, 2005, Cabinet gives a big push to IT, (2005) http://timesofindia.indiatimes.com/articleshow/1041697.cms (accessed on 7th March 2005)
43. Bhatnagar S, Mandals online in Andhra Pradesh
44. South Asian Com, Technology to fight Poverty

# Measuring the Performance of Digital Divide Strategies: The Balanced Scorecard Approach

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**Abstract.** Although the digital divide issues have attracted global attentions, literature surveys still show no significant progress towards evaluating effectiveness of the digital divide strategies and projects for bridging the gaps. The objective of this paper is to improve the performance measurement method for digital divide strategies by adapting the balanced scorecard approach. A structured framework is presented to integrate the balanced scorecard perspectives and digital divide dimensions for guiding the development of effective performance measurement indicators and an associated dictionary. Also provided are examples of using the indicators in some government agencies to demonstrate the flexibility and usefulness of the adapted balanced scorecard approach.

## 1 Introduction

In recent years, there has been a growing number of research works related to the digital divide (DD) issues with local and global concerns. A great deal of efforts focus on addressing the causes and impacts of DD, the status of DD in one country or in a region, as well as the strategies to narrow the digital gaps [2,24]. However, two major shortcomings have been found in the previous researches. First, there are diversified perspectives and inconsistent indicators for considering and measuring DDs. Second, there is no mechanism to verify the relationship between DD strategies and performance indicators. The literature also shows that there has been not much progress towards clearly illustrating the evaluation methods of DD strategies [25]. As a result, the links between strategic objectives and performance measures of DD-related government strategies are weak, and no guidelines as well as benchmark exist for directing the strategic planning process and for measuring the effectiveness of implemented strategies and projects. In other words, for all policy makers and researchers, challenges are to show the links between strategic objectives and performances metrics for guiding the development, execution, and measurement of DD strategies.

On the other hand, the balanced scorecard (BSC), developed by Kaplan and Norton [7], has been deemed as a performance measurement and strategic management tool for

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translating strategies into actions. Four perspectives illustrated in the BSC include financial, customer, internal process, and learning and growth. The importance of the BSC is obvious based on the fact that about 60% of Fortune 1000 companies have implemented the BSC for measuring business performances, and that the BSC related research articles on social sciences online databases such as the Wilson Web have grown twice within the last five years. However, although the BSC has been applied to a large number of business areas, such as for monitoring business process [15], measuring and managing E-business projects [3], forming the foundation for the strategic management of information systems [14], monitoring the performance of an organization [4] etc, very few research, if not totally absent, has devoted to DD or governmental issues. As a matter of fact, models and methods for government strategic management had rarely been discussed before the BSC was brought up [10,17].

In order to make up the absence of effective measurement methods for evaluating the performance of DD strategies, we develop a strategic framework and associated performance measures for DD strategies by adapting the balanced scorecard (BSC) model to incorporate DD dimensions. We adopt the BSC approach to evaluate the DD strategies for two reasons. First, the BSC is characterized by its adaptability to fit the application context, and the content of the BSC perspectives can be changed without endanger the entire BSC framework [10]. Second, the BSC provides the essential concept of balancing the attentions between financial and non-financial measures, internal and external factors, leading and lagging indicators, as well as current outcomes and future performances. In the following sections, we first propose an integrated framework in section 2 that aims at mapping the key DD dimensions to BSC perspectives for developing proper DD strategies and performance measures. Section 3 presents the generic DD-related BSC (DD-BSC) in detail. Section 4 delineates the development of performance indicators for measuring and managing DD strategies. The last section contains examples of actively using these indicators with discussions, followed by conclusions and directions of future studies.

## 2 The Integrated DD-BSC Framework

In order to effectively measure the performance DD strategies by adapting the BSC concept, the performance metrics should be high relevant to the strategies, capable of being tracked, and owned by a person or group with the power to influence the outcome [13]. Moreover, the metrics selected for the BSC should be limited, simple and capable of measuring what really matters [9,13,14,17]. It is suggested that the BSC is better designed at the managerial or organizational level so that the indicators would not be too trivial but could still cover both the traditional and potential metrics [14]. In the DD domain, an integrated framework has been proposed as a blueprint for the government to deal with issues of assessing and bridging both the domestic and international DDs [25]. The four DD dimensions in this framework, namely, ICT Diffusion, Equal Opportunities, Information Society/E-Readiness, and Competitiveness, cover almost the whole spectrum of DDs. Nevertheless, the strategic objectives and performance indicators and their links have not been sufficiently illustrated in the framework. In order for fully evaluating DD strategies while keeping the BSC perspectives and

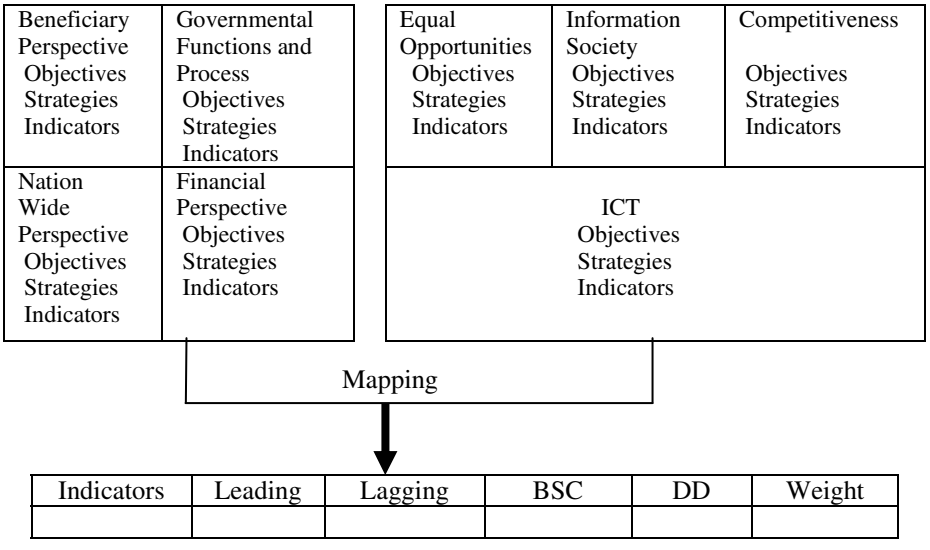


**Fig. 1.** The framework for developing DD performance measures

metrics clear and simple, we propose an integrated DD-BSC framework as shown in Figure 1. This framework combines the DD dimensions with the BSC perspectives to form the foundation for forming the DD strategies and generating the associated performance measures.

In figure 1, the proposed DD-BSC framework contains four DD-based perspectives that are financial, beneficiaries, governmental functions and processes, and nation-wide learning and growth. In each perspective, the mission, vision, strategic objectives, strategies, and performance indicators are to be presented for further measurement and management. Both leading and lagging indicators can be identified and tracked. Since the DD-BSC framework maps the BSC perspectives with the DD dimensions, DD-related performance indicators in all the perspectives can then be carefully selected and categorized. An associated DD measurement dictionary can be subsequently edited to list all the indicators with their properties. These indicators can further be utilized to provide management a broader view for investigating both the status of DD as well as the performances of DD strategies. The proposed framework and process for developing DD strategies and performance indicators complement the absence of the sophisticate performance measurement and strategic management methods in both the DD and BSC fields.

## 3 The DD-BSC for Strategic Management

In the government sector, the determinants of governmental success are not simply related to gross products or profits, but to the capability of innovation and competence, the potential to make progress, as well as the ability of providing people with better quality of lives and public services. Yu and Wang [24,25] intensify the importance of

solving both domestic and international DD problems in their empirical study of DD status in Taiwan. They also address the impact of information economic and economic divide, which are part of the constituent in the ratings of Information Society Index and national competitiveness, on the degree of DD in a nation. Taking these considerations into account, the whole mission of reducing DDs is to integrate ICT into society in an equal, effective, and sustainable way to improve human lives. The global vision is to convert DDs into digital opportunities. In the following, the generic DD-BSC with strategic objectives and related strategies in four perspectives will be described. Table 1 provides an overview of major contents of this DD-BSC. In table 1, only the strategies that are critical, simple and more at central governmental level are listed. Since the main concept of the BSC is the cause-effect relationships between strategies, it is designed in the way so that each well-controlled level will fully support the execution of strategies on the upper level.

The beneficiary perspective is mainly probed into the interests of government, people and enterprises on what they would benefit from digitization and the actions they expect government to initiate. Governmental functions and processes perspective is to explore the topics that deal with the DD and the tactics that can promote government's function and processes to leverage the advantages for beneficiaries to a better state. The nation-wide learning and growth perspective is more like a retrospect of nation's improvement in terms of the national capability and functional productivity. In financial perspective, not only public financial management and budget control are major concerns, but also economic performance and quality of lives are observed to ensure the achievement towards improving nation-wide learning and growth status. Governments must initiate well-planed financial strategies and carefully manage resources they own to support all the programs and projects in sight.

## 4 The Development of the Performance Measures

For continuously and effectively monitoring and managing performances of DD strategies, the performance measures must be critical, link to strategic objectives, consider both leading and lagging indicators, accurately reflect the facts of proper actions, provide precise and balanced information within and between the interrelated perspectives, as well as take into account not only the short term, financial and tangible outcomes, but also the long term, non-financial and intangible performances [8,13,14,17].

To identify DD-related factors and establish performance metrics, we first collect and analyze data from various sources to form an original set of performance indicators that are categorized by the BSC perspectives and strategic objectives. The data sources include technology related indicators [1], status of global DD [2], rating methods for Information Society Indexes [5], rating methods for national competitiveness [6,26], as well as the DD status reports of Taiwan [19,20,21,23]. In pursuit of the completeness, necessity and usefulness of the indicators, the second step of this research is to conduct an interview with team members of a government digital divide group that is in a task force division for promoting and auditing E-government projects in Taiwan. Again, to guarantee the reliability and validity, this research also refers to previousquestionnaires from National Association of Counties [16], Oxford Internet Survey [18], Riquelme & Buranasantikul [22], and WSIS [27] to develop our own DD-BSC questionnaire

**Table 1.** The generic DD-BSC

| | |
|---|---|
| **Beneficiaries: government, businesses and civilians** | |
| Strategic objectives | 1. Satisfy users' needs for technological equipment and systems.<br>2. Ensure universal accessibilities and ICT equity.<br>3. Deliver quality public services.<br>4. Improve information literacy. |
| Strategies | 1. Establish a safe, healthy, protected information society.<br>2. Enrich on-line information and create better opportunities.<br>3. Propose e-commerce and e-government values and benefits.<br>4. Foster the uses of information technology. |
| **Governmental Functions and Processes** | |
| Strategic objectives | 1. Keep the technologies and techniques up-to-date.<br>2. Provide infrastructure and technical supports.<br>3. Establish and maintain government efficiency. |
| Strategies | 1. Establish national ICT infrastructure<br>2. Enforce strategic alliances.<br>3. Improve information education systems and environment.<br>4. Amend all necessary laws and regulations.<br>5. Recruit talented people.<br>6. Standardize all internal processes. |
| **Nation-Wide Learning and Growth** | |
| Strategic objectives | 1. Elevate the national capability and productivity.<br>2. Foster the growth of e-government and e-commerce.<br>3. Sustain national competitive advantages. |
| Strategies | 1. Continuous improving government efficiency, business efficiency and ICT infrastructure.<br>2. Foster the usage of computers, information, Internet.<br>3. Upgrade and sustain the capabilities of R&D.<br>4. Encourage the development and application of patents.<br>5. Upgrade the capabilities of innovation.<br>6. Accumulate knowledge at community level.<br>7. Leverage the level of information literacy.<br>8. Provide lifetime educational opportunities. |
| **Financial** | |
| Strategic objectives | 1. Control Budget.<br>2. Benefit from a well-performed financial planning.<br>3. Upgrade the economic effectiveness. |
| Strategies | 1. Systemize the editing and auditing of budgets.<br>2. Inspire administrative efficiency for business trading.<br>3. Utilize the advantages of private sectors.<br>4. Provide healthy environment for investment management.<br>5. Create incentives for attracting local/international investment.<br>6. Allocate and integrate all applicable resources to optimize economic performance. |

The questionnaire contains both structured and unstructured questions. In the interview, the respondents are free to express their thoughts to the open questions concerning DD performances. In the structured part, the respondents are invited to validate the indicators for each strategic objective within each perspective including to distinguish leading factors from lagging factors and to give weights to these indicators. The weight is scaled from 1= extremely unimportant to 5=extremely important.

Tables 2 to 5 show the performance measures generated by this process for every BSC perspectives and DD dimensions. Each indicator is further encoded as a 3-digit number in a way that the first digit is the abbreviation of the perspective; the sequent digits are the order numbers of the strategic objective in the perspective and of the indicator within that objective respectively. Letters B, G, N and F represent the four BSC perspectives; in addition, I stands for ICT Diffusion, E for Equal Opportunities, S for Information Society, and C for Competitiveness in the DD dimensions. For an example, indicator "# of Internet populations" is encoded as B11 to represent the first indicator in the first objective of the Beneficiary perspective. The encoded indicators will be used for building the DD measurement dictionary later.

**Table 2.** Measures for beneficiary perspective

| **Perspective** | *Beneficiaries: include government, businesses and civilians* |
|---|---|
| **Objectives** | **Measures** |
| Satisfy users' needs for technological equipment and systems. | 1. # of internet populations<br>2. # of online consumers<br>3. # of e-government websites.<br>4. Degree of ICT connectivity.<br>5. Degree of wireless environment. |
| Ensure universal accessibilities and ICT equity. | 1. Degree accessibility to public official information.<br>2. The degree of public outreach.<br>3. % of satisfaction on discrimination policy.<br>4. # of multi-stakeholder portals for indigenous peoples.<br>5. Degree of the usage of ICT equipment. |
| Deliver quality public services | 1. % of satisfaction on ICT services.<br>2. Contact details on websites (website map or website index).<br>3. Degree of availability and content of privacy and security policy on websites.<br>4. % of satisfaction on consumer protection, privacy policy, content regulation, electronic signatures and date security. |
| Improve information literacy. | 1. The amount of opportunities on technical education.<br>2. Number of language-related ICT tools.<br>3. Degree of accessibility to scientific knowledge.<br>4. # of digital public libraries and archives. |

**Table 3.** Measures for governmental functions and processes perspective

| **Perspective** | *Governmental Functions and Processes* |
|---|---|
| **Objectives** | **Measures** |
| Keep the technologies and techniques up-to-date. | 1. % of R&D on GDP.<br>2. # of training programs for ICT professionals.<br>3. # of ICT applications benefits in all aspects of life. |
| Provide infrastructure and technical supports. | 1. % of satisfaction on enabling environment.<br>2. Degree of telecommunications privatization.<br>3. The absence of strategic alliance.<br>4. The absence of standardization. |
| Establish and maintain government efficiency. | 1. Percentages of technological employees in working forces.<br>2. % of satisfaction on cyber crime prevention policies.<br>3. The turnaround time for and e-mail response.<br>4. The absence of telecommunications licensing and regulation.<br>5. Degree of perceived national e-strategies. |

**Table 4.** Measures for nation-wide learning and growth

| **Perspective** | *Nation-Wide Learning and Growth* |
|---|---|
| **Objectives** | **Measures** |
| Improve the level of information literacy. | 1. Increased number of ICT usages.<br>2. Increased number of Internet populations.<br>3. Increased resources on information curriculum materials.<br>4. Commitment to intellectual property policies. |
| Foster the growth of e-government and e-commerce. | 1. Increased amount of e-commerce.<br>2. Increased number of e-government participants.<br>3. Average # of citizens adopts e-services. |
| Sustain national competitive advantages. | 1. % increased on the expenses of infrastructure over national budgets.<br>2. % increased on the expenses of technology development over national budgets.<br>3. Increased number of patents.<br>4. Decreased number of cyber crime instances.<br>5. Scores improved in ISI ranking.<br>6. Scores improved in WEF ranking.<br>7. Scores improved in IMD ranking.<br>8. Scores improved in Brown University ranking. |

**Table 5.** Measures for financial perspective

| **Perspective** | *Financial* |
|---|---|
| **Objectives** | **Indicators** |
| Control Budget | 1. The absence of fair auditing system.<br>2. % of annual budgets on information infrastructure<br>3. % of actual versus budgeted expenses on ongoing development.<br>4. % of actual versus budgeted expenses on maintenance. |
| Benefit from a well-performed financial plan | 1. Increased number of foreign businesses.<br>2. Regulations on tariffs and trade barriers.<br>3. Increased amount of foreign direct investment. |
| Upgrade the economic effectiveness | 1. Absence of incentives.<br>2. The absence of policies to integrate resources.<br>3. International rakings on economic efficiency.<br>4. Comparisons of economic indexes (GDP, national income) |

While developing the DD-BSC, the DD measurement dictionary can be established in parallel. The property of each indicator in the dictionary is carefully recorded with its description, the BSC or DD code, leading or lagging nature, and the importance weight. Table 6 shows a portion of an example DD measurement dictionary.

**Table 6.** An example of the DD measruement dictionary

| indicator | leading | lagging | BSC | DD | W |
|---|---|---|---|---|---|
| # of internet populations | | X | B11 | S1 | 5 |
| Degree of the ICT connectivity | X | | B14 | | 5 |
| # of internet hosts | X | | | I1 | 1 |
| # of web pages | X | | | I2 | 3 |
| Households use of Internet | | X | | I3 | 4 |
| Degree of bandwidth infrastructure | X | | | I4 | 5 |
| use of broad bandwidth | | X | | I5 | 5 |
| Degree of the usage of ICT equipment. | | X | B25 | | 3 |
| Average households # of computers | | X | | I5 | 3 |
| Fixed phone lines per 1000 inhabitants | | X | | I6 | 3 |
| Cell phone per 1000 inhabitants | | X | | I7 | 3 |
| % of R&D on GDP | X | | G11 | C1 | 1 |
| # of training programs for ICT professionals | | X | G12 | S2 | 4 |
| % increased on the expenses of infrastructure over national budgets. | X | | N31 | S3 | 5 |
| % increased on the expenses of technology development over national budgets. | X | | N32 | S4 | 5 |
| Scores improved in ISI ranking. | | X | N35 | | 5 |
| Computer score | X | | | C2 | 5 |
| Internet score | X | | | C3 | 5 |
| Information score | X | | | C4 | 5 |
| Social score | X | | | C5 | 5 |

Table 6 also shows some cause-effect relationships such as the one between "The degree of the ICT connectivity" and "# of Internet populations" in beneficiary perspective. "The degree of the ICT connectivity" is defined as leading driver which we believe will promote the increase of the "# of Internet populations". It can further be evaluated by four other indicators extracted from DD dimensions. The "# of internet hosts" is a commonly used index in IMD, ISI and other reports of ICT investigations. However, businesses sometimes choose not to set up their own hosts but register in systems that are located in other countries due to the economic reasons. The "# of web pages" however, would expand the reaches and is much more important than the "# of Internet hosts". The "# of Internet hosts", "# of web pages" and "the degree of bandwidth infrastructure" are able to predict the outcome of the degree of the ICT connectivity, and are thus recognized as leading indicators. The "# of Internet populations" is defined as lagging indicator with respect to "The degree of the ICT connectivity". Obviously, the indicators will effectively measure the result of the strategies including establish a safe, healthy, protected information society; enrich on-line information; popularize e-commerce and e-government; and foster the uses of information technology. The "Degree of the usage of ICT equipment" and its sub items are weighted 3 according to the interview since that the ample usage of ICT equipments is just a matter of time in the digitalization era. The quality and the usefulness are more important. Although the "% of R&D on GDP" is found commonly adopted in literature surveys, it is considered not as important as the "% increased on the expenses of infrastructure over national budgets" and "% increased on the expenses of technology development over national budgets" in Taiwan. For one hand, the content and the scope of R&D are not clearly defined; on the other hand, the actual money that government will spend on solving the baseline technology and infrastructure problems is more realistic. Again, the "Scores improved in ISI ranking" can be evaluated by indicators in a more detail level. The results provides by ISI, WEF, IMD as well as the report from Brown University Taubman Center for Public Policy are very important signals for Taiwan government and are therefore weighted 5.

## 5 Discussions and Conclusions

By mapping the BSC perspectives with the DD dimensions for developing performance measures for DD strategies, the resulting DD-BSC of this research provides good chances for government to view the status of DD, the performance of DD strategies, as well as the relationships between leading and lagging factors, etc. Figures 2 to 5 illustrate some examples of applying single or multiple dimensional indicators in the proposed DD-BSC for cross-sectional analysis of DD factors.

Using a single indicator to view the status of particular DD factor, figure 2 shows the number of Internet users in Taiwan from 2000 to 2003, and figure 3 shows the detail items that consist of the degree of ICT connectivity. By combining two indicators together, figure 4 points out how the degree of ICT connectivity affects the Internet populations. We notice that the increase of internet hosts, the households' use of internet, as well as the broad bandwidth accounts are faster than that of internet populations. The reason might be that the number has reached the limit of current efforts. To explore the issue further, the government needs to follow up the

corresponding actions and cause-effect relationships. Furthermore, these indicators can be categorized according to what the users expect to derive from within. For example, a user may group all related items together to examine how civilians perceived the quality of public access. Figure 5 shows the example. The items used are B23: "% of satisfaction on discrimination policy", B31: "% of satisfaction on ICT services" and G32: "% of satisfaction on cyber crime prevention policies". Since there are no such values in the existing systems in Taiwan, the values in figure 5 are generated randomly only for showing the example. However, it implies the absence of the DD measurement in the current system and might be a good start for the government to improve. Besides, although table 6 shows that the "degree of ICT connectivity" consists of five sub items, the model-based calculation of the "degree of ICT connectivity" is yet pending. The weights given in this table only show the importance each indicator is in the evaluation of DD status and DD strategy performance. It is necessary to develop a more sophisticate and proper mechanism in the future studies to effectively set the values or levels of the indicators.

As mentioned in the previous section, the DD-BSC is never a static model and is subject to the uniqueness of a nation or different DD scenarios. Although this paper

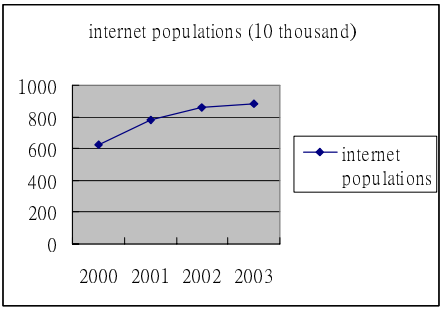


**Fig. 2.** Trends of Internet populations

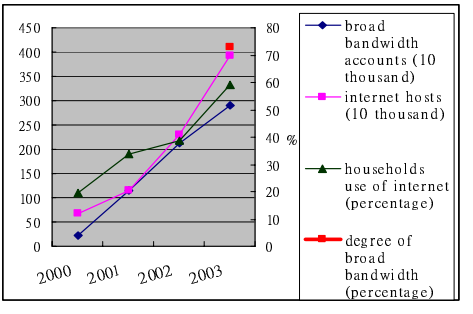


**Fig. 3.** Degree of ICT connectivity (degree of broad bandwidth not available in 200002)

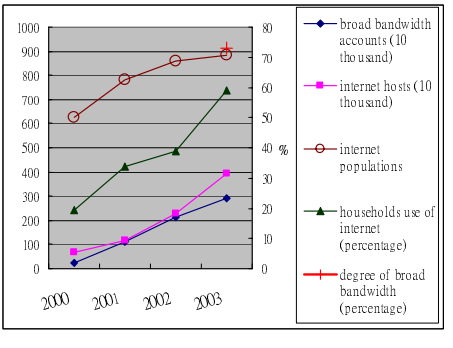


**Fig. 4.** Internet populations and degree connectivity

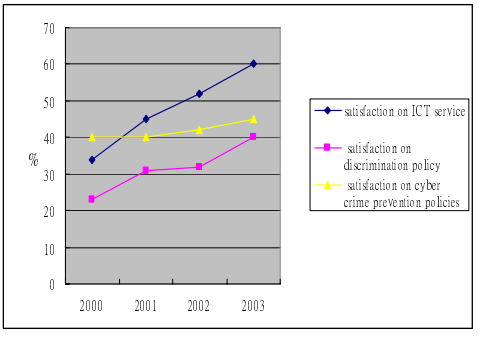


**Fig. 5.** Perceived quality of public access of ICT

applies the DD-BSC template to Taiwan, the framework is generic and can be easily adapted to different contexts and used in other countries. Additionally, Lohman et al. [12] suggested that the contents of BSC should be updated whenever the scorecard is no longer support the control or the objectives are changed, so that the BSC will maintain its relevance. Especially in this research, the strategic objectives outlined in the DD-BSC are strongly related to the status of ICT development, diffusion and utilization that are upgraded and updated continuously with fast pace. On the other hand, Lipe and Salterio [11] proposed the way of evaluating the effectiveness of BSC by comparing the actual results with the target value. However, the assessment and management of values, tangible and intangible, in citizens, businesses, governments, and the whole nation is still a topic waiting for further exploration. In addition, the DD issue involves multidimensional perspectives including domestic and international considerations, economic and political effects etc. Another possible approach for evaluating the effectiveness of the BSC is to measure the time and level of improvement towards the DD strategic objectives by means of survey and case studies. In any case, further study regarding to the evaluation of the DD-BSC itself is necessary.

In addition, this research is possibly the first attempt to evaluate both the DD status and performances of DD strategies at the same time by adapting the BSC concept. The results may help governments continuously monitoring and managing their strategies, actions and outcomes. Moreover, this research reveals the incompleteness of the current measures for the DD status and strategy performances. Future studies will also focus on refining the generic DD-BSC framework and measures proposed in this paper, conducting more interviews with DD-related government agencies, applying this measurement and management method to practical government projects, and performing empirical studies regarding the effectiveness of DD strategic management in Taiwan.

## References

1. Archibugi, D. and CoCo, A.: A New Indicator of Technological Capabilities for Developed and Developing Countries. Science and Technology Policy Research Electronic Working Paper Series. http://www.sussex.ac.ud/spru, (2004).
2. Bridges.org.: Panning_the_Digital_Divide – Understanding and Tackling the Issues. Bridges.org Report, http://www.bridges.org/spanning/pdf/spanning_the_digital_divide.pdf (2001).
3. Grembergen, W.V. and Amelincks, I.: Measuring and Managing E-business Projects through the Balanced Scorecard. Proceedings of the 35th Hawaii International Conference on System Sciences, Hawaii, United States, 8 pages (2002).
4. Hoque, Z.: A Contingency Model of the Association between Strategy, Environmental Uncertainty and Performance Measurement: Impact on Organizational Performance. International Business Review, 13 (2004) 485-502.
5. IDC/World Times: Information Society Index. The World Paper http://www.worldpaper.com (various years).
6. IMD: The World Competitiveness Yearbook. International Institute for Management Development, Lausanne (various years).
7. Kaplan, R.S. and Norton, D.P.: Using the Balanced Scorecard as a Strategic Management System. Harvard Business Review, January-February (1996a) 75-85.

8. Kaplan, R.S. and Norton, D.P.: The Balanced Scorecard: Translating Strategy into Action. Harvard Business School Press (1996b).
9. Kaplan, R.S. and Norton, D.P.: Strategy Maps Converting Intangible Assets into Tangible Outcomes. Harvard Business School Press (2003).
10. Lang, S.S: Balanced Scorecard and Government Entities. The CPA Journal, 74 (6) (2004) 48-52.
11. Lipe, M. G., Salterio, S.: A note on the judgmental effects of the balanced scorecard's information organization. Accounting Organizations and Society, 27 (2002) 531-540.
12. Lohman, C., Fortuin, L. and Wouters, M.: Designing a Performance Measurement System: A Case Study. European Journal of Operational Research, 156 (2004) 267-286.
13. Mair, S.: A Balanced Scorecard for a Small Software Group. IEEE Software, November/December, (2002) 21-27.
14. Martinsons, M., Davison, R. and Tse, D.: The Balanced Scorecard: a Foundation for the Strategic Management of Information Systems. Decision Support Systems, 25 (1999) 71-88.
15. McGregor, C.: Balanced Scorecard Driven Business Process Definition Using XML. Proceedings of the 36th Hawaii International Conference on System Sciences, Hawaii, United States, 8 pages (2002).
16. National Association of Counties: 2000 E-Government Survey. http://www. mcconnellinternational.com/ereadiness/The_Global_E-Government_outlook.pdf (2000).
17. Niven, P. R.: Balanced Scorecard Step-by-Step, for Government and Nonprofit Agencies. New York, Wiley (2003).
18. Oxford Internet Survey, http://users.ox.ac.uk/~oxis/questionnaire.pdf, Oxford Internet Institute (2003).
19. RDEC: Programms on promoting E-government. The Research, Development and Evaluation Commission, Executive Yuan, Taiwan. http://www.rdec.gov.tw (2001).
20. RDEC: Reports of Digital Divide Investigation in Taiwan and FuKieng Area. The Research, Development and Evaluation Commission, Executive Yuan (2003).
21. RDEC: Reports of Digital Divide Investigation in Taiwan and FuKieng Area. The Research, Development and Evaluation Commission, Executive Yuan (2004).
22. Riquelme, H. and Buranasantikul, P.: Electronic Government's services performance Evaluation Schema. Questionnaire. (2004).
23. Tseng, S.F., Chen, C. K. and Wu, C.I.: A Constructing Framework of Digital Divide Index in Taiwan 2002 Report. Research Report Sponsored by Research, Development and Evaluation Commission, Executive Yuan, Taiwan (2002).
24. Yu, C.C. and Wang, H.I.: Digital Divide in Taiwan: Evidences, Comparisons, and Strategies, Electronic Government, 1(2) (2004a) 179-197.
25. Yu, C.C. and Wang, H.I.: An Integrated Framework for Analyzing Domestic and International Digital Divides, EGOV 2004, R. Traunmuller (Eds.), Lecture Notes in Computer Science, 3183 (2004b) 293-299.
26. WEF: The Global Competitiveness Report. World Economic Forum, http://www. weforum. org. (various years).
27. WSIS Stocking Online Questionnaire, www.itu.int/wsis/stocktaking, World Summit on the Information Society (2005).

# Policy and Practice in Standards Selection for E-Government Interoperability Frameworks

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**Abstract.** Interoperability has been identified as a major issue to be addressed by every e-government agency. An interoperability framework aims to provide the basic standards that every department which is relevant for the e-government strategy implementation should adopt. Criteria for selection and inclusion of standards in an interoperability framework are crucial, since they influence the utility that the framework delivers to the e-government agencies. This paper identifies and compares the policies of the main e-government agencies in the definition of these criteria and it checks the policies against the practice that they exhibit in the actual interoperability frameworks.

## 1 Introduction

During late 90s, most administrations in OECD countries released their e-government strategies. Each e-government strategy is supported by its own framework policies, covering security, confidentiality, delivery channels, etc. One of such policies is the interoperability framework [6], [18].

Interoperability between computing components may be generally defined as "the ability to exchange information and mutually to use the information which has been exchanged" [5]. An interoperability framework aims to provide the basic standards that every department which is relevant for the e-government strategy implementation should adopt. This interoperability framework should enable, at least, the interoperability between information systems from different agencies in order to provide services to citizens and businesses in an integrated way.

In this paper the most known interoperability frameworks are presented. After that, the criteria that determine whether a standard is eligible for the framework are described. These criteria are studied from two perspectives: that of the policy statement, and that of the practice. Finally, some conclusions are formulated.

This work is part of a research on the use and utility of the interoperability frameworks for e-government, which is being conducted by the author, and the first results of which were published in Cava (2003) and Guijarro (2004). The research kicked-off within the E-Forum Association[1]. From January until September 2003, the Shared Infrastructures Working Group carried out an study of the

[1] Visit http://www.eu-forum.org

M.A. Wimmer et al. (Eds.): EGOV 2005, LNCS 3591, pp. 163–173, 2005.

interoperability issues of the shared infrastructures that support the delivery of e-government services. Furthermore, since January 2004, a research has being coordinated by the author to analyse the e-government initiative of the Regional Government of Valencia from the strategic and technical viewpoints, and an interoperability framework is currently being generated within the Telecommunications and Information Society Department of the Regional Government of Valencia[2].

## 2 Interoperability Frameworks

In this section, five of the major initiatives being carried out by e-government agencies in the interoperability arena, which have produced corresponding interoperability frameworks, are briefly described.

The e-Government Unit[3], formerly known as Office of the e-Envoy, in the UK has based its technical guidance in the e-Government Interoperability Framework (e-GIF), which was issued in 2000, and updated to its version 6.0 in April 2004. e-GIF mandates sets of specifications and policies for joined-up and web enabled government. It covers four areas: interconnectivity, data integration, e-services access and content management [10].

The French ADAE[4], formerly known as ATICA, published "Le Cadre Commun d'Intéroperabilité" (CCI) in January 2002 and its last version (2.1) in September 2003. CCI comprises the recommendations for strengthening public electronic systems coherence and for enabling multi-agency electronic service delivery [1].

The Federal Government Coordination and Advisory Agency for IT in the Federal Administration (KBSt)[5] in Germany, published the Standards and Architectures for e-Government Applications (SAGA) in February 2003, and updated to its version 2.0 in December 2003. SAGA, which stems from the BundOnline 2005 e-government initiative launched in September 2000, is a guideline that serves as an orientation aid for decision-makers in the e-government teams in German administrations [16].

The European Commission Enterprise and Industry Directorate-General, through the IDABC Program[6], issued its Architecture Guidelines (version 4.1) in March 1999, as a supporting tool for the Decision of the European Parliament and the Council 1720/1999/EC "Interoperability and access to Trans-European Networks for the electronic Interchange of Data between Administrations". Current version is 7.1 and it was issued in September 2004 [14]. These guidelines (hereafter IDABC AG) provide concepts and reference for optimum interoperability between European Institutions, European Agencies, and Administrations in member States. Furthermore, IDABC published the final version 1.0 of its European Interop-

[2] Visit http://www.avantic.es

[3] Visit http://www.cabinetoffice.gov.uk/e-government/

[4] "Agence pour le Développement de l'Administration Électronique". Visit http://www.adae.gouv.fr/

[5] Visit http://www.kbst.bund.de/

[6] Interoperable Delivery of European eGovernment Services to public Administrations, Business and Citizens - IDABC. Visit `http://europa.eu.int/idabc/`

erability Framework (IDABC EIF) in November 2004 [15]. This document provides a common framework for discussion around interoperability, pinpointing which interoperability issues should be addressed when implementing pan-European e-Government services, but it avoids prescribing any concrete Architecture Framework, which was to be the main objective of successive releases of IDABC AG.

Finally, the Federal Chief Information Officers (CIO) Council[7], in the USA, issued the Federal Enterprise Architecture Framework (FEAF) in September 1999 [7], and published its second version of the E-Gov Enterprise Architecture Guidance (CIOC EAG) in July 2002, for guiding the e-government initiatives financed by the President's Office [8].

## 3 Standards Development Organisations

When dealing with standardisation, controversy arises when attempting to classify the myriad standardisation organisations, which we will call Standards Development Organisations (SDOs) hereafter.

Following Egyedi (2001), a distinction can be made between formal standards bodies and standards consortia. Regarding the first ones, "formal standardisation refers to the voluntary consensus standards processes that take place in technical committees under the auspices of national, regional (e.g. European), and international standards bodies. The procedures that govern these committees express democratic values, aim to be inclusive and reflect the desirability of a technical and politically neutral standards process (e.g. in the approval stage of a standard only the negative votes which are accompanied by technical arguments are counted)." Examples of these bodies are ISO[8], ITU[9] and ETSI[10]. On the other hand, a standards consortium, examples of which have emerged in the field of information and communication technologies with high market relevance, is defined as "an alliance of firms and organisations, financed by membership fees, formed for the purpose of coordinating technology development and/or implementation activities. Its outcomes are publicly available, multi-party industry specifications or standards. Usually its members are large companies, which indicates that the resulting standards are likely to be very relevant for the market. These consortia are also referred to as market-driven consortia." Examples of these consortia are the IETF[11], the W3C[12], and OASIS[13].

[7] Visit `http://www.cio.gov`

[8] Visit `http://www.iso.org`

[9] Visit `http://www.itu.int`

[10] Visit `http://www.etsi.org`

[11] The IETF is the protocol engineering and development arm of the Internet. Though it existed informally for some time, the group was formally established in 1986. (taken from `http://www.ietf.org`)

[12] Tim Berners-Lee and others created W3C as an industry consortium dedicated to building consensus around Web technologies. (taken from `http://www.w3.org`)

[13] OASIS (Organization for the Advancement of Structured Information Standards) is a not-for-profit, international consortium that drives the development, convergence, and adoption of e-business standards. (taken from `http://www.oasis-open.org`)

Apart from the above SDOs, several companies perform activities aimed at creating communities of interests around their proprietary technologies and emulate standardisation procedures. Such is the case of Sun's Java Community Process (JCP)[14], which has succeeded in involving other companies and individuals in developing and implementing the Java platform.

## 4 Policy Principles for Standards Selection in Interoperability Frameworks

In this section, the main documents that describe the interoperability frameworks are analysed. The purpose of the analysis is to identify the principles that each e-government initiative has setup for steering the selection of the standards to be included in the interoperability framework.

### 4.1 General Criteria

Each interoperability framework stresses in a particular way the required characteristics for a standard to be included in the interoperability framework.

In e-GIF 6.0 the selection of specifications has been driven by [10]:

- interoperability
- market support – the specifications selected are widely supported by the market, and are likely to reduce the cost and risk of government information systems
- scalability
- openness – the specifications are documented and available to the public
- international standards – preference will be given to standards with the broadest remit, so appropriate international standards will take preference over EU standards, and EU standards will take preference over UK standards

The French ADAE, following the recommendations of the e-Government Conference held in Como, Italy, in July 2003, has included an ambiguous support for open standards in the e-Government Strategic Plan, under the ADELE Program, which states that "The aim of the French government is not to impose systematic recourse to free software and open standards in the administration, but to ensure that the whole offer - including the part based on free software - is taken into account at the moment of choice, while interoperability and mutualisation must remain the founding principles of this choice." [2]

The German KBSt fixes a strong basis for the selection of standards when it states that "SAGA pursues the following aims:

1. To ensure ongoing flows of information between citizens, the Federal Government and its partners (interoperability)

[14] Visit `http://jcp.org`

2. To establish comparable procedures for the provision of services and for the definition of data models (re-usability). Federal-state governments and communal administrations have the opportunity to make use of the development results of the BundOnline 2005 initiative.
3. To provide specifications in the form of publicly accessible documentation (openness)
4. To consider developments on the market and in the field of standardization (cost and risk reduction)
5. To ensure the applicability of solutions against the background of changing requirements in terms of volume and transaction frequencies (scalability)" [16]

However, when the concrete procedure for standard evaluation is described, it simply states that "The Federal Ministry of the Interior proposes the standards and architectures which are to be generally adopted for e-government in Germany. This proposal is based on contributions by and annotations from the SAGA forums, the evaluation by the expert commission and the final draft by the authors. The Federal Ministry is subsequently responsible for co-ordination with the Federal departments." [16]

The European Commission, through the IDABC Programme, has published the following guidelines. In 2002, IDABC AG 6.1 established that "it is the general IDA recommendation that IT systems should be based on:

- Formal European and International Standards
- Standards originated in the Internet World via the work of the IETF and W3C
- Relevant other wider adopted information IT specifications in the public domain, referred to as Publicly Available Specifications (PAS). A PAS is a specification that meets certain criteria making it suitable for processing as an ISO/IEC International Standard." [13]

Furthermore, in the IDABC EIF states that one of its basic principles is the use of open standards [15]. The current version of IDABC AG (7.1) has been modified and it endorses the EIF principles. The issue of open standards enforcement is dealt more deeply in the following section.

Finally, the CIOC states that "The FEAF principles are summarized here in order to emphasize their applicability and importance to this E-Gov guidance" [13]. One of the FEAF principles is as follows: "The Federal Government should adopt open system ["voluntary industry" in [13]] standards in which the interrelationships of components are fully defined by interface standards available to the public and maintained by group consensus. The Federal Government should adopt, acquire, and integrate those components that conform to specification. An open system ["non-proprietary" in [13]] architecture is the goal; however, initially partially open ["compliant" in [13]] systems will be attained. This principles could lead to use of JAVA and future JAVA-like protocols, which give a high priority to platform independence. The Federal Government should be able to ensure compliance with these standards" [7]. Note the change of some terms from CIOC (1999) to CIOC (2002).

Although the CIOC principles may seem ambiguous, the Office of Management and Budget of the President of the USA (OMB) issued a circular [19] which clearly states the policy in this subject. The circular states that "all federal agencies must use voluntary consensus standards in lieu of government-unique standards in their procurement and regulatory activities, except where inconsistent with law or otherwise impractical".

### 4.2 Open Standards Enforcement Policy

As the previous analysis shows, different requirements are put over a candidate technology to be included in the interoperability framework. On one hand, the UK e-Government Unit and the German KBSt only require that technical specifications should be open. On the other, the IDABC EIF explicitly requires that the adopted standards should be qualified as "open standard", and the USA OMB requires that they should be "voluntary consensus standards".

The fact that a specification should be open only requires that it should be publicly available. On the other hand, when a standard is said to be open, more requirements are meant to be met.

There is not a unanimously agreed definition of "open standard". One of the earliest definitions was provided by the IEEE 1003.1 – 1988 POSIX standard, where "open specifications" are "specifications that are maintained by an organisation that uses an open, public consensus process to accommodate new technologies and user requirements over time".

The ICT Industry, through the Computing Technology Industry Association (CompTIA), puts forward the following definition: "An Open Standard can be seen as a set of rules and specifications that collectively describe the design or operating characteristics of a programme or device and is published and made freely available to the technical community. Open standards are vetted through an open process." [9].

The OMB goes further inside the subject of the standardisation process and uses the term "voluntary consensus standards", which are defined [19] as "standards developed or adopted by voluntary consensus standards bodies, both domestic and international. A voluntary consensus standards body is defined by the following attributes:

- openness;
- balance of interest;
- due process;
- an appeal process;
- and consensus, which is defined as general agreement, but not necessarily unanimity, and which includes a process for attempting to resolve objections by interested parties, as long as all comments have been fairly considered, each objector is advised of the disposition of his of her objection(s) and the reasons why, and the consensus body members are given an opportunity to change their votes after reviewing the comments"

On the other hand, non-consensus standards, industry standards, company standards or de facto standards, are developed in the private sector but not in the full consensus process.

The above attributes match the principles used by ANSI for accrediting SDOs in the USA [3], such as the EIA (Electronics Industries Alliance) and the TIA (Telecommunications Industries Alliance).

The IDABC "open standard" definition that is contained in EIF is taken from the Open Standards and Open Source Software in Government (OSOSS) Programme[15], financed by the Dutch Government. It defines open standards as those ones meeting the following requirements:

1. The standard is adopted and will be maintained by a not-for-profit organisation, and its ongoing development occurs on the basis of an open decision-making procedure available to all interested parties (consensus or majority decision etc.);
2. The standard has been published and the standard specification document is available either freely or at a nominal charge. It must be permissible to all to copy, distribute and use it for no fee or at a nominal fee;
3. Intellectual property – i.e. patents possibly present – of (parts of) the standard is irrevocably made available on a royalty-free basis;
4. There are no constraints on the re-use of the standard.

The definition has raised controversy among the ICT industry in Europe, which points out that any "open standard" definition - and specially the EIF definition - should be carefully assessed as to the impact such definition will necessarily have on the different stakeholders, including the computing industry in general" [9]. CompTIA is specially worried about the impact on the public procurement practices, which may not observe of the principles of non-discrimination and equal treatment, which underlie the EU public procurement policy. Furthermore, CompTIA is afraid that "defining open standards in a way that excludes standards including royalty-bearing technology held by commercial entities in fact would force such intellectual property rights holders to give up their rights which would amount to an indirect expropriation" [9]. This issue is subject to consideration in the following section.

### 4.3 Intellectual Property Rights and Standards

Intellectual Property Rights (IPR), which includes both copyright and patents, are an important issue in standardisation, and therefore when standard selection criteria is at stake. As it has been shown in the previous section, among the interoperability frameworks under study, it is the IDABC EIF, the one that explicitly regards the IPR as an issue[16].

[15] Visit `http://www.ososs.nl`

[16] There are however definitions of "open standards", not linked to interoperability frameworks, that also include IPR disclosure. See, for example, Oregon House Bill 2892.

When dealing with IPR inside the standardisation procedures, two license agreements are commonly referred to, which describe the terms to which a patent contributor to a standard must (or may) adhere to:

- Royalty-free (RF) basis
- Reasonable and non-discriminatory (RAND) basis. Under RAND licensing, if a technology that is part of the standard is to be licensed for a fee, the terms must be nonexorbitant, published, and the same for all implementers (rather than subject to individual negotiation).

Each SDO establishes its own IPR policy, but some common features can be identified:

- The Formal Technical Standards Organisations (TSO), such as ISO, ITU and ANSI, usually establish that "where essential technology is patented, a patentee can be asked for a declaration that it is willing to license on RF or RAND terms", and, "if this is not forthcoming or the patentee does not wish to be involved in the standardization process at all, the TSO is encouraged '... to seek an alternative approach" [17]
- Standards consortia show diverse policies. W3C "seeks to issue Recommendations that can be implemented on a RF basis. Subject to the conditions of this policy, W3C will not approve a Recommendation if it is aware that essential claims exist which are not available on RF terms." [20] whereas RAND is perfectly permissible under the ATM Forum rules.

Once light has been shed on the IPR Policy of the SDOs, it can be concluded that IDABC is pressing towards an scenario where not only proprietary specifications are discouraged, but also those standards that, even following open processes, do not exhibit an RF licensing policy. In CompTIA's [9] opinion, "such would be contrary to the overall policy of the [European] Commission to strengthen IPR protection, but would moreover be found contrary to the EU's obligations under the WTO Agreement on Trade-related Intellectual Property Rights (TRIPS Agreement)".

## 5 Practice in Standards Selection for Interoperability Frameworks

In this section, the above policies are checked against the practice that each e-government agency exhibit. Documents that are published by the e-government agencies are again the source for the analysis of their practice. The documents we are interested on are technical catalogues which enumerates the standards included in the interoperability framework. These catalogues are usually provided as annexes to the core documents that state the policy. It is not the intent of the analysis to identify all possible standards and SDOs applicable to the interoperability frameworks, nor to create even a comprehensive set. The aim of the

analysis is to illustrate how much alignment the e-government agencies enforce between their policies and their practice.

The analysis traced a limited set of technologies, specifications and standards from different SDOs, both TSOs and standards consortia. These technologies, specifications and standards are the following: IPv4, HTTP or SNMP from the IETF; XML and WSDL from the W3C; SAML from OASIS; J2EE from the JCP; RTF and .NET from Microsoft; PDF from Adobe; and JPEG from the ISO.

The results of the analysis were the following ones:

- In the UK e-GIF 6, IPv4, WSDL, SAML, RTF, PDF and JPEG has the status of "adopted", which is the highest one in the e-GIF (lower status are "recommended", "under review", and "for future consideration").
- In the ADAE CCI, IPv4, SAML, RTF, PDF and JPEG have the status of "applicable", whereas SAML is shown as "candidate".
- In the KBSt SAGA, IPv4, WSDL, PDF and JPEG have the status of "mandatory", no reference is made to RTF, but WMV is shown as "under observation". On the other hand, J2EE 1.4 is "mandatory", whereas .NET is kept "under observation". The status grades in SAGA are "mandatory", "recommended", and "under observation".
- In IDABC AG, IPv4, HTTP, XML, and PDF, have the status of "mandatory"; SAML, J2EE, RTF, and JPEG have the status of "recommended", and WSDL is "under consideration". The status grades in AG are the same as in SAGA.
- Finally, in CIOC EAG, SMTP, WSDL, SAML, J2EE, and .NET are included, but no reference to data format standards is made.

From the above results, some issues may be pointed out:

- The IETF, W3C and OASIS are regarded as reference standardisation bodies by the five e-government agencies under study.
- When document formatting is an issue in the interoperability framework, which is the case for e-GIF, CCI, SAGA and AG, both open standards and proprietary de facto standards are selected, as it is the case for PDF from Adobe and RTF from Microsoft.
- When application platforms is an issue in the interoperability framework, which is the case for SAGA, AG and EAG, J2EE is always selected but some interoperability frameworks do not assign the same level of recognition to .NET.

## 6 Conclusions

The e-government agencies policy and practice have been scrutinized in order to clarify the criteria for the selection and adoption of standards in their interoperability frameworks. The study has been based on the analysis of the publicly available documents.

From the policy viewpoint, it has been identified a clear commitment in e-government agencies to enforce the use of open standards. There is no unanimity, however, in the set of requirements that a standard must fulfil in order to be qualified as open standard. The European Commission, through the IDABC Programme, is pushing for the most ambitious set of requirements, although this strategy is facing the opposition of the ICT industry.

In the practice arena, nevertheless, the common practice is that open standards are adopted, but also specifications and proprietary technologies are used in e-government de facto implementations. We strongly believe that the adoption of the latter has been driven by the existing gap in areas such as document formatting and application architectures, where de facto standards have seized the market.

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## References

1. ADAE (2003), Le Cadre Commun d'Intéroperabilité version 2.1 (`http://www.adae.gouv.fr/article.php3?id_article=219`, visited 3/3/2005)
2. ADAE (2004) The e?Government Strategic Plan 2004?2007 (`http://www.adae.gouv.fr/article.php3?id_article=315`, visited 3/3/2005)
3. ANSI (2000), National Standards Strategy for the United States.
4. Cava, I. & Guijarro, L. (2003), Interoperability issues of shared infrastructures for e-government, in Proc. of EGOV 2003 Conference, pp. 369-372, Prague.
5. CEC. Commission of the European Communities (1991), Council Directive 91/250/EEC of 14 May 1991 on the legal protection of computer programs.
6. CEC. Commission of the European Communities (2002), eEurope 2005: An information society for all. An Action Plan to be presented in view of the Sevilla European Council, 21/22 June 2002, COM (2002) 263 final.
7. CIOC. Federal Chief Information Officer Council (1999), Federal Enterprise Architecture Framework, version 1.1.
8. CIOC. Federal Chief Information Officer Council (2002), E-Gov Enterprise Architecture Guidance, draft-version 2.0.
9. CompTIA (2004), European Interoperability Framework - ICT Industry Recommendation. White Paper. 18 February, Brussels.
10. e-Gov Unit (2004), e-Government Interoperability Framework, version 6.0.
11. Egyedi, T.M. (2001), Beyond Consortia, Beyond Standardisation? New Case Material and Policy Threads. Final Report for the European Commission. Delft. The Netherlands.
12. Guijarro, L. (2004), Analysis of the interoperability frameworks in e?government initiatives, in Proc. of EGOV 2004 Conference, pp. 36-39, Zaragoza.
13. IDABC. Enterprise DG (2002), Architecture Guidelines for trans-European Telematics Networks for Administrations, version 6.1, Brussels.

14. IDABC. Enterprise & Industry DG (2004a), Architecture Guidelines for trans-European Telematics Networks for Administrations, version 7.1, Brussels.
15. IDABC. Enterprise & Industry DG (2004b), European Interoperability Framework for pan-European e?government services, version 1.0, Brussels.
16. KBSt (2003), Standards and Architectures for e-Government Applications, version 2.0. (http://www.kbst.bund.de/SAGA , visited 11/3/2005)
17. Marasco, A., (2004) IPR and standards. ANSI. (http://www.incits.org/tc_home/m1htm/docs/m1040063.pdf, visited 4/3/2005)
18. OECD, Organisation for Economic Co-operation and Development (2003), The e-Government Imperative, OECD e-Government Studies, France.
19. OMB (1998), Federal participation in the development and use of voluntary consensus standards and in conformity assessment activities, Revised OMB Circular No. A-119.
20. WWW Consortium (2004), W3C Patent Policy, 5 February.

# SIGES-PERE: A Collaborative GIS for Radiological Disaster Management

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**Abstract.** We present a collaborative-application to the National Center of Disaster Prevention in Mexico (CENAPRED), which is focused on helping in the decision making process during the radiological disasters, related to "Laguna Verde" nuclear plant. This application coordinates the activities of External Plan of Radiological Emergency (PERE) that has been generated for this purpose. In addition, the application is based on a Geographical Information System (GIS) into a collaborative architecture to support the interaction from several entities, which work with special training groups in a virtual reality environment. The architecture consists of a collaboration model and it generates a schema of components to find out the independence and standardization of the system so that it can be implemented in any GIS-platform.

## 1 Introduction

Nowadays, Geographical Information Systems (GISs) are powerful and useful tools as means of information, visualization and research or as decision making applications. Recently, intelligent spatial analysis is the main need presented in the Geocomputation trends. Spatial data have an important role in this situation; many times, the information is extended at different places. The problem is greater, because the spatial data present different formats and specifications such as scale, projection, spatial reference, representation type, thematic, DBMS type, and date. For these reasons, the *heterogeneity* of the spatial data formats complicates the spatial analysis.

Other problem related to the heterogeneity in GIS is the collaboration process. This collaboration can not be accomplished due to several GIS-platforms are totally dependents for any commercial software or environment. Up-to-date, this situation is a barrier to the users that attempt to integrate spatial data and to make spatial analysis in a collaborative way for GIS-Government.

GIS-applications are very useful from implementing cartographic systems to de-sign applications to aid the simulation, training and prevention disaster tasks. Additionally, the systems and architectures of collaborative work represent important tools to coordinate group activities. With the mixture of these technologies, it is possible to solve problems related to interoperability and heterogeneity of the spatial applications.

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Nowadays, the appearance of global networks such as Internet and Intranets, it is possible to improve organizational process to allow a better performance of the systems. Recently, some solutions or collaborative tools (independent of the GIS-architecture), are very limited. These solutions attempt to solve particular problems, some examples are shown in [3], [4], [6], [9], [10], [11]. Other works related to the research integrate workflow solutions and collaborative tools finding group consensus, but it is not a global solution for the participation of multiple users.

In this work we present an architecture to solve a particular case study, according to the specified subject domain. Probably, this architecture can be general for any GIS that provides collaboration, cooperation services to multiple users. However, the case study of this work is focused on implementing a GIS to support simulation, training and execution processes related to prevention disaster PERE plan (it is a plan, which describes the actions that the specialists must perform when a radiological emergency is presented. It considers several actions to guide such as population evacuation, emergency routes, communication and infrastructure available, etc.

PERE is applied to "Laguna Verde" nuclear plant in Mexico. Therefore, the main goal of this work is to provide a solution for this scope and also to define a standard collaboration-architecture for any GIS.

The rest of the paper is organized as follows. In Section 2 we present the case study. Section 3 describes the solution to the case study and also the problems to implement collaborative aspects. A general architecture for any GIS to provide col-laboration capabilities is shown in Section 4. Our conclusions, future works and possible applications are sketched out in Section 5.

## 2 Case Study

In the mexican Laguna Verde nuclear plant, as in any nuclear plant in the world, there exists the risk of an *radiological emergency*. This type of emergency occurs when there is a very high pressure within the reactor of the nuclear plant; then it is necessary to make steam liberation, this steam is radiologically contaminated. The steam liberation is called *radiological emergency*, so there are two plans to follow in the case of this type of emergency: "Internal Plan of Radiological Emergency" (PERI) y "External Plan of Radiological Emergency" (PERE) [7].

The PERI is carried out by internal personnel of the nuclear plant. In this plan, the technical procedures to reduce the high pressure within the reactor and to make the steam liberation are outlined. The PERE is performed by external institutions to the nuclear plant. In this plan are presented the procedures to put out of danger the population living close to the nuclear plant. Also, there are procedures to warn the population about the emergency situation, to evacuate and to give medical assistance for affected people. Other aspect considered in the PERE is the necessity of training to the institutions involved in the plan (called Task Forces – TF). On the other hand, in the same plan is established the necessity of making *Cabinet Exercises*, that are radio-logical emergency maneuvers.

Nowadays, these maneuvers are made-up with several efforts of different Mexican Government Institutions working as TF, such as: Army (SEDENA), Interior Ministry (SEGOB), Navy (SEMAR) and National Centre for Disaster Prevention (CENAPRED) among others. Recently, these maneuvers are performed by using a great number of human and economical resources when training exercises are carried out.

Although the procedures have been developed and defined in the PERE, the maneuvers are very expensive to be realized, because they need a lot of time and money to move the personnel from their quarters to the maneuver field. Also there are a lot of things to be solved:

- The maneuvers of the PERE are made periodically with a degree of acceptable trustworthiness. Nevertheless, there are not statistical records that allow to com-pare the results and progress obtained at each one of the exercises.
- There are not simulations that allow to observe the real displacement of the TF on the field.
- There are not tools to obtain maps of optimal evacuation routes.
- The information used in PERE, it is visualized in paper topographic maps. Then other aspects can not be contemplated and distinguished. For instance, three dimensional rendering of the topography of the land, as guide for each TF.
- The dispersion information of radiological pollution agents, used during the training, is generated in independent program called RASCAL (Risk Assessment Calculator).

According to this, it is necessary to find out pedagogical and technological strategies for creating an environment of learning and training for the TF. In this proposal we present the SIGES-PERE application to support some tasks related to the PERE. The solution is oriented to development of GIS, which will be able to make three fundamental tasks: Simulation, Training and Execution. Also, the SIGES-PERE integrates not only spatial data but also statistical information into an application that can facilitate the manipulation of the data and modify the conditions during the maneuvers.

The simulation mode is based on the automatic generation of disaster scenarios, with characteristics randomly generated from a knowledge base of risk situations. Also, when the system works in this mode, it will make the decisions based on the PERE (stored in the knowledge base), to solve the contingency. When SIGES-PERE works in the Training mode; it will generate automatically disaster scenarios. Nevertheless, the decisions will be made by the leader of each TF. In this way, these leaders will apply the PERE procedures when interacting with the SIGES-PERE. The Execution mode will serve as a guide for TFs when a real emergency is presented. In this operation mode, the disaster scenario will be defined by the system administrator. The decisions will be made by the leaders of each TF.

In all cases, the information will be visualized in a graphical way (spatial data). Dynamic data will appear in real-time over the cartographic information. These data will represent relevant information related to the situation of the

scenario such as location of the TF in the field, condition of the population, state of the hospitals, and so on.

## 3 Proposed Solution

In this Section we present the solution applied for the problem described in Section 2. Such solution is presented in two parts: the modeling of the case study and the architecture proposed to implement the model.

### 3.1 Operation Modes

SIGES-PERE involves the use of a spatial base in a digital format; these formats will be raster and vector, which are used to locate the spatial position (geographic reference) of the elements involved in PERE.

Therefore, it is necessary to generate the set of rules that must be followed when executing PERE. These rules will allow to know the behavior of all the actions that will be carried out. In addition, we have to define the conditions that take part of in the analysis such as: climatologic properties, infrastructure, density of population, land use, among others. It implies that the set of rules of PERE and the conditions of the environment will be stored in a knowledge-base.

As we have mentioned in the previous section, the solution is based on three operation modes, which are described as follows.

**Simulation Mode.** In this operation mode, random scenarios of disaster are generated and the system automatically will make the decisions that consider advisable. The scenarios will be generated considering the group of conditions that could be presented. By using the knowledge-base (the catalogue of scenarios), we can define the values for the variables of risk conditions. The decisions will be carried out according to the procedures defined in the same knowledge-base. Next, the general processes that compose the operation mode are described in Fig. 1.

**Training Mode.** In this operation mode the disaster scenario are generated in automatic way, as in the simulation mode. But, in this mode the decisions are made by the leaders of TF. In sense, training exercises of simulation of PERE will be able to be made. Nevertheless, the decisions of the actions (activity) to

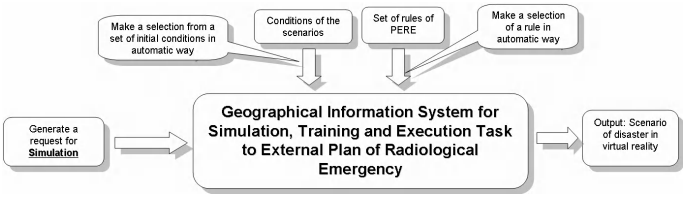


**Fig. 1.** Processes of the simulation mode into SIGES-PERE

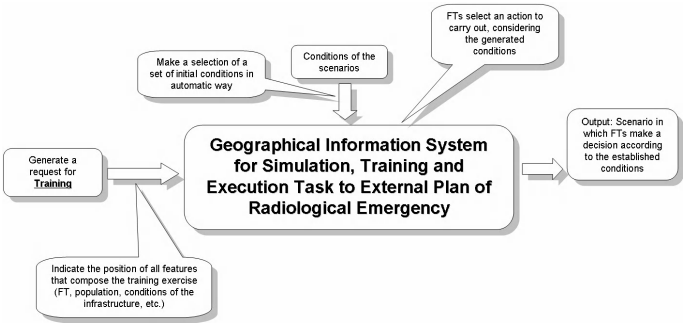


**Fig. 2.** Processes of the training mode into SIGES-PERE

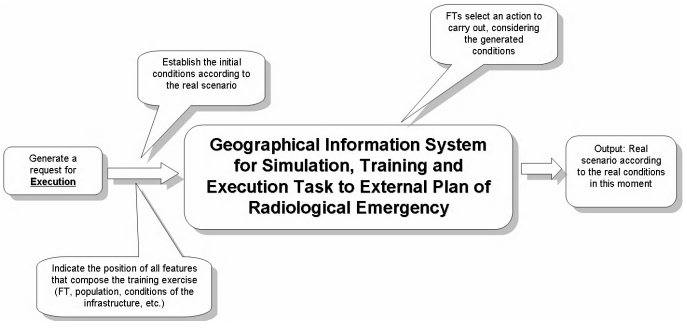


**Fig. 3.** Processes of the execution mode into SIGES-PERE

follow could be modified by each leader manually, according to the presented situation. In addition, the conditions of the scenario could be modified in the moment of executing the maneuvers, which allow to give pursuit to the risk event. This mode will be possible to observe the displacement and location of the TF, as well as the state of the infrastructure and the displacement and/or location of the population (see Fig. 2).

**Execution Mode.** This operation mode will be used to give pursuit to the situation in the context of a real emergency. Since the conditions, decisions and pursuit are made-up by each unit of the TF. These elements generate in the system the real scenario of the disaster and it will be made with base in the field readings (see Fig. 3).

### 3.2 Architecture of SIGES-PERE

The architecture of SIGES-PERE is composed of six fundamental modules. This application will be installed within the Primary Emergency Control Center (ECC). On this system, each TF will count on an independent terminal in which

they will be able to execute the SIGES-PERE application to interact with the rest of TFs, by means of a Local Area Network (LAN). These modules perform the following tasks:

- *Visualization module.* This module manages the geographic data, it allows to users view the state of the disaster scenario, by rendering not only the cartographic information but also dispersion of the pollution, the position of each element of the TFs, statistical information, etc. The visualization can be done in two different ways, first in a traditional 2D layered viewing (each type of information is grouped into a layer; so the layers are overlapped to make-up a map). On the other hand, the information can be displayed into a 3d environment, where more detailed information can be reached, although we can visualize only a part of the entire disaster scenario.
- *Command module.* This module is oriented to obtain the information about the decisions made by the leader of each TF. The module translates the decisions to actions performed on the field, and modifies the disaster scenario. The module contains two operation modes: manual and automatic. In the Automatic mode, the decisions are made automatically by the system based on the set of rules stored on the knowledge base. The Manual mode uses the network to get the actions from the TF terminals, i.e. the decisions are made by the leaders of each TF.
- *Establishment module.* This module is used for establishing the conditions of the disaster scenario. These conditions could be about weather (force and direction of wind, rain, temperature, etc.), roads (if there is an accident in any road, if a road is closed, etc.), nuclear plant state (the steam liberation was done at 13:00), among others. As in the case of the Command Module, the Establishment one works in two modes: manual and automatic. In the automatic case, the conditions are taken from the knowledge base, where a set of disaster conditions exist. The manual mode is used to establish real disaster conditions.
- *Spatial Analysis module.* This module is in charge of the management and analysis of spatial data. It is the gate to access to the geographic information about everything that is taking part of the PERE.
- *Administrator module.* In this module are defined the roles and rules that each person will take within the system. This module has operation to create user accounts and profiles, as well as enable permissions to access to different resources.
- *GIS Engine module.* This is the principal module of the system; in this module are integrated the resources and actions performed within the system. It is the main control of the SIGES-PERE.

In Fig. 4 we appreciate that every TF makes a request to the system by means of ArcIMS. This component is focused on sending to GIS Engine the request to the spatial database and retrieve the scenario with the base-map. According to the situation, that has been proposed by the administrator, the scenario is retrieved to the TF and it can operate in any operation mode, which is considered by the administrator. The processes are performed by the GIS Engine

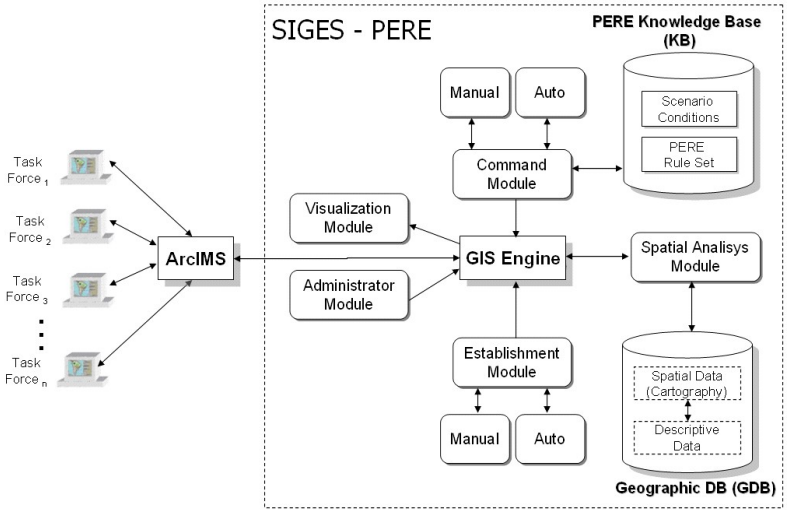


**Fig. 4.** Architecture of SIGES-PERE

and the spatial analysis depends on the situation. The values of parameters and conditions are established by the knowledge-base according to the proposed scenario.

### 3.3 Collaborative Aspects

In the model presented above, there are neither modeled nor implemented any collaborative aspect. Nevertheless, it is intuitive that there must be collaborative entities, because the TFs are working together in a network environment. It is necessary to count on a set of elements that allows to realize the collaboration, between users and TF resources. Also, such elements must be independents of the TF as well as the operation models of the system. Several works have been made to resolve such problems [1], [2]. However, they do not provide a general architecture to collaboration (i.e., it is necessary to implement one for each case study). Moreover, these works do not support *interoperability* among different collaborative applications. Applications that are not necessarily GIS ones. For example, it is not possible to make a GIS interoperates with a Collaborative Virtual World (CVW). Then, we propose an architecture to build collaborative applications that fulfill the constraints outlined above.

## 4 Architecture of Collaboration-GIS Based on Components

As we mentioned on the last section, we propose an architecture for implementing collaboration services into a GIS. We have established three main goals to achieve this collaboration:

- Allow to perform the collaboration in an intuitive and a natural way between different users and entities that form the TFs.
- Independent architecture from the task of TFs and the operation modes related to SIGES-PERE.
- Independent architecture from the application to be able to use in other applications.

### 4.1 Collaboration Model

The collaboration model is composed of three main features:

- *Task-Forces*, they are defined as the different existing actors that interact with the GIS. Each one of them defines the actions, which can take with other TFs in-side the SIGES-PERE.
- *Collaborative Geographical Information System*. It is defined as any GIS being added; it is composed of a collaboration interface.
- *Resources*, they are defined as the elements of interaction with TFs. They can be static or dynamic features of interaction according to the action that represents. These resources can implement collaboration tools such as shared editors, boards, etc. Moreover, they are used to access the meaning of other elements like vehicles, shelters, etc.

In our model there are interacting groups of users belonging to different TFs, and groups of resource services. We will denote $F$ to the group of all existing TF within the SIGES-PERE and will denote $R$ to the group of all resources. The capabilities of work, the collaboration of any user and the way that they interact are defined by the TF. For instance, the activities and actions of any member of the Defense Ministry are different to the ones of any user member of the Civil Guard. In other words, users receive different services from the resources, depending on the TF that they belong to. For instance, by using a resource of localization, a TF can modify some user states, while other TF can only obtain the movements.

Each TF partially describes the form that it will interact with other TFs by defining a set of collaborative interfaces, which provide access to the services provided. We use a *directed graph* (Eqn. 1) to define all possible interactions between the elements of the GIS, we have considered the proposal that is described in [2]. On the other hand, the model makes an interaction between users belonging to different TFs, as well as sets of resources that provide different services. As we have mentioned above $F$ is the group of all existing TF inside the SIGES-PERE and $R$ is the group of all resources.

$$G = (V, E) \text{ where } V = F \cup R \text{ and } E \subseteq F \cup R \times F. \tag{1}$$

Each edge represents a service relationship, i.e., if an edge goes from TF1 to TF2, it indicates that a member of TF1, will offer a type of collaboration service to a member of TF2. At the same way, it also exists an edge from TF2 to TF1, a member of TF2 will offer a collaboration service to a member of TF1. It is depicted in Fig. 5.

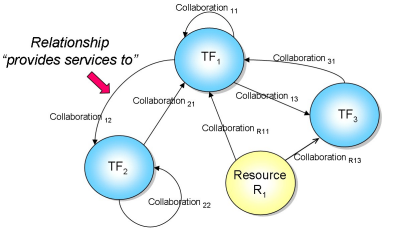


**Fig. 5.** Definition of interactions between different TFs and resources

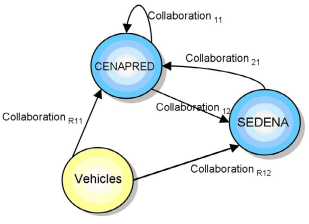


**Fig. 6.** Collaboration between TFs and resources

Each edge on $G$ defines a particular collaboration; this allows a user to collaborate in a particular way depending on the role of its counterpart. In other words, it has access to a set of different collaboration actions.

As we can see on Eqn. 1, the definition of $E$, the resources do not receive services from TF, because the resources are conceptualized as reactive entities that take ac-tions as a response to user's requests. As a result of using the services exposed by resources, a user can modify its state, the state of other users or any database related to it.

As we mentioned, relationships defined in the graph are translated in collaboration actions between the users into SIGES-PERE. For instance, if a CENAPRED user needs to collaborate with a SEDENA user, it is necessary to send a collaboration request to the SEDENA user, which allows both users to exchange their collaboration actions; this collaboration is shown in Fig. 6. Probably, the CENAPRED user can ask information related to the localization of a certain group of soldiers, and SEDENA user responds according to the information requested by SIGES-PERE.

By using this schema, it is possible that SIGES-PERE defines different types of collaboration among diverse TFs. At the same time, it is indispensable to integrate several types of TF, and each one can define the interaction mechanism with other features of SIGES-PERE.

### 4.2 Architecture of Collaboration

In this section, we describe the proposed architecture for implementing the scheme of collaboration in the SIGES-PERE application. The architecture is

based on the *Body-Soul* model, which is described in [5]. This model presents a flexible architecture oriented to implement collaboration schemas of different elements into the systems.

The architecture establishes for each collaboration element an object, which is created with its defined properties. This object interacts with other objects to represent the collaboration environment. The objects are distributed and they provide the services to collaborate. Therefore, the architecture is composed of three main features, which are described as follows:

- *Input/Output Information Component (IOIC).* Its function is to handle and allow that the generated data can be standardized to be distributed for the collaboration interface.
- *Collaboration Interface.* The interface is in charge of maintaining a repository of references to generate objects that represent the TFs. In addition, it administrates the collaboration and maintains the state of the collaborating features.
- *Distributed Objects (TF).* These objects represent to the TF. They maintain the reference to the collaboration interface and allow to define collaboration entities.

The architecture provides interconnectivity services for the users. The system provides services of any collaboration type such as collaboration tools (forums, boards, etc), decision making systems, workflows, smart functions, and so on.

The SIGES-PERE has been implemented in C++. The collaborative model has been developed in Java and RMI (described in [8]). We made the integration, by means of JNI, but future versions we will use C++/CORBA to implement the collaboration modules.

### 4.3 Preliminary Results

By applying this architecture, we have converted the GIS-application, which is called SIGES-PERE into an embedded-collaborative system. This application solves the problematic outlined in Section 2, and it integrates the collaborative aspects mentioned in Section 3. SIGES-PERE is a GIS, which contains the common spatial functions: Spatial Visualization Operations (Pan, Zoom In, Zoom Out), Spatial Overlap-ping Operations, 2D and 3D Representation Operations, Virtual Flights and an efficient user-friendly interface to the clients. In Fig. 7 is shown the main interface of SIGES-PERE.

The collaboration model provides a collaboration interface for users of different TFs. The implementation is still in the test phase; however, it allows users to collaborate with a restricted number of tools. The implementation is based on distributed objects to make collaboration. The distributed objects are implemented in Java, by means of the Java RMI platform. In future versions, we will use C++/CORBA, be-cause all components that we use to make spatial analysis are developed in this language. Additionally, the current version uses JNI to communicate Java with the applications written in C++.

Moreover, we have made interoperability tests between SIGES-PERE and a Collaborative Virtual World defined in [1].

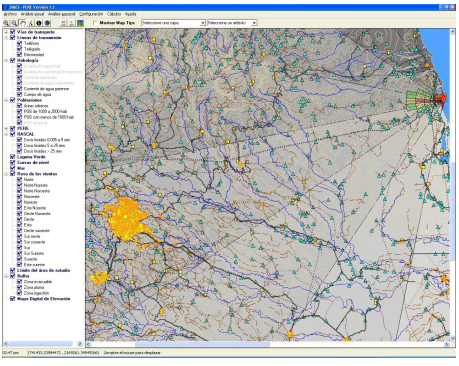

**Fig. 7.** Main interface of SIGES-PERE

## 5 Conclusions and Future Work

This work presents a solution to aid in the tasks of the PERE, as well as the training of the TFs that are in charge of executing these tasks in the field. The system allows to integrate dispersed data within a collaborative GIS-environment. In this system all the TF can use the data when they need. Also, a TF can interact with other TFs to optimize resources and avoid duplicate tasks.

With this approach, it is possible to develop the collaborative system independently of the particular system. An advantage of this; is the possibility of changing the collaboration policies without modifying the system ones. Just, it is necessary to change the roles that each user plays in the collaborative environment. Another feature of the architecture is to provide the mechanism to define the collaboration policies. It is made in a formal way by means of a *directed graph* in which all roles and collaborations are defined. With such definition, it is possible to assign permissions and restrictions to specific roles independently of other ones, and without the use strict schemas as user levels or hierarchies.

As a future work we must define security schemas that allow users to be sure about the confidentiality, integrity, service availability, access control and no-repudiation, because some TFs will be far from the risk areas. For example, one of the TF is the Federal Government represented by the President and its cabinet. So, the security system is very important.

As we have mentioned, there will be some changes in the implementation, we will migrate the collaboration modules from Java RMI to C++/CORBA, in order to integrate more resources and improve the interoperability of SIGES-PERE.

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## References


1. Carreto, C.: Modelo y Arquitectura para la Implementación de Mundos Virtuales Distribui-dos Colaborativos, M.S. Thesis, Centre for Computing Research, Mexico City, (2004)
2. Carreto, C., Menchaca, R. and Quintero, R.: Modelo de Interacción para Entidades Colabo-rativas dentro de un Ambiente de Realidad Virtual sobre Internet, XI International Congress on Computing CIC'2002, Mexico City, (2002)
3. Gardels, K.: Open GIS and on-line environmental libraries, ACM SIGMOD Record, Vol. 26, No. 1, (1997)
4. Manoharan, T., Taylor, H., Gardiner, P.: A collaborative analysis tool for visualisation and interaction with spatial data, Proceedings of the Seventh International Conference on 3D Web Technology, (2002)
5. Menchaca R. and Quintero R.: Distributed Virtual Worlds for Collaborative Work based on Java RMI and VRML, Proceedings of the IEEE 6th International Workshop on Groupware CRIWG 2000, Madeira, Portugal, (2000)
6. Min-Soo Kim.: ODYSSEUS/OpenGIS: Design and Implementation of an OpenGIS System Based on the ODYSSEUS Object-Relational DBMS, M.S. Thesis, Database and Multime-dia Lab, Computer Science Division, Korea Advanced Institute of Science and Technology, (2002)
7. Plan de Emergencia Radiologico Externo, National Center of Disaster Prevention of Mex-ico, (2001)
8. Quintero, R. and Menchaca, R.: Implementation Aspects of Synchronous Collaborative Dis-tributed Virtual Worlds. 5th IASTED International Conference, Computer Graphics and Im-aging, Kawaii Hawaii, USA. (2002)
9. Rauschert, I.: User interfaces: Designing a human-centered, multimodal GIS interface to support emergency management, Proceedings of the Tenth ACM International Symposium on Advances in geographic Information Systems, (2002)
10. Rujukan, S.: Geographical information system: a management perspective, Ottawa: WDL Publications. (1998)
11. Sergio, P.: Coordination aspects in a spatial group decision support collaborative system, Proceedings of the 2001 ACM Symposium on Applied Computing, (2001)

# Feasibility Study for a Legal Knowledge System in the County of Herford

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**Abstract.** In this paper we present a feasibility study we conducted in a German county in order to assess the potential of a legal knowledge system in the domain of family law. The goals of this project were to describe the actual work processes, to propose optimized processes if needed and to develop a prototype. Our study was based on interviews, on two test cases submitted to clerks and on an online questionnaire. We identified potential problems both in terms of productivity and quality of administrative decisions and demonstrated that it is possible to optimize work processes using a knowledge management solution consisting of a legal rule-based system and a knowledge-sharing component.

## 1 Introduction

In the 1970s, interdisciplinary research between lawyers and computer scientists began on ways to model the law and support legal reasoning [4], based on a deeper understanding of the law and legal processes. The field of legal knowledge systems has been constantly growing since. It is now possible to build models of legislation [5] and to use markup languages such as the MetaLex application of XML in order to create complex relationships between sections of legal code and to enable the use of sophisticated, collaborative hypertext systems for helping to browse, review and compare versions of draft legislation [2].

To get a good picture on best practices for development and operation of legal knowledge systems, we recommend a recent report by the Australian government that analyses advantages and disadvantages of this technology [1]. It furthermore contains the results of a large survey showing current and planned applications of legal knowledge systems by public agencies in Australia. However the field known as Artificial Intelligence and Law is much more than an applications area, it is also concerned with topics such as reasoning, knowledge representation, learning or decision-making [9].

Between October 2004 and January 2005 we made a feasibility study in the German County of Herford in Nordrhein-Westfalen in order to assess the potential of a legal knowledge system in the domain of family law. This system should allow clerks to manage more efficiently the recovering of social benefits paid to elderly persons. In short, the state supports elderly persons that are without financial resources and, under given conditions, it has a right to ask

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some of this money back from the relatives (mostly the children) of these elderly people. The offices we worked with are in charge of deciding whether a child has to support financially his/her parents, and if yes, how much money is to be paid.

The goals of this feasibility study were:

- To describe the actual work processes.
- To evaluate the consistency and the quality of the actual work processes.
- To propose optimized work processes.
- To develop a prototype for a legal knowledge. system

Our team[1] created a model of the relevant laws and regulations used in order to make such parent support decisions. We also led interviews with the clerks in order to identify their work processes and to describe how they acquire and share knowledge, as the regulations in that domain change quite often and the workers have to rely on up-to-date legal sources. Furthermore, we developed two test cases that were submitted to twenty clerks, from which ten responded. Finally we created an online questionnaire in order to find out how the respondents solved the test cases, what information and knowledge they needed and where they found it if they had to specifically research it. That was a very interesting experimentation field as the work processes were weakly formalized and as the knowledge was completely decentralized and disseminated, and not directly explicit in many cases. Indeed, the clerks have to interpret regulations in order to make a decision, and formalizing this process can be quite difficult.

## 2 Actual and Optimized Processes

In order to describe the actual work processes we used a conceptual framework called MIMIK (Method and Instruments for Modeling Integrated Knowledge) [6]. It consists of 8 types of diagrams, most of them being inspired or directly taken from exist-ing modeling techniques and particularly UML [3]. The goals of MIMIK are to identify:

- Strategic goals of an organization
- Actors and roles
- Knowledge resources
- Processes
- Interactions between these elements.

As in UML or other modeling tools, it is not necessary to use all models in order to provide a good representation of reality. In order to model the domain

[1] This project was led in cooperation by FOKUS, the County of Herford and the Fachhochschule für Öffentliche Verwaltung Nordrhein-Westfalen (FhöV). The FOKUS team was made of Thomas Gordon, Dirk Arendt, Olivier Glassey and Jonas Pattberg. The County was represented by Paul Bischof, Marion Ziemens and Michael Borgstedt; Monika Müller acted as legal expert on behalf of the FhöV, along with independent consultant Rainer Fisher.

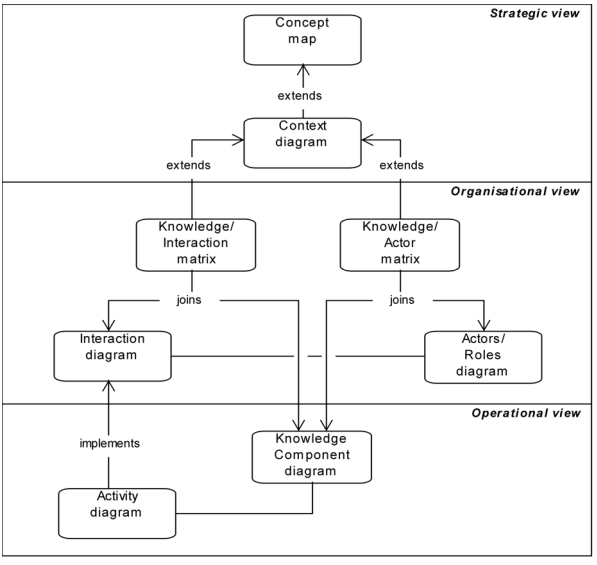


**Fig. 1.** Metamodel of the MIMIK framework and formal relations between diagrams: knowledge-interaction matrices formally link knowledge components to the interactions that implement a use case; knowledge-actor matrices create a formal relation between knowledge components and real actors within an organization

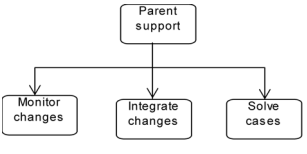


**Fig. 2.** Concept map showing strategic processes for "Elternunterhalt" (parent support): monitoring the changes in law and regulations, integrating these changes into the daily work of the organization and handling the actual parent support cases

with the clerks and the legal experts, we worked mostly with text scenarios and developed simple graphical models. However this simple visualization technique allowed us to validate the models we created and to show clearly the optimized processes we proposed. On the basis of validated abstract diagrams, it becomes possible to develop detailed models at the operational level. We will show some of these models as we go along the paper and illustrate them with examples from the Herford feasibility study.

Concept maps are the top-level diagrams and show the strategic goals of an organization in terms of functions or processes (Fig. 2). Let us mention that the meta-model of our framework is in itself a concept map. These concept maps can be de-composed in several levels, a terminal node of this type of diagram is implemented by a context diagram.


**Fig. 3.** Context diagram showing how clerks monitor changes from various legal sources

Context diagrams (Fig. 3) are almost exactly the same as use cases in UML, but we added the concept of knowledge packet. A knowledge packet is an abstract representation of a set of knowledge components. These components encapsulate documents, databases, files, implicit knowledge and so on. They provide metadescriptions for "knowledge units" and are implemented with RDF (Resource Description Frame-work), a W3C standard for defining metadata and encoding machine-readable semantics. RDF is based on XML and uses graph theory. However in MIMIK diagrams, knowledge packets and knowledge components are only represented with a graphical stereotype and allow us to show what type of knowledge is necessary in order to complete a process and which knowledge is relevant in a given context.

For the first mission (Fig. 3) we found out that the clerks who answered the online questionnaire used legal texts and databases extensively, including case law:

- The majority of the clerks (75%) uses legal texts weekly, the other 25% use them once a month or less.
- They all read various specialized publications in the domain of social welfare. 65% of the respondents read these several times per month.
- They all (except one) take part in training seminars about once a year.
- 40% of their work time is dedicated to doing legal research for particular cases, reading legal journals and publications and calculating the amounts of money the relatives have to pay.

However, each clerk is doing it his/her own way and using different sources (up to 20 different legal sources). Furthermore, there is absolutely no structured or formalized sharing and integration of this knowledge. For example, different units at the communal and district levels develop their own forms and spreadsheets tables in order to acquire data from the potential social beneficiaries and to calculate the amounts of money their relatives might have to pay. In some cases, clerks only share knowledge with their colleagues during informal discussions on the phone or at the coffee break and only a handful of them use email to share their specific domain knowledge. The only "formal" knowledge acquisition activity consists of an annual continuing education seminar.

We believe that these tasks could really be optimized with the use of knowledge management technology. Furthermore the IT infrastructure is already in place: although most workers only use word processing tools, they all use email and most of them also have Internet access. Our idea for process optimization (Fig. 4) was to select one or several clerks that would have the formal responsibility to monitor the changes in the legal sources and to publish these changes using the prototype that we will present in the next section.

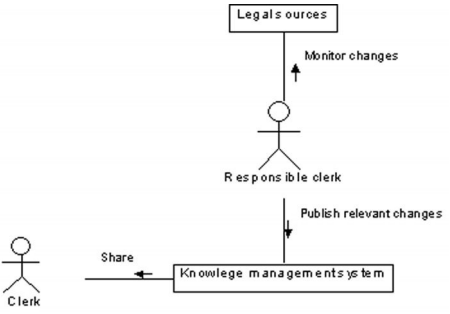


**Fig. 4.** Collaboration diagram showing optimized processes for monitoring and publishing changes

On the other hand the actual work processes describing how the cases are treated and decisions are made were rather formal, although implicit. With the help of clerks we were able to define how they conducted interviews: Fig. 5 shows the general approach they use, but we also developed detailed interaction and activity diagrams.

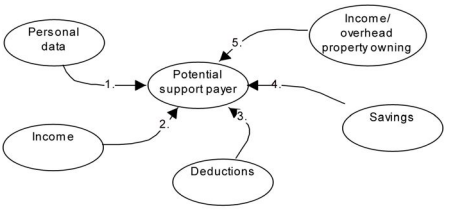


**Fig. 5.** Normal interview sequence, such as described by the clerks

As mentioned in the introduction, one of the goals of this feasibility study was to evaluate the quality and the consistency of the work processes: we developed two test cases that were solved by 10 clerks. We will not present the detailed results here, only a few key points:

- Between 75% and 79% of the respondents
  - found that the cases were clear, well formulated and realistic
  - said they understood what they were expected to do
  - believed they had all the necessary information in order to solve the cases
  - agreed that they had enough knowledge and support tools to solve the cases
- However 44% of them said they had problems to solve the cases and
  - in case 1, 20% of the solutions were not defensible and the respondents needed an average of 152 minutes to solve it

- in case 2, 33% of the solutions were not defensible and the respondents needed an average of 162 minutes to solve it.

Many answers given to us by the respondents were different from the solutions provided by experts mentioned in the introduction, but after verification, some of them were legally defensible given often changing regulations and various interpretations of these regulations.

| | ML | B 1 | B 2 | B 3 | B 4 | B 5 |
|---|---|---|---|---|---|---|
| Gesch. Ehefrau | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Sohn A | 273.00 | 375.00 | 348.60 | 272.00 | 0.00 | 375.00 |
| Sohn B | 200.00 | 199.00 | 170.40 | 137.50 | 0.00 | 138.00 |
| Tochter C | 0.00 | 0.00 | 81.00 | 87.50 | 0.00 | 0.00 |
| Zeit | | 60 min | 75 min | 150 min | 120 min | 75 min |

| | B 6 | B 7 | B 8 | B 9 | B 10 | Demonstrator |
|---|---|---|---|---|---|---|
| Gesch. Ehefrau | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Sohn A | 375.00 | 272.00 | 273.00 | 272.73 | 305.00 | 272.73 |
| Sohn B | 183.33 | 199.00 | 200.00 | 0.00 | 224.00 | 200.00 |
| Tochter C | 0.00 | 127.00 | 127.00 | 127.27 | 71.00 | 0.00 |
| Zeit | 120 min | 120-150 min | 150 min | 150 min | 225 min | |

**Fig. 6.** Case study 2: the ML (Musterlösung) column shows the solution of the legal experts, B1 to B10 list the responses of the participants and the Demonstrator column presents the answers provided by our prototype (in Euros)

In order to avoid indefensible results and to speed up the case resolution process, we proposed a legal knowledge system where legal experts and computer scientists would model and program legal rules on the basis of legal sources and where clerks would use this up-to-date and coherent legal knowledge system (Fig. 7).

Finally, let us mention that the knowledge-based solution we proposed also had organizational consequences, which we will present in another publication. Here we will only describe briefly the prototype we developed.

## 3 Prototype

This prototype is based on two different tools: a legal rule-based system to support the resolution of the cases and a knowledge-sharing system.

Legal rule-based systems require and use one or more computer models of the relevant legislation. In our case the prototype was written with software called StatuteExpert, a rules engine platform developed by an Australian firm called SoftLaw. Specialized for government, this platform can integrate large bodies of complex legislation, regulations, policy and administrative procedures. Its end-user interface is a simple web browser. In the United Kingdom, the Assert rule-based system was been developed using SoftLaw's technology, to help low income

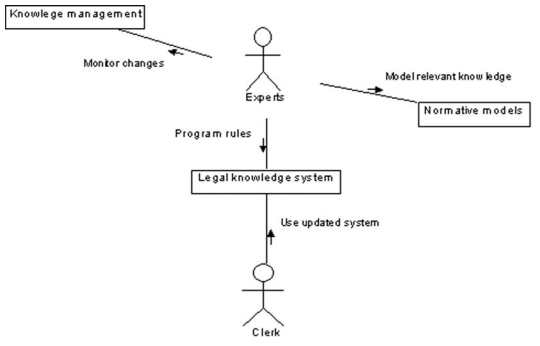


**Fig. 7.** Collaboration diagram for the general architecture of legal knowledge system

citizens to assess their entitlement to a range of housing benefits from several different government social programs. Nearly 700 pages of legislation have been modelled in the Assert system, in a knowledge base consisting of about 7,000 rules.

Our prototype currently includes about 200 rules created from the legal model de-fined by the project's team. It enables users to decide whether someone is obliged to pay parent support and to decide who has to pay what (for example in the case where several brothers and sisters have to pay different amounts of money depending on their financial situation). This system also offers online help for each question that a user might have during the process of solving a case.

The demonstrator is able to completely and correctly solve both test cases, and we estimated that a clerk using it would need between 30 and 60 minutes to solve each of these cases (as opposed to 152 and 162 minutes on average for the clerks that took part in our survey).

In order to develop a prototype for sharing knowledge, we first worked on a general architecture based on RSS. RSS is a family of XML file formats for web syndication. This acronym has several interpretations: Rich Site Summary, RDF Site Summary or Really Simple Syndication. The latter is currently the most commonly used, as RSS provides "items" containing short descriptions of web content together with a link to the full version of the content. This information is provided as an XML file called an RSS feed. In order to access these feeds, users rely on applications called feed readers that check RSS-enabled Web pages and retrieve any updated content that it finds. Websites featuring RSS feeds include The New York Times, The Wall Street Journal, BBC, news.com, Liberation, etc. RSS is not only used as a news aggregator, it is also widely implemented in the weblog community in order to share the latest weblog entries. A weblog (or blog) is a web application with periodic posts on a common webpage. Blogs are used to maintain individual diaries, to follow political campaigns, to broadcast various types of media, to support communities of writers, and so on. It is already

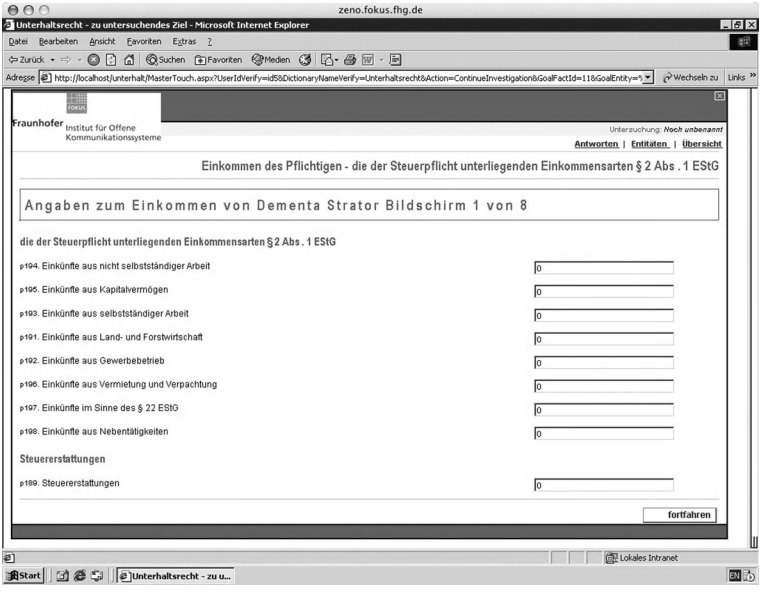


**Fig. 8.** Depending on the answers already given, the system only asks relevant questions to its users

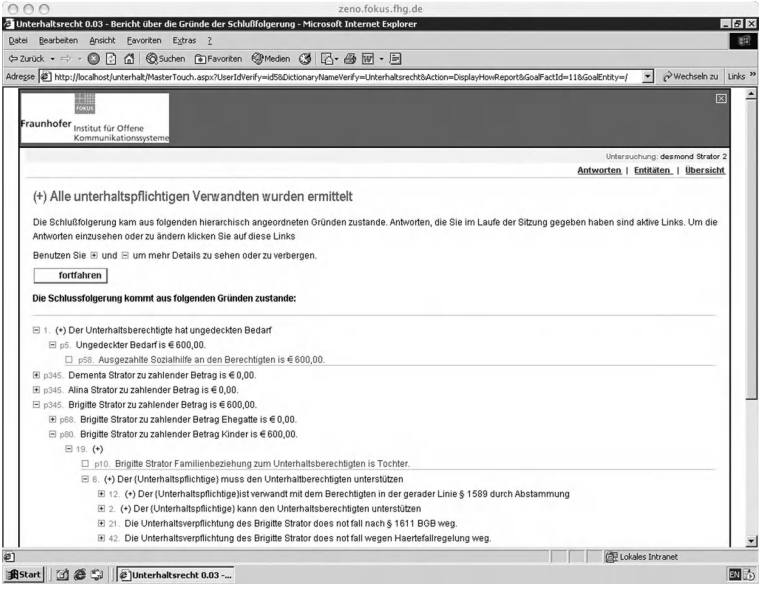


**Fig. 9.** Generation of reports for each decision and explanations based on facts

a quite popular technology: according to a Pew Internet and American Life Project survey [8], there were 8 millions bloggers in the United States at the beginning of 2005 and 27% of Internet users say they read blogs. Furthermore [7] showed that RSS can be used for public participation platforms, for example to facilitate public consultation, deliberation, participation or "engagement" in policy-making processes such as urban planning. For a good starting point on RSS we recommend [10].

The prototype used existing services to publish knowledge: Blogger.com, a weblog platform owned by Google, Feedburner.com, a free post-processing service that al-lows publishers to enhance their feeds, and Bloglines.com, an online feed aggregator.

End users can publish new knowledge via a Web interface or a simple email sent to a dedicated address. This requires no specific knowledge (other than being able to send an email), the input text is automatically transformed in an RSS feed by the system. However a "moderator" with basic knowledge of content management systems can validate this new content before it is available to anyone, as Blogger offers the possibility of publishing only validated content. In our Herford example, clerks could notify their colleagues when they have found a new piece of knowledge in legal databases, online law commentaries, or when they have themselves implemented a new form or a new calculation formula. A moderator could then validate or complete this knowledge published by a clerk. All clerks could then rely on this knowledge in their daily work, as it would have been validated by a "domain expert". Furthermore, specific thematic RSS feeds can be defined: users can then choose precisely what knowledge they want to receive.

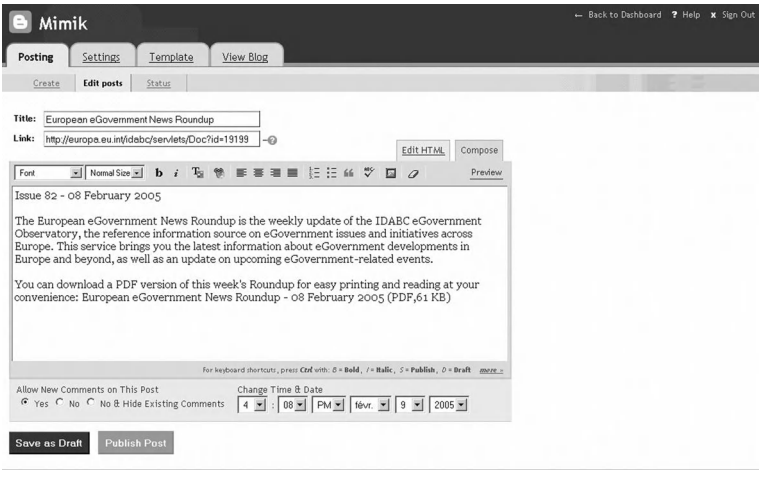


**Fig. 10.** End users can publish new knowledge via the Web interface provided by Blogger

Once new knowledge has been published, it can be used in very flexible ways. Users can simply visit the Web page of the blog, but they can also use Web aggregators such as Bloglines.com or even their own email client. This last point is at the moment still very important, as the Internet and American Life Project survey mentioned above stated that only 5% of Internet users rely on dedicated aggregators to get RSS feeds. RSS aggregators and, to some extend, email clients offer powerful content management capabilities, such as filters to limit access to only relevant content: a user can for example subscribe only to feeds that aggregate content on social welfare is-sues and limit this to parent support, they can furthermore implement filters stating that all feed elements not concerning the Land of Nordrhein-Westphalen are to be deleted. This is very useful to avoid information overflow, that is to limit the risk that the users will not read the feeds anymore because they receive to much irrelevant information.

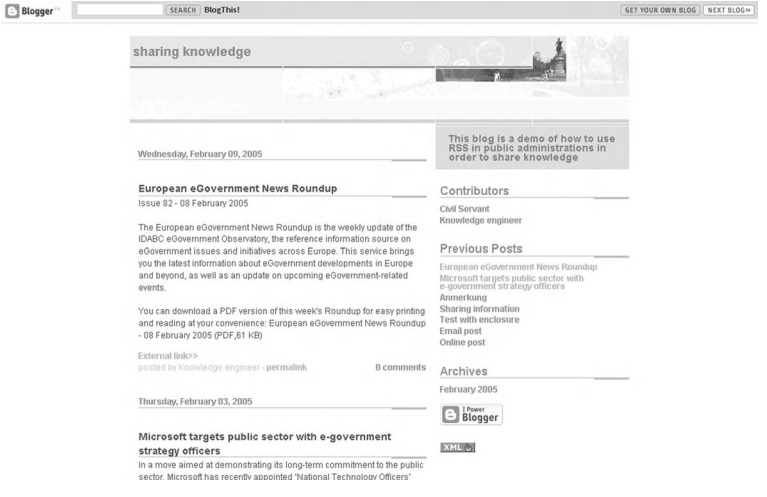


**Fig. 11.** Web page for sharing content

RSS feeds support "enclosures", which allow the addition of any type of multimedia files, similar to an attachment in an email. Thus we added this functionality to our prototype: it can be used to share automatically new documents, new files or any new piece of digitalised information. With an advanced RSS reader, it becomes possible to check periodically (once a day, every week, etc.) selected feeds and to download relevant documents automatically. The user is notified when new information is available. Our prototype is functional and can be accessed at `http://mimik-demo.blogspot.com/`. It offers flexibility for both publishers and readers, it supports basic moderation, it provides automatic notification when new content is published and moderators have the possibility to create thematically aggregated content. How-ever Blogger's features in terms of user rights management, content validation and security are quite limited,

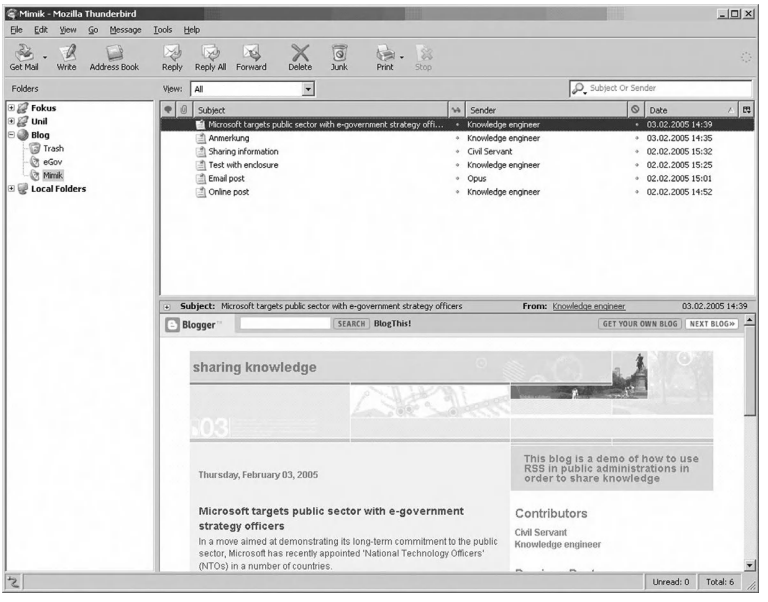


**Fig. 12.** RSS content in Thunderbird email client

therefore we are currently testing several dedicated blogging platforms, as well as complete content management system supporting RSS.

## 4 Conclusion

This study showed that there were potential problems in the domain of parent support in the County of Herford, both in terms of productivity and quality of processes. We also established that it was possible to optimize their work processes, notably by using information and communication technology and introducing a legal knowledge system. Moreover our legal rule-based prototype demonstrated the feasibility of modeling and implementing relevant laws and regulations with an acceptable amount of effort.

However a complete survey would be necessary in order to quantify improved productivity and quality and to evaluate potential cost reductions:

- Detailed cost analysis for actual work processes: how much time is needed on average to solve real cases? How many cases are solved a year and with which resources? What does it cost to Herford administration and what does it represent in terms of revenues?
- Detailed cost estimations for optimized processes: how much would the development of a real system cost? How much would necessary training and maintenance cost?

Fraunhofer FOKUS and the Herford administration are currently planning a follow-up project. Moreover we plan to test RSS technologies for knowledge shar-

ing in public administrations and to investigate issues such as security, privacy, quality and reciprocity of contributions.

## References


1. Administrative Review Council: Automated assistance in administrative decision-making. Report to the Attorney General No 46, Barton, Australia (2004)
2. Boer, A., Hoekstra, R. & Winkels, R.: Metalex: Legislation in XML. In T. Bench-Capon,A. Daskalopulu, and R. Winkels, editors, Legal Knowledge and Information Systems (Jurix 2002), IOS Press (2002), 1-10
3. Booch, G., Rumbaugh, J. & Jacobson, I.: The Unified Modeling Language User Guide, Addison-Wesley, Boston (1999)
4. Buchanon, B.G. & Headrick, T.E.: Some speculation about artificial intelligence and legal reasoning. Stanford Law Review, 23(1) (1970) 40-62
5. van Engers, T.M.: Power: Using UML/OCL for Modeling Legislation - an Application Report." International Conference on Artificial Intelligence and Law (ICAIL 2001). Ed. Henry Prakken. St. Louis, (2001) 157-67
6. Glassey, O.: Knowledge Component-based Architecture for Process Modelling, eGOV INTEROP'05 Conference, Geneva, Switzerland, February 23-24 (2005)
7. Gordon, T.F.: An Open, Scalable and Distributed Platform for Public Discourse, Infor-matik 2003. In: Klaus Dittrich, et al. (Eds.), Frankfurt am Main: Springer Verlag, Vol. 2 (2003) 232-34
8. Rainie, L.: The State of Blogging, Pew Internet & American Life Project, (2005). `http://www.pewinternet.org/`, last accessed March 10, 2005
9. Rissland, E.R., Ashley, K.D. & Loui, R.P: AI and Law: A fruitful synergy, Artificial Intelligence, 150(1-2) (2003) 1-15
10. Winer, D.: RSS 2.0 Specification, RSS at Harvard Law, (2005). `http://blogs.law.harvard.edu/tech/rss`, last updated January 30, 2005, last accessed March 10, 2005

# A Quality Inspection Method to Evaluate E-Government Sites

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**Abstract.** Electronic government allows a broad range of citizens to access governamental information and services, as well as to participate in the government decision-making process. On the other hand, it imposes a higher challenge on a web designer to avoid digital exclusion. Before proposing guidelines to design e-gov sites, it is important to have objective methods to evaluate their quality. Traditional inspection methods do not cover the specificities of e-gov sites. This work proposes an extension of Nielsen's heuristic evaluating method, applied to the information, services and citizens' participation categories. Broad accessibility, interoperability, security and privacy, information truth and precision, service agility, and transparency are added. The g-Quality method was instrumental as an objective evaluation form. It was applied to 127 Brazilian e-gov sites. The extended method found more problems, resulting in more negative ratings than the Nielsen's original method. The Brazilian public sites quality level was determined by using the g-Quality method, producing positive results.

## 1 Introduction

The use of Information and Communication Technologies (ICTs) have been pointed out as being some of the fundamental paths towards improving democracy and increasing people's participation in the decision-making process. Countries are investing more and more in technological improvement for guaranteing universal ICTs accessibility [1]. However, having a computer and an Internet connection are necessary, but far from being enough to achieve an electronic government (e-Gov), name given to the on-line exchange and transactions between governamental institutions and the population. E-gov means citizens having access to governmental information, getting on-line services and also participating in the government decision-making process. The three items must be made accessible in any e-Gov portal [2]. However, by implementing the so-called e-governance, a greater participation of the population in the decision-making process is sought, as well as greater control of the State's actions. That way, through the Internet, one could access the budget and investment plans of a determined city, not to mention sending and receiving complaints and suggestions for the application of public resources. Consequently, besides working for the digital inclusion, governments around the world must invest in designing webportals that offer information efficiently and services to their citizens, which also allows people's participation [3].

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Like all new ideas, the electronic government concept is still designing its tools and measures. During the research that resulted in this article, it was verified that neither specific design guidelines nor evaluation criteria has been designed to address the specificities of e-gov sites such as interoperability, accessibility, transparency and information accuracy. The lack of such design and evaluation guidelines may be the cause for e-gov excluding more than including people in the digital society.

It was proposed an inspection method of evaluating the e-gov sites, the g-Quality. The method is an extension of the heuristic evaluation proposed by Nielsen [4]. The criteria and respective components, which are defined in this research, were formatted into a questionnaire, to guide the evaluators' analysis process. The method was applied to evaluate 127 e-Gov Web sites, including the federal web site (representing the country), all Brazilian capitals (representing the states) and all of Rio de Janeiro's state cities (municipal level). The case study has shown that the method is sound to evaluate e-gov sites. Interesting results include security and privacy, accessibility, and information truth and precision.

## 2 Electronic Government

Electronic government, most commonly called e-gov, means the use of Information and Communication Technology (ICT) to attempt the governamental directives and obligations defined by each country rights principles and development of democracy levels. Tambouris et al. [2] analize electronic government different websites through three constitutive caracteristics. Satisfying meeting the citizens' needs, regarding information acquisition is the first webportal constitutive caracteristic. It enables the access of government directive and decision information. A Pew Internet and American Life Project have indicated that "65% of Americans expect to find government information online". This same research shows Internet as the first place that most users will go to for any kind of information.

The second e-gov constitutive characteristic is rendering services, which allow on-line transactions of government products and services. Through an on-line governmental portal, it is possible to have 24-hour access to public services from home, from work or any other place connected to the Internet. An e-gov webportal high-positioned in maturity and quality of usage evaluation as the Singapore G2C portal, offers over 500 online services, from buying a home, finding a job, to dealing with death and taxes. Other countries, such as the UK central government, are fixing goals for delivering electronically – or digitally – all governmental services to citizens.

The third e-gov constitutive caracteristic is promoting citizen participation in government decision making-process. In this perspective, webportals offer population the possibility of consulting government statistical data and giving suggestions in webforums about the government policy or the electronic service delivery quality. They can also vote via Internet in the most attractive governmental decisions. In a country best-developed speaking in e-government initiatives as Canada, people can access public costs and budget, and choose who will represent their interests. Two out of three Canadian Internet users say they would vote on federal, provincial and municipal elections over the Net if the options were available to them, says a NFO CFgroup study.

The challenge in designing these governmental portals is not to restrict people's participation to only the service consumer character of getting governamental services and information. For completing the direct democratic process, citizens should be able to receive a feedback about their suggestions or opinions for measuring their influence in the decision process.

Each e-Gov sites presents a configuration related to these three constitutive characteristics: information migration percentage, service offer, and citizen's participation capacity. An e-Gov site, for example, can be totally informative if it is 100% informative, 0% service and 0% participatory. Depending on the site's features, a particular evaluation heuristic might have a more or less relevant role in its evaluation. It means that while doing an e-gov website heuristic evaluation, it is of primary importance to take in to account what category is more relevant and what are the website objectives. An e-government site that is focused on on-line governmental services, the e-procurement, doesn't have the objective of offering the design tools for people's participation, voting or giving opinions in an electronic forum. So, if through people participation usability inferences in e-procurement websites are used. Otherwise, in the site specialized in increasing people's participation in the governamental decision making process, it is not recommendable to use e-procurement usability criteria.Another important factor that should be taken into account involves the percentages regarding information, services, and participatory government processes to be migrated into the Web. This will indicate the government's strategy and migration maturity.

In the government's pursuit to let citizens to access government services from the Web, several obstacles should be examined to maintain existing relationships which are clear in the traditional venue when a citizen seeks information, requires a service or wishes to participate in government decisions.

In order to obtain government information through traditional means, such as finding out about a particular real estate tax, the citizen must first approach the pertaining government sector. After checking that the desired information is available, since it is official, the citizen has total assurance regarding its usage, validity (expiration date), and non repudiation (official guarantee of acceptance).

In a non electronic reality, if a government service is needed, such as handing in the yearly income tax form, the citizen must approach a Brazilian IRS office. Upon its delivery, a receipt guarantees that the document has been duly processed, and one can rely on its security and on the privacy of the information rendered.

Citizens who wish to participate in government decisions, for instance, in the participatory budgeting assembly, may attend its meetings to present motions, verify and/or record demands quite easily and, on some occasions, participate in the decisions by voting.

When the government tries to migrate the provision of services to the Web environment – be it to display information, to render services, or to establish participation channels – it must take into account the peculiarities of the traditional means. It must guarantee access and information accuracy, non-repudiation of data, security and privacy. Such peculiarities may trigger problems that are not detected by the Heuristic Evaluation method proposed by Nielsen.

Hence, to embrace these peculiarities, which are not covered by the traditional evaluation method, the broadening of the heuristic evaluation criteria for the e-Gov domain is proposed.

## 3 Evaluation Criteria for E-Gov

A multidimensional Web-based e-government evaluation is discussed in [13]: usability testing; user feedback; usage data; and Web and Internet performance data. It stands out that specific methods are appropriate for obtaining different types of information at various stages of the Web site's life cycle. Among them, Nielsen's usability heuristic evaluation method [6] is broadly used, particularly in the initial phases of the project. The method consists of a set of rules that a usability expert should be looking at when evaluating an interface. The set of heuristics were upgraded to fit web site interaction requirements. Nielsen's heuristic rules were complemented with others rules to evaluate all possible e-gov sites.

Many evaluators have found that Nielsen's list does not always meet their specific needs and they frequently require alternative guidelines or some re-interpretation of Nielsen's original descriptions in order for each item to make sense. The difficulty of creating a single set of heuristics that can accommodate every system, achieve thorough results, and be interpreted reliably by multiple evaluators [6].

To access the electronic government domain on the Web, bearing in mind that the citizen should be the main focus, it was realized that the heuristics could be grouped under five evaluation criteria, namely:

- *Cognitive Effort:* Use of individual attention to understand and learn a task. By minimizing the cognitive effort, users will perform tasks more intuitively, thus reaching their objectives more effectively;
- *Tolerance:* Citizen's motivation and patience in awaiting, understanding and performing tasks according to site responses;
- *Reach:* Possibility of reaching a greater number of citizens, whatever the technical features of the user's equipment or their special physical or cognitive needs;
- *Physical Effort:* Easiness to use the site, as a result of data reuse;
- *Trust:* Demonstrating reliability and credibility, guaranteeing security in the information exchange and in the site navigation.

Nielsen's usability heuristics, we suppressed any further explanation [7], [8]. The last five are the extension required to evaluate e-gov sites, as follows:

- *Visibility of system status:* the system should always keep users informed about what is going on, through appropriate feedback within reasonable time.
- *Match between system and the real world:* the system should speak the user's language. Follow real-world conventions, making information appear in a natural and logical order.
- *User control and freedom:* users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue.

- *Consistency and standards:* users should not have to wonder whether different words, situations, or actions mean the same thing.
- *Error prevention:* even better than good error messages is a careful design which prevents a problem from occurring in the first place.
- *Recognition rather than recall:* make objects, actions and options visible. The user should not have to remember information from one part of the dialogue to another.
- *Flexibility and efficiency of use:* Accelerators may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users.
- *Aesthetics and minimalist design:* dialogues should not contain information which is irrelevant or rarely needed.
- *Help users recognize, diagnose, and recover from errors:* error messages should be expressed in plain language, precisely indicate the problem, and constructively suggest a solution.
- *Help and documentation:* even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation.
- *Accessibility* – e-gov site should include all citizens. Consequently, the site should attend people with special needs.
- *Interoperability* – e-gov site should be able to exchange information and services as in actual government bureau. In order to achieve interoperability, at least communication protocols should be defined, but it is recommended standards.
- *Security and privacy* – Government site should be protected against hackers because people will rely on the information. Additionally, citizens' information should be protected when sent to e-gov sites.
- *Information truth and precision* – Information must be true and precise since it will influence citizens' life. It is the government responsibility to maintain its sites updates and corrected.
- *Service Agility* – Time response to citizens' requests is fundamental to create trust; i.e. communication is a two-way road.
- *Transparency* – The governments must make available to the public all pertinent information, such as, public expenditures, so as to allow a clear view of governmental operations. The publication of government budgeting and spending permits people to accompany better what is planned and what has been executed in the governmental administrations (Fiscal Responsability Law) [10].

The five criteria are mapped to the sixteen heuristics as illustrated in Figure 1. Heuristics can be mapped to more than one criterion with similar or different weight, in the range 0-3, from the least to the most important. No relevance receives weight 0; low relevance receives 1; average relevance receives 2 and high relevance receives 3.

When satisfying such criteria, citizens on the Web will get better navigation. The usability propriety embraces all quality criteria, however not with the same intensity, as the legends for Figure 1. Some properties such as Security and Privacy satisfy only the trust criterion. Another such as the property "Service Agility" reflects only in Tolerance and Trust criteria for the citizen.

To implement the g-Quality method, the heuristics were charted on an evaluation table, a checklist, presented in the addendum. The *checklist* also quantifies the

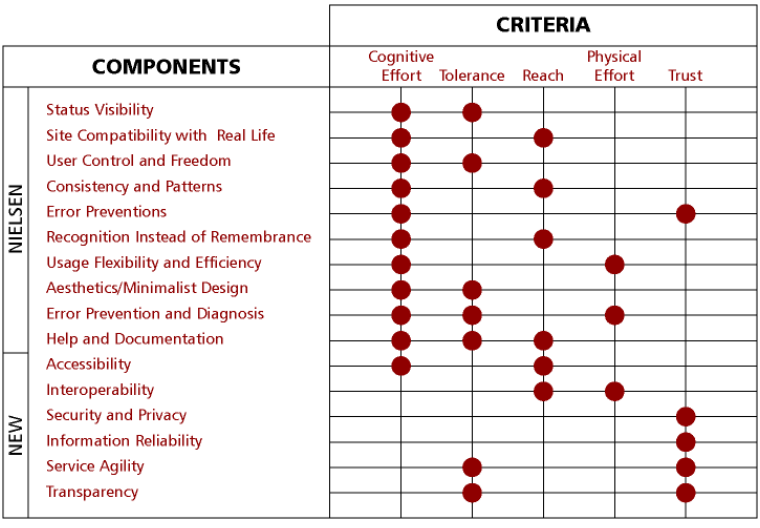


**Fig. 1.** e-gov evaluation criteria and heuristic rules mapping

migration scope, to the Web environment, of the government procedures in the various categories – information, services, and participation.

## 4 Case Study

In this section, to test the efficiency of the g-Quality Method for the e-Gov domain, a case study was presented, including scenario, method implementation and data analysis. The efficiency of the method is thus tested.

### 4.1 Scenario

The proposed method was implemented to analyze the quality of Brazilian e-Gov sites, with the following breakdown: 9 federal sites, 91 municipal sites (all of them in Rio de Janeiro state) and 27 municipal sites (from Brazilian state capitals). The sites were picked through a search service, covering the gov.br domain. If the sight being searched could not be found in the gov.br domain, the one found (.com or .org) would be taken into consideration, later checking if it was the official one.

To analyze the collected data, two government site classifications were taken into account: 1) according to the government jurisdiction (municipal, state and federal); and 2) according to the number of inhabitants in the municipality. This was based on a classification made by IBGE (Brazilian Institute of Geography and Statistics) Agencies, whereby a small municipality has less than 25,000 inhabitants, a medium-sized one has between 25,000 (inclusive) and 50,000 and a big one has more than 50,000 (inclusive).

### 4.2 Subject (E-Gov Sites)

We divided e-gov sites in three types:

- Informative sites: the government uses the web site channel to display information that is useful to its citizens as well as to make transparent its decisions.
- Services: the government uses the web site channel to allow a broader access to its products and services, such as citizen's income tax electronic submission and follow up.
- Participative: the government uses the web site channel to allow citizens to talk and get an answer from the government. Services such as participative budget and a talk to us e-mail service are good examples.

### 4.3 Implementation of the G-Quality Method E-Gov

The g-Quality method was implemented by seven specialists in the Post-Graduate Program of Computer Sciences of the Universidade Federal Fluminense, between September and November 2004. The evaluators took a course, to discuss usability inspection methods and the evaluation criteria to be used for the e-Gov domain, as well as the checklist.

The first step involved the checklist piloting, which enabled detection of possible inconsistencies. Four external specialists used the checklist to evaluate a government site, as well as the course students. These results were compared in order to assess the checklist's objectivity and pertaining adjustments were made.

It was concluded that the digital migration would be measured based on the existence, or not, of a specific information, service or participation resource.

Considering that each heuristic can be mapped into various sub-items and that each sub-item can have a positive or negative influence, we weighted each sub-item using an interval of less than four to three. In this way, we highlighted the positive and negative points of each sub-item and used these weights to obtain their weighted average.

To fill out the checklist, we used the following concepts: 2 – for "always"; 1 – for "sometimes'" and 0 – for "never/option not applicable". For locations in which no government sites were found, a 0 value was attributed. Finally, each value was multiplied by the attributed weight to calculate the weighted average, and the result for each heuristic was normalized.

The quantitative data were presented in tables and graphs, so as to facilitate their quantitative analyses. Some graphs are shown in the following item, along with the respective analyses of the collected data.

### 4.4 Data Analysis

It was analyzed 127 e-gov sites using g-Quality method. There are many cities that have no official site. Only seven e-gov sites were considered good according to our evaluation method from the following cities Aracaju (SE), Belo Horizonte (MG), Brasília (DF), Curitiba (PR), Natal (RN), Recife (PE), Rio de Janeiro (RJ) e São Paulo (SP).

Most e-gov sites only handle information delivery. In average, only 10% of the government services are available through e-gov sites, considering the capital cities.

**Table 1.** Percentage Criteria

| Criteria | Evaluation Grade (0-100%) |
|---|---|
| Cognitive Effort | 37.14 |
| Tolerance | 39.12 |
| Reach | 36.14 |
| Physical Effort | 26.94 |
| Trust | 24.74 |

**Table 2.** RJ e-gov sites heuristic evaluation

| Components | Evaluation Grade (0-100%) |
|---|---|
| Visibility of system status | 24.4 |
| Match between system and the real world | 52.1 |
| User control and freedom | 48.0 |
| Consistency and standards | 67.1 |
| Error prevention | 36.1 |
| Recognition rather than recall | 57.0 |
| Flexibility and efficiency of use | 1.5 |
| Aesthetics and minimalist design | 48.6 |
| Help users recognize, diagnose, and recover from errors | 56.1 |
| Help and documentation | 7.7 |
| Accessibility | 9.61 |
| Interoperability | 23.1 |
| Security and privacy | 0.4 |
| Information truth and precision | 16.6 |
| Service Agility | 30.43 |
| Transpareny | 25.0 |

This number is even lower to interior cities. It was observed that the government digital service migration has been slow, with the exception of the Porto Alegre (RS) e-gov site. Citizens' participation, in general, is constrained to e-mail. There are some voting services [9], but restricted to a selected group.

Comparing the three focused governmental spheres, it could be concluded that, according to the not only evaluation criteria but also to the realized heuristics, the Federal e-Gov Websites have the best percentiles. In cause of the analysis homogeneity, only Rio de Janeiro e-gov websites data were discussed argued in this data analysis.

Due to as illustrated in Table 1, current RJ e-gov sites have serious problems related to information trust. Sites are not well designed. Surprisingly, the problem is not to make sense of what to do, but the effort required to accomplish the task. Unfortunately, Brazilian e-gov sites lack reliance, putting in danger their feasibility to represent the government (who wants to get information from a site that cannot be reliable).

Table 2 illustrates, in more detail, the evaluation of RJ e-gov sites. One of the most striking observations was the lack of any design standard, even within sites from the same city.

During the evaluation process, it was perceived that there was a preoccupation with the e-gov websites design in terms of functionality patronization, together with an agreeable aesthetic. However, the navigation structure organization, the user action feedback and error prevention are aspects, wich can be checked by the Nielsen heuristics had poor evaluation results in the evaluated websites. "Flexibility and efficiency of use" also presented a much lower value than the desired (1.5%). This shows that the websites are not worried about service customization and personalized user attendance, indispensable factors when taking into account citizen web users necessities. It is possible to notice the lack of preoccupation with offering usage help and documentation as relevant faults as observed in the website evaluation.

Using the heuristics proposed in this work, "Service Agility" (45.7%) had the highest value. However, analyzing the e-mail contacts, the majority of the messages weren't answered. Homepages updating, "Information truth and precision" checked-in component need a lot of improvement (16.6%). Facilitating citizen usage of e-gov websites means "Interoperability" and to "Accessibility", along with other low evaluated heuristics.

In the "Security and privacy" heuristic, evaluation results were much closer to 0 (zero), this being a noteworthy problem for this kind of domain. Personal information that requires privacy should be securely transferred on the net so that the user feels at ease to interact with the system without the risk of frauds.

As for "Transparency" it could be noticed that the government administrations have not used the Internet as a channel for rendering public accounts to citizen. Only 32.6% of the sites have this data available on the Web.

According to Nielsen's heuristics, Brazilian e-gov sites have average usability. Although it is common knowledge that Brazilian e-gov sites are still not appropriate to be properly used as an information medium for most citizens.

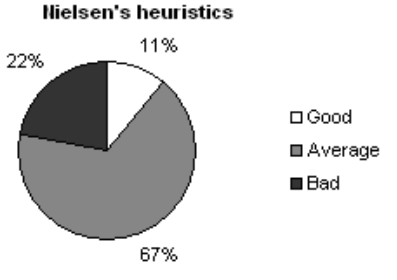


**Fig. 2.** Brazilian e-gov sites – Nielsen's evaluation

The heuristics that have been included, such as accessibility, security and privacy, information truth and precision, have shown to be fundamental to highlight the problems in e-Gov Web sites. As illustrated in Figure 3, Brazilian e-gov Web sites have been evaluated as mostly bad to average quality.

In general, the number of sites classified as good are the ones which attend poorly the citizens's needs. However, when considered all heuristics of the g-Quality Method, the percentage of good sites even decreases (7%).

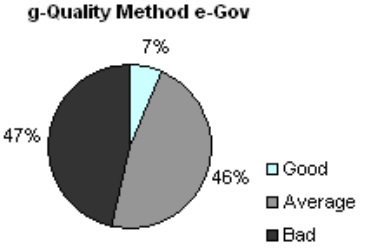


**Fig. 3.** Brazilian e-gov sites – g-Quality Method evaluation

## 5 Conclusion

The paper suggests an extension to the Nielsen's heuristic evaluation method. It can be observed that the inclusion of specific heuristics (accessibility, interoperability, security and privacy, information truth and precision, service agility, and transparency) enable a more thorough and in-depth inspection. These heuristics were charted according to previously defined evaluation criteria (cognitive effort, tolerance, reach, physical effort and reliability). A quality evaluation of 127 Brazilian e-gov sites is reported, comparing the result when the new method is used versus the Nielsen's original method. The g-Quality method found more problems, resulting in more negative ratings than the Nielsen's original method.

It was noticed that without the extra heuristics, Brazilian e-gov sites would be evaluated as average, which is not at all an accurate assessment. The g-Quality method could refine this evaluation and show not only that Brazilian e-gov sites are not yet adequate, but also to highlight what are the main problems such as security and information veracity.

All the pages for each site were totally evaluated. Besides usability problems, such as the lack of padronization and bad design, the sites reflected the lack of government responsibility for the digital inclusion. It is not enough to make infrastructure available for the citizen. It is necessary to guarantee an efficient interaction in the government Web applications. If the government is democratic and "for all", these characteristics be provided on the Web, as allowing citizen's an unrestricted participation, including those with special needs.

Brazilian government is spending money and effort to make e-gov reality. Citizens are willing to participate and cooperate. This joint effort should not be wasted. There is hope to make it right, but guidelines emphasizing security and information truth are required.

When issues are raised, which are relevant to both the citizen and the government, a set of measures must be established to evaluate e-Gov sites, so as to provide better quality. It is hoped that this research contributes to the process by raising new indicators to improve electronic government systems.

Developing e-Gov sites evaluation methods, as the one presented here, are the first steps to understanding the problems. Next, and more importantly, guidelines are been developed to build efficient e-Gov sites.

## References


1. Kuk, George, Gow, Ian. Digital divide and quality of electronic service delivery in local government. In 2002 International Conference on the Digital Divide: Technology & Politics in the Information Age. 2002.
2. Tambouris, Efthimios, Gorilas, Stelios and Boukis, George. 2001. Investigation of Electronic Government. Avaible in : www.eurociti.org.br, 12/02/2005.
3. Watson, T. Mundy, B.. A Strategic Perspective of Electronic Democracy. In Communications of the ACM, Vol. 44, No. 1, pp. 27-30. 2001
4. Nielsen, J. Usability Metrics. Disponível em http://www.useit.com/alertbox/20010121.html, 15/05/2004.
5. Nielsen, J. Usability Engineering. Boston: Academic Press, Cambridge, MA, 1993.
6. Zazenlenchuk, T,. In Search of the Holy Grail:Alternatives to Nielsen's Heuristics. 2004. http://www.indiana.edu/~usable/utips/february_03.htm, 13/01/2005.
7. Nielsen, J. Ten Usability Heuristics. Available on http://www.useit.com/papers/heuristics/heuristic_list.html, 14/10/2004.
8. Nielsen, J., Designing WEB Usability: The Practice of Simplicity. New Riders Publishing, 2000.
9. Garcia, A.C.B; Pinto, F.; Ferraz,I.N. Technology as a new backbone to democracy. In:WEB BASED COMUNITIES 2004 IADIS INTERNATIONAL CONFERENCE, 2004, Lisbon. Iadis International Conference Proceedings. Lisbon: IST, 2004, 572p. p.215-222.
10. Chalin, A. et al. E-gov.br: a próxima revolução brasileira : eficiência, qualidade e democracia : o governo eletrônico no Brasil e no mundo. São Paulo: Prentice Hall, 2004. 380p. /in portuguese/
11. e-Ping-Versão 1.0 do documento e-Ping. Available on http://www.governoeletronico.e.gov.br/governoeletronico/index.html. Assessed in October 2004. /in portuguese/
12. Governo Federal. Cartilha de Usabilidade para Sítios e Portais do Governo Federal – Versão 01 – 30/06/2004. Assessed in July 2004. /in portuguese/
13. Wood, F. et al. A Practival Approach to e-Governament Web Evaluation. IEEE Computer Society. p. 22-28. 2003.

# Addendum: Examples of Checklist items

Options: (2) - Always, (1) - Sometimes, (0) - Never/Option not applicable.

| Components | Sub-items | Indicate option |
|---|---|---|
| Visibility of system status | Provides *feedback* information on user location. | |
| | Keeps user informed regarding processing progress. | |
| Match between system and the real world | Uses metaphors common to citizen's real world. | |
| | Other: _____ | |
| User control and freedom | Guides users to non-existing links. | |
| | Requests user confirmation of relevant actions before executing these... | |
| Consistency and standards | Uses an information hierarchy pattern, creating specific pages for each specific navigation level. | |
| | Standardizes scheme for colors, font, ..., links, including e-gov sites. | |
| Error prevention | Informs which fields are mandatory and how each field should be filled out. | |
| | Calls the user's attention when field completion is incorrect. | |
| Recognition rather than recall | Relevant or commonly sought information is highlighted in the site. | |
| Flexibility and efficiency od use | Offers shortcuts so those more experienced users can access information with fewer clicks. | |
| | Personalizes pages to suit different citizen profiles. | |
| Aesthetics and minimalist design | Information is provided in progressive detail levels. | |
| | Avoids scrolling. | |
| Help users recognize, diagnose, and recover from errors. | When filling out forms, the site informs the user what is causing the error and instructs on how to correct it. | |
| | In case of failure, previously input items can be rescued. | |
| Help and documentation | Offers help tool. | |
| | Offers personal help resources online and in real time. | |
| Accessibility | Allows visual perception through text markers. | |
| | Site compliance with W3C recommendations. | |
| Interoperability | Offers document under patterns xml, swx, rtf, pdf , txt, htm or html. | |
| | Foresees gradual substitution of "login/password" for access (preferentially for intelligent cards). | |
| Security and privacy | Uses digital certification. | |
| | Uses virtual keyboard for password input. | |
| Information truth and precision | When necessary, informs last update of each page. | |
| | When necessary, informs date of each displayed content. | |
| Service Agility | Offers other contact means besides Internet. | |
| | User requests are complied with in due time. | |
| Transparency | It monitors the budgetary execution. | |
| | Renders public account to citizens. | |

# Organisational Changes, Skills and the Role of Leadership Required by eGovernment

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**Abstract.** This paper is based on a research project presently carried out by the European Institute of Public Administration (EIPA). The Ministry for Public Service in Luxembourg has requested EIPA to conduct a report on "Organisational Changes, Skills and the Role of Leadership required by eGovernment" to provide a basis for discussions during the EU Presidency of Luxembourg in the eGovernment working group of the European Public Administration Network (EPAN) in the first half of 2005. The report should provide some input for the recommendations to be agreed upon by the Director-Generals responsible for public administration in the EU by the end of 2005. The report will be finalised in June 2005.

## 1 Introduction

The present working plan of the European Public Administration Network Working Group on eGovernment sets out a list of priorities for the years 2004-05, among them "Organisational changes, Skills and the Role of Leadership required by eGovernment", which include:

- Organisational changes required to implement eGovernment services fast;
- Models through which organisational changes take place;
- Requirements of modernised service delivery processes regarding the sharing of data, business process redesign and human resources;
- Acquisition of the different skills (not only ICT skills) which managers and clerical staff need in order to govern and manage change.

In its 2003 Communication, the European Commission re-defined eGovernment as "...the use of ICT combined with organisational change, new skills in order to improve public services and democratic processes and public policies". [11] However, eGovernment is more than that: It implies major socio-economic innovations and politico-administrative institutional changes based on new IST applications and developments. Transforming culture is thus a key dimension of eGovernment. It is well known that existing institutions of social and political life exert a strong influence on the behaviour and attitudes both

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of the general public and of the civil service. "The way we do things here" can never be changed easily through technical re-engineering. The institutional setting influences the nature of innovation in government and it determines its pace and selectivity. eGovernment programmes must therefore develop strategies and change management processes that focus on cultural issues and closely involve the stakeholders (in particular public employees) as full partners of the change process.[1]

It has been acknowledged that eGovernment calls for strong leadership at different levels to provide a strategic vision for and the operational implementation of innovation and change processes in public administration. Politicians and public sector managers need to be committed to investing in the future with a long-term view. All too often political leaders long for visible results (i.e. essentially service delivery) within their terms of office. However, such considerations of immediate political survival lead to fragmented if not backward processes. Decision makers will need to gain a thorough understanding of the issues at stake in order to sustain the fast growing political interest in eGovernment and to direct it towards meaningful goals. A new approach is required for everything from procurement to the major principles and values of privacy legislation. This transformation cannot be accomplished by the public service alone but requires strong, committed and informed leadership at the political level. Leadership and the commitment both of politicians and public sector managers are crucial in order to manage change.[2]

Cooperation is a great challenge since it involves the departure from deeply ingrained behavioural structures. Identification with the goals of the agency or body to which one belongs is often stronger in the public sector than elsewhere. Many obstacles have to be overcome, including many competing goals, a dense grid of regulations, the fragmentation of traditional public sector institutions and many historical legacies. Our richness in diversity of cultures poses a major challenge to the unity that is required to make eGovernment work effectively and efficiently. The way we think, live and work together varies. Actors are embedded in different structures and have different policies, visions and attitudes. There is a need for a win-win approach enabling us to establish common goals and standards (e.g. a common service platform). This is not only true for the pan-European level but also for national, regional and local administrative systems. During the last few years, encouraging signs of enhanced cooperation have been observed. Interorganisational and interdepartemental cooperation, which is of vital importance for innovation alliances, has considerably increased.

Putting people first is a precondition for success: the interests, expectations, fears and dangers which eGovernment solutions give rise to must be addressed proactively. Moreover, eGovernment must not be confined to information processing within the modernisation of administrations, but should be geared towards knowledge management and good governance. Cooperation among stakeholders, including at European level, is a prerequisite in this process. Naturally,

[1] EIPA Como report.
[2] EIPA Como report.

public service ethics must be revitalised in this process of transformation. While government may learn a lot from business management, work organisation and personnel practices, its difference also needs to be recognised. eGovernment will only be successful if people in the public sector can be brought "on board". However, there is widespread concern among public employees that the increased productivity due to eGovernment will translate into job cuts. Such fears must be addressed and two intertwined lines of action should be implemented everywhere in that respect:

- Employees and their representative unions should be involved in cooperative change management;
- The basic and specialist skills needed for effective eGovernment must be identified and provided through vocational training for all public employees and managers. Investment in appropriate skills will ultimately pay off. Some Member States have started to set up skill maps as part of their eGovernment strategies.[3]

## 2 Required Skills

The relevance of a skilled labour force has recently been emphasised in the Kok report and, more specifically, in relation to eGovernment, in the CoBra Recommendations to the eEurope Advisory Group: "Successful transformation will only be possible with the full commitment and engagement of all stakeholders. In this context civil servants are key actors in the transformation of the administrations. Skills training of civil servants with respect to new ways of working and networked governance are essential".

The increasing importance of ICTs and the Internet for public administration calls for complex skills to drive change in government. In terms of eGovernment, ICTs and the Internet imply modernised service delivery processes regarding the sharing of data, business process redesign and human resources. This in turn requires organisational change, new top level leadership (*eLeaders*), with mid-level leadership (*eChampions*) supporting their work. Both clerical staff and managers need to develop a new and challenging set of skills.

A new type of manager is required with a complex vision, integrating the reengineering of work processes, administrative structure(s) and culture(s) with a citizen-centred approach, bearing in mind that ICTs and the Internet are at the core of those new competencies. Managers must be able to lead (and not be led by) the organisation's IT department and outside partners and must be able to integrate the organisation's ICT strategy into its broader goals. Apart from basic technical skills, general managers need an understanding of information management and the information society. [7] This new type of (general) manager must have traditional knowledge and public management skills, i.e. HRM, organisation, financial management, etc.; skills in network management

[3] EIPA Como report.

in different policy areas such as health, education and social work; basic IT literacy; as well as knowledge and skills in the management of information systems, communication networks and related aspects of information society policy.

The 2003 OECD analysis will serve as a point of departure for further analysis of the skills required for both public sector managers and employees. For details see table 1 below.

**Table 1.** Essential skills for dealing with eGovernment processes

| Skills | Needed by |
|---|---|
| **Information Technology**<br>Basic IT literacy<br>Specialist IT skills | All employees, **managers** and IT specialists |
| **Information management**<br>Internal information management<br>External information management<br>Privacy protection<br>Feedback mechanisms | **Managers** and IM specialists |
| **Information Society**<br>Understand capabilities of ICT<br>Ability to evaluate trends<br>Foresee ICT's impact on organisational culture<br>Ability to set ICT strategy | **Managers** |
| **Management/Business**<br>Organisational change<br>Risk management<br>Accountability frameworks<br>Financing arrangements<br>Cooperation and collaboration<br>Public-private partnerships | **Managers** |

Source: OECD

Decision makers in the EU have emphasised the importance of new skills for effective eGovernment implementation on various occasions. More specifically, the Mid-Term Programme 2004-2005 for Cooperation in Public Administrations in the EU aims at "identifying the acquisition of the different skills (not only technical skills) which are needed by managers and clerical staff to govern and manage change. By the end of 2005 the eGovernment skills required will be appraised and recommendations will be agreed by the Member States" [3]. To date, a variety of training schemes (short term) and educational programmes (postgraduate programmes) have been developed in the EU Member States (e.g. UK, Finland, Italy, Austria, Germany, Estonia to name but a few. A recent EU study has confirmed that approaches to the training of public employees vary in the EU, with responsibilities for training being quite scattered among the different levels of administrations in the EU Member States [3]. For details see table 2 below.

At present, a European training curriculum does not exist. However, training programmes within the EU Member States very often follow the scheme outlined by the OCED (see also table 1). Various Member States are developing programmes to support the development of staff skills, in line with the complex evolutionary process underway. Subjects linked to leadership skills and the

**Table 2.** Training systems in EU Member States (ex EU-15)

| EU Member States | Semi-decentralised | Decentralised | Centralised |
|---|---|---|---|
| **Austria** | | X | |
| **Belgium** | X | | |
| **Denmark** | | X | |
| **Finland** | | X | |
| **France** | X | | |
| **Germany** | | X | |
| **Greece** | X | | |
| **Ireland** | X | | |
| **Italy** | X | | |
| **Luxembourg** | | | X |
| **Portugal** | X | | |
| **Spain** | | X | |
| **Sweden** | | X | |
| **The Netherlands** | | X | |
| **United Kingdom** | X | | |

Source: Hellenic National Center for Public Administration (2003)

digitalisation of the public administration are the main common priorities for training in the public sector in the EU according to a recent EPAN study [3].

## 3 Objectives of the Study

In response to the challenges described above, the Ministry for Public Service in Luxembourg has requested the European Institute of Public Administration (EIPA) to draft a report on "Organisational Changes, Skills and the Role of Leadership required by eGovernment" to provide a basis for discussions during the EU Presidency of Luxembourg in the first half of 2005. The report should provide some input for the recommendations to be agreed upon by the end of 2005.

More specifically, the report will

- describe the context in the EU Member States (MS),
- identify learning points and transferable good practice with regard to organisational change, skills and leadership requirements,
- focus on the identification of the new skills required,
- attempt to draw up a list of recommendations for future action which focus on the identification of skills.

## 4 Methodology

The following methodology will be applied:

1. A questionnaire for the relevant contextual information will be sent to the EPAN eGovernment Working Group members.

The questionnaire aims to identify:

- what measures MS propose to encourage organisational change;
- what measures MS propose to encourage leadership;

- how national eGovernment strategies and action plans include measures on skills;
- what programmes exist;
- what could be done at the European level/in the framework of EUPAN.

2. Case studies and (semi-structured) interviews

Approximately 5-10 cases will be analysed. Existing sources such as the eEurope Awards, back office study, etc. will be used as well as additional cases to achieve a balance in terms of the size of MS, geographical spread, different levels and types of administrations and different policy sectors.

Each case (or group of cases) will be assigned to a country representative who will be in charge of the analysis of the case which will include a visit to and interviews with the responsible administrations.

In terms of actors, we will focus on two types: employees (or ordinary civil servants) and managers/leaders, in line with the OECD schema above. We will not look at specific tasks like IT specialists/managers or information managers.

## 5 First Stage Findings

Effective eGovernment implementation requires changes to skills and the skill acquisition process of staff. Basic ICT skills (such as use of a PC, mobile devices, standard programmes) are a precondition for both ordinary civil servants and managers. More advanced ICT skills (e.g. software development, web-design, database design, the use of specialised programmes, etc.) can also be required depending on the type of work to be performed.

In addition, however, modern working conditions often require further mixes of generalised and more advanced skills and competencies. In a fast changing government work environment, with a wide variety of work forms and perhaps also contractual arrangements, there is an increasing need for individuals to take more responsibility for their own work and sometimes also their own skills development. This includes fostering abilities like self-organisation and self-management, inter-personal skills, dealing with unexpected rather than routine situations, greater initiative and self reliance, etc.

Much work is increasingly being organised on a 'project' basis, i.e. individuals or teams are given a specific task or project, some resources, quality requirements and a deadline. How, where and when the work is carried out in detail, as long as these requirements are met, is left to the workers themselves. Coping with the extra responsibility, and perhaps stress, this can cause needs to be acquired as a skill in its own right. Although many work processes remain routine in both traditional and eGovernment contexts, most government workers are being exposed to these new demands on their abilities. Indeed ICT can, in the best circumstances, take over routine functions leaving workers free to undertake more interesting and specialised tasks, for example as 'case workers' having direct citizen contact.

ICT thus has a somewhat paradoxical effect on skills and competencies, requiring simultaneously both more and less independence on the part of the individual worker. On the one hand, ICT contributes to placing more responsibility on individuals to enhance their own skills profiles, especially in contexts where there is more independent working (including teleworking, or eWorking, where staff may work some of their time at home, on the move, or at different geographic locations), and where each employee has specific responsibility to complete her or his work successfully. On the other hand, the complex nature of new types of work, and the knowledge needed to successfully complete it, often requires greater inter-working, cooperation and team work, i.e. more reliance on others both within and outside the government organisation.

It is the task of managers and leaders to develop and implement eGovernment policies and strategies and ensure that their own skills, plus the skills of ordinary civil servants, are upgraded to cope with this. A crucial component here is ensuring that organisational and other changes take place in the context of eGovernment which maximise efficiency and effectiveness (and this includes fostering the well-being and working conditions of civil servants) and providing enhanced services to users (citizens and business), thereby contributing directly to an increase in public value.

This means that government organisations, like private companies, must increasingly provide continuous learning for individual employees in order match the fast changes taking place in the new public management environment. In addition, this individual skill enhancement must be seen as part of a broader 'organisational learning' strategy, i.e. the management and exploitation of knowledge within the organisation. Only if governments are able to systematically preserve and manage the collective and interchangeable know-how of their workforce, thereby reducing the threat posed by departing employees as well as ensuring that the productive potential of the organisation is fully maintained and exploited, will eGovernment succeed. Thus, knowledge management within government is closely related to the continuous learning of the workforce.

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## References

1. CoBra Recommendations to the eEurope Advisory Group, Amsterdam 27-28 September 2004
2. Criado, J. Ignacio, in: Construyendo la e-Administración Local. Las Tecnologías de la Información y laComunicación e Internet en los Ayuntamientos de la Comunidad de Madrid. Madrid: Instituto Complutense de Ciencia de la Administración.
3. EPAN Study on current and future use of new technology in human resources management in European Public Administrations (2003), presented to the EU Directors of Public Administration in Rome, December 2003
4. Leitner, Christine (2003), E-government in Europe: The State of Affairs, IDA Report and eGovernment News No.5, September 2003 edition

5. Mid-Term Programme 2004-2005 for Cooperation in Public Administrations in the EU, approved by the Ministers responsible for Public Administration in the EU on 1 December 2003.
6. New Local Government Network (2003). e-Government and Organizational Transformation. Lessons from Liverpool and Hertfordshire. London.
7. OECD (2003) Policy Brief, Checklist for eGovernment leaders
8. OECD (2003), The eGovernment Imperative
9. Report from the High-Level Group chaired by Wim Kok, Facing the Challenge: The Lisbon strategy for growth and employment, November 2004.
10. Strategic Computing & Telecommunications in the Public Sector (2000). Eight Imperatives for Leaders in a Networked World. Harvard: John F. Kennedy School of Government.
11. The role of eGovernment for Europe's Future, COM(2003) 567 final, adopted on 26 September 2003.

# PA's Boundaries and the Organizational Knowledge Processes

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**Abstract.** Some researchers propose a wide variety of technological tools that can improve the management of a specific knowledge. However, often those prescriptions are based only on the characteristics and on (promised) potentialities of the technological solutions. This paper is written on the premise that "[s]o as information technology tunnels deeper and deeper into everyday life, it's time to think not simply in terms of the next quadrillion packets or the next megaflop of processing power, but to look instead to things that lie beyond information" [3]. Our contribution analyses the main characteristics of the knowledge management strategy in the PA. Moreover the paper proposes the social practical perspective as interpretative framework for future researches.

## 1 Introduction

The new business environment, characterised by dynamic, discontinuous and radical changes, requires a deep re-thinking of business models, strategies, processes and key resources as they have been considered in the old economy. The enterprises have to compete in an environment with a very high complexity, where also small random events could cumulate and become magnified by positive feedbacks [1]. In this kind of scenario, the enterprise have to be always ready to react to a continual reassessment of organisational routines to ensure that the organisational decision making processes keep pace with the dynamically changing business environment. To reach this aim, knowledge is becoming one of the most important resources of firms because, in a turbulent and rapid changing scenario, the ability in "managing" knowledge guarantees an higher internal variety of possible solutions to the problems of the business change. Hence, it is widely accepted that firm's competitive advantage flows from its unique and valuable knowledge and from methods and processes that the enterprise adopts for managing it [16], [6], [15].

The importance of knowledge management is increasingly recognised both in business and public sector. However, knowledge management methodologies, tools and systems (KMS) have been developed in (and for) the business community, hence their application to the public sector need a deep re-thinking and adaptation work. The challenge for public administration is to find and develop a successful process of re-engineering, managing, distributing and, in one word, improving its knowledge [2].

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In order to understand the importance of an effective KMS in the public sector, it is important to consider that much of the public authorities' work refers to elaboration of data, information and knowledge on citizens, businesses, societies, environment, laws etc. Moreover, the development of e-Government projects deeply influences the public sector, requiring a rethinking of knowledge distribution and management. Ample access to remote information and knowledge resources is needed in order to facilitate the delivery of citizens' oriented services, a more efficient and effective communication and cooperation between administrations, and a support for complex administrative decision making. However, the attempts to experiment and implement KM based organisation models and information systems in the public domain are still in the early phases, although with different levels of development in the different countries.

## 2 The Research Problem

In all the industrialised countries, public administrations have significantly embraced new Information and Communication Technologies (ITCs) and they are undergoing important Business Processes Reengineering as (BPR) as result of e-Government projects. To enhanced this process, the public administrations have to focus their attention on the knowledge. This implies that knowledge have to be managed as a valuable asset and a key resource, and this necessarily implies an organisational change in the public sector (that at present manages only data and information).

The public administrations can be considered as huge knowledge firms since they collect and process data and information about citizens and companies as taxpayers, service consumers, criminal offenders, voters, soldiers, recipients of welfare, etc. The challenge for the public administrations is to exploit their knowledge resources in order to improve their processes and to offer more effective and efficient services to the users. In their traditional work processes, the administrations use information to generate other information; e.g. taxation information is being put to use when calculating tax payments, and service information is being put to use when citizens apply for public services [10]. Only in few cases this information is combined across offices or agencies, and rarely it is analysed by the different administrations in order to obtaining systematic knowledge. These problems are still up despite the introduction of the e-Government perspective in the public sector. The adoption of electronic systems is not sufficient to guarantee the switch from an information focused perspective to a knowledge based perspective. Often the e-Government processes are simply copies of the traditional information focused processes, even if based on the information and communication technologies, and hence they don't necessarily add value to the services.

A first objective of our research activities will be to obtain a deeper understanding of problems which have prevented knowledge management from spreading out in public administrations. Then we will focus on the concept of the communities of practice and the processes that, crossing their borders, could enable organizational cognitive activities. Moreover our research aims to analyse what are the organisational structures and business processes that could facilitate and promote a focused knowledge approach in PAs.

In order to well define the focal concepts used in our research activity, in the next section we will specify what we mean for knowledge, also distinguishing the differences between explicit and tacit knowledge. Then, in the following sections, we will try to define how knowledge can be managed in public administrations and which relationship exists among knowledge and the ICTs.

## 3 On Knowledge Processes

The first problem in analysing knowledge is to define what knowledge is. This debate is still open in literature, and different definitions are used. Two main positions can be highlighted in the knowledge definition debate: on one hand we can find the perspective of knowledge as a set of more structured information. Knowledge is a step of a scale, starting from the atomic data and ending with the wisdom through a more and more structured set of data and information. In such perspective data are the atomic notion about the state of the world, information is defined as a structured set of data that are endowed with meaning and purpose, knowledge is a set of connected information and wisdom is knowledge put in action [11].

Indeed at the opposite extreme, we can find the constructivist approach of Nonaka and Takeuchi that refers principally to the management studies literature [16], [8]. This approach explicitly introduces some cognitive mechanism of individuals, and shortly defines knowledge as a "justified true beliefs" [16]. The authors suggest that the individual can justify the truthfulness of his beliefs from observation of the world, and this process is grounded on a personal sense making, a unique viewpoint and individual experience. However the authors argue that the knowledge creation is a spiral-process, a social one which consists in the interaction and the combination of explicit and tacit knowledge through four possible different phases. Nonaka and Takeuchi [16] suggest that "the key to knowledge creation lies in the mobilisation and conversion of tacit knowledge". The term tacit knowledge, coined by Polanyi [17], [18], refers to knowledge that is personal, linked to a specific context, hard to formalize and difficulty to share. Tacit knowledge is deeply rooted in the individual's action and experiences, as well as the ideas, the values or the feelings. It cannot be formalised into an executable computer programme, and can hence not be subjected to automation. Therefore it cannot be easily managed even if it is the most valuable resource in the knowledge creation process. Instead explicit knowledge can be formalised in words or numbers, and it is easily sharable in manuals, papers, data, etc. Making explicit the tacit knowledge is an important step (*externalisation* phase) in the model of organisational knowledge creation developed by Nonaka and Takeuchi [16]. We have to underline that the phases in which tacit knowledge is involved are the most critical in the knowledge creation process, and during these conversion patterns is more difficult to manage the process.

Moreover Nonaka and Takeuchi argue that the conversion of tacit to explicit knowledge is facilitated by particular organisational models and structures. In this sense the public administrations, characterised by the rigidity of their processes and the intricateness of their bureaucracy, are not facilitating or enabling knowledge sharing. Bureaucracy organisation tends to centralise knowledge and to push knowledge upwards in the organisations instead of making it widely available [10]. Public administrations may be

described as huge knowledge repositories, but even if there is a lot of knowledge in that repositories, it is not necessarily available anywhere, anytime and for anybody. This means that knowledge is not effective managed in the public context, and that a lot of "wheel reinventing" processes are going on in the administrations. Hence it is clear that the concept of knowledge in public administrations is linked to the organisational structure and context, so the administrations have to change their traditional organisational model in order to facilitate the better manage and use of their knowledge.

## 4 Organizational Knowledge in PA and the ICT Support

In the last decade, private companies have developed a lot of different knowledge management approaches, methodologies, systems and tools because they have understood the crucial importance of managing knowledge. Only developing their internal knowledge base and enhancing the knowledge creation process, the enterprise will gain a consistent and durable competitive advantage. The question is to understand if the causes that have driven private companies to focus their attention and efforts in managing knowledge, could show in public administration the same effects in the same way [10]. Let's examine some of the reasons that could increase the attention of public administrations in managing knowledge.

Generally the public sector has an enormous size. This fact, combined with its geographical dispersions, implies that often crucial pieces of knowledge available at a specific place, that could be reused elsewhere, are not necessarily available at all the offices, departments or units. It could be a great advantage for the public administration the possibility to access to core knowledge of every service, having the opportunities to diversify some characteristics of the service according to the local context and variance. Another phenomenon that increases the attention about knowledge in the public sector is the outsourcing and downsizing process. In the public sector, as in the private one, some knowledge assets may be externalised (and hence disappear form the organisation) with the outsourcing services. But the risk is to loose crucial pieces of knowledge that are rooted in particular individual that will change their job. Sharing knowledge among the members of the organisation could facilitate maintaining core knowledge and competencies inside the organisation' boundaries even if one or some of the employees will be no more in the PA.

Moreover we have also considered the influences of an increasing competitive pressure on the public administrations. This is not a valid consideration for public administration in general, but it is true for parts of the public organisations, as, for example, the service providing agencies. Privatisation processes, outsourcing and pressure for improved public services make possible to consider also a public sector influenced by the competitiveness and driven to a more knowledge based approach. Finally cheap computing enables public administrations to promote e-Government services and to focus their attention on the sharing of data and information. All these consideration induce to consider KM as a crucial approach in the public context. But it is important to underline another aspect about knowledge: it is deeply tied to human actions and to relationship among organisations' members. To manage knowledge is a very complex process: it is not easily to capture, to formalise, to share, to create knowledge, and it is not simply

to convince the employees to do it. Hence for implementing a successful knowledge management in a public organisation, it is necessary to motivate the people and to re-organise and to re-think the bureaucracy structure.

According to Carlsson [6], we suggest that KM "has to become network-focused if knowledge intensive firms' are to gain and sustain competitive advantage from knowledge management". There are a number of empirical studies that can support and confirm this idea. For example Powell et al. [19], in a study in the biotechnology industry, suggest that the network of firms, and not the single firm, is the primary source of innovative ideas. Also Kogut [13] proposes a formalisation in which the productivity of a firm is directly dependent from the value imputed to membership in a network (network capability). Moreover, the research area focused on the industrial districts concords about the importance of a network organisational model in order to enhance and improve the effectiveness of knowledge management approach in an enterprise [4], [7], [12], [14].

It is extremely difficult to try to implement a knowledge management system without technology, but, otherwise, technology by itself doesn't make knowledge management system work. ICT is an enabler of connections, relations, and communications but it is not able to make them happen. ICT could facilitate the creation of knowledge by allowing people to effectively interact, but cannot force them to do it. Knowledge management consists in working with people and their ideas, since the introduction of ICT must be adapted to each group, community, department or administration. It may not be possible to find a unique technological solution that is suitable across an entire enterprise if we don't consider the differences among groups, departments and offices and their particular needs. Moreover technological choices should be related to the nature of the knowledge that is managed and to the organisational structure of each group. Therefore the technological solutions adopted depend on what the organisation is trying to achieve differentially in different communities or departments.

ICT is characterised by its double ability to automate operations and simultaneously generate information about the underlying productive and administrative processes. But changing the public administrations attention from information focused automation towards knowledge focused applications is not only a question of technology. This process needs an organisational and structural re-thinking of public sector, giving a value to the rising local experiences. Hence, different technological solutions, like internet portals, knowledge bases, groupware, forum and so on, have to fit with a more dynamic and innovative organisational structure, more suitable to the users' needs.

## 5 Communities of Practices

As Brown and Duguid [3] suggest, we consider that "[p]ractice [] creates epistemic differences among the communities within a firm, and the firm's advantage over the market lies in dynamically coordinating the knowledge produced by these communities despite such differences" (p.198). Part of literature recognizes that knowledge is generated inside the community of practices (CoP) [22] or that organizations are social interpretative systems [9]. Hence our contribution is focused on the concept of practice, considered "as the way in which work gets done and [] knowledge is created" [3]. Con-

sidering the social practical perspective, each CoP exists since its members have shared experiences; they have contributed to a common knowledge and developed a collective interpretative perspective. CoPs have their own identity, hence they have built up social boundaries (more or less strong) in order to distinguish themselves from other groups.

CoPs need to preserve their boundaries to maintain their identity and their characteristics, but at the same time, being a member of a community also means to be an active part in managing the relationships between the own community and other groups. Moreover, according to several authors [5], [22], connecting different variety of actors creates the opportunity to generate innovation, thus new knowledge can be created. Wenger [21] has pointed out the importance of these social processes of knowledge and interpretation management into and among the CoPs. He has introduced the concept of "negotiation of meaning", as a continuous and dynamic process of mutual agreement among different persons or CoP. As Wenger [21], [22] suggested, the negotiation of meaning could be represented by the interaction of two processes: participation and reification. "Participation refers to a process of taking and also to the relations with others that reflect this process. It suggests both action and connection." [21] Participation is an active process through which the members of different communities become part of each other trough mutual recognition. Participation should be viewed as an active process in which the possibility to mutually recognize, identify and accept members of different communities, is the characteristic element. The concept reification is the mental process by which it becomes possible to translate in real terms something that only has an abstract existence. "We project our meanings into the world and then we perceive them as existing in the world, as having a reality of their own." [21] Practically this process happens when we, projecting our meanings in the world, perceive them as "real": for us they exist objectively. The concept of reification is referred to the process of molding our experiences through the production of objects that will freeze this experience.

We are now going to focus on some concepts we have previously explained, in order to notice that both, participation and reification can contribute to connect different communities through their boundaries. Wenger [21] considers two different mechanisms of connections among communities: brokering (based on the participation process) and boundary objects (based on the reification process). Brokering is the possibility to belonging to different communities and to be able to transfer different practices from one to another. Brokering process consists in translating, coordinating and aligning different perspectives from multiple communities. Hence the brokers could create new connections among communities, facilitating the coordination and discovering new perspective. Leigh Start [20] started to use the term boundary object in order to describe those objects by which it is possible to coordinate the perspectives of different communities. Inter-group connections created in this way are "reificative" since they use reification to connect groups that do not use the shared practice. Thus the result is that those objects allow inter-community communication without creating links between perspectives and meaning of the various groups. Therefore, the boundary object function as coordinator among groups, but his does not imply that the perspectives of the groups are the same. As connections through participation differ from those created through reification, the same dichotomy exists between brokers and boundary objects. For instance, reification

creates links among communities which go beyond the limitations of time and space typical of participative connections. On the other hand, reification (or boundary object) could be easily misunderstood if it becomes an isolate object without any kind of individual participatory engagement. However, to become boundary objects, software and artefacts must have specific characteristics and they must be consciously used. If this is not the case, the boundary object will strength the power position of one group reinforcing the boundary rather than bridge it [22], [5]. The characteristics of boundary objects are explained in the following section.

## 6 Future Research: Boundary Objects and Software Code

Wenger [22] discusses three characteristics for objects to work as boundary bridges. First, everybody must be able to use them. This reflects the need to represent knowledge that is embedded in practice. Second, they must show real differences as well as common ground. Real differences are needed to make the object interesting; common ground is needed because otherwise the object will not be understood at all by one of the parties. Third, both groups must depend in some way on the knowledge transferred by the boundary objects so that there is the incentive for adjusting experiences and competences.

Following these points we can consider, for example, software as a possible boundary object. In details we could analyse one of the most interesting topics, the open source development model, from a social practical perspective based on community of practices and negotiation of meaning. The open source phenomenon is going to become very important also in the public administration domain. It concerns different aspects, such as coordination mechanisms, intellectual propriety rights, distribution models, innovation strategies and reuse policies.

Possible future research could investigate the link between public organization and open source development models, analyzing strength and weak points that OS software could add to the public administration. Our contribute would points out that this, and other future researches, should take into consideration the importance of a social practical perspective in analyzing organizational phenomena. Studying the rising of the communities inside an organization and its interactions with others communities could enable a deeper understanding of organizational dynamics. This process could facilitate the analyses of different eGovernment tasks and guidelines, since the social aspects have an important role in assuring the success or failure of a project.

## References

1. Arthur, Brian [1996]. “Positive Feedbacks in the Economy”, Scientific American, 262, p. 92-99.
2. Bolici, F. and A. D’Atri [2002].“On Knowledge Management in Italian Public Administrations”, in Proceedings of E-Learn2002. October 15-19, Montreal, Canada.
3. Brown, J.S. and P. Duguid. [2000]. The Social Life of Information. Boston: Harvard Business School Press.
4. Capello, R. [1999]. Spatial Transfer of Knowledge in High Technology Milieux: Learning versus Collective Learning Process. Regional Studies, 33 (4), pp. 353-365.

5. Carlile P.R., [2002], A Pragmatic View of Knowledge and Boundaries: Boundary Object in New Product Development, Organization Science, 13 (4): 442-455.
6. Carlsson, S.A. (2001). "Knowledge Management in Network Contexts", Proceedings of the 9th European Conference on Information Systems (ECIS-2001), Bled (Slovenia), pp. 616-627.
7. Corò, G. and R. Grandinetti [1999]. "Evolutionary Patterns of Italian Industrial Districts". Human Systems Management, 18, pp. 117-129.
8. Davenport, T. and L. Prusak [1997]. "Working Knowledge: How Organisations Manage What They Know". Boston: Harvard Business School Press.
9. Daft, R.L. & Weick, K.E. (1984). Toward a model of organizations as interpretation systems. Academy of Management Review, 9(2): 284-295.
10. Friis, C. [2002]. "Knowledge in Public Administration" in the Proceedings of the Workshop on Knowledge Management in e-Government '02. Copenhagen, May.
11. Gamble, P. and J. Blackwell [2001] "Knowledge Management: a State of the Art Guide". London: Kogan Page.
12. Gulati, R. , N. Nohria and A. Zaheer [2000]. "Strategic Networks". Strategic Management Journal, 21, pp. 473-496.
13. Kogut, B. [1998]. "The Network as Knowledge". Wharton School Working Paper.
14. Kogut, B. [2000]. "The network as knowledge: generative rules and the emergence of the structure". Strategic Management Journal, 21, pp 405-425.
15. Nonaka, I. and D.J. Teece (Eds.) [2001]. Managing Industrial Knowledge: Creation, Transfer and Utilization. London: Sage.
16. Nonaka, I. and H. Takeuchi [1995] "The Knowledge Creating Company. How Japanese Companies Create the Dynamics of Innovation". Oxford: Oxford Unity Press.
17. Polanyi, M. [1958]. "The Tacit Dimension". New York: Doubleday & Company.
18. Polanyi, M. [1967]. "Knowledge in Organisations". Boston: Butterworth-Heinemann.
19. Powell, W. et al. [1996]. "Learning from collaboration: knowledge and networks in the Biotechnology and Pharmaceutical Industries", California Management Review, 40 (3), p.228-240.
20. Star, S.L. [1989]. The Structure of Ill-Structured Solutions: Boundary Objects and Heterogeneous Distributed Problem Solving, in Huhn, M. e L. Gasser (eds.), Readings in Distributed Artificial Intelligence. Menlo Park, USA: Morgan Kaufman.
21. Wenger, E. [1998]. Communities of Practice. Learning, Meaning and Identity. N.Y.: Cambridge University Press.
22. Wenger, E. and W.M. Snyder [2000]. Communities of practices: the organizational frontier, Harvard Business Review, 78, I, p.139-145.

# Providing Pan-European E-Government Services with the Use of Semantic Web Services Technologies: A Generic Process Model

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**Abstract.** In this paper, we present our experience of using the Governance Enterprise Architecture (GEA) for designing Pan-European eGovernment Services (PEGS) implemented by Semantic Web Service (SWS) technologies. GEA consists of a set of models and serves as a top-level generic Enterprise Architecture for the overall governance domain. Here we use one of the GEA models (the generic process model for service execution) as a blueprint, and instantiate it in the specific business (cross-boarder new company establishment) and technology setting (SWS). Although based on a specific business case, the paper generalizes and focuses on the case-independent, core aspects of PEGS provision with SWS to present a reusable model. For presenting the model, we employ a use case-based, narrative description.

## 1 Motivation

During the last years, there is an increasing interest, and research in the fields of Service Oriented Architectures, Web Services, and the Semantic Web. The conjunction of these three has recently resulted in a growing literature [1], coupled with some modest implementation results in the emerging field of Semantic Web Services [11]. The work conducted under these lines combines the flexibility, reusability, and universal access that typically characterize a web service, with the power of semantic mark-up, and reasoning in order to make feasible the invocation, composition, and automatic execution of complex services with multiple conditional paths of execution, and nested services inside them [7].

Although still in this premature level of development, the semantic web service paradigm provides a very promising infrastructure for next generation e-government services [8], [18]. A number of European research projects on the field of Semantic Web Services for public administration (PA) is currently under progress. All projects face more or less the following problems: (a) There is no generic domain analysis for the overall PA system at any level of granularity. (b) There are no generic PA models for processes, and objects. (c) There are no ontologies for modeling PA objects and relationships. (d) There are no standard vocabularies for describing PA concepts.

Due to this shortage, the researchers have to build from scratch, PA ontologies to be used as test-beds for demonstrating the functionalities of their systems. This is problem-

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atic for many reasons, as these initiatives re-invent the wheel (without actually inventing it!). Apparently, the main focus of these initiatives is not to build a PA domain ontology, but rather to test and validate specific technological solutions. This results in proposing ad hoc descriptions for the PA domain and far from being considered reusable. At the same time, in the USA, the Department of Defence (DoD) has recently assigned to MITRE SA to examine current candidate standard upper ontologies and assess their applicability for a U.S. Government or U.S. Military domain [19].

## 2 Past Work

During the last years, and trying to address the lack of a domain analysis for PA, we have been working towards the creation of a top-level description for the PA domain. The deployment of the Governance Enterprise Architecture (GEA) has been the main result of this work, so far [14]. GEA consists of a family of data and process models describing in a generic fashion the overall governance system. We define the governance system as the aggregation of two sub-systems, and more specifically (a) the "Provide Public Service", and (b) the "Formulate Public Policy" sub-systems [20]. The methodology used for deploying GEA has been basically top-down: we employ public administration theory for the parts where we could find ready-to-use models, [4], [9] and apply the Language Action Perspective (LAP) theory [3], [24], [10] to model the society – public administration interaction as a linguistic communication [14], for the parts of the architecture that PA theory could not provide adequate descriptions (e.g. the field of service provision). Parts of the GEA have been verified bottom-up during the design, and implementation of real eGovernment services, mainly through the work conducted under the InfoCitizen [22], [23], and the EU-Publi.com [21], [12] IST R&D projects.

The generic process model for executing a PA service is amongst the GEA models [16]. The model analyses the sequence of PA service execution. In this paper, we used this generic process model, as a blueprint in order to design the service provision process, in a specific setting: Pan-European eGovernment services (PEGS) provision using Semantic Web Service technologies.

These types of services attract the interest of the EU IDABC programme [2] and fuel the work related to the European Interoperability Framework [6]. Recently, a set of seminal reports has been drafted by CapGemini regarding PEGS [5]. The work presented here could serve as a valuable input to this general line of work.

The model presented below has been constructed during the EU-Publi.com project. We used the GEA model to design a specific business case of PEGS: the "new company establishment" service, as provided by Greek public authorities to Italian citizens. The project pilot employed the GEA model, using SWS technology. Here, we present the abstraction of this case specific model, in order to propose a general description applicable in different business cases of public services.

## 3 Model Presentation

The general problem to be addressed in the above setting and thus the scope of the model presented could be expressed as follows:

An entity E (person, company, organization) acting as a client and located in an EU country A, needs to receive a service that is produced by a public administration agency PA_B located in an EU country B…

**Fig. 1.** The problem to be addressed

It is obvious that this description is broad enough to include any kind of PEGS delivery. Moreover, this scenario covers the provision of national public administration services, where instead of PA_B, we may have PA_A, without serious implications to the description, except from the fact that in this case the execution is much simpler.

In the table that follows, we have kept the major phases of planning, input & processing, and output from the generic description and we present a list of generic use cases, which describe the process of the service execution in a Semantic Web Service environment, as derived during the implementation of the EU-Publi.com pilot. Then, we describe each phase, and use case in details. We choose a use case based presentation to give a narrative, explanatory, and reader-friendly description of the model.

**Table 1.** Generic use cases for electronic PA service provision

| |
|---|
| **PLANNING PHASE** |
| *USE CASE 1: The Client identifies and locates the service URL as provided in country B* |
| *USE CASE 2: The Client explores the Service* |
| *USE CASE 3: The Client (with the help of the Service Provider) instantiates or "tailors" the service* |
| *USE CASE 4: The Client explores the instantiated service* |
| *USE CASE 5: The Client triggers and the Service Provides logs the new case* |
| **INPUT & PROCESSING PHASE** |
| *USE CASE 6: The Service Provider finds, collects and processes evidences* |
| *USE CASE 7: The Service Provider (with the help of SWS technologies) solves semantic discrepancies* |
| **OUTPUT PHASE** |
| *USE CASE 8: The Service Provider prepares and communicates the output of the service* |
| *USE CASE 9: The Service Provider handles the consequences of the service* |

### 3.1 Planning Phase

In this phase, there is a set of use cases, which serves as a means for the client of the service to *identify, explore, tailor and orchestrate* the electronic version of the service in the web. We have called this phase "Planning" to clearly distinguish it from the actual execution of the service. This separation has a sound theoretical basis: following the Language Action Perspective, we distinguish two types of citizen-PA conversations: informative, and performative [17], Mulder et al. 1999). The planning phase of PA service execution constitutes the informative part, while the execution phase, the performative part of the overall citizen-PA conversation. The planning phase ends with the service invocation.

The use of SWS entirely changes the way the Planning phase is performed. Briefly this new way of execution is characterized by the disengagement of the client from the process, in the sense that all the communications, contacts and visits have been substitute by specific information system's functions. Thus, the client of the service

becomes able, to run all the planning phase from his/her PC, to drastically cut down the overall time for getting all the relevant information and to manage complicated services without any external help.

More specifically in this informative phase the first step is to support him/her in finding and identifying the correct service (actually the correct URL where she/he can get the service), and to assist him/her to explore and tailor it to his/her specific needs without needing professional help.

The use cases that follow present generically these planning features for any type of public administration service.

**USE CASE 1: The Client Identifies and Locates the Service URL.** The first step of the planning phase is to support the client in finding and identifying the correct service (actually the correct URL where she/he can get the service).

As the client needs a service from another country, there is a need to provide him/her with an infrastructure that will allow him/her to locate the service's URL in a different country.

Trying to identify a service (and the service provider) in a foreign administrative system increases the already existing difficulties at a national level. For example, the type of the service provider for a particular service may differ from one country to another. Geographical fragmentation, and central versus regional service provision may also reveal great differences between administrative systems. The problem could be expressed as "*WHO* (public administration agency) provides WHICH service electronically and from *WHERE* (URL address)". To address these issues, we introduce two new infrastructures:

(a) The *National Web Service Repository (NWSR)*. This is an electronic repository, available in the web, which holds meta-data information for public administration services available as e-services at the national level. It could be implemented as a type of semantically enhanced UDDI registries.

(b) Then, at the European level, one single portal would provide access to all national repositories. This portal is part of the *European Web Service Broker (EWSB)* infrastructure or a Communal Semantic Gateway [5].

Using the EWSB the client reached the NWSR that stores the links to all the public administration services available as e-services for the country of interest. The client enters key words in a query interface and the NWSR returns the selected services. The use case ends with the NWSR providing the URL to the client.

**USE CASE 2: The Client Explores the Service.** The client needs information about the service, so he/she uses the URL provided in the previous steps and accesses the relevant information stored in the NSWR. NWSR holds brief descriptions of all stored services.

There are two important limitations to the service descriptions as exist in the NWSR.

- The service execution may follow numerous alternative paths depending upon conditions that could not be known in advance, but decided during the service execution.

– Depending on the administrative system of each country, the service execution may differ (e.g. the registration of one's child birth, as executed in various municipalities of the same country).

Thus, a detailed service description may not be feasible, at the NWSR level.

**USE CASE 3: The Client "Tailors" the Service.** "Tailoring" here, means all the necessary preparatory actions that need to be performed by the system in order to automatically guide the client through a (usually) complicated set of possible alternatives in order to identify the exact and correct version of the service of interest.

As the client expresses his/her interest to identify the specific provider for the service under request, the NWSR returns a set of questions that will be used by the system for the service provider identification. These questions depend on the criterion used for "tailoring" the service (e.g. for a birth certificate, the system should ask the user to enter the municipality where he/she was born). The NWSR "knows" the internal logic of each service instantiation and uses this knowledge in order to address the proper queries to the client.

The client provides necessary information and the NWSR identifies the particular instance of the service provider. Succeeding in this, the NSWR returns the actual URL link of the service as provided by the specific service provider (first functionality of the NWSR). The use case ends with the NWSR providing the instantiated service URL to the client.

**USE CASE 4: The Client Explores the Instantiated service.** This use case is similar to use case 2, having in the place of the NWSR, the actual Service Provider for the service. The Service Provider provides detailed information for the service execution. The client's communication with the NWSR has ceased, as a direct communication link with the actual service provider has been established.

**USE CASE 5: The Client Triggers and the Service Provider Logs the Case.** From now on, the client interacts with the IS of the service provider. We assume that the client has decided to officially ask for the particular service execution. So he/she sends an official request to trigger the service (pre-) registration. At this point, we pass from the *informative* part to the *performative* service execution part.

This request is processed by a specially designed software component that provides the necessary management of the overall service execution workflow. We have called this component "Orchestrator", and we implement it as a BPL4WS engine. Thus, the Orchestrator becomes the first software component, inside the service provider's information system, that is accessed by the client during the service execution.

The Orchestrator is the system component that "knows" the internal logic, and the details of the execution workflow. For each service provided as e-service, there is always the service's Orchestrator that invokes, manages and terminates the workflow throughout the service execution. The Orchestrator "moves" the execution of the service according to a pre-defined model. The business logic and knowledge needed for this task already exists inside each service provider, as each public agency "knows" the process to be followed.

The Orchestrator receives the request, checks its completeness and appropriateness, and directs it to the service provider's legacy service registration system. As the information system of the service provider logs the case, the first official administrative action (*performance*) takes place. All the previous stages have been informal, and PA keeps no record of them. Now, the case is registered by the service provider.

After successfully registering the application, the registration legacy system sends a confirmation message to the Orchestrator. By receiving this confirmation, the Orchestrator triggers the service execution. At this point, use case 5 is terminated.

It is important to mention that there are two alternative options for each service:

- The service may be directly executable (simple service).
- The service may invoke other services, which are called here "nested services". Nested services are used to provide input to the main service. In these cases, a new service is invoked in order to produce the required evidences (input) to be checked by the service provider (complex service).

In both cases, the Orchestrator coordinates the execution through the sequencing (workflow) rules of the service. But in the latter case, the Orchestrator "knows" only at a high level the part of the process that is related to the execution of the nested services and perceives the nested services as black boxes (input-output view). The Orchestrator "knows" for each nested service, (a) the responsible public administration agency for the service execution (to automatically direct the service execution to the appropriate service provider), (b) the required input, and (c) the anticipated output. The latter information is critical as it may be needed in order to decide the conditional continuation of the overall service execution, or in other words to decide the appropriate execution path. These nested services exist autonomously and are accessible through the NWSR.

### 3.2 Input and Processing Phase

This is perhaps the most demanding phase in electronic public administration service delivery, especially in multi-country settings. The client needs assistance in order to collect all the evidences needed by the service provider to be validated in order to successfully execute the service. As an evidence is primarily pure information, in the real world the evidences are "packed" in, and communicated via, administrative documents. We call these documents "evidence placeholders". Interestingly, there is a many-to-many relationship between the entities "evidence" and "evidence placeholder" [13], [15]. The client has to collect all the evidence placeholders needed for the service execution.

The multi-country setting adds additional requirements to the service execution: all evidence placeholders (and the evidences they carry) have to be converted to an appropriate format in order to become linguistically and semantically compatible to the administrative system they are supposed to be used. Moreover, the grouping of evidences into evidence placeholders varies when passing from one country to another. So the system should be capable support these two aspects of evidences', and evidence placeholders' conversion. The infrastructure responsible for this task is the Communal Semantic Gateway.

How is this phase different from the current situation? Currently, all the evidence placeholders (administrative documents) needed for the execution of the service should

be found, and collected by the client. The client becomes a postman amongst several public agencies, gathering documents, signatures, and moving certificates from one agency to the other. Even worst, in a multi-country setting, the client has usually insurmountable obstacles: the type of the service provider may be different, the documents may vary or even do not exist as such, the evidences needed for the service may be "strange" (e.g. what is the ID card number?). On the contrary, with the use of SWS technologies these inconsistencies can be solved, as the service is automatically and transparently to the client composed and executed. The following two use cases describe these tasks in detail.

**USE CASE 6: The Service Provider Finds, Collects and Processes all the Necessary Input (Evidences).** In order to automatically find, collect and process all the evidences needed for a service validation, there are several aspects to be taken into account. There are some services that all evidence placeholders needed for the service execution are explicitly predefined and are not subject to conditions arising during the execution. This type of service is called here "single-stage service". To execute a single-stage service, the client presents all the evidences needed for the execution in advance. The service is executed in one stage: The service provider gathers the full set of evidences in advance, checks them altogether and executes the service.

Though, this is not always the case. Many services cannot be executed in one single stage. There are occasions where the evidences and/or the evidence placeholders needed are determined during the execution. This happens when there are multiple execution paths for the service, depending on the evidences provided by the client. One could argue that it could be possible for the client to provide in advance all necessary conditional evidences, according to the rules determining each time the differentiated path of service execution. This option could be feasible in simple cases, where for example just one bifurcation of the process exists. But in complex processes, with multiple bifurcation points, each leading to a number of alternative execution paths this could lead to a huge set of "if... then... else..." clauses that could not be manageable by the client. So the administration may repeatedly contact the client during the service execution, and ask for more evidence placeholders.

For this reason, we introduce the notion of the "multi-stage service". These are services that may need input during their execution, which means they ask for more evidence placeholders to be provided during the execution. In this line, we define the notion of a "processing stage", as an independent cycle of iterative execution, during which a set of evidences are identified, collected, and processed. In complex multi-stage services, there may exist a very complicated execution tree with an exponential number of execution paths.

In each such stage, the processing is performed upon the set of evidences participating in the specific stage, according the business logic of the service. Each stage produces as output either the conditional call of another stage, or the termination of the evidences' processing.

For each stage, the following steps take place. Notice that all actions performed by the system in the description that follows, are currently undertaken by the client:

*Step (a) The Service Provider (system) collects the evidence placeholders needed for the execution of the stage.* In this step, the system has to collect all the evidence

placeholders that hold the evidence needed for the execution of this stage. Usually, the service provider requires the provision of specific evidence placeholders (e.g. birth certificate). Sometimes, the service provider may suggest alternative evidence placeholders, and give the option of choosing one of the alternatives to the client (e.g. birth certificate, or ID card, or passport). This happens due to the many-to-many relationship between the entities "evidence" and "evidence placeholder". So practically, the system posses the list of the evidence placeholders to be collected for the execution of the specific stage. Now, these evidence placeholders should be somehow gathered by the system: (a) There may already exist an available valid placeholder, or (b) A valid placeholder does not exist.

The system starts with the first option. The client may possess a valid placeholder, in the form of a previously issued administrative document. In this case, the document should be converted to an appropriate electronic format in order to be entered into the system.

If a valid placeholder is not available through the client, two options exist:

- The service provider may accept a simple or a binding declaration by the client regarding the evidence needed. In this case, the document signed by the client becomes a valid evidence placeholder. Generally speaking, the more serious the consequences of the service, the less possible for the administration to accept a simple client's declaration.
- A new public administration service should be triggered in order to "produce" a valid placeholder (nested service). This nested service should provide as output, an administrative document that could serve as a valid placeholder for the evidence(s) needed. In this case, a recursive overall service execution is triggered.

By the end of this step, all required evidence placeholders for this particular stage have been collected, and the required evidences have been inserted into the system.

*Step (b) The Service Provider processes evidence placeholders and evidences.* This processing implies checks in several dimensions (e.g. completeness, consistency, authenticity, format, range, database checks), which could be grouped in two types:

- The placeholders are checked as a whole, to verify their authenticity, validity, etc.
- Then the evidence "packed" in the placeholder is checked in various ways, e.g. common sense, completeness, consistency, format, business logic.

*Step (c) The Service Provider decides the ensuing process path based on evidences.* The logic of the service execution may impose conditional execution paths. So the Service Provider, after checking the set of collected evidences, decides the next step. As already discussed above, the output of this decision may be either the call of another stage, or the termination of the evidences' processing.

*Step (d) If another stage is to be executed GO TO Step (a), ELSE the Service Provider terminates evidence collection and processing and moves to step (e).*

*Step (e) The Service Provider checks the overall service procedural & logical preconditions.* When all the previously described iterative steps (a) to (d) have been executed, all checks based on the individual set of evidences have finished and all stages required for the service execution have been performed. Still the service has to pass some additional checks as a whole. For example, has all organizational rules been followed, during the

service execution (e.g. a FIFO queue for applications)? Has the right person addressed the case inside the agency? Is the overall execution consistent, and compliant to the rules? This step occurs once per service execution, as it refers to the overall service.

*Step (f) The Service Provider decides on the client's request.* This step can be perceived as the output of Step (e). Checking of evidences (in stages) and of procedural/logical preconditions leads finally to an administrative decision.

**USE CASE 7: The Service Provider Solves Semantic Discrepancies.** This is a use case applicable only in multi-country settings. Chronologically, this use case is not supposed to follow the previous one. It could be perceived as being internal to the previous, aiming at solving linguistic and semantic discrepancies during the evidences' collection and processing. We focus on the collection and processing of evidences placeholders and evidences in a multi-country setting.

To address this, specific domain knowledge is needed. The European Web Service Broker could be a repository for holding this knowledge. There are certain assumptions made at this point: (a) All national PAs have developed PA domain ontologies. (b) In the EWSB, a European meta-ontology of PA is stored. Mapping amongst the national PA ontologies would be possible through the EWSB meta-ontology, avoiding the exponential number of ontology mappings required to make each country's ontology compatible with all the other EU countries ontologies. Of course, this is a very difficult infrastructure to be built that requires the precedent creation of PA domain ontologies at the national level. Although formal ontologies are very difficult to be specified and managed for such extended domains as national administrations, this is a core prerequisite for solving semantic incompatibility in multi-country settings. In this line, we have developed two national test-bed ontologies, and provide mapping between them using SWRL. Administrative forms are translated semantically in an automated way, as the system handles the differences between countries.

This use case is not supposed to be sequential, but rather iterative. At the end of each use case execution cycle, a semantic discrepancy is solved, with the mechanism described above.

### 3.3 Outcome Phase

At Step (f) of use case 6, the administrative decision for the specific request has been made. After that, the administration has to perform the following two types of actions to successfully close the case. The first is related to the main and actual output of the service, while the second with its consequences (by-products or secondary outputs).

**Use Case 8: The Service Provider Prepares and Communicates the Output.** No matter what the administration has decided, the decision should be cast in a written official form: it should become an official document with registration number, date of issuance, signatures, etc. This document is perceived as the main output of the service.

**Use Case 9: The Service Provider Handles the Consequences of the Service.** There are two types of consequences due to a public service execution.

*Update the Public Administration Registry:* The first type of consequence is the update of the information kept by the service provider. This is a local consequence, as it

involves only the service provider. Through this function, data consistency and integration is achieved locally at the service provider. This type of consequence is mandatory for all services.

*Inform Consequence Receivers:* The second type of consequence is the communication of service related information to other public administration agencies. We call this type global consequence, as it involves the overall administrative system. This activity in a multi-country setting may become very complex and demanding. Through handling global consequences, data consistency and integration is achieved amongst PAs.

At this point, the execution of the service has finished. We presented the overall lifecycle of the PA service execution in a PEGS environment supported by SWS technologies. The model is generic enough to cover any type of PA service provision, thus reusable in different e-Government sub-domain implementations based on SWS technologies.

## 4 Conclusion – Future Work

In this paper, we employ the GEA "Provide Service Process Model" in order to design PEGS delivery using SWS technologies. The generic model has been proven a valuable roadmap, in order to propose the service execution model over a SWS environment. The comparison between the presented tables 1 (generic process execution), and 2 (process execution in Pan-European setting with SWS technologies) can easily reveal the close association of the two descriptions. Certain differences exist, e.g. the multi-country setting creates additional requirements, and use case 7 in table 2 was introduced to address them, but the core structure of the execution process remains compatible to a great extend.

We have also demonstrated some aspects of the value-added in PA service provision by employing the SWS paradigm: the service is executed mainly by the Service Provider with the support of the SWS infrastructure, and the Client has minimum participation. Applying SWS technologies, very complex PA services having multiple nested services and various stages can be invoked, composed and executed almost automatically.

In this paper we avoided to present the case specific scenario addressed in the EU-Publi.com project (new company establishment) but try to distinguish, and focus on the case-independent, core aspects of PEGS provision process as executed with SWS, and present this generic model using a use case based narrative description.

We intend to validate the presented model by employing it to more services. Moreover, we plan to elaborate more on the model, in order to provide a formal representation using a standard business process language (e.g. BPL4WS). As a further step, and after the model's validation, and verification, we envision applying it as part of an e-government SWS-based ERP kernel that could be easily parameterised and configured for a variety of different services offered by public administration at different levels and countries.

## References

1. Davies, J. et al. (2002). Towards the Semantic WEB - Ontology Driven Knowledge Management, John Wiley.
2. European Commission (2004). DECISION 2004/387/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

3. Goldkuhl, G. (1996). Generic business frameworks and action modeling. 1st Inter. Workshop on Communications Modeling - The Language/Action Perspective, Springer.
4. Hogwood B., L.A.Gunn (1984). Policy Analysis for the Real World, Oxford Univ. Press.
5. IDA-CapGemini (2004). Architecture for delivering pan-European e-Government services, v.1
6. IDABC (2004). European Interoperability Framework. Luxembourg, European Communities.
7. K. Sycara et al. (2003). "Automated Discovery, Interaction and Composition of Semantic Web Services." Journal of Web Semantics 1(1): 27-46.
8. Klischewski, R. (2004). Semantic Web for e-Government - a Research Agenda. AIS SIG SEMIS Newsletter Volume 1, Issue 1.
9. Lane, J.-E. (1995). The Public Sector: Concepts, Models and Approaches, Sage Publications.
10. Lind M. G. Goldkuhl (2001). Generic Layered Patterns for Business Modeling. 6th Inter. Workshop on the Language-Action Perspective on Communication Modeling, Montreal.
11. M. Paolucci et al. (2002). Semantic Matching of Web Services Capabilities. The SemanticWeb-ISWC 2002: 1st Int'l Semantic Web Conf.
12. Peristeras, V., et al. (2003). Enhancing e-Government through the use of Web Services and Semantic Web technologies. 3rd European Conference on e-Government. Dublin.
13. Peristeras V. and Tarabanis K. (2004). Advancing the Government Enterprise Architecture - GEA: The Service Execution Object Model. Electronic Government, DEXA, 3rd Inter. Conf. EGOV 2004, Zaragoza, LNCS 3183. Springer: pp. 476-482.
14. Peristeras V., Tarabanis K. (2004). Governance Enterprise Architecture (GEA): Domain Models for e-Governance. 6th ACM Inter. Conf. on e-Commerce (ICEC'04), Delft.
15. Peristeras V. and Tarabanis K. (2004). The Governance Enterprise Architecture (GEA) Object Model. Knowledge Management in Electronic Government, Lecture Notes in Computer Science 3035, (5th IFIP Inter. Working Conference, KMGov 2004, Krems, Austria, May 27-29). M. A. Wimmer, Springer: 101-110.
16. Peristeras V., Tarabanis K. (2005). The GEA Generic Process Model for Public Administration Service Execution. 8th Inter. Conf. for Business Information Systems (8th BIS), Poznan.
17. Reijswoud Van V.E., et al. (1999). "Communication Action Based Business Process and Information Modelling with DEMO." The Information Systems Journal Vol. 9(2)
18. (SICoP) Semantic Interoperability Community of Practice (2005). Introducing Semantic Technologies and the Vision of the Semantic Web, White Paper Series Module 1.
19. Semy, S. K. et al. (2004). Toward the Use of an Upper Ontology for U.S. Government and U.S. Military Domains: An Evaluation, The MITRE Corporation.
20. Tarabanis, K. and V. Peristeras (2000). "Towards an Enterprise Architecture for Public Administration: A Top Down Approach." European Journal of Information Systems 9 (Dec. 2000): pp. 252-260.
21. Tarabanis, K. and V. Peristeras (2002). Requirements for Transparent Public Services Provision amongst Public Administrations. Electronic Government: 1st Inter. Conf., EGOV 2002, Aix-en-Provence, France, September 2-5, 2002. Proceedings. Springer-Verlag. vol. 2456: pp.330 - 337.
22. Tarabanis, K et al. (2001). Towards a European Information Architecture for Public Administration: The InfoCITIZEN project. e-Work and e-Commerce, IOS Press.
23. The InfoCitizen Project (2002). Del. 2.2.: Service Interoperability Macro Architecture.
24. Weigand H., et al. (1998). Modelling Electronic Commerce Transactions - A Layered Approach. 3rd Inter. Workshop, The LAP on Communication Modelling.

# A Proposal for a Semantic-Driven eGovernment Service Architecture

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**Abstract.** Governments from all over the world are currently developing solutions and initiatives for the provision of solutions in the field of eGovernment. This leads to a heterogeneity problem that makes it necessary to provide interoperability mechanisms. This paper proposes an overall approach to overcome the current drawbacks of electronic communication among different PAs. In addition, new services are included to improve the eventual performance of this kind of systems. Web semantic technologies are used and some domain-specific profiles are proposed.

## 1 Introduction

Nowadays, eGovernment solutions are getting momentum. As many efforts are being devoted to this framework in each country, many solutions are soaring in most of the western countries. The very first consideration we must take into account is that eGovernment solutions are not just providing new interface to access the same services. Indeed, the introduction of eGovernment involves a complete reengineering process to make a reorientation of services and facilities towards citizens and their needs instead of administrative procedures and their cycles.

The final status we would like to achieve in this environment involves the provision for transactional services. The aim for the presented proposal is quite ambitious and it is aimed to undertake that goal by using high level services.

The presented proposal in this paper involves the provision of intelligent agents that using a holistic approach can perform operations in an open and interoperable network where operations can be performed regardless of details of implementation for eGovernment platforms. In the current situation (a myriad of short-scope solutions, diversity of platform, criteria to define operation, ...), we need to provide some basis to conquer this major goal.

This paper presents an service architecture for supporting eGovernment solutions using a semantic support in a holistic approach. The architecture presented supports the interaction among heterogeneous agents to accomplish the task of providing eGovernment services in a holistic way.

Previously to the proposal, we must take into account concerns, requirements and limitations from the environment that may not be present in other environments or, at least, are large more important than in others:

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**Accessibility.** As citizen pay the project from the taxes, we must ensure that the access to the services is not driven by the software or hardware platform. Of course, it is required to provide contents for people with sensorial limitations.

**Security.** Security services must provide facilities not needed in other environments such as:

- No repudiation neither in destination nor in origin
- Confidentiality even for the Public Administration (here after PA) that is the destination of the information if they are not expected to access a single part of the information.
- Integrity service for all transactions.
- Provision of certificated confirmation of reception.

**Unification of interfaces.** A large amount of different PAs may be involved and no interoperability was foreseen in the design phase so it is our responsibility to provide the required mechanisms to make solutions possible.

**Dynamic environment.** Functionalities provided may change quite quickly depending not just on functional or design issues but also due to the legal framework. These changes may be quite deep and include no just modifications on data model but also on available functionality.

The rest of the paper is organized as follows. First, we will present a review of Semantic technology that may be useful in our approach. Secondly, a state of the art about eGovernment initiatives is presented. The next section is the proposal for the construction of a semantic based solution for the provision of eGovernment solutions in current-fashion systems; this chapter includes a review of semantic support, requisites, software components involved and communications mechanism. Finally, some conclusions on the presented ideas are shown.

## 2 Semantic Web

Speaking about semantic data, we are addressing the problem of dealing with not just data but information. The aim for this discipline is the provision of information understandable by machines. In literature we can find several definitions or approximations to the concept of ontology. A quite suitable definition for ontology may be [1]:

> An ontology is a formal, explicit specification of a shared conceptualisation of a domain of interest.

By means of this definition we are addressing an ontology as a way to put in a concrete way abstract information about a certain domain by means of machine-understandable data format.

From the definition, it is clear that there are two separated features that should be taken into account, usually, using different techniques. On one hand we must deal with the *conceptualisation* itself and this is the task for a multidisciplinary team. We need not just IT people but also people with skills on the

subject under study, in the case of eGovernment, we must address people with knowledge on law and experience on Public Administration management. On the other hand, we must bear in mind the technical feature of the topic: for the description of an ontology we must use some kind of language to express it in *formal* and *explict* way. To undertake this, we may use different languages [2]. We can make a fast review of different chances available to *express knowdledge*:

RDF and RDF Schemas (Resource Description Framework) [3]. It is a XML-based format to provide a standard description of web services from the W3C[1].

DAML (DARPA Agent Markup Language) [4]. We can consider DAML as an extension of RDF for expressing semantic information about resources.

OIL (Ontology Interchange Language and Ontology Inference Layer) [5]. It is the result of the European IST project On-To-Knowledge[2] and it is oriented to the representation of the semantics of Web resources. This language is superseded by DAML+OIL.

OWL (Ontology Web Language) [6]. It is a W3C Recommendation that covers most of DAML+OIL and it is intended to provide a fully functional way to express ontologies. We can find different sublanguages of OWL oriented towards different purposes: OWL Lite, OWL DL, OWL Full. Each one includes the previous one so it is compatible backwards.

A similar problem we face in this area of research is the description of Web Services. We need some suitable way to express their semantic information. To accomplish this task, we can choose between several options. We will outline the most outstanding ones:

OWL-S (Ontology Web Lenguage - Services) [7]. It is a particular ontology for the description of Web Services taking OWL as a basis and including information to facilitate the description and localization of services.

WSMO (Web Service Modeling Object) [8]. The SDK WSMO working group is the working team responsible for the development of this initiative aimed to the provision of a formal way to present the semantic information about Web Services.

In our approach, we decide to use OWL. From a functional point of view, both, WSMO and OWL, could be a suitable election as we can get a similar expressivity capacity to present those concepts we are dealing with. The main reason to choose OWL is related to the software available for handling and developing this kind of data. There are available some software packages that allow us to manage this information such as Jena [9] or Protégé [10] and related plugins [11]. Although, there are software tools currently available for WSMO at the present moment, they are not as mature as required to face a large scale project.

[1] `http://www.w3.org`
[2] `http://www.ontoknowledge.org/`

Also, as OWL-S is just a subespecification of OWL, we can make use of an already-developed or legacy OWL ontology for the provision of an OWL-S file suitable in our approach.

## 3 State of the Art

We can currently find a large amount of national project oriented towards the provision of eGovernment services. In the scope of the different countries, we can find several initiatives:

**SAGA [12]** in Germany.
**e-GIF [13]** in United Kingdom.
**ADEA [14]** in France.
**FEAF [15]** in USA.

In the same way, we can find a similar project in nearly each developed country.

A part from these initiatives, we can also find other schemas or proposals for the development of frameworks for eGovernment environments such as the Zachman framework [16]

As we can see, nearly every country has its own model or proposal for the provision of services in the eGovernment framework. The obvious consequence for this is the lack of interoperability as they to do not foresee the possibility of any cross border interaction.

The analysis of these projects [17] may lead to establish some conclusions about them. The first thing we may notice at first glance is the lack of real indications, a solid framework, a data model or even software infrastructure to address the problem of providing solutions in a eGovernment environment. Most of the presented proposals just provide some general basis or recommendation for the development of software product under some generalist ideas.

These solutions are oriented to the provision of a common framework for the development of eGovernment solutions. Also, they are intended to provide interoperability at least at some level (functional or data interoperability) and, as minimum, interoperability in projects developed under the same project, i.e., the same country.

Bearing these ideas in mind, we purpose facing interoperability problems at a higher level as it is no possible at data level or functional level. Thus, the purposed field for the provision of a framework to deploy solution is on the semantic level.

To deal with knowledge for services oriented towards citizens, there are currently some projects in the framework of the European Union, the most outstanding are:

- OntoGov [18]. This project addresses the problem of services in eGovernment under a semantic point of view and it is aimed to provide an ontology to model the problem in a maintainable way.

- Terregov [19]. This project's main goal is to provide an interoperable layer that allows citizen to access eHealth services in a transparent manner by means of web services.
- Epri [20]. This project is aimed to increase the role of Information Society Technology among the administration, mainly in EU, national and regional level.

## 4 Our Proposal

A brief review of the already presented ideas may lead us to conclude that to provide eGovernment solutions in a global environment we need to address the search in an upper level, a semantic one. Thus, we must overcome the functional or the data level and deal with a semantic approach. This would allow us to focus on the problem from a higher point of view and provide real solutions to bring suitable solutions in these projects in order to serve citizens better. As stated previously, the addressed framework for interoperability issues has moved up to a semantic layer once it seems difficult to achieve solutions on data level (most of currently available solutions have already developed their own data models) or on a functional level (developed projects do not consider the possibility of interaction among different platforms).

We will present an Reference Architecture [21] for the provision of services in a eGovernment environment using a semantic approach. The yields of this proposal are mainly contributions to interoperability problems, added-value services for the available functionality and accessibility improvements to services.

### 4.1 Requisites

Bearing in mind these ideas, we consider suitable the inclusion of the following features on our design:

**OpenSource.** Software elements must be available for every user involved in the project and no assumption can be done about the operative system or required tools. Of course, it is not acceptable to force the adoption of some certain programs when there are available free and open alternative.

**Adoption of Open Standards.** By using open standards in every layer of projects, it is possible to guarantee the maintenance and the support for new improvements in the scope of constant researching. The use of open standards is not referred just to standard about data models but also related to network connection, presentation information such as HTML and so forth.

**Interaction With Any Agent.** The interaction must be supported even with agents not provided by administrations. Thus, it will be possible to develop agents by anybody that may become part of the system. This feature will largely increase eParticipation as you allow citizens to really take part of Public Administration by means of their contributions.

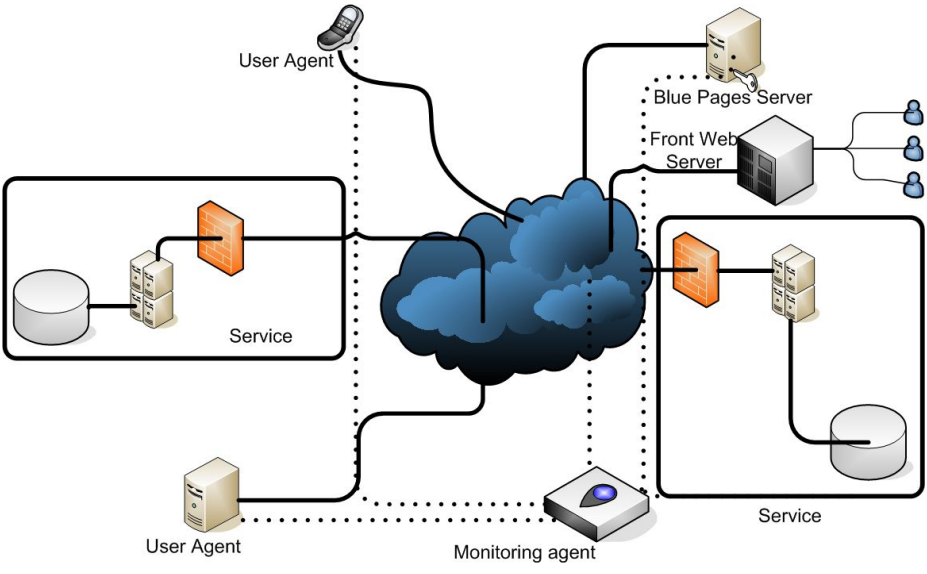


**Fig. 1.** Network model

**Support for Multiplatform Devices.** Agents in the system may use different network supports, i.e., agents may use wired network, WAP devices, Wi-Fi devices or any other support as they work with open standards. This idea should also be applied to platform in other dimension: Operative System, Data formats, etcetera.

**Ontology-driven.** By using this feature, we will achieve a high level of interoperability as machines will be able to process data with little or no human participation. This also provides interesting advances on server composition and mechanization of procedures by means of autonomous systems. This feature requires a lot of efforts to properly implement it. We consider this as a must in our proposal as we assume that no interaction is possible in lower levels.

### 4.2 Actors Involved

In our model of the problem to be solved, we consider the inclusion of several components (see Figure 1). These ones are responsible for undertaking the interchange of data and the execution of the processes they are responsible for. The most outstanding elements in our system are briefly presently in next lines.

**Client Agent.** A wide range of agents may be involved in the interchange of information. As a matter of fact, support for service should be completely independent of user's platform. Thus, we will support an adapted service for each client: WWW-based clients stand alone clients, mobile clients, etc. Of course, the nature of the client will restrict the way this service is provided. Anyway,

we must bear in mind that agent's requirements and facilities may change from one to another. Anyway, in our proposal, agents will be responsible for tasks related to composition and orchestration operations as the formers requires the use of information depending on each particular use and so, we can include a higher level of flexibility on the design of the system. It is important to note that agents in this platform are, by default, assumed to be mobile agents as they will be responsible for the biggest part of the workflow of operations. In other words, our platform is thought to provide services for mGovernment; despite of this consideration, we can also provide solutions based on web access just by including a front-office as an agent in the system responsible for providing web contents. This component will be on charge for providing HTML-based contents, the proper managing of user's sessions and other tasks inherent to Web Server.

**Service Providers.** These elements are the final responsible for the service provision. This role is usually assigned to PAs. These components are responsible for the eventual execution of the expected services.

**Blue Page Server.** We need in this architecture some elements that solve the problem of locating the server. In this way, we should provide a registry server. This service is nowadays being carrying out by UDDI server. These servers are responsible for locating the proper server to each request the user make by looking up in an internal table of data. This solution brings up problems about semantic searches and constrains for providing advanced services [22]. Therefore, we will implement this function using an OWL-S matcher that uses the provided ontology for describing services. This server will accept requests from agents in the system and submit the result of searches after identifying the suitable service provider in each case.

**Monitoring Agent.** As an additional security mechanism, we also include in the proposed reference architecture a component responsible for the monitoring and registration of data interchanged in the network. The service provided by this element is related to the certification of data sent and received, both on demand from any agent and by itself. It, also, facilities the monitoring of services by making measures of performance, evaluating possible security risks and inferring about patterns of behaviour in prevision of suspicious agents in the system. We must beard in mind that agents in this proposal are heterogeneous and may be provided by third parties as they are compliant with the architecture.

Due to the nature of the information involved and the security concerns involved we must make clear to all agents in the system which information and how will be used: we must be compliant with security directive that fits with the environment.

**Broker.** Brokerage services are a common feature in most environments related to e-technologies. Thus we can find brokers for eLearning environments [23], eBusiness [24], etcetera. In this environment, the social, cultural and political implications of brokerage services may involve a large amount of services with deep consequences that may affect the way we currently understand the interaction among citizens and PAs.

A part from technical considerations, this component, as it is not under the management of users, may arise some shortcomings and limitations that should be considered:

– When a broker acts on behalf of the user, it must have the same security level granted that the citizen himself when accessing PAs. So we must transfer in some way security credentials but making sure that no reuse or fraudulent use is possible.
– In the process of accessing or updating personal data from the user, the broker must act on behalf of the user. Thus, it is needed to provide mechanisms to avoid repudiations from the user in the data managed.

The aim for this service is the provision of a module that may act on behalf of citizens and perform operations in more sophisticate way. Examples of use for this feature (see Figure 2) are:

– Advanced searches for public offers such as jobs or grants. Facilities provided may federate searches over several PAs and get, thus, a full list of offers that fits the requested conditions.
– Advanced gathering information. By using this option, users may collect the different data that different PAs hold about them without needing to ask each single administration about this particular information.

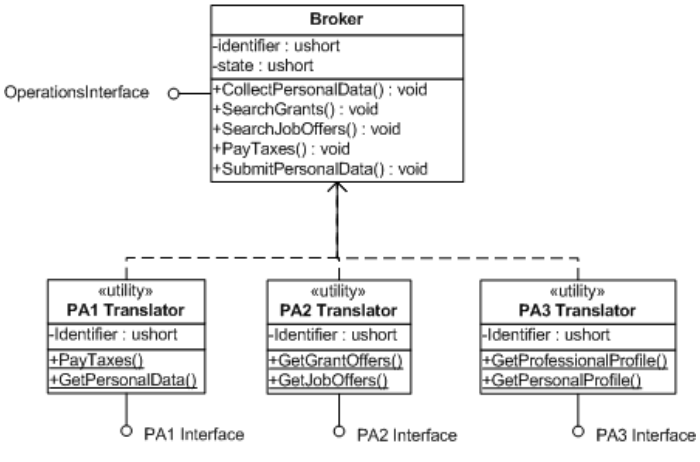


**Fig. 2.** Broker Model

It is important to note that this broker will just deal with semantic information and it must not deal with information from any other lower level than the semantic one, neither data layer nor functional layer. The only software entity who actually will handle that level of information in the system is the service provider.

### 4.3 Sharing Knowledge: An eGovernment Ontology

The proposed architecture is playing its role in a semantic level, i.e., services are defined and used just in the semantic layer. So far, this platform is not concerned with invocation methods for services as we take for granted the provision of them by means of some platform-independent support such as Web Services [25] or any other available system.

In order to be able to achieve this interoperability in the global system, we must assume a holistic approach and provide an ontology for the description of all possible solutions in the system. We get, thus, a semantic convention to express all events, actors and situations we can face in the system.

The ontology that will provide the basis for the system includes the definition of:

- Classes to define actors, including service provider.

```
<owl:Class rdf:ID="Citizen">
  <rdfs:subClassOf rdf:resource="#Person"/>
  <rdfs:subClassOf>
    <owl:Restriction>
      <owl:onProperty rdf:resource="#hasNationality"/>
    </owl:Restriction>
  </rdfs:subClassOf>
```

- Classes to define life events.

```
<owl:Class rdf:ID="Birth">
  <rdfs:subClassOf rdf:resource="#LifeEvent"/>
  <rdfs:subClassOf>
    <owl:Restriction>
      <owl:onProperty rdf:resource="#hasProtagonist"/>
      <owl:toClass rdf:resource="#Person"/>
    </owl:Restriction>
  </rdfs:subClassOf>
```

- ObjectProperty to express properties of services.

```
<owl:ObjectProperty rdf:ID="chiperServize">
  <rdfs:subPropertyOf rdf:resource="#hasSecurity"/>
  <rdfs:range rdf:resource="#Service"/>
</owl:ObjectProperty>
```

Problems that arise in the provision of the former lay in the complexity of providing a unique, clear and unambiguous definition of the entire problem by means of a concrete realization of an ontology. We must take into account not just the current situation but the future situation the system may evolve to. Also, when trying to express the same concept in a heterogeneous cultural/political environment, there may be no possible agreement. In this case, we may need to lose part of the semantic meaning in benefit of interoperability.

Regardless of these shortcomings, we must consider the ontology, the semantic description of our full environment, as the backbone for the construction of the entire system. This representation of knowledge will be managed by agent users, brokers, service providers and, as well, by blue pages server.

For the description of this ontology, we can choose among several technical options according to the current state of the art. The decision taken in our case is the use of OWL for this task. Main reasons for this are that we can find some software implementation available, the richness available for the description of services and the possibility to provide the information in several layers according to particular situations: OWL Lite, OWL DL and OWL Full.

Besides of the language selected for this purpose, we must also consider two additional issues related to the ontology provision. We must have some clear methodology for the development and maintenance of the former. Also, we must have available some tools for the managing of the former. In large scale software projects such as the present one, the amount of data we must deal with is large enough to make impossible to treat data manually; so we must have tools to help us in those tasks.

### 4.4 Communicating Agents

So far, we have presented all software components involved in the system that collaborate together for providing services in an interactive and autonomous way. The missing piece of the system is related to the communication support. The architecture needs a support for data interchanging among involved agents in the system. To solve this system there are several options: FIPA systems [26], Web Services [25], KQML languages [27], etcetera.

We dismissed the option of FIPA protocol due to the limitations imposed by the system such as the centralized model and the need for control on each agent in the system. Also, it was rejected the option of using the so-called classical Web Services as they impose some certain platform and the need for further agreement on data formats.

We finally choose as the way to exchange information a KQML particular implementation mapped into a XML managed by a process on a certain port in each agent. Main reasons for this selection are linked to the low amount of resources, the simplicity for implementation even in low-capacity devices such as cellular phones, and the possibility to use current-fashion facilities in data interchange for ciphering or parsing. This implementation of KQML based on KIF makes use of the provided ontology to express information and to request for services (mainly in blue pages servers).

### 4.5 Convergence Layer

We have stated the existence of an upper layer, the semantic one, where all operations are requested/addressed regardless of the real implementation. As the platform has to really implement the functionalities, we must also face the problem of making this really works in data-based already developed systems.

The point for this problem is just related to the Service Provider. In our platform, agents, brokers and blue page server deals just with information expressed by semantic means but the server for services, the system actually provided by administrations, does not. To accomplish a real implementation, we must make the server provider capable of interact with the rest of the system, i.e., the semantic layer. To make this possible, we suggest the implementation of a proxy component that makes the translation from semantic contents to data information and vice versa. It is important to note that each proxy must be developed ad-hoc for the server it is going to be attached.

This proxy will not make any other function but the translation expressed previously. This will be accomplished by using a mapping not just for data formats but also may involve the composition and recomposition of messages to make them fit in the semantic layer.

## 5 Conclusion

As result of the large amount of resources devoted to the development of eGovernment solutions, a huge amount of projects are being deployed. Each project proposes its own solution for data models and its own functional analysis. As a consequence, little interaction is possible. The proposed solution in this paper provides a global semantic-based approach to this problem. Therefore, we make the interaction among systems possible providing backward compability with no needs for upgrading legacy systems. The price to pay is the development of a higher layer for these services.

Outcomes from this proposal can significantly improve the quality and the quantity of services in a eGovernment framework.

In order to develop it, we must face a process to identify the required services and agents in the system. To complete this process, the chosen methodology is the UMP (Unified Modelling Process) [28] combined with the proposal by Bass et al.[21]. Once the system is defined in terms of a Reference Architecture, we must also deal with another critical issue for the final performance of the system: the definition of a proper ontology that can support the different concepts involved.

The final status for the proposed architecture is a common and global place where heterogeneous agents may interact using the provided support, mainly as far as the semantic support is concerned. The implications of this are quite deep and involve several related fields such as eParticipaton or eDemocracy.

## Acknowledgment

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## References


1. Gruber, T.: A translation approach to portable ontology specifications. Knowledge Acquisition (1993) 199–220
2. Gómez-Pérez, A., Fernández-López, M., Corcho, O.: Ontological Engineering. Springer (2003)
3. Consortium, W.W.W.: Rdf. Web available (2005) http://www.w3c.org/RDF/.
4. The DARPA Agent Markup Language Homepage: Daml. Web available (2005) http://www.daml.org/.
5. Ontoknowledge project: Oil. Web available (2005) http://www.ontoknowledge.org/oil/.
6. W3C: Web ontology language. Web available (2004) http://www.w3.org/2004/ http://www.w3.org/2004/OWL/OWL/.
7. Coalition, O.S.: Owl-s: Semantic markup for web services. Web available (2005) http://www.daml.org/services/owl-s/1.1/.
8. SDK WSMO working group: Wsmo. Web available (2005) http://www.wsmo.org/TR/d2/v1.1/.
9. HP: Jena. (2005) http://www.hpl.hp.com/semweb/.
10. Stanford Medical Informatics: Protege. Web available (2005) http://protege.stanford.edu/.
11. Stanford Medical Informatics: Protege owl plugin. Web available (2005) http://protege.stanford.edu/plugins/owl/.
12. KBSt: Saga. Web available (2005) http://www.kbst.bund.de/-,182/SAGA.htm.
13. UK GovTalk: e-GIF. Web available (2004) http://www.govtalk.gov.uk/.
14. French Government: Adea. Web available (2004) http://www.adae.gouv.fr/adele/.
15. Software, P.: Feaf. Web available (2004) http://government.popkin.com/frameworks/feaf.htm.
16. ZIFA: Zachman framework. Web available (2004) http://www.zifa.com.
17. Gijarro, L.: Analysis of the interoperability frameworks in e-government initiatives. EGOV'04 (2004)
18. Ontogov. Web available (2005) http://www.ontogov.com/.
19. Terregov. Web available (2005) http://www.terregov.eupm.net/my_spip/index.php.
20. Epri. Web available (2005) http://www.epri.org/epriweb/contents/home.php.
21. Bass, L., Clements, P., RickKazman: Software Architecture in Practice. Addison Wesley (2003)
22. Luis Alvarez, Luis Anido: Uddi services in egovernment services. eGov-Interop'05 (2005)
23. Rodriguez, J., Anido, L., Fernández, M.J., Mikic, F., Alvarez, L.M.: A web services broker for e-learning. Lecture Notes in Computer Science **2657** (2003) I–659–668
24. Anido, L., Álvarez, L.: Towards interoperable frameworks for e-business. IEEE International Conference on Information & Communication Technologies: From Theory to Applications. (2004)
25. W3C: Web services. Web available (2005) http://www.w3.org/2002/ws/.
26. Fundation for Intelligent Physical Agents: Fipa. Web available (2005) http://www.fipa.org/.
27. Universty of Maryland: KQML - Knowledge Query and Manipulation Language. Web available (2005) http://www.cs.umbc.edu/kqml/.
28. Booch, Rumbaugh, Jacobson: The Unified Modeling Language User Guide. Addison Wesley Professional (199)

# Knowledge Engineering Suite: A Tool to Create Ontologies for Automatic Knowledge Representation in Knowledge-Based Systems

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**Abstract.** This paper is focused on the process of systematic knowledge acquisition to be used in knowledge-based systems. The result is a computational structure that can be used inside the organization (Intranet) as well as outside (Internet). This structure is the Knowledge Engineering Suite, an ontological engineering tool to support the construction of ontologies in a collaborative environment and is based on observations from the Semantic Web, UNL (Universal Networking Language) and WordNet. We use both a knowledge representation technique called DCKR to organize knowledge, and psychoanalytic studies, focused mainly on Lacan and his language theory to develop a methodology called Mind Engineering to improve the synchronicity between knowledge engineers and specialists on a particular domain.

## 1 Introduction

The importance of knowledge-based systems is that they provide some particular characteristics of human intelligence to the computer, such as the capacity to understanding natural language and simulate reasoning under uncertainty conditions. Definition of the relevant information to be inserted into a knowledge-based system is a major problem in the construction of such systems, mainly because the process is basically experimental and depends mostly on the ability of the knowledge engineer. In particular, there is a high difficulty related to the definition of the terminology used to nominate the concepts and the relations [1]. Despite the high number of methods to perform the knowledge acquisition process, there is no one that deals with the understanding and learning of people involved in the process, both specialists and knowledge engineers.

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More recently, the notion of ontology has become popular in fields such as intelligent information integration, information retrieval on the Internet, and knowledge management. The reason is partly due to what they promise: a shared and common understanding of some domain that can be communicated through people and computers [2]. Cooperative work has been used by different development teams worldwide, with reference to WordNet, Semantic Web and UNL (Universal Networking Language) through the construction of ontologies using collaborative tools. The use of ontological engineering tools, or metatools, to support the Knowledge Engineering process enables the process of organizing a knowledge base established on the relationship between relevant expressions within a context. Ontologies, as a basis for automatic generation of knowledge acquisition tools, simplify the system specification phase by taking advantage of ontologies defined during the Knowledge Engineering process [3]. Nevertheless, experience shows that often the bottleneck of building sharable ontologies lies more in the social process than in the technology itself [4]. Therefore, a methodology for the process of knowledge acquisition was developed, so that the specialist and the knowledge engineer can work in synchronicity, in cooperative networked organizations. We call this methodology Mind Engineering. This synchronization process begins with the understanding of human intelligence, its unconscious manifestations and its relationship with words, since, according to Lacan, every human investigation is linked irreversibly to the inner space created by language.

In the present development, a tool was created to support the Knowledge Engineering process by assisting developers in the design and implementation of ontologies on a specific domain.

In earlier works, we used a methodology called DCKR (Dynamically Contextualized Knowledge Representation) [5]. DCKR allows to build a knowledge base, improving the construction of the ontology of the domain and the automatic representation of cases in knowledge-based systems, either in the legal area [6] or any other knowledge management domain [7].

It follows a description of the methodology for knowledge synchronization. This methodology allowed an exceptional coherence among the semantic relations of what are called 'indicative expressions', mainly by the support of all this computational structure during the process. This allowed the knowledge engineer and the specialist to develop, more than the knowledge representation of the domain, abilities such as an inherent conscience, discipline, persistence, and empathy.

## 2 Knowledge Representation in Knowledge-Based Systems

We use a special process to extract and represent knowledge in the process of developing knowledge-based systems. The main purpose is to allow an automatic process of text indexing, on the basis of a controlled vocabulary and a dictionary of normative terms, constructed persuasively through the relevance

of pre-defined terms, called key-normative terms [8]. Given the need to turn the acquisition process faster, it was necessary to evolve the process using IR (Information Retrieval) techniques to associate the relevance of the terms with the frequency of the words added to the controlled vocabulary and the dictionary of normative terms; this approach resulted in a methodology of knowledge representation called DCKR - Dynamically Contextualized Knowledge Representation [9]. DCKR is a methodology of knowledge representation centered on a dynamic process of acquisition of knowledge from texts, defined through the elaboration of a controlled vocabulary and a dictionary of terms, associated to an analysis of frequency of the words and indicative expressions of the specific context (see figure 1).

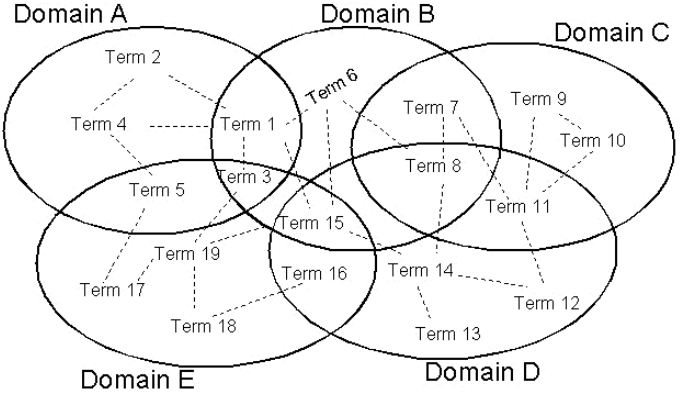


**Fig. 1.** The semantic relations of indicative expressions

### 2.1 UNL, Semantic Web and WordNet

In the process of knowledge acquisition for the preparation of a knowledge base of intelligent systems, methodologies that use web environments and cooperative development have to be used. Nowadays, there are three main solutions worldwide that use the Internet for the development of ontologies: UNL, Semantic Web and WordNet.

UNL (Universal Networking Language) [10] is a language for computers to share information through a network. It is meant for representing the natural language, so that computers can process the text and represent it in different languages.

WordNet [11] is a lexicon reference system inspired in psycholinguistic theories on the human lexical memory. The nouns, verbs, adjectives and adverbs of the English language are, organized in sets of synonyms, each one representing a lexical concept. Different semantic relations link the sets to each other.

The Semantic Web [12] is an extension of the current Web, in which the information has a very well defined meaning, allowing computers to process the

information contained in web pages and to understand it, performing operations that facilitate the users' work.

The three initiatives are meant to facilitate the automatic processing of information contained in documents, allowing computers to perform more intelligent operations and to retrieve information in a more efficient way.

### 2.2 The Use of Ontologies in the System

The ontologies structure is the heart of a knowledge-based system that uses DCKR methodology. The reason for that is because all processing and storage of gathered information and knowledge base organization is done using this structure. It also plays an important role in the quality of the results presented to the user.

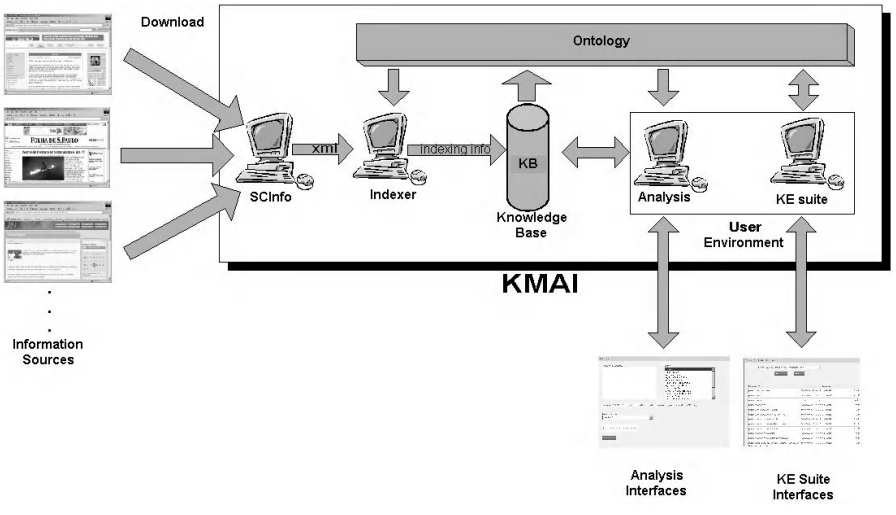


**Fig. 2.** Ontologies in the system

The participation of the ontology structure in the system occurs in three moments (see figure 2). At the first moment, the system extracts information from different previously selected sources. Each one of these documents is indexed based in the ontologies defined by the specialists and knowledge engineers during the knowledge engineering process. It means that the system will mark the documents with all indicative expressions found in the text, storing them in an organized way in the knowledge base. Thus, it is possible to make a pre-classification of the cases in the base according to what was defined in the knowledge organization promoted by the ontologies.

In a second moment, the ontologies are important in the analysis interface available to the user. The process begins at the moment in which the user types the input text for the search. At this point, the indicative expressions defined

by the user that coincide with the ones presented in the ontology are identified. These expressions identified in the entry case determine the stream of relations that will be used by the system. It means that there is a dynamic relation between the way the user enters the indicative expression in the analysis interface and the way the relations in the Knowledge Engineering Suite are defined for this expression.

The first versions of the Knowledge Engineering Suite worked with key expressions, an approach that resulted in some rigidity in the ontology organization, for the weight of the information that was typed by the user in the search text was not considered. This rigidity is acceptable in cases in which the content of the documents stored in the system is standardized, with a small degree of variation. But in cases with broader domains and with different sources of information with no control over its contents, this approach was not efficient.

For this reason, it was decided to apply an approach that turns the use of ontology more dynamic in the analysis process. In this new approach, the importance of the indicative expressions to be considered is defined by the user. The system gives priority to the expressions and search for the corresponding derivations for each case, according to the knowledge base. A priori, there is no hierarchy in the organization of the ontology in knowledge base. The weight of the relations will be based only in what is required by the search, where the context intended by the user is defined.

The third moment where the ontology takes part is in the Knowledge Engineering Suite, available in the system and integrated in its architecture. Through the Knowledge Engineering Suite the user is able to update the knowledge base with new expressions. At each new update in the ontology, the system re-indexes all the texts stored in the knowledge base, so the users may use this new ontology organization to search for documents previously indexed. It allows the verification of old documents that are related to a context that is important at the present moment. This way, it is possible to define a dateline about a subject, locating its start point.

### 2.3 The Knowledge Engineering Suite

The Knowledge Engineering Suite is an Ontological Engineering Tool for collaborative work on the Web, aiming to ease the sharing of knowledge between the Knowledge Engineering team and the specialist team. The Suite allows to build relationships between complex terms, considering its concept in the specific domain of application. These relationships are based on AI (Artificial Intelligence) techniques [13], theories of language, Semantic Web, WordNet, and UNL.

The creation of an infrastructure for the acquisition of knowledge for cooperative work on the Web is an efficient and effective tool of knowledge acquisition for intelligent systems. Many different techniques of Knowledge Acquisition exist; but Knowledge Engineering Suite (see figure 3) is integrated as part of DCKR methodology. Here, tools such as the Frequency Extractor, the Semantic Extractor and the Knowledge Engineering Suite have been associated with the methodology to help in the task of knowledge acquisition.

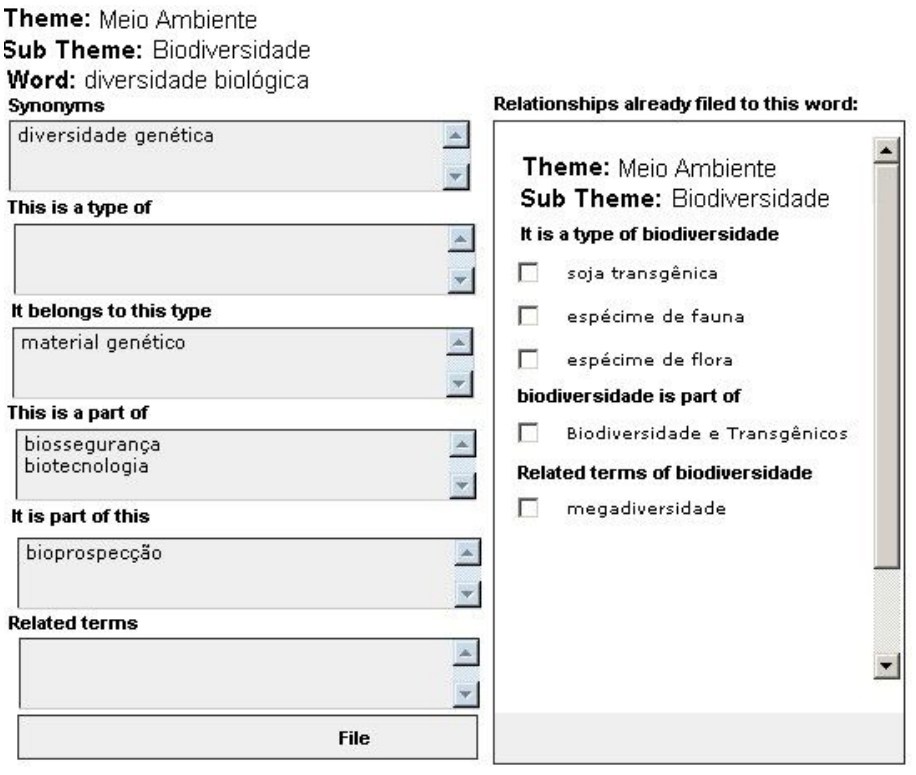


**Fig. 3.** Editing Module – Ontology construction (insertion and consistency checking)

This application works with extractors of automatic standards in conjunction with knowledge engineers and domain specialists as according to specifications found in the methodology DCKR, which consists of a dynamic process of analysis of the general context involving the theme to be focused on. The Suite is an editor of ontologies structured in a form to allow a cooperative work on the Web between the Knowledge Engineering team and the specialists team.

This computational environment of shared access has two main objectives: organization and representation of knowledge, and updating of the knowledge base. It is basically composed by four modules, which are:

1. *Filing.* It allows to set up a contextualized dictionary, by selecting themes and sub-themes for the classification of indicative expressions. In this environment the user defines the theme and sub-theme under which new indicative expressions will be inserted. A domain can be categorized in various themes and sub-themes;
2. *Search.* It informs about other terms already filed on the base, which have some phonetic similarity with the term typed. This tool allows the verification of possible typing errors, besides preventing duplicated filing of the

same term. It is a search system based on phonetic similarity. It supplies the user with a list of similar indicative expressions found in the knowledge base, in alphabetical order, when a query is typed by the user. The search module is used in the filing, edition and administration modules;

3. *Relationship Editor.* Allows the building of the relationship tree, always considering the similarity between all the terms filed and the ones already existing on the base. These relationships allow the system to expand the search context. The organization of the tree allows the dynamic definition of the weights of the indicative expressions according to the query of the user. The fields with all available relationships are presented. They are the following: -synonyms; -related terms; "this is a type of"; "it belongs to this type"; "this is a part of"; "it is part of this". The editor presents the existing relationships and allows to include them (see figure 3). Each relationship has a weight related to the defined indicative expression in the query by the user.
4. *Administration Environment.* The knowledge integration and the validation between words are made in accordance with the context of themes and subthemes. The environment is organized in three levels: High Level - allows to insert themes and sub-themes, to validate exclusions, to include and to exclude users, to check productivity of each user and to check descriptions of the dictionaries, themes, sub-themes and indicative expressions; - Medium level- allows to check productivity and historical data; and, Low level- allows to check descriptions.

The definition of related concepts implies research work or help from a knowledge specialist on the matter. They are terms that can be considered as synonyms of themes and secondary themes, as well as close to the application context. An identifiable limit does not exist for the number of related concepts. Therefore it is important to observe the application of the terms in real cases. The specialists are helped in this task by a technological structure.

The module of related concepts is used by the domain specialists. They can work in their office, and then the contents are integrated into the knowledge base through the knowledge acquisition module (see figure 3). In order to enable the specialists work, a methodology based on the Theory of Juridical Argumentation [2] and Extensive Interpretation is used.

All the concepts, linked each other, generate a semantic-like network. This network improves the system capacity to recognize concepts, independently of finding it or not in the text. The network is organized into levels, indicating the "distance" between two concepts. These levels are used later on in the similarity measure.

However, all this structure and methodology was not enough to turn the cooperative work efficient and effective. A more holistic approach was necessary, which allows a greater coherence between the relations of the expressions, mainly in the definition of the related terms where the participation of the specialist is almost exclusive. It is important to highlight that this structure of contextualized ontologies allows automatic information indexing by the system and a knowledge acquisition that gives more qualitative answers in the retrieval process.

## 3 Enabling the Synchronicity in a Collaborative Networked Organization

The different unfolding of the human inventivity, although it is so diversified, has the same origin, the unconscious mind and the human perceptions. This is because distinct constructions eventually lead the mind to the same reference. Therefore we created a methodology that allows the immediate perception of the specialist to arise, without the pretension to reach all the knowledge, but with clear objectives, for example, to eliminate the common resistance of people to technological innovations, standing out the importance of management of human capital [14].

During the development of tasks of Knowledge Engineering, it was observed that the efficiency of the acquisition process had a direct relation with good relationship between the knowledge engineer and the domain specialist, no matter what the quality or content of the interviews were, or the efficient application of the support tools. Thus, keeping this relationship in perfect synchrony is a key factor for the success of the system and a challenge for which the stages defined in the present work serve as a model of relative success.

Common sense tells us that immediate perception (intuition) has greater effectiveness on the best solution for a problem than the application of rules of the propositional logic. However, the most accepted proposal is people trying to solve deductive problems applying rules such as those of the propositional logic. According to Lacan [15], if we consider that the unconscious is structured as a language, it is possible to reconstruct the unconscious associations between the words, thus disclosing a context.

There are elements, like the cognitive complexity and the capacity to learn, that supply the underlying individual traces on which the specialized knowledge and abilities are based, and similarly, sociability and confidence supply the anchors to develop and to keep a net of relationships. Thus, identifying that non-cognitive knowledge is also important knowledge of the institutions and, for this reason, they must be part of the capital of these organizations, it is necessary to look for a way to identify it and to represent it in the knowledge based systems. Therefore, this complex net of communications between the diverse areas of talent will provide the necessary flexibility, versatility and adaptability intelligences.

All the languages are structured as an articulating system. But their character and coherence is a unique articulated system. Thus the cognitive point of view concerning the symbolic acquisitions has as foundation the meanings generally supported by natural language or specialized languages such as the formal ones. To have these elementary meanings present in the work of a team requires synchronous thinking.

This synchronization process starts with the understanding of human intelligence, its unconscious manifestations and its relationship with words. Therefore, in accordance with Lacan [16], every human investigation is tied irreversibly in the interior of the space created by the language. But, for the success of this dynamics of cerebral exercise, it is essential the person to be in a positive attitude.

The brain registers, learns and builds ramifications only when it is open to what is new.

### 3.1 Mind Engineering Methodology

There are many different techniques of Knowledge Acquisition. We created Mind Engineering (see figure 3) to help developing the following process (DCKR methodology): (1) Inventory of the entire domain (classification of all sources of digital information that will be in the system database); (2) Application of the word frequency extractor based on the database inventoried; (3) Comparison between extractor results with the specialist needs; (4) Construction of a representative vocabulary of the domain by the specialist and knowledge engineers; (5) Application of the semantic extractor on the database using the representative vocabulary (indicative expressions); (6) Definition of a list of words based on the evaluation of the results of the frequency of the indicative expressions found in the inventory (7) Construction of the ontologies in the Knowledge Engineering Suite based on this controlled vocabulary (8) Definition of synonyms, related terms, homonyms, hyponyms, hypernyms and meronyms.

The acquisition of knowledge carried out by the team of Knowledge Engineers had a bigger effectiveness in the area of its specialization [5], [6] than the acquisition performed by the same team in domains different from its specialization [7], where some obstacle of communication caused the need of a new acquisition process to be implemented.

Not having synchronization problems, the deep knowledge of the specialists on the AI technique applied in the system modeling (e.g., Case-Based Reasoning) allowed the transference of knowledge into the computational language in a very positive way for the final target of the system.

It was observing the elements presented in the two processes that we were able to systematize a series of questions, improving the speed and quality of knowledge represented in the system.

Additionally, uncommon procedures of knowledge acquisition were adopted, such as neurolinguistics and meditation techniques, to defragment the emotional memory of the specialist and to facilitate the learning process (see figure 4). This happened due to the following problems: (1) Resistance against the system; (2) Difficulty to reproduce the process of decision-making; (3) Low quality of the knowledge handled.

However, the focus object is not the area of application of the system (domain), but the work of the specialist and the knowledge engineer to define the target of the system and create the knowledge base of this system. To identify and to classify knowledge levels is essential, therefore both (specialists and engineers) have to be trained on the learning process; that requires them to overcome the comfort zone. Knowledge Engineering is mostly a process of knowledge exchange.

The importance of existing knowledge for new acquisitions comes from the basic role they play inside the construction of the representation and from the idea given by that acquisition process to those representations. The importance

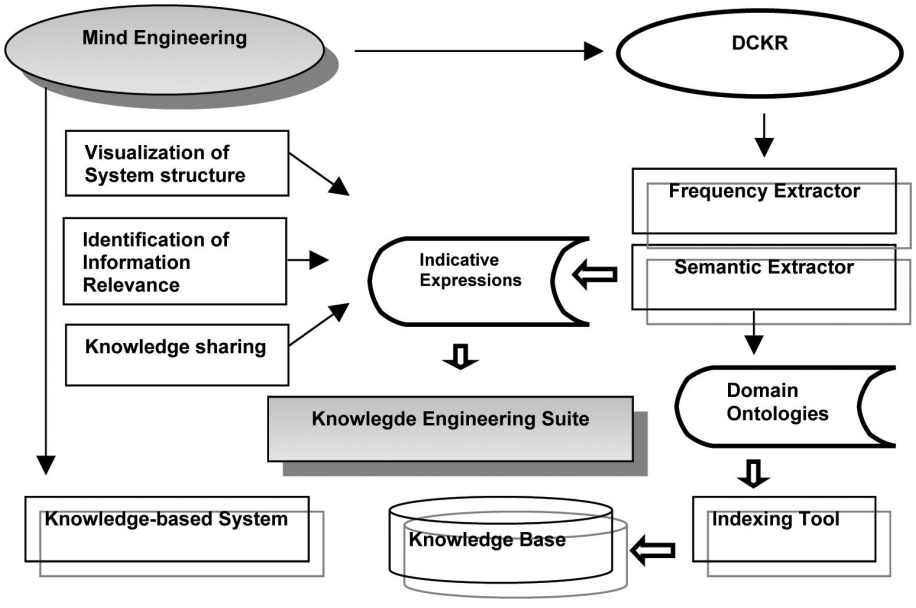


**Fig. 4.** Mind Engineering Methodology applied to the construction of ontologies in Knowledge-based Systems

of this phase is the exchange of knowledge; the specialist gets to know how his knowledge could be organized, that is, the basic concepts of the technique of Artificial Intelligence used in the representation of knowledge. Thus he will be able to contribute with more effectiveness and will have a greater interest in participating in the process. For the knowledge engineer, the exchange will lead to a more immediate perception of the target of the system and will increase the interest in going deeper in the study of the domain. Both will be prepared to deal with this overload and to obtain the ability necessary to plan or to choose a perspective that determines which elements of the situation must be treated as important elements and which can be ignored. By perceiving that the vast information or knowledge is reduced to a number of characteristics and relevant aspects, the decision making process becomes easier.

The continuous sharing of the established visions makes the specialists and engineers to work in better cooperation in the construction of the ontologies of the domain. This productive process is continuous and can lead to changes in the system implementation phase.

## 4 Conclusion

The systematization and organization of domain specialist teams together with the team of Knowledge Engineering became a big challenge in the development of knowledge management systems. The cooperative work between the teams does

not only require the deep knowledge on the application domain, but also on the organization of its knowledge base. The creation of a computational environment on the web allowed a greater sharing of information and better results of the teams in the construction of knowledge-based systems.

The Knowledge Engineering Suite enables a cooperative work among people in different places, structuring a continuous knowledge base and easy visualization (knowledge tree) through relationship networks and supplies an exceptional coherence among the semantic relations of the indicative expressions, mainly by the support of all this computational structure during the process. This allowed the knowledge engineer and the specialist to develop much more than the knowledge of the domain, but abilities such as conscience itself, discipline, persistence, and empathy.

## References


1. Resende, Solange Oliveira. Sistemas Inteligentes: fundamentos e aplicações. Barueri, SP: Manole,2003.
2. Duineveld, A. J. et al, 1999. WonderTools? A comparative study of ontological engineering tools. Twelfth Workshop on Knowledge Acquisition, Modeling and Management.Voyager Inn, Banff, Alberta, Canada.
3. Eriksson, H. et al, 1999. Automatic Generation of Ontology Editors. Twelfth Workshop on Knowledge Acquisition, Modeling and Management.Voyager Inn, Banff, Alberta, Canada.
4. Benjamins, V.R., 1998. The ontological engineering initiative (KA)2, Formal Ontology in Information systems. IOS Press, Amsterdam.
5. Hoeschl, Hugo. C. Bueno, Tania. C. D., Barcia, Ricardo. M., Bortolon, Andre., Mattos, Eduardo Da Silva. Olimpo: Contextual structured search you improve the representation council of UN security with information extraction methods In: å. Artificial International conference on inteligence and law, 2001, St. Louis. ICAIL 2001 Proceedings. New York: ACM SIGART, 2001, p.217 - 218.
6. Bueno, Tânia Cristina D'Agostini. O Uso da Teoria Jurídica para Recuperação em Amplas Bases de Textos Jurídicos. 1999. 94 f. Dissertação (Mestrado em Engenharia de Produção) - Universidade Federal de Santa Catarina, Florianópolis, 1999.
7. Ribeiro, Marcelo Stopanovski. KMAI, da $RC^2$D à PCE. Gestão do conhecimento com inteligência artificial, da representação do conhecimento contextualizado dinamicamente à pesquisa contextual estruturada. [2004]. Dissertação (Mestrado em Engenharia de Produção) - Universidade Federal de Santa Catarina, Florianópolis, 2003.
8. Bueno, Tânia C. D. et al, 1999. JurisConsulto: Retrieval in Jurisprudencial Text Bases using Juridical Terminology. Proceedings of the Seventh International Conference On Artificial Intelligence And Law. ACM, New York.
9. Hoeschl, Hugo. C. et al, 2003. Structured Contextual Search For The Un Security Council. Proceedings of the fifth International Conference On Enterprise Information Systems. Anger, France, v.2. p.100 - 107.
10. UNL. Universal Networking Language. Available at: `http://www.unl.ias.unu.edu/unlsys/index.html`. Access on: 19 jan. 2004.

11. WORDNET. Available at: http://www.cogsci.princeton.edu/~wn/. Access on: 19 jan. 2004.
12. Semantic Web. Available at: http://www.w3.org/2001/sw/. Access on: 19 jan. 2004.
13. Kolodner, J. Case-Based Reasoning. Morgan Kaufmann, Los High, CA. 1993.
14. Gratton, Lynda, Ghoshal, Sumantra. Managing Personal Capital Human: new ethos will be the "Volunteer" Employee, The European Management Journal, vol 21, n° 1 pp1-10, February, 2003.
15. Lacan, Jacques. Os seminários de Lacan. Disponível em CD Rom, 2000.
16. Miller Jacques-Alain, 1988. Percurso de Lacan: uma introdução. Jorge Zahar Editor Ltda, 2a edição, Rio de Janeiro.

# Guided Interactive Information Access for E-Citizens

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**Abstract.** Governments, especially local ones, are using the web to provide a number of services that are mainly informative and aim at improving the quality of life of citizens and at promoting the local community "abroad". These services include among others, job placement services, tourist information (hotels, restaurants, etc.), yellow pages to promote local industries and activities, and are supplied in addition to institutional services such as law, regulations and opportunities information bases. We argue that traditional methods commonly used by administrations to implement these services do not really work, and propose a new access paradigm based on conceptual manipulation. This paradigm is applied to a job placement example.

## 1 Introduction

The World Wide Web has changed the way public administrations work in a number of important and diverse ways. Perhaps one of the areas overlooked in the current debate and research on e-government is the access to public information. The quantity and diversity of information available from public government sources is now quite large and increasing, and publishing and maintaining information have become important tasks for administrations, particularly local administrations. Information available to citizens includes "institutional" communication (the official publication of laws and regulations) but also information on opportunities and promotional information. This non-institutional information is often more interesting to the general public than laws and regulations are. It is aimed at improving both the quality of life of single citizens and the economic opportunities for local concerns: it includes both funding and grants, job placement services, but also tourist information such as hotel, restaurants, entertainment, etc. and yellow page services to promote local companies.

This significant amount of information is currently managed by traditional access paradigms that focus on retrieval of data on the basis of precise specifications: examples of this approach include queries on structured database systems, and information retrieval. However, most search tasks, especially in the present context, are exploratory and imprecise in essence: the user does not usually know precisely what he wants (e.g. a specific law, or a specific restaurant), but rather he needs to explore the information base, find relationships among concepts and thin alternatives out in a guided way. Traditional access methods are not helpful in this context, so that new access paradigms are required. We show how dynamic taxonomies, a model recently proposed for the intelligent exploration of heterogeneous information bases, can provide a uniform

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framework for guided browsing and personalized exploration for both institutional and non-institutional information bases.

## 2 Traditional Information Access Methods

Most informative material is textual and unstructured, so that information retrieval techniques [20] are currently used both in pull and push strategies [16]: almost no editorial or manual processing of information is required, which means low costs and the immediate availability of new material. However, the limitations of commercial information retrieval systems are known [1]. The major problem is the extremely wide semantic gap between the user model (concepts) and the system model (strings of characters). Despite a number of improvements ranging from inflectional normalization, to intelligent thesauri such as WordNet [2], to relevance ranking [6], any user of search engines experiences low precision and recall for all but the most concrete queries. In addition, information retrieval systems are extremely poor from the point of view of user interaction: users formulate their queries with no or very little assistance, a difficult tasks because they often do not know precisely what the information base contains. Finally, results are presented as a flat list with no systematic organization, so that browsing the infobase is usually impossible.

In taxonomy-based systems, such as Yahoo, a hierarchy of concepts can be used to select areas of interest and restrict the portion of the infobase to be retrieved. Taxonomies support abstraction and are easily understood by end-users, but they are not scalable for large databases. In fact, a normal taxonomy can be used for discrimination just down to terminal concepts, which are no further specialized: at that point, the list of items associated with the selected terminal concept must be inspected manually. As the infobase grows, the average number of documents becomes too large for manual inspection [9].

Solutions based on semantic networks have been proposed in the past [14] and are now addressed again in the context of ontologies and Semantic Web. This approach is quite expensive in terms of design and maintenance of complex conceptual schemata. Although general ontologies are more powerful and expressive than plain taxonomies, they are difficult to understand and manipulate by the casual user. Consequently, user interaction must be mediated by specialized agents, which increases costs, time to market and decreases generality and flexibility of user access. Most importantly, it is difficult to explain the agent internal logic to users, so that agent decisions are often opaque and not easily understood. The solution we propose can be seen as a complement, in addition to being an alternative, to complex ontologies: a preliminary discussion of how our taxonomy-based model can provide a user-understandable, transparent view on complex semantics is reported in [13].

## 3 Dynamic Taxonomies

Dynamic taxonomies [7], [8] are a general knowledge management model for complex, heterogeneous information bases. It has been applied to very diverse areas, including news archives, encyclopedias, multimedia databases [10], electronic commerce [11],

and medical guidelines [19]. The intension of a dynamic taxonomy is a taxonomy designed by an expert. This taxonomy is a concept hierarchy going from the most general to the most specific concepts. A dynamic taxonomy does not require any other relationships in addition to subsumptions (e.g., IS-A and PART-OF relationships). Directed acyclic graph taxonomies modeling multiple inheritance are supported but rarely required

In the extension, items can be freely classified under several topics at any level of abstraction (i.e. at any level in the conceptual tree). This multidimensional classification is a generalization of the monodimensional classification scheme used in conventional taxonomies and models common real-life situations. First, an item is very rarely classified under a single topic, because items are very often about different concepts. Second, items to be classified usually have different independent features (e.g. Time, Location, etc.), each of which can be described by an independent taxonomy. These features are often called *perspectives* or *facets*.

By defining concepts in terms of instances rather than properties, a concept C is just a label that identifies all the items classified under C. Because of the subsumption relationship between a concept and its descendants, the items classified under C (*items(C)*) are all those items in the *deep extension* [17] of C, i.e. the set of items identified by C includes the *shallow extension* of C (all the items directly classified under C) union the deep extension of C's sons. By construction, the shallow and the deep extension for a terminal concept are the same.

There are two important consequences of our approach. First, since concepts identify sets of items, logical operations on concepts can be performed by the corresponding set operations on their extension. Second, dynamic taxonomies can find all the concepts related to a given concept C: these concepts represent the conceptual summary of C. Concept relationships other than IS-A are inferred through the extension only, according to the following *extensional inference rule*: two concepts A and B are related if there is at least one item d in the infobase which is classified at the same time under A (or under one of A's descendants) and under B (or under one of B's descendants). For example, an unnamed relationship between Michelangelo and Rome can be inferred if an item classified under Michelangelo and Rome exists in the info-base. At the same time, since Rome is a descendant of Italy, also a relationship between Michelangelo and Italy can be inferred. The extensional inference rule can be seen as a device to infer relationships on the basis of empirical evidence.

The extensional inference rule can be easily extended to cover the relationship between a given concept C and a concept expressed by an arbitrary subset S of the universe: C is related to S if there is at least one item d in S which is also in items(C). Hence, the extensional inference rule can produce conceptual summaries not only for base concepts, but also for any logical combination of concepts. In addition, dynamic taxonomies can produce summaries for sets of items produced by other retrieval methods such as information retrieval, etc. and therefore access through dynamic taxonomies can be easily combined with other retrieval methods.

Dynamic taxonomies work on conceptual descriptions of items, so that heterogeneous items of any type and format can be managed in a single, coherent framework. In addition, since concept C is just a label that identifies the set of the items classified un-

der C, concepts are language-invariant, and multilingual access can be easily supported by maintaining different language directories, holding language-specific labels for each concept in the taxonomy.

## 4 Information Access Through Dynamic Taxonomies

The user is initially presented with a tree representation of the initial taxonomy for the entire infobase. Each concept label has also a count of all the items classified under it (i.e. the cardinality of items(C) for all C's). The initial user focus F is the universe (i.e. all the items in the infobase).

In the simplest case, the user can then select a concept C in the taxonomy and *zoom* over it. The zoom operation changes the current state in two ways. First, concept C is used to refine the current focus F, by intersecting it with items(C); items not in the focus are discarded. Second, the tree representation of the taxonomy is modified in order to summarize the new focus. All and only the concepts related to F are retained and the count for each retained concept C' is updated to reflect the number of items in the focus F that are classified under C'. The reduced taxonomy is a conceptual summary of the set of documents identified by F, exactly in the same way as the original taxonomy was a conceptual summary of the universe. In fact, the term *dynamic taxonomy* is used to indicate that the taxonomy can dynamically adapt to the subset of the universe on which the user is focusing, whereas traditional, static taxonomies can only describe the entire universe.

The retrieval process is an iterative thinning of the information base: the user selects a focus, which restricts the information base by discarding all the items not in the current focus. Only the concepts used to classify the items in the focus, and their ancestors, are retained. These concepts, which summarize the current focus, are those and only those concepts that can be used for further refinements. From the human computer interaction point of view, the user is effectively guided to reach his goal, by a clear and consistent listing of all possible alternatives.

Dynamic taxonomies can be integrated with other retrieval methods in two ways:

1. focus restrictions on the dynamic taxonomy provide a context for other retrieval methods, thereby increasing the precision of subsequent searches; or
2. the user can start from an external retrieval method, and see a conceptual summary of the concepts that describe the result.

These two approaches can be intermixed in different iteration steps during a single exploration. The integration of dynamic taxonomies with information retrieval is especially important because dynamic taxonomies can be used to describe abstract, conceptual queries and information retrieval can be used to define concrete queries (for instance proper names). By offloading conceptual manipulation to the dynamic taxonomy component, the information retrieval component needs not be very sophisticated, and in fact, a simple text retrieval system is usually adequate.

## 5 An Example

The example presented here is a job placement application, based on Knowledge Processors' Universal Knowledge Processor [18], a commercial system based on dynamic taxonomies that features real-time operations even for very large information bases. Curricula are represented by a dynamic taxonomy based on 15 facets, ranging from Age to Geographical Location of candidates (figure 1). Curricula are also accessible via full-text search for information not described through the taxonomy, e.g., specific programming languages. The information base shown in figures 1-5 is a real information base, taken from a job placement company. Curricula were originally stored in relational structures and managed by a commercial information retrieval system: they were automatically reclassified according to the dynamic taxonomy conceptual schema. The entire pilot application was built in less than two days.

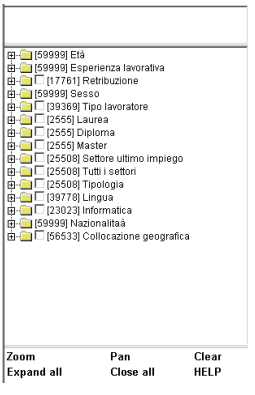


**Fig. 1.** Facets for curricula

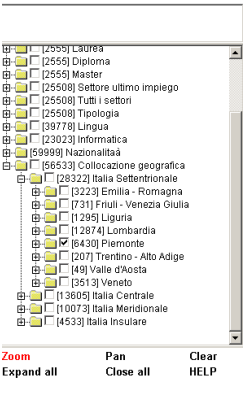


**Fig. 2.** Preparing to zoom on Northern Italy> Piedmont

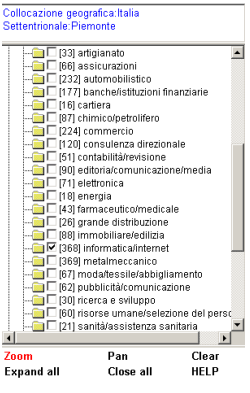


**Fig. 3.** Preparing to zoom on Computer/Internet

In figure 2, the result of a zoom on Geographical Location> Northern Italy> Piedmont is shown: 6430 out of 60,000 curricula are selected. Figure 3 shows the conceptual summary of this set: the computer/internet activity area for latest job is being zoomed on. Figure 4 reports the conceptual summary for ages of applicants. Two zoom operations were sufficient to reduce the number of curricula to be manually inspected from 60,000 to 368, and to 15 if we only consider the 20-25 year age group.

Figure 5 shows how information retrieval is seamless integrated with dynamic taxonomies. The infobase is queried for all documents containing the word cobol: 145 curricula qualify and the left pane shows the conceptual summary for these curricula, in which the Age facet was expanded.

Although we have conducted no formal tests, users that tried the dynamic taxonomy version of the information base reported a higher productivity, an easier assessment of alternatives and a perceived higher quality of results. Incidentally, the current example


**Fig. 4.** Conceptual summary by Age for candidate curricula

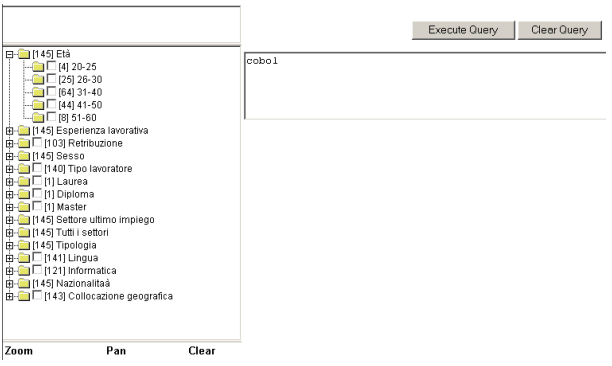


**Fig. 5.** Conceptual summary for curricula containing the term "cobol"

shows that dynamic taxonomies can solve a number of practical problems in human resource management too, a promising research area that we are investigating.

## 6 Benefits of Dynamic Taxonomies for Information Access

The advantages of dynamic taxonomies over traditional methods are dramatic in terms of convergence of exploratory patterns and in terms of human factors. Three zoom operations on terminal concepts are sufficient to reduce a 1,000,000-item information base described by a compact taxonomy with 1,000 concepts to an average 10 items [9]. Dynamic taxonomies require a very light theoretical background: namely, the concept of a subject index (i.e. the taxonomic organization) and the zoom operation, which seems to be very quickly understood by end-users. Hearst et al. [4] and Yee et al. [21] conducted usability tests on a corpus of art images, showing a significantly better recall than access through text retrieval and, perhaps more importantly, the feeling that one has actually considered all the alternatives in reaching a result.

Dynamic taxonomies cleanly separate the process of classifying documents from the use of the classification information in the browsing system, and considerably simplify the design of the conceptual taxonomy. First, dynamic taxonomies actually perform concept association mining. This simplifies index creation and maintenance since concept associations, which are often quite dynamic in time, need not be forecasted and accounted for in schema design. At the same time, the user is presented with associations the schema designer might not even be aware of. In traditional approaches, only the relationships explicitly described in the conceptual schema will be available to the user for browsing and retrieval, so that all of them must be anticipated: a very difficult if not helpless task.

Second, since dynamic taxonomies synthesize compound concepts, these need usually not be represented explicitly. Sacco [8] developed a number of guidelines that produce taxonomies that are compact and easily understood by users. Some of these

guidelines are similar to the faceted classification scheme by Ranganathan [5], at least in its basic form: the taxonomy is organized as a set of independent, "orthogonal" subtaxonomies (facets or perspectives) to be used to describe data. As an example, a compound concept such as *IT in Southern Italy* need not be accounted for, because it can be synthesized from its component concepts: *Sector>IT* and *Location>Southern Italy*. Thus, one of the main causes of complexity in the design of comprehensive taxonomies is avoided: by synthesizing concepts, we avoid the exponential growth due to the description of all the possible concept combinations, and the resulting taxonomy is significantly more compact and easier to understand. In addition, breaking compound concepts into their base components allows the user to easily correlate concepts and explore such correlations. In the example, the user focusing on *Sector>IT* will immediately find all the relevant locations related to agriculture (which include *Southern Italy*). If compound concepts are used (*IT in Southern Italy*), correlation information is hidden inside labels, and cannot be carried out automatically but requires the manual inspection of labels. Finally, the excellent convergence of dynamic taxonomies allows the designer to define taxonomies that are much simpler and smaller than traditional ones.

Personalization and access control can be supported by using boolean expressions on the concepts in the taxonomy. Such an expression defines a user profile and can be automatically added to user queries in a way similar to query modification in relational database systems [15]: the current user profile will be considered as the initial context or focus, instead of the universe of discourse: when the initial reduced taxonomy is presented, only the concepts under which there are documents satisfying the current profile are preserved. This same user profile (or multiple versions of it) can be used to implement push strategies [12].

## 7 Conclusions

Dynamic taxonomies represent a dramatic improvement over other search and browsing methods, both in terms of convergence and in terms of full feedback on alternatives and complete guidance to reach the user goal. In addition, they can provide multilingual access, easy personalization, access control and push strategies. Dynamic taxonomies can be applied to "institutional" information and solve a number of important problems in that area [13]. By providing a very diverse example of "non-institutional" information, we show here that they can be used as a single tool to solve most of the information access and dissemination needs of e-administrations. This implies means lower IT costs but also, and more importantly, a lower cognitive effort required from e-citizens.

As a further step in this direction, we are completing an application based on a commercial dynamic taxonomy engine [18] that manages an announcement list and supports both interactive pull access and proactive push dissemination. Its main features are rich content, different facets and easy and intuitive dissemination. The availability of alternate representations, implemented with traditional technologies, provides an excellent way to conduct a large-scale usability study and the relative simplicity of the semantic content and of the size of the information base makes qualitative measures of precision, recall and time to get results viable and meaningful.

## References


1. Blair, D. C., Maron, M. E: An evaluation of retrieval effectiveness for a full-text document-retrieval system. Comm. ACM, 28:3 (1985)
2. Fellbaum, C. (ed.): WordNet-An Electronic Lexical Database. MIT Press (1998)
3. Groenbaek K., Trigg R. (eds.): Hypermedia. Comm. ACM 37, vol. 2 (1994)
4. Hearst, M., et al.: Finding the Flow in Web Site Search, Comm. of the ACM, 45, 9 (2002)
5. Ranganathan, S. R.: The Colon Classification. Rutgers University Press (1965)
6. Robertson, S. E., Sparck Jones, K.: Relevance weighting of search terms. J. of ASIS. 27 (1976)
7. Sacco, G.M.: Navigating the CD-ROM, Proc. Int. Conf. Business of CD-ROM, (1987)
8. Sacco, G. M.: Dynamic Taxonomies: A Model for Large Information Bases. IEEE Transactions on Knowledge and Data Engineering 12, 2 , p. 468-479 (2000)
9. Sacco, G. M.: Analysis and Validation of Information Access through Mono, Multidimensional and Dynamic Taxonomies, Tech Report Dept. of Informatica, Univ. of Torino (2002)
10. Sacco, G. M.: Systematic Browsing for Multimedia Infobases, in Proc. CISST2003, Int. Conf. on Imaging Science, Systems, and Technology (2003)
11. Sacco, G. M.: The Intelligent E-Sales Clerk: the Basic Ideas, Proc. INTERACT'03 Int. Conf. on Human-Computer Interaction (2003)
12. Sacco, G. M.: Dynamic taxonomy process for browsing and retrieving information in large heterogeneous data bases. US Patent 6,743,349 (2004)
13. Sacco, G. M.: No (e-) Democracy without (e-) Knowledge, Int Conf. TCGOV 2005, pp. 147-156 (2005)
14. Schmeltz Pedersen, G.: A Browser for Bibliographic Information Retrieval, Based on an Application of Lattice Theory. Proc. ACM SIGIR Conf. (1993)
15. Stonebraker, M.: Implementation of integrity constraints and views by query modification. Proc. ACM SIGMOD Conf. (1975)
16. Story, G. A., et al.: The Rightpages Image-Based Electronic Library for Alerting and Browsing. IEEE Computer, 25:9 (1992)
17. Straube, D. D. & Ozsu, M. T.: Queries and query processing in object-oriented database systems, ACM Trans. on Information Systems, 8: 4 (1990)
18. Universal Knowledge Processor, `www.knowledgeprocessors.com`
19. van Rijsbergen, C. J.: Information Retrieval. Butterworths (1979)
20. Wollersheim, D., Rahayu, W.: Methodology For Creating a Sample Subset of Dynamic Taxonomy to Use in Navigating Medical Text Databases. Proc. IDEAS 2002 Conf. (2002)
21. Yee, K-P., et al.: Faceted Metadata for Image Search and Browsing, Proc. ACM CHI Conf. (2002)

# The Opportunities and Barriers of User Profiling in the Public Sector

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**Abstract.** Like the private sector, the public sector makes more and more use of user profiling to personalize the electronic services that are being offered to citizens. User profiling offers great opportunities to make communication more effective and efficient, to infer and predict citizens' behavior and to even influence behavior. However, some drawbacks must be considered. Important differences between the private and public sector hinder the full employment of user profiling for governments and some general user profiling obstacles, such as access, trust, control and privacy have to be overcome to make fruitful use of user profiling.

## 1 Introduction

User profiling gives governmental organizations tremendous possibilities for their e-government strategies. Fully personalized portals, for example, provide citizens with exactly those services they need, increasing citizen satisfaction levels. It helps in making communication more effective and efficient, inferring and predicting citizens' behavior and even influencing it, in order to make citizens abide by the law. However, governments face more, different and more profound organizational obstacles than the private sector when engaging in user profiling. This paper tries to answer the question what those barriers might be and how user profiling in the public sector differs from user profiling in an e-commerce environment.

## 2 User Profiling

People use all kinds of ICT applications in order to support and execute the many activities that constitute their daily lives. Especially ICT applications that are aimed at providing or supporting electronic services require data on individual users to achieve their function. To give a few examples: an online store needs to have individual user data such as an address to deliver the goods that are purchased. The city administration, which is approached by an impaired citizen requesting a special parking permit near her house, must have at its disposal both data about her address and about the nature and severity of the impairment.

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Such data are often provided by the individual user but can be stored for re-use by the organization.

From the user's perspective, the potential benefit of a single access point is not realized when the organizations treat each contact as if it were a first-time contact. Also, from the user's perspective, single access is particularly efficient for contacts with sets of organizations or departments within organizations which in the user's opinion have a common goal or interest in the user.

Although these services might be offered by different departments or even by different organizations, the citizen will perceive them as part of one 'event' and might easily become frustrated if having to perform the entire scenario, and provide the specific data, over and over again. Re-use of data collected or provided on earlier occasions strengthens the relationship between user and organization. A good user-experience during the contact will lead to (more) satisfaction about the application used, e.g. the e-commerce or the site, and more importantly, to a (more) positive image of the organization behind the application.

The re-use of data might be done by means of user profiling. The process of using user profiles, and the underlying activities of creating, maintaining and updating user profiles, is what we will refer to as user profiling.

We define the term user profile as follows:

*A user profile is a (structured) data record, containing user-related information including identifiers, characteristics, abilities, needs and interests, preferences, traits and previous behavior in contexts that are relevant to predicting and influencing future behavior [22].*

Some categories of user-related information concern stable, unalterable 'properties' of the user, such as name, age and gender. Other categories relate to properties that can easily alter over time (e.g. developing new preferences or abilities) and context (e.g. having a need for information during international travel, but not during national travel). User profiling is a process that requires a long-term commitment from organizations and users. The kinds of user data collected and used imply that user profiles are regularly, if not continuously, updated with new user data.

From the organization's perspective, user profiling is a means to achieve organizational goals and/or to perform organizational activities in a more efficient and effective way. What kinds of organizational goals are to be achieved depends on the nature of the organization. For a retail organization, for example, user profiling would be a means to improve customer relationships, consequently sell more products and ultimately make more profit. For public organizations whose task is to enforce the law, user profiling is a means to increase citizens' compliance to the law. Differences in the nature of organizations determine largely how user profiling might be used in various kinds of organizations.

Both private and public organizations must build up a sound, longstanding relationship with their customers and citizens. That relationship is created and maintained by efficient and effective communication. With regards to private organizations, clients will not return if their service expectations are not met.

This will eventually lead to decreasing sales. Basically, the same also applies to governments: the Weberian principle teaches us that governments wield power over subjects, but that power is only theirs for as long as subjects allow it [29].

User profiling has additional objectives. It gives those organizations offering electronic services the possibility to gain insight into the behavior of individual users and influence them at the same time. If organizations have sufficient knowledge about their customers or citizens and are able to apply the knowledge in persuasive strategies, then they stand a better chance of organizational success. Customers will continue buying or using products and services, and citizens will be inclined more to comply with the law and only lay claim to those resources to which they are truly entitled.

## 3 Different Conditions for User Profiling in the Private and Public Sector

Although private and public organizations may have similar aims with user profiling, their conditions for employing user profiling are fundamentally different [24].

Public organizations are guided by *political regulation*, leading to equal rights for citizens, whereas businesses are guided by *market regulation* and differentiate between valued and less-valued customers. Businesses can afford to simply ignore less-valued customers. Public organizations have to offer their services to each citizen on an equal basis. Businesses can concentrate on the best customers that have access to technology and are motivated to use opportunities, such as those offered by user profiling. Moreover, though the private sector is restricted by consumer laws and self-regulation when applying user profiling, the public sector is much more regulated. For example, in many countries privacy regulations are much stricter for government agencies than for businesses. These two factors, (in-)equality in treating customers or citizens and the different status of regulations, will give the private sector an advantage in the innovative use of user profiling.

The government is a *referee on its own playing field* of policy, management and services. It controls its own behavior in its approach to citizens. This also means that it can enforce new laws and regulations relatively easily and quickly. This also goes for the applications of user profiling that are highly sensitive with regard to privacy and security. For example, after September 11, 2001, the American government was able to adopt the Patriot Act in only a few months. This led to highly advanced uses of data mining and user profiling of potential suspects of terrorism, thereby passing every government privacy rule and using the latest techniques developed in the corporate sector where fewer such rules exist (see for example [14]).

Unlike most businesses, the government is not a simple or straightforward organization but a *gigantic complex of organizations* on all levels and of all kinds. This means that the databases in the public sector steering each application of user profiling are more complicated (highly regulated), encompassing (every

citizen) and fragmented (a collection of basic registrations with own standards, techniques, rules, supervisions and managements) than those in the private sector. Although the integration of databases also poses problems to the private sector, the extent of these problems is incomparable to the problems envisaged in the public sector. At present, all kinds of official citizen and business registrations are being standardized and linked in networks. However, this linkage of all databases is a huge operation and will not be finished soon. The effect of this different state of affairs is that – at least for the time being – the public sector is much more preoccupied with issues concerning organization, regulation and standardization whereas the business sector is able to go ahead with innovative use of user profiling on a limited though more advanced scale. A striking example of the scale and complexity of governments is found in the United Kingdom where the National Health Service collaborates with local, regional and national authorities to develop lifelong electronic health records for 50 million patients [1]. Being very ambitious, this is an enormous operation that takes the next 10 years to be fully operational and involves dozens of organizations and thousands of people in order to be a success.

In comparison with the public sector, the private sector made considerable progress with the tailoring of products and services in the course of the 20th century. The drive to reach individual consumers was simply much stronger than the drive for governments to communicate with individual citizens. Customers can choose where to buy products and services and businesses need to sell their products and shall therefore always compete with their competitors for the favor of the customer. Therefore, market research, bookkeeping and records of buying and selling have dominated corporate activities for the past 150 years. The corporate sector has invented technologies of group segmentation, direct marketing, market research, individual customer relationship marketing etc. In contrast, the *government lacks the experience* with those innovations but has on the other hand accumulated considerable experience with compiling and maintaining enormous registrations of citizens, real estates, enterprises etc. It has therefore become an expert in using personal information on an enormous scale, for example in printed and electronic forms.

Unlike most businesses, public organizations have a *monopolistic proposition*. In comparison to commercial clients, citizens have no options to change to another service provider. So on first sight, there seems to be no threat to the rationale of the existence of governmental agencies as there is no market place competition (see also above). For that reason, there seems to be no urgent need to upgrade e-government services to the level of personalized e-services in order to keep customer satisfaction at a high level, which has been a very important driver for businesses in the personalization movement. But that doesn't mean that public servants won't have to bother and won't sense any pressure at all to improve their services. Because as soon as performances drop beneath acceptable levels chances are that the public starts to complain. When this situation prolongs radical top-down interventions like outsourcing are on the verge. For

instance, this year the Dutch Tax Office decided to outsource parts of its call center activities once number of complaints about the service grew.

In the course of the 1990s, public opinion, political pressure and competition (e.g. losing services through privatization) forced government departments to become more user-oriented towards their citizens or clients, to integrate their fragmented service counters, to save on the administrative costs imposed on citizens and corporations and to supply all kinds of user-driven electronic applications. Suddenly, government departments adopted all kinds of customization technologies from the commercial sectors in order to become more service-oriented and user-centered (see for example [3]). In the first decade of the 21st century, however, attention and priorities have again shifted to law enforcement and security issues (due to e.g. September 11, 2001). Nowadays, both objectives, i.e. user-driven electronic services and screening or surveillance applications, may fuel the need for government user profiling.

## 4 Organizational Obstacles to User Profiling

Offering personalized services might imply that the user is given an important role in the way the business process is designed and implemented. It is even possible to give customers access to all kinds of back-office systems, for example to place an order directly in the organization's back-office, as it is the case with electronic banking and many internet stockbrokers and internet stores. Or to enable the users to control and maintain the user profile themselves, instead of the organization [17]. Examples of applications that enable user control are for instance applications such as MSN and ICQ.

This means that an organization's production and logistical processes must be able to cope with it. If that is not the case, the information systems (see below) and the processes will have to be redesigned. In general, redesign processes and reorganizations are complicated and they cost (at least) time and money (see for example [22], [20]). In one way or another, these costs will have to be considered in the investment proposal.

Another organizational obstacle in user profiling is the question who is responsible for what, especially when more than one organization make use of the profile. Not only do control issues have to be arranged with citizens (as will be discussed further on), but also within the government when organizations are collaborating, who will keep the user profile up-to-date? Who is entitled to make changes? In these circumstances it is necessary that there are clear procedures and processes to indicate which department and which officials (and how) have access and are responsible for an electronic file. The painstaking introduction of the Electronic Patient Record (EPR) in the Netherlands is proof that it is not always easy to agree on standards and processes [4]. Discussions on the use of a single personal identification number, a medication record and billings systems held up the introduction of the EPR for years. A solution might be to create an organization, or spot within the government, where control is being exercised. Because this means a change in the lines of responsibility for and being account-

able to, some shift in organizational tasks and responsibilities will have to take place. The resulting shifts in power constitute a delaying factor [25].

Legal obstacles also face governments. As discussed previously in this paper, legal conditions for public organizations engaging in user profiling are governed by political regulation, which is different from the market regulation guiding the private sector. Privacy infringement issues and the risk for citizen exclusion make it for instance difficult for governments to adopt user profiling strategies from the commercial sector. Another obstacle is relevant when public organizations start to collaborate and start offering joint services. In public administration it is important that collaboration is legally recorded, if only for the protection of the public's interests. It is important that the division of powers, the decision-making structure and the scope for influencing are clear. And there must also be supervision, democratic control and publicity. Collaboration on the basis of mutual agreement can occur between municipalities, provinces and district water boards or a combination of these three. Also national governments can participate. Such an agreement has to comply with quite a number of regulations (see for example [26], for a discussion about collaboration between Dutch municipalities).

## 5 User Obstacles to User Profiling

In order to implement user profiling, organizations have to overcome a number of hurdles on the user side of user profiling. First, users need to have access to ICT, in order to be able to use their user profile. Second, the user has to accept the use of user profiling. This acceptance is determined by trust, control and privacy issues.

### 5.1 Access

Access to ICT is a basic requirement to engage in user profiling. Access is not limited to the possession of ICT, access is also about the motivation and the skills to use ICT [23]. In general three groups of users can be distinguished, according to the intensity of usage and acceptance of applications that take advantage of user profiles. Probably, these groups do not differ significantly from those that use and accept ICT and new media in general. There are no reasons to suppose that the divide in use and acceptance of user profiles will differ from the existing 'generic' digital divide.

The first group is the *information elite*. The information elite consists of active information seekers and communicators, strongly motivated to use the digital media. They have complete and multi-channel physical access, and they are experienced users who possess the required operational, information and strategic skills. They might be the ones most interested in user profile applications, but they are also the most critical users. Several niche markets of user profiling applications can be explored for the information elite.

The second group is the *electronic middle* class. About 55 percent (the majority) of the population in developed high-tech societies has access to the digital

media, usually only one or two channels (at home and at work). They use the digital media only for a few purposes, first of all for entertainment and secondly, for simple applications of information, communication and transaction. Only very basic, highly accessible, user friendly and trustworthy user profiling applications will attract their attention, which are consequently the only applications that are appropriate for a mass market.

The third and final group consists of the *digital illiterates*. The unconnected and the non-users form about one third (30%) of the population in developed high-tech societies. With no access to computers and the Internet, they only use digital media such as televisions, telephones and audio-visual equipment. Within this group, the elderly (over 65), unemployed women, people with little education, people with a low income, disabled people and migrants or members of ethnic minorities are over-represented. A large proportion of these groups lacks the motivation, the resources and the skills to use computers, the Internet and complicated other digital media. All the conditions for effective user profiling applications are simply absent among this part of the population. This is an important issue for government services in particular, as they are supposed to reach the entire population. Solving this problem requires additional effort in providing basic public access sites (of computers and the Internet) with service staff and/or similar applications of user profiling on the basis of old media (print media, telephony and face-to-face service).

### 5.2 Acceptance

Acceptance is a complex issue that transpires through the whole user profiling framework. Users and organizations have to accept each other, ICT has to be accepted and finally the user profile has to be accepted. Acceptance is a continuous process that does not stop when the decision is made to adopt user profiling. People are unstable in their preferences and behavior, so it might well be possible that an individual accepts the use of his user-related information at a certain point in time, for example because it offers direct benefits, but is not willing to accept it at another time. Organizations should therefore pay attention to user acceptance throughout the creation, implementation and use of user profiles. A few factors are especially relevant for acceptance, these factors are trust, control and privacy.

Perhaps the most essential additional factor determining acceptance is *trust*. Trust is a critical factor for the adoption and acceptance of new technologies and is generally accepted as a prerequisite for good personalization practice [6]. Users are not likely to reveal confidential information about themselves to an untrustworthy party, and they may be suspicious of data harvesting practices if they feel the information may be misused in some way. Research [16] demonstrated that lack of trust was the major reason for people not to adopt online shopping. Warkentin, Gefen, Pavlou, and Rose [28] studied the role of trust in the adoption of e-services. They found that trust in the organization using the technology and trust in governmental policies are important determinants for the adoption. They state that trust is a crucial enabler affecting purchase inten-

tions, inquiry intentions and the intention to share personal information. The latter intention, of course, is especially relevant in user profiling. Dahlberg, Mallat & Öörni [11] interviewed participants in a focus group about the factors that determined their decision to adopt mobile payment services. Trust proved to be an important factor for the acceptance of these services. Gefen, Karahanna and Straub [15] have studied trust in online shopping. They state that trust influences the intention to buy online. Finally, Brigss et al. [6] point to the fact that trust and personalization have a reciprocal relationship. Trust is not only a prerequisite for good personalization, good personalization also generates trust.

The second acceptance factor is control. A study by Roy Morgan Research [19] shows that 59% of the 1524 Australian respondents in a survey state that their trust in the Internet increases when they feel they have control over their personal information. The study also showed that:

- 91% of the respondents want to be asked for explicit permission before companies use their information for marketing purposes;
- 89% of the respondents want to know which persons and which organizations have access to their personal information;
- 92% of the respondents want to know how their personal information is used.
- User control obviously is a critical condition for user acceptance of profiling and personalization. However, the study cited does not answer the question whether the users themselves should host the user profile themselves, nor whether trusted third parties can resolve the users' anxiety about control issues.

Alpert et al. [2] studied user attitudes regarding the personalization of content in e-commerce websites. In their study, the users expressed their strong desire to have full and explicit control of personal data and interaction. They want to be able to view and edit (update and maintain) their personal information at any time.

Byford [7] perceives personal information as a property or asset of the individual ('Byford's property view'). The user is the owner of his or her personal information. In Byford's property view, individuals see privacy as the extent to which they control their own information in all types of Internet exchanges. The property aspect of the exchange manifests itself in the users' willingness to trade personal information for valued services such as free e-mail or special discounts from merchants.

A user profiling system that is not supported by a good system for user control of personal information is bound to lead to acceptance problems. However, building a user interface that allows users to control the information in their profiles is a complicated problem, especially if the interface provides controls that go beyond a very course level of granularity [8]. Although users have indicated they want to be in control of their personal data, very little users make use of the possibilities that websites offer to control personal information. A number of ecommerce web sites give users access to their profiles; however, it is unclear that many users are aware of this [8]. Reports of operators of personalization

systems have indicated that users rarely take actions to proactively customize their online information [18].

The third factor determining acceptance is privacy. Wang, Lee and Wang [27] distinguish four types of privacy threats:

- improper acquisition of information (e.g. uninvited tracking of the users' web usage);
- improper use of information (e.g. distribution of data to third parties);
- privacy invasion (e.g. spamming a mailbox with uninvited direct mailings);
- improper storage and control of personal information (e.g. no opting-out, no means to remove incorrect or unwanted information)

It is still unclear which privacy threats and concerns are (most) influential for acceptance of user profiling. But it is clear that privacy is important for the users' acceptance of internet, and hence for acceptance of user profiling. An overview of studies regarding privacy and personalization on the Internet shows that users have significant concerns over the use of personal information for personalization purposes on the Internet [21]. CyberDialogue [10] found that 82% of all Internet users say that a website's privacy policy is a critical factor in their decision to purchase online. Even more salient is that 84% of the respondents have refused to provide information at a website because they were not sure how that information would be used. The fact that there is a concern, however, does not necessarily imply that users don't provide any information. The lack of trust in privacy policies moved a large majority of users to give false or fictitious information over the Internet, and thus protect their privacy [9], [13]. Examples of this development include 'Anonymous Web surfing' and the use of pseudonyms. According to research conducted by the Winterberry Group, this development is increasingly becoming a problem for the collection of user related information [12]. It also makes it apparent that many users are reluctant about user profiling.

Users might be willing to sacrifice some privacy and trade personal information, in exchange for recognizable rewards, such as information that suits their needs or preferences better. But even in the case they are willing to give up their parts of their privacy, they have to be reassured that their personal information is not used in ways they do not approve. Mander, Patel and Robinson [18] suggest two solutions to address privacy concerns: make use of encryption of passwords and sensitive data to guard information (possibly external) audit and evaluation procedures for data security and privacy issues. Bonett [5] states that organizations should declare a privacy statement (or disclosure statement) on their site, which describes the kinds of information gathered and the policies for using and sharing personal information.

## 6 Concluding Remarks

As this paper shows, user profiling has opportunities for governments in their e-government strategies. However, although the possible benefits are numerous,

there are some specific hurdles to be taken such as legal, and governance obstacles, which hinder the development of user profiling.

For governments it does not suffice to fully adopt user profiling strategies from the private sector. The conditions for employing user profiling simply differ too much from the private sector. In contrast to the private sector, for the public sector widespread acceptance of user profiling and personalized e-government services is of the utmost importance, since public organizations have to offer their services to each citizen on an equal basis. This creates problems for citizens who lack sufficient computer skills to create, maintain, use or control a user profile, let alone to those who simply don't have any internet access. For that reason, in the public sector users should play a much more important role in developing and implementing personalized e-services then in the private sector.

However, when doing so governments should be aware of a diffusion paradox. For a successful diffusion governments should start with those who are able to handle complicated applications: the information elite. However, the information elite is known for its critical attitude towards user profiling and leaving behind personal information on the internet. So there may be some initial resistance when members of the information elite are invited.

Another though nut to crack is that once diffusion has started the information elite has an advantage over other, less computer skilled citizens. To balance this unequal situation the latter have to be supported in order to catch up with the information elite. In conclusion, when investing in personalized e-services governments also have to consider educational programs in order to make life easier to all members of society, and not only to the happy few.

## 7 Future Research

This paper argues that, besides differences between the public and private sector, both organizational obstacles and user obstacles may possibly hinder the use of user profiling. The organizational obstacles mentioned here are organizational and legal obstacles. The user obstacles discussed are trust, the control of the user profile and privacy concerns. Future research addressing these obstacles would be useful for further e-government developments. For governments it would be wise to develop own, public sector specific, strategies. This would increase the changes for successful user profiling and helps to avoid the obstacles described in this paper.

The described obstacles, as well as the differences between the public and private sector all have consequences for the development of user profiling for governments. Many of the obstacles are closely related, for example, giving user direct access to back offices to change their profile is technically challenging, thus posing a technical obstacle, and expensive to solve, posing a financial obstacle. When privacy concerns are not solved, it is unlikely that users will trust user profiling.

The strong relationship between the various concepts has its consequence for user profiling. Nowadays we see that governments as well as businesses are trying

to take away some of the obstacles, for example by using a privacy statement on their websites to solve privacy concerns. Other organizations let users control their own data. The intertwinement of the various concepts however asks for more than taking away the separate hurdles, what we need is a more integrated view of user profiling, its obstacles and the solutions to those obstacles. This integrated perspective should be a main topic of research in the next years.

## References


1. Accenture: Leadership in Customer Service: New Expectations, New Experiences. Accenture, (2005)
2. Alpert, S.R., Karat, J., Karat, C.-M., Brodie, C., Vergo, J.G.: User attitudes regaring a User-Adaptive eCommerce Web Site. User Modelling and User-Adapted Interaction, 13(4) (2003) 373-396
3. Bekkers, V.J.J.M.: E-government: meer dan e-commerce voor overheden. Tijdschrift management & informatie, 8(2) (2000) 11-20
4. Berg, M.: Kaf en Koren van kennismanagement: Over informatietechnologie, de kwaliteit van zorg n het werk van professionals (inaugurele rede). Erasmus Universiteit, Rotterdam (2001)
5. Bonett, M.: Personalization of Web Services: opportunites and Challanges. Ariadne Magazine (28) (2004)
6. Briggs, P., Simpson, B., De Angeli, A.: Personalisation and Trust: A reciprocal Relationship? In: Karat, C.-M., Blom, J.O. and Karat, J. (eds.): Designing Personalized user experiences in eCommerce. (2004)
7. Byford, K.S.: Privacy in Cyberspace: constructing a model of privacy for the electronic communications environment. Rutgers Computer and Technology Law Journal (24) (1998) 1-74
8. Cranor, L.F.: I Didn't buy it for myself: Privacy and ecommerce personalization. In: Karat, C.-M., Blom, J.O. and Karat, J. (eds.): Designing Personalized user experiences in eCommerce. Kluwer Academic Publishers, Dordrecht (2004)
9. Culnan, M.J., Milne, G.R.: The Culnan-Milne survey on consumers & online privacy notices: Summary of Responses. In: Interagency Public Workshop: Get Noticed: Effective Financial Privacy Notices. Washington DC, (2001)
10. CyberDialogue: Online consumer personalization survey. The personalization consortium, Wakefield (2001)
11. Dahlberg, T., Maalt, N., Öörni, A.: Trust enhanced technology acceptance model – consumer acceptance of mobile payment solutions. Helsinki school of economics, Helsinki (2004)
12. Direct Marketing: Anonymous Web Browsing Threatens Profiling Practices of E-marketers. (2001)
13. Fox, S., Raine, L., Horrigan, J., Lenhart, J., Spooner, T., Carter, C.: Trust & Privacy Online: Why Americans want to rewrite the rules. The Pew Internet & American Life Project, Washington DC (2000)
14. GAO: Data Mining. Federal Efforts cover a wide range of uses. United States General Accounting Office, (2004)
15. Gefen, D., Karahanna, E., Straub, D.W.: Trust and TAM in Online Shopping: An Integrated model. MIS Quarterly, 27(1) (2003) 51-90
16. Hoffman, D.L., Novak, T.P., Peralta, M.: Building consumer trust online. Communications of the ACM, 42(4) (1999) 80-85

17. James, H.: Customer-Centric E-business. Business Communications Review, 30(8) (2000)
18. Manber, U., Patel, A., Robinson, J.: Experience with personalization on Yahoo! Communications of the ACM, 43(8) (2000) 35-39
19. Roy Morgan Research: Privacy and the community. (2001)
20. Silverman, M.J., Weinstein, A.J.: INDOPCO and the fax treatment of reorganization costs. Tax executive, 49(1) (1997) 31
21. 21. Teltzrow, M., Kobsa, A.: Impacts of User Privacy preferences on personalized systems: acomparative study. In: Karat, C.-M., Blom, J.O. and Karat, J. (eds.): Designing personalized user experiences for eCommerce. Kluwer Academic Publishers, Dordrecht (2004)
22. van der Geest, T.M., van Dijk, J.A.G.M., Pieterson, W.J. (eds.): Alter Ego: State of the art on user profiling. An overview of the most relevant organisational and behavioural aspects regarding User Profiling. Telematica Instituut, Enschede (2005)
23. van Dijk, J.A.G.M.: The Deepening Divide, inequility in the information society. London: Thousand Oaks (2005)
24. van Dijk, J.A.G.M.: e-Government. In: Bouwman, H., van Dijk, J.A.G.M., van den Hooff, B. and van de Wijngaert, L. (eds.): ICT in Organisaties. Boom, Amsterdam (2002)
25. van Venrooy, A.: Nieuwe vormen van interorganisationele publieke dienstverlening. Eburon, Delft (2002)
26. Vereniging van Nederlandse Gemeenten (VNG): Intergemeentelijke samenwerking en ICT: De grenzen verkennnen. VNG, Den Haag (2003)
27. Wang, H., Lee, M.K.O., Wang, C.: Consumer Privacy concerns about Internet marketing. Communications of the ACM, 41(3) (1998) 63-70
28. Warkentin, M., Gefen, D., Pavlou, P.A., Rose, G.M.: Encouraging citizen adoption of e-Government by building trust. Electronic Markets, 12(3) (2002) 157-162
29. Weber, M.: Gezag en bureaucratie: Geredigeerd en ingeleid door prof. dr. A. van Braam. Universitaire Pers Rotterdan, Rotterdam (1970)

# Personalized Access to Multi-version Norm Texts in an eGovernment Scenario

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**Abstract.** In this paper, we present some results of an ongoing research involving the design and implementation, in an eGovernment scenario, of a multi-version repository of norm texts supporting efficient and personalized access. In particular we defined a multi-version XML data model supporting both temporal versioning –essential in normative systems– and semantic versioning. Semantic versioning is based on the applicability of different norm parts to different classes of citizens and allows users to retrieve personalized norm versions only containing provisions which are applicable to their personal case. We describe the organization and present preliminary performance figures of a prototype system we developed.

## 1 Introduction

Nowadays we are witnessing a strong institutional push towards the implementation of eGovernment support services, aimed at a higher level of integration and involvement of the citizens in the Public Administration (PA) activities that concern them. In this framework, collections of norm texts and legal information presented to citizens are made available and are becoming popular on the internet. The offering of personalized versions is aimed at improving and optimizing the involvement of citizens in the eGovernance process. In existing systems, personalization is either absent (e.g. `http://www.normeinrete.it`) or predefined by human experts and hardwired in the repository structure (e.g. `http://www.italia.gov.it`), whereas flexible and on-demand personalization services are lacking.

In this challenging scenario finds place the research activity entitled "Semantic web techniques for the management of digital identity and the access to norms", which we are carrying out as part of the PRIN national project "European Citizen in eGovernance: legal-philosophical, legal, computer science and economical aspects" [8]. One of the main objectives of such activity is the development of techniques allowing an effective and efficient access to multi-version norm repositories supporting temporal queries and personalization facilities. First of all, the fast dynamics involved in normative systems implies the

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coexistence of multiple *temporal versions* of the norm texts stored in a repository, since laws are continually subject to amendments and modifications. For instance, it is crucial to reconstruct the consolidated version of a norm as produced by the application of all the modifications it underwent so far. Moreover, another kind of versioning plays an important role, because some norms or some of their parts have or acquire a limited applicability. For example, a given norm may contain some articles which are only applicable to particular classes of citizens (e.g. public employees). Hence, a citizen accessing the repository may be interested in finding a *personalized version* of the norm, that is a version only containing articles which are applicable to his/her personal case.

In this paper, we present the current achievements of our research activity concerning efficient and personalized access to multi-version XML document repositories. We defined an XML data model which combines semantic annotations with temporal versioning in order to provide a multi-versioning mechanism capturing limited applicability and supporting personalized access. We then describe and evaluate the performance of a prototype system we developed to support and test these features.

The paper is organized as follows: Sec. 2 describes the complete infrastructure involved in the research project. Sec. 3 investigates the aspects of selective access to multi-version documents, while Sec. 4 describes the implemented prototype and presents its preliminary performance evaluation. Finally, Sec. 5 concludes the paper.

## 2 The Complete Infrastructure

In order to enhance the participation of the citizens to an eGovernance procedure of interest, their automatic and accurate positioning within the reference legal framework is needed. To solve this problem we employ Semantic Web techniques and introduce a *civic ontology*, which corresponds to a classification of citizens based on the distinctions introduced by subsequent norms which imply some limitation (total or partial) in their applicability. In the following, we refer to such norms as *founding acts*. Moreover, we define the citizen's *digital identity* as the total amount of information concerning him/her –necessary for the sake of classification with respect to the ontology– which is available online [14]. Such information must be retrievable in an automatic, secure and reliable way from the PA databases through suitable Web services (*identification services*). For instance, in order to see whether a citizen is married, a simple query concerning his/her marital status can be issued to registry databases. In this way, the classification of the citizen accessing the repository makes it possible to produce the most appropriate version of all and only norms which are applicable to his/her case.

Hence, the resulting complete infrastructure is composed by various components that have to communicate between each other to collect partial and final results (see Fig. 1). Firstly, in order to obtain a personalized access, a secure authentication is required for a citizen accessing the infrastructure. This is per-

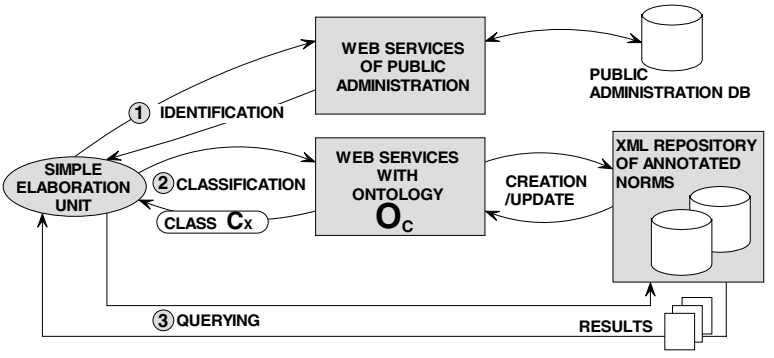


**Fig. 1.** The Complete Infrastructure

formed through a simple elaboration unit, also acting as user interface, which processes the citizen's requests and manages the results. Then, we can identify the following phases:

- the **identification phase** (step 1 in Fig. 1) consists of calls to identification services to reconstruct the digital identity of the authenticated user on-the-fly. In this phase the system collects pieces of information from all the involved PA web services and composes the identity of the citizen.
- the citizen **classification phase** (step 2 in Fig. 1) in which the classification service uses the collected digital identity to classify the citizen with respect to the civic ontology ($O_C$ in Fig. 1), by means of an embedded reasoning service.
  In Fig. 1, the most specific class $C_X$ has been assigned to the citizen;
- finally, in the **querying phase** (step 3 in Fig. 1) the citizen's query is executed on the multi-version XML repository, by accessing and reconstructing the appropriate version of all and only norms which are applicable to the class $C_X$. The querying phase will be deeply analyzed in the next Section.

In order to supply the desired services, the digital identity is modelled and represented within the system in a form such that it can be translated into the same language used for the ontology (e.g. a Description Logic [2]). In this way, during the classification procedure, the matching between the civic ontology classes and the citizen's digital identity can be reduced to a standard reasoning task (e.g. ontology entailment for the underlying Description Logic [5]).

Furthermore, the civic ontology used in steps 2 and 3 requires to be created and constantly maintained: each time a new founding act is enforced, the execution of a **creation/update phase** is needed. Notice that this process (and also the introduction of semantic annotations into the multi-version XML documents) is a delicate task which needs advice by human experts and "official validation" of the outcomes and, thus, it can only partially be automated. However, computer tools and graphic environments (e.g. based on the Protégé

platform [12]) could be provided to assist the human experts to perform this task. For the specification of the identification, classification and creation/update services, we plan to adopt a standard declarative formalism (e.g. based on XML/SOAP [15]). The study of the services and of the mechanisms necessary to their semi-automatic specification will be dealt with in future research work.

## 3 Personalized Access to Versions

Our research is currently focused on the querying phase described in Sec. 2. In particular, we defined efficient techniques for querying repositories storing legal documents supporting temporal and semantic versioning.

Temporal concerns are widespread in the eGovernment domain and a legal information system should be able to retrieve or reconstruct on demand any version of a given document to meet common application requirements. In fact, whereas it is crucial to reconstruct the current (consolidated) version of a norm as it is the one that currently belongs to the regulations and must be enforced today, also past versions are still important, not only for historical reasons. For example, if a Court has to pass judgment today on some fact committed in the past, the version of norms which must be applied to the case is the one that was in force then. Temporal versioning aspects are examined in Subsection 3.1. We then extend the temporal framework with semantic versioning in order to provide personalized access to norm texts, as described in Subsection 3.2. Semantic versioning also plays an important role, due to the limited applicability that norms or some of their parts have or acquire. Hence, it is crucial to maintain the mapping between each portion of a norm and the maximal class of citizens it applies to in order to support an effective personalization service. Finally, notice that temporal and limited applicability aspects though orthogonal may also interplay in the production and management of versions. For instance, a new norm might state a modification to a preexisting norm, where the modified norm becomes applicable to a limited category of citizens only (e.g. retired persons), whereas the rest of the citizens remain subject to the unmodified norm.

### 3.1 Temporal Versioning

We first focused on the temporal aspects and on the effective and efficient management of time-varying norm texts. Our work on these aspects is based on our previous research experiences [3,4]. To this purpose, we developed a temporal XML data model which uses four time dimensions to correctly represent the evolution of norms in time and their resulting versioning. The considered dimensions are:

**Validity time.** It is the time the norm is in force. It has the same semantics of valid time as in temporal databases [9], since it represents the time the norm actually belongs to the regulations in the real world.

**Efficacy time.** It is the time the norm can be applied to concrete cases. While such cases do exist, the norm continues its efficacy even if no longer in force. It also has a semantics of valid time although it is *independent* from validity time.

**Transaction time.** It is the time the norm is stored in a computer system. It has the same semantics of transaction time as in temporal databases [9].

**Publication time.** It is the time of publication of the norm on the Official Journal. It has the same semantics as event time in temporal databases [10]. As a global and unchangeable norm property, it is not used as a versioning dimension.

The data model was defined via an XML Schema, where the structure of norms is defined by means of a contents-section-article-paragraph hierarchy and multiple content versions can be defined at each level of the hierarchy. Each version is characterized by timestamp attributes defining its temporal pertinence with respect to each of the validity, efficacy and transaction time dimensions.

Legal text repositories are usually managed by traditional information retrieval systems where users are allowed to access their contents by means of keyword-based queries expressing the subjects they are interested in. Advanced systems (e.g. Norma-system [13]) allow users to reconstruct a consistent version of the retrieved norm with respect to validity (consolidated act). We extended such a framework by offering users the possibility of expressing temporal specifications for the reconstruction of a consistent version of the retrieved normative acts with respect to all time dimensions.

Starting from a first implementation of our temporal model, which is described in [3,4], we deeply redesigned the overall system architecture, the document storage scheme and the query processing methods in order to improve efficiency. The redesign also took into account the new problems arising from the extension to support semantic versioning. The new system organization will be described in Section 4, whereas a detailed comparison between the two architectures can be found in [11].

### 3.2 Semantic Versioning

The temporal multi-version model described above has then been enhanced to include a semantic versioning mechanism to support personalized access, that is retrieval of all and only norm provisions that are applicable to a given citizen according to his/her digital identity. Hence, the semantic versioning dimension encodes information about the applicability of different parts of a norm text to the relevant classes of the civic ontology defined in the infrastructure ($O_C$ in Fig. 1). At the current stage of the research, semantic information is mapped onto a *tree-like* civic ontology, that is based on a taxonomy induced by IS-A relationships. The tree-like civic ontology is sufficient to satisfy basic application requirements as to applicability constraints and personalization services, although more advanced application requirements may need a more sophisticated ontology definition.

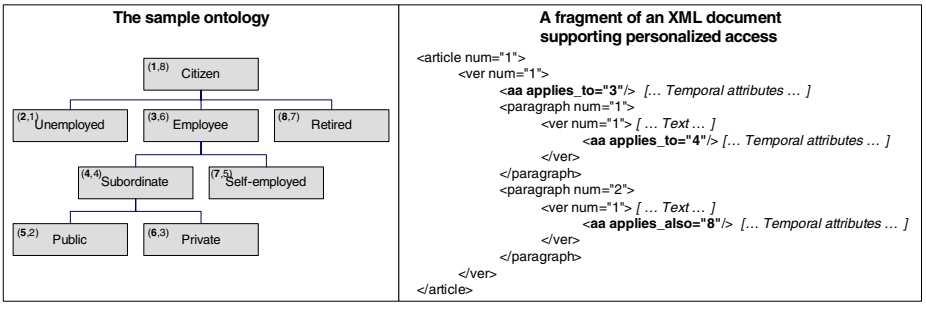


**Fig. 2.** An example of civic ontology, where each class has a name and is associated to a (pre,post) pair, and a fragment of a XML norm containing applicability annotations

For instance, the left part of Fig. 2 depicts a simple civic ontology built from a small corpus of norms ruling the status of citizens with respect to their work position. The right part shows a fragment of a multi-version XML norm text supporting personalized access with respect to this ontology. As we currently manage tree-like ontologies, this allows us to exploit the pre-order and post-order properties of trees in order to enumerate the nodes and check ancestor-descendant relationships between the classes. These codes are represented in the upper left part of the ontology classes in the Figure, in the form: (pre-order,post-order). For example, the class "Employee" has pre-order "3", which is also its identifier, whereas its post order is "6". The article in the XML fragment on the right-hand-side of Fig. 2 is composed of two paragraphs and contains applicability annotations (tag *aa*).

Notice that applicability is inherited by descendant nodes unless locally redefined. Hence, by means of redefinitions we can also introduce, for each part of a document, complex applicability properties including extensions or restrictions with respect to ancestors. For instance, the whole article in the Figure is applicable to civic class "3" (tag *applies_to*) and by default to all its descendants. However, its first paragraph is applicable to class "4", which is a restriction, whereas the second one is applicable to class "8" (tag *applies_also*), which is an extension. The reconstruction of pertinent versions of the norm based on its applicability annotations is very important in an e-Government scenario. The representation of extensions and restrictions gives rise to high expressiveness and flexibility in such a context.

### 3.3 Accessing the Right Version for Personalization

The queries that can be submitted to the system can contain four types of constraints: temporal, structural, textual and applicability. Such constraints are completely orthogonal and allow users to perform very specific searches in the XML norm repository. Let us focus first on the applicability constraint. Consider again the ontology and norm fragment in Fig. 2 and let John Smith be a "self-employed" citizen (i.e. belonging to class "7") retrieving the norm: hence,

the sample article in the Figure will be selected as pertinent, but only the second paragraph will be actually presented as applicable. Furthermore, the applicability constraint can be combined with the other three ones in order to fully support a multi-dimensional selection. For instance, John Smith could be interested in all the norms ...

- which contain paragraphs (*structural constraint*) dealing with health care (*textual constraint*), ...
- which were valid and in effect between 2002 and 2004 (*temporal constraint*), ...
- which are applicable to his personal case (*applicability constraint*).

Such a query can be issued to our system using the standard XQuery FLWR syntax as follows:

```
FOR    $a IN norm
WHERE  textConstr ($a//paragraph//text(), 'health AND care')
AND    tempConstr ('vTime OVERLAPS PERIOD('2002-01-01','2004-12-31')')
AND    tempConstr ('eTime OVERLAPS PERIOD('2002-01-01','2004-12-31')')
AND    applConstr ('class_7')
RETURN $a
```

where `textConstr`, `tempConstr`, and `applConstr` are suitable functions allowing the specification of the textual, temporal and applicability constraints, respectively (the structural constraint is implicit in the XPath expressions used in the XQuery statement). Notice that the temporal constraints can involve all the four available time dimensions (publication, validity, efficacy and transaction), allowing high flexibility in satisfying the information needs of users in the eGovernment scenario. In particular, by means of validity and efficacy time constraints, a user is able to extract consolidated current versions from the multi-version repository, or to access past versions of particular norm texts, all consistently reconstructed by the system on the basis of the user's requirements and personalized on the basis of his/her identity.

## 4 Implementation and Performance Evaluation

The temporal and personalization query features have been implemented in a prototype system, which represents a complete redesign and extension of a previous system described in [3,4]. The new architecture is based on an "XML-native" approach, as it is composed of a Multi-version XML Query Processor designed on purpose, which is able to manage the XML data repository and to support all the temporal, structural, textual and applicability query facilities in a single component. The prototype is implemented in Java JDK 1.5 and exploits ad-hoc data structures (relying on embedded "light" DBMS libraries) and algorithms which allow users to store and reconstruct on-the-fly the XML norm versions satisfying the four types of constraints. Such a component stores the XML norms not as entire documents but by converting them into a collection of ad-hoc

temporal tuples, representing each of its multi-version parts (i.e. paragraphs, articles, and so on); these data structures are then exploited to efficiently perform structural join algorithms [1] we specifically devised and tuned for the temporal/semantic multi-version context. Textual constraints are handled by means of an inverted index. The improvement with respect to our first temporal prototype are manifold: the system accesses and retrieves only the strictly necessary data by querying ad-hoc and temporally-enhanced structures without accessing whole documents; hence, there is no need to build space-consuming structures such as DOM trees to process a query and only the parts which satisfy the query constraints are used for the reconstruction of the results. Furthermore, the new architecture also provides support to personalized access by fast handling of the applicability constraints. Owing to the properties of the adopted pre- and post-order encoding of the civic classes, the system is able to very efficiently deal with applicability constraints during query processing by means of simple comparisons involving such encodings and semantic annotations.

As a consequence, we expected a high overall query processing efficiency together with low memory requirements. In order to evaluate the performance of our system, we built a specific query benchmark and conducted a number of exploratory experiments to test its behavior under different workloads. The experiments have been effected on a Pentium 4 2.5Ghz Windows XP Professional workstation, equipped with 512MB RAM and a RAID0 cluster of 2 80GB EIDE disks with NT file system (NTFS). We performed the tests on three XML document sets of increasing size: collection C1 (5,000 XML norm text documents), C2 (10,000 documents) and C3 (20,000 documents). In this paper, due to space requirements, we will present in detail the results obtained on the collection C1, then we will briefly describe the scalability performance shown on the other two collections. The total size of the collections is 120MB, 240MB, and 480MB, respectively. In all collections the documents were synthetically generated by means of an ad-hoc XML generator we developed, which is able to produce different documents compliant to our multi-version model. For each collection, the average, minimum and maximum document size is 24KB, 2KB and 125KB,respectively.

Experiments were conducted by submitting queries of five different types (Q1-Q5). Table 1 presents the features of the test queries and the query execution time for each of them. All the queries require structural support (St constraint);

**Table 1.** Features of the test queries and query execution time (time in msecs, collection C1)

| **Query** | **Constraints** | | | **Selectivity** | **Performance** |
|---|---|---|---|---|---|
| | **Tm** | **St** | **Tx** | | **(msec)** |
| *Q1 (Q1-A)* | - | √ | √ | 0.6% (0.23%) | 1046 (1095) |
| *Q2 (Q2-A)* | - | √ | √ | 4.02% (1.65%) | 2970 (3004) |
| *Q3 (Q3-A)* | √ | √ | - | 2.9% (1.3%) | 6523 (6760) |
| *Q4 (Q4-A)* | √ | √ | √ | 0.68% (0.31%) | 1015 (1020) |
| *Q5 (Q5-A)* | √ | √ | √ | 1.46% (0.77%) | 2550 (2602) |

types Q1 and Q2 also involve textual search by keywords (Tx constraint), with different selectivities; type Q3 contains temporal conditions (Tm constraint) on three time dimensions: transaction, valid and publication time; types Q4 and Q5 mix the previous ones since they involve both keywords and temporal conditions. For each query type, we also present a personalized access variant involving an additional applicability constraint, denoted as Qx-A in Table 1 (the corresponding performance figures are in parentheses).

Let us first focus on the "standard" queries. Our approach shows a good efficiency in every context, providing a short response time (including query analysis, retrieval of the qualifying norm parts and reconstruction of the result) of approximately one or two seconds for most of the queries. Notice that the selectivity of the query predicates does not impair performances, even when large amounts of documents containing some (typically small) relevant portions have to be retrieved, as it happens for queries Q2 and Q3. Our new system is able to deliver a fast and reliable performance in all cases, since it practically avoids the retrieval of useless document parts. Furthermore, consider that, for the same reasons, the main memory requirements of the Multi-version XML Query Processor are very small, less than 5% with respect to "DOM-based" approaches such as the one adopted in [4,3]. Notice that this property is also very promising towards future extensions to cope with concurrent multi-user query processing.

The time needed to answer the personalized access versions of the Q1–Q5 queries is approximately 0.5-1% more than for the original versions. Moreover, since the applicability annotations of each part of an XML document are stored as simple integers, the size of the tuples with applicability annotations is practically unchanged (only a 3-4% storage space overhead is required with respect to documents without semantic versioning), even with quite complex annotations involving several applicability extensions and restrictions.

Finally, we only post here a comment about the performance of our current prototype in querying the other two collections C2 and C3 and, therefore, concerning the scalability of the system. We ran the same queries of the previous tests on the larger collections and saw that the computing time always grew sub-linearly with the number of documents. For instance, query Q1 executed on the 10,000 documents of collection C2 (which is as double as C1) took 1,366 msec (i.e. the system was only 30% slower); similarly, on the 20,000 documents of collection C3, the average response time was 1,741 msec (i.e. the system was less than 30% slower than with C2). Also with the other queries the measured trend was the same, thus showing the good scalability of the system in every type of query context.

## 5 Conclusions

In this paper, we presented the current results of an ongoing research activity we are carrying out in the context of a national research project in order to support efficient and personalized access to multi-version XML document repositories in an eGovernment scenario. We defined a data model supporting both tempo-

ral versioning and personalized access, built a prototype system implementing the data model and evaluated its performance through some exploratory experiments. In the future, we will strengthen the proposed approach, in particular by considering more advanced application requirements leading to a more sophisticated (e.g. graph-based) ontology definition, and by completing the required technological infrastructure with the specification and implementation of the remaining auxiliary services described in Section 2.

## References


1. S. Al-Khalifa, H.V. Jagadish, J. M. Patel, Y. Wu, N. Koudas, and D. Srivastava. Structural joins: A primitive for efficient XML query pattern matching. In *Proc. of 18th ICDE Conf.*, San Jose, CA, 2002.
2. F. Baader, I. Horrocks, and U. Sattler. Description Logics for the Semantic web. *Künstliche Intelligenz*, 16(4):57–59, 2002.
3. F. Grandi, F. Mandreoli, and P. Tiberio. Temporal modelling and management of normative documents in XML format. *Data & Knowledge Engineering*, 47, 2005 (in press).
4. F. Grandi, F. Mandreoli, P. Tiberio, and M. Bergonzini. A temporal data model and management system for normative texts in XML format. In *Proc. of 15th WIDM Conf.*, New Orleans, LA, 2003.
5. I. Horrocks, and P.F. Patel-Schneider. Reducing OWL entailment to Description Logic satisfiability. In *Proc. of ISWC 2003*, Sanibel Island, FL, 2003.
6. The Italian e-Government portal. `http://www.italia.gov.it/`.
7. The "norme in rete" (norms on net) home page. `http://www.normeinrete.it`.
8. The "Semantic web techniques for the management of digital identity and the access to norms" PRIN Project Home Page. `http://www.cirsfid.unibo.it/eGov03/`.
9. C. S. Jensen, C. E. Dyreson, and (Eds.) et al. The consensus glossary of temporal database concepts - February 1998 version. In O. Etzion, S. Jajodia, and S. Sripada, editors, *Temporal Databases — Research and Practice*, pages 367–405. Springer-Verlag, 1998. LNCS No. 1399.
10. S.-K. Kim, and S. Chakravarthy. Modeling time: Adequacy of three distinct time concepts for temporal data. In *Proc. of 12th ER Conf.*, Arlington, TX, 1993.
11. F. Mandreoli, R. Martoglia, F. Grandi, and M.R. Scalas. Efficient management of multi-version XML documents for e-Government applications. In *Proc. of 1st WEBIST Conf.*, Miami, FL, 2005.
12. OWL plugin for Protégé. `http://protege.stanford.edu/plugins/owl/`.
13. M. Palmirani, and R. Brighi. Norma-system: A legal document system for managing consolidated acts. In *Proc. of 13th DEXA Conf.*, Aix-en-Provence, France, 2002.
14. S. Rodotà. Introduction to the "One world, one privacy" session. In *Proc. of 23rd Data Protection Commissioners Conf.*, Paris, France, `http://www.paris-conference-2001.org/eng/contribution/rodota_contrib.pdf`, 2001.
15. Web services activity. W3C Consortium, `http://www.w3.org/2000/xp/Group/`.

# An Infrastructural Approach to Secure Interoperability of Electronic IDs: The Bridging Backbone

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**Abstract.** In this paper we propose a solution to secure interoperability between electronic ID management infrastructures enabling the provision of cross-border eServices to mobile citizens. Our proposal considers an interoperability architecture based on a *federation of national infrastructures* and follows a *cooperation based approach* which is fully compatible with and respectful of organizational and technical independence of existing national systems.

Provision of cross-country services to mobile citizens requires involved national citizen eAuthentication infrastructures (CEIs) to cooperate for establishing the identity of citizens, without interfering with organizational and technical solutions adopted in each CEI. Indeed, for obvious organizational and political reasons, there cannot be a single organization which is responsible for securing the authentication process in its entirety: instead, national organizations must keep full autonomy and responsibility for authenticating accessing citizens. Interoperability cannot be based on imposing a common technical architecture.

In order to be effective, technical solutions must satisfy this highly critical organizational constraint. As a consequence, any strongly centralized solution for addressing secure interoperability issues, although technically feasible and usable in strictly hierarchical environments (like, for example, some multinational companies), is not satisfactory in this more general context and is doomed to fail.

Moreover, different national organizations usually adopt different organizational schemes: for example, in some states there exists a single organization which is responsible for issuing national eIDs and validating foreign eIDs (centralized management of validation), while in other states these duties are distributed among different autonomous organizations, even from different public administrations (distributed management of validation).

These requirements strengthen our argument in favor of a *cooperation based approach* and an interoperability architecture which is based on a *federation of national infrastructures*, where the rules governing the federation dictates roles and responsibilities of each involved member State and conditions for their delegation and relying.

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The cooperative approach is also followed by similar e-government projects which are currently being deployed in the United States [13], [8], [7].

Our solution to secure interoperability, by delegating the responsibility for citizen authentication to national CEIs, also satisfies the crucial requirement of preserving full compatibility with legacy eAuthentication systems.

The paper is organized as follows. In Section 1 we present our reference architecture for interoperability; in Section 2 we describe interoperability scenarios in eService provision to mobile citizens. Our solution to secure interoperability, the bridging backbone, is illustrated in Section 3, and in Section 4 we describe some peculiar functionalities it provides.

## 1 Reference Architecture

The architectural model adopted in our approach is inspired by the CEN's eAuth CWA [1] and considers the following three layers where interoperability has to be tackled: the *citizen device* layer, the *infrastructure* layer and the *application* layer.

The citizen device layer is the physical environment where the device is operating while accessing the infrastructure. The device can either be a smart-card (as it is common in many member States) or any other device supporting strong authentication (like mobile phones with cryptographic capabilities). Accessing devices must be linkable to personal identity, if needed, but should also be detachable from it in cases where only role identification is performed or where a certain degree of anonymity has to be guaranteed.

The infrastructure layer includes every component ranging from the physical interface with the citizen device to communication networks and systems, up to remote servers, including (i) a *user access point*, that is the local (w.r.t. the citizen device) part of the infrastructure, used by the citizen device for accessing the system, (ii) an *eService access point*, that is the remote part of the infrastructure, where the service providers system components interface with the infrastructure, and (iii) *validation services*, supporting eAuthentication procedures.

The application layer contains the applications which deliver services to users accessing the system by using citizen devices. For our purposes we will focus on applications requiring user authentication and, possibly, authorization credentials.

Our approach to interoperability considers three levels of functionalities, with increasing complexity, where interoperability has to be provided:

- identification and authentication: that is the process of associating a personal identifier with a citizen (identification) and proving trustworthiness of such association (authentication);
- authorization: that is the process of deciding whether to permit a particular action based on an identifier;
- electronic signature: that is the process of establishing authenticity of data and identity of the signer mainly for the purpose of producing verifiable records of transactions.

True interoperability can only be achieved if there exists a clear mapping between trust levels in various CEIs. This involves the definition of various degrees of trust existing

in each CEI so that each device/system/service, once correctly placed with respect to this classification, can interoperate with other devices/systems/services with a correct understanding of mutual levels of trust during the interaction. For example, an authentication mechanism based on username and password issued during a completely online process cannot share the same level of trust of an authentication method based on credentials issued after careful physical identification.

Another important issue to be solved, which is orthogonal to interoperability of CEIs, is interoperability of electronic signatures. This is a difficult and very controversial point: for example, recommendations for management of electronic signatures contained in a EU directive have been interpreted in very different ways by different member states, and its use in some states as a basis for performing eAuthentication will surely be a source of potentially never-ending legal and juridical disputes. Furthermore, interoperability of security policies, user profiles and certificate validation are critical elements.

Future adoption of privilege management systems for handling authorizations and access rights of citizens depending on their role (doctor, policeman, CEO) within an organization, rather than on their identity alone, will also raise non-trivial semantic interoperability problems. Although this is an important research area to be investigated, role-based privilege management systems can only be built on top of effective and reliable authentication systems, and must be kept separate from them.

## 2 Interoperability Scenarios and Problems

Different interoperability scenarios can be envisaged, depending on whether the citizen device layer, the infrastructure layer and the application layer, are *on-us* (meaning national/domestic) or *not-on-us* (meaning foreign/alien). It is easy to imagine that different scenarios give rise to technical and organizational interoperability problems of different dimensions and nature.

Once a value is fixed for one layer, all possible interoperability scenarios are clearly identified. For example, the Italian access network (which means that the citizen device is physically in Italy) has to provide access in the five interoperability scenarios listed below:

- Italian devices accessing Italian services,
- Italian devices accessing foreign services,
- foreign devices accessing Italian services, and
- foreign devices accessing foreign services. This has two sub-cases:
  - foreign devices accessing their national services, and
  - foreign devices accessing services provided by a different foreign country.

As a further example of how this approach to modeling interoperability scenarios works, here below you can see a table showing the possible kinds of interoperability scenarios obtained by choosing the citizen device belonging to the Italian domain.

<table>
<tr><th></th><th>Italian application</th><th>foreign application</th></tr>
<tr><td>Italian infrastructure</td><td>Italian CEIs</td><td>partial interoperability</td></tr>
<tr><td rowspan="4">foreign infrastructure</td><td rowspan="4">partial interoperability</td><td>same CEIs</td></tr>
<tr><td>partial interoperability</td></tr>
<tr><td>different CEIs</td></tr>
<tr><td>full interoperability</td></tr>
</table>

A synthetic characterization of the different kinds of interoperability scenarios follows:

- *national CEIs*: components in all three layers belong to the same domain,
- *partial CEIs interoperability*: components in two layers belong to the same domain,
- *full CEIs interoperability*: components in each layer belong to different domains.

From an architectural viewpoint it is also important to identify interfaces lying between different components. Indeed, in the case of interoperability of national CEIs, some of them are managed by different national systems, raising the need for establishing a secure and reliable dialog among them.

A first interface is between the citizen device requesting access to the system and the physical devices communicating with it at the user access point.

A second interface is between the user access point and the service access point, that is between the local terminal application and the access point to the requested service.

A third interface is between a user or service access point and the validation service used to verify the validity of credentials presented by users. This interface is highly critical for services requiring user authentication.

The fourth interface is between a service access point and an eService.

An example scenario at the widest possible interoperability level is the following: an Estonian citizen wishes to make access to an Italian service while visiting Belgium. In this case, the first interface is physically in Belgium, the second interface spans the three countries, the third interface is physically in Estonia, and the fourth is in Italy.

Problems of high technical complexity stem from the need of managing the whole process in an efficient and effective manner, while ensuring, at the same time, interoperability of geographically distributed IT-based systems, independently of technical solutions used by participating organizations, and fulfillment of privacy and security constraints in a democratic manner [10], [9]. There are in fact two critical functional capabilities for the interoperability architecture: security and performance.

The first delicate functionality is end-to-end security. By this term it is meant the capability of ensuring traditional security requirements (from basic ones: confidentiality, integrity, authentication, authorization, to derived ones: auditing, non repudiation, etc.) from the citizen accessing devices all the way down to the point providing the required service.

The second one is performance experienced by end-users. Due to the cooperative approach that has to be followed in designing the overall interoperability architecture and to the size of federated systems of national CEIs that will result, each service invocation may require establishing and traversing several times geographically long and organizationally complex communication paths. A carefully designed architecture must

be able to cache information at usage points and keep it fresh to avoid the well-know attacks based on exploiting stale security information.

## 3 Our Solution: The Bridging Backbone

Efficient satisfaction of the end-to-end security requirement requires the definition of a highly secure and efficient exchange layer among national CEIs, allowing Management Centers of the involved CEIs to quickly exchange all information required to properly authenticate accessing citizens and enabling an efficient and secure management of service provision. This exchange layer is overlaid to and logically distinct from existing CEIs. It is important to stress that, for reasons of efficiency, only cross-border interactions which are important for security and privacy purposes or for documenting interaction between CEIs, will be required to pass through this overlaid layer.

During provision of cross-border services to mobile citizens, national systems used for managing electronic IDs interoperate at different layers as follows: after citizen credentials are obtained from the citizen device and understood by the access network, the citizen's request is first relayed to the competent national infrastructure Management Center for authentication and afterwards to the management centers which are competent for providing the requested services. National CEIs interface each other through a highly secure communication network which is logically distinct from national access networks. Our proposal to techno-organizational problems in secure interoperability among CEIs will thus be based on defining a permanent infrastructure layer, called *bridging backbone*, providing security services to interactions between Management Centers of national CEIs. Each of these Centers will continue to operate in the normal way under the "national CEIs" scenario, while it will cooperate with the other Centers under the other two interoperability scenarios, each working within its responsibility boundaries.

In our approach, security functions have to be based on a permanent infrastructure layer, since this is the only approach which is able to guarantee, at a reasonable cost, efficiency of eService provision and effectiveness of security in open and intrinsically insecure environments like the Internet. In other words, we do not deal with security functions within application, but consider them as infrastructural services, much in the same way communication services are nowadays considered: from the application viewpoint, in fact, details regarding how messages are transported by the communication network to their destination are completely transparent. In the same way, applications in our architecture do not take care of the management of security functions, which are instead provided by an independent layer put on top of the layer providing communication services.

A mandatory requirement of the cooperation based approach is the ability to document transactions that were carried out during interaction between national Management Centers. Given the legal value attached to data being managed and exchanged in this process and the fact that many various kinds of mistakes can take place during the interaction, it is necessary to clearly and unequivocally understand who did what. The absence of a super-national organization that can supervise and direct the activity of national Management Centers makes these certification functions a mandatory require-

ment. Moreover, as certification functions in a federation of national infrastructure play a back-office and subordinate role, they are fully acceptable by involved organizations, both from political and organizational viewpoints.

It is important to stress that in the real world of non-electronic services and whenever some kind of contractual responsibility is involved, security functions are always based, to various degree, on some form of permanent infrastructure. For example, public utilities like power supply, water, and sewage are provided by Municipalities to houses on the basis of the house ownership or renting. People interact with banks in buildings and offices clearly and permanently identifiable as bank settings (even ATMs are usually placed in trustable environments). Also e-banking, the currently most widespread eService among the ones where trust is a fundamental aspect, is based on an initial set-up phase where a security infrastructure is established: the customer goes physically to branch offices for signing the contract and receives codes and instructions for accessing the service on the Internet.

A further important point regarding security in interaction between institutions (as compared to interaction among people) is that organizations typically do not allow any inside member to unilaterally establish trust with external entities. The reality of institutional cooperation shows that inter-institutional trust is always based on bilateral agreement at the organizational level. The electronic counterpart of this convention is that, at the IT level, there must be an infrastructure layer providing security functions, and security functions are provided with reference to and after that an agreement is formally in place between the involved organizations.

This approach gives maximum flexibility to each involved organization, by respecting its techno- organizational choices, and allows to design and build a scalable and efficient system, because interoperability is not based on country-to-country system interfaces deriving from bilateral agreements. The bilateral agreements approach would be, in fact, viable and effective only when there are very few actors: as soon as the stakeholders are more than three or four its complexity becomes unmanageable.

## 4 Management of Security/Authorization Services on the Bridging Backbone

The management of authorization rights is a further critical element for interoperability. Traditionally, the task of authorizing access requests to a given service is accomplished by the service provider itself, which ultimately holds the responsibility for service provision, but, in geographically dispersed scenarios, performance considerations may suggest a pushing solution where preliminary authorization information is properly and progressively moved towards the front-end side of the architecture (i.e., the system access points). Critical issues of efficient distribution and update of authorization data derive, that can be solved by using approaches similar to those adopted for improving efficiency of PKI certificate validation.

In the following we consider an authorization model, inspired by the requirements which led to the development of languages and models [12], [11], [14], [2] for management of authorization rights in distributed network environments.

In the considered authorization model we identify three main entities: *subjects*, *resources* and *actions*. Entities are specified by a set of attributes of the form $\langle n, v \rangle$, where $n$ is the attribute name and $v$ is the attribute value. Attributes values can be statically defined or can dynamically change over time.

A subject is an entity which wants to perform an action on a resource. Subjects can be either accessing citizens or processes acting on citizens' behalf.

A resource is a computational entity which is available for use to authenticated subjects on the interoperability architecture. A resource is typically specified by using the following information: the name of the resource, the host where it is located, and the application protocol and the network port which must be used for accessing the resource. Example of resources are FTP directories, file systems and eService applications.

An action is an operation which a subject wants to perform on a resource. Actions can be specific to a particular resource or application protocol and thus, not all actions can be performed on a given resource. The complete set of actions which can potentially be performed on a resource must be explicitly agreed upon by the organizations involved and stated in formal agreement documents. Example of actions are the following: read, write, execute, HTTP GET, HTTP POST.

Authorization policies are sets of authorization rules which specify if and how subjects can perform actions on resources by using constraints on resource and action attributes (f.e. "only HTML documents can be accessed"), or context constraints (f.e. "access is granted between 9 AM and 7 PM", "access is granted only twice a day", "access is limited to a maximum of two concurrent users"). In order to simplify the definition of authorization policies, authorization rules need not refer to every particular instance of subjects, resources or actions but can refer to classes of subjects. When evaluating an authorization policy, rules may conflict and can be combined in different ways. We assume that the authorization rights granted by an authorization policy consists of the union of the authorization rights granted by each applicable authorization rule therein contained.

We now illustrate a scenario where authorization rights are statically defined and cannot be changed, and a scenario where authorization rights can be dynamically modified. In both cases, users are authenticated by the bridging backbone at the beginning of the session, by performing a single sign-on procedure. Notice that, by following this approach, each organization still retains full control of the hosts operating on the network, and, as already mentioned, no changes to applications or to intra-organizational architectures are required.

In a static scenario, the set of authorization rights owned by users is statically determined by the configuration of the bridging backbone, and does not change during time unless the bridging backbone is externally reconfigured by manual intervention. The set of authorization rights owned by a user consists of direct authorization rights, which are explicitly granted by the bridging backbone, and derived ones, which are obtained by delegation and relying.

We can model authorizations by using a labeled directed graph whose nodes are labeled by subjects and resources and whose edges are labeled by actions. The set of authorization rights owned by each subject can be represented as the transitive closure of the peer-to-peer authorization relation starting from authorizations directly owned by

the subject: a subject $s$ can perform an action $a$ on a resource $r$ iff there exists a path from $s$ to $r$ labeled $a_0, \ldots, a_n$ where, for all $i = 1, \ldots, n$, if action $a_i$ is performed then action $a_{i+1}$ can also be performed.

In the initial state of the dynamic scenario, i.e. soon after the bridging backbone is set up, the only interactions allowed by the bridging backbone are authorization requests from accessing citizens to the Policy Decision Point, which evaluates authorization policies and replies with authorization decisions.

When a subject wants to perform an action on a resource, it sends an authorization request containing attributes of the resource, action, and other related information to the authorization server. The authorization server, upon receiving the request for authorization, examines it and retrieves policies which are needed for determining whether and how to satisfy the request. As a result of the decision process, the authorization server sends back to the requesting subject a response containing the authorization decision. If the authorization request is accepted the authorization server proceeds in activating a procedure which reconfigures some software components affecting the behavior of the bridging backbone. Only after this reconfiguration process is successfully completed, the subject is allowed to establish a secure communication channel with the resource over the bridging backbone and to perform operations which are compliant with authorization policies agreed upon by involved organizations. The secure channel is destroyed at the end of the work session or after a timeout occurs.

## 5 Conclusions

In this paper we propose a solution to security and interoperability issues raised by management of electronic IDs in provision of cross-border eServices to mobile citizens: the bridging backbone. Our proposal considers an interoperability architecture based on a *federation of national infrastructures* and follows a *cooperation based approach* which is fully compatible with and respectful of organizational and technical choices of existing systems. Indeed, the bridging backbone provides infrastructural security services (like confidentiality and integrity services, authentication, authorization and auditing), in an easy and transparent manner, independently from locally deployed network technology and topology. The bridging backbone provides security services as a layer lying between the application and communication layers, which is in charge of monitoring network connections and securing them according to the cooperation policies of the federation of involved infrastructures (see [5], [4], [6], [3] for details).

In our view security is an infrastructural service of inter-organizational communication, not an add-on service. Our approach, by providing applications with security services in a completely transparent, infrastructural way, allows separating the issues related to security services and business logic, thereby reducing the risks of introducing security flaws. This is in contrast with the standard approach, where security services are usually provided at different levels of the protocol stack.

Moreover, we solve the organizational pitfalls of a naive use of PKIs, where trust can be established unilaterally, by allowing cooperation between members of different organizations only on top of the bridging backbone layer, which is set up only after a bilateral agreement is formally in place at the organizational level. Additionally, au-

diting services provided by the bridging backbone give the ability to certify successful e-services interaction and composition, to identify culprits of unsuccessful service provision, and to monitor actual performance of service provision [5].

## References


1. CEN/ISSS Workshop on e-Authentication, 2004. `http://www.cenorm.be/`.
2. Gail-Joon Ahn. Specification and Classification of Role-based Authorization Policies. In *Twelfth International Workshop on Enabling Technologies: Infrastructure for Collaborative Enterprises* June 09 - 11, 2003 Linz, Austria, 2003.
3. Franco Arcieri, Elettra Cappadozzi, Enrico Nardelli, and Maurizio Talamo. SIM: a Working Example of an E-government Service Infrastructure for Mountain Communities. In *Workshop Electronic Government (DEXA-eGov'01), associated to the 2001 Conference on Databases and Expert System Applications (DEXA'01)*, pages 407–411, Munich, Germany, September 2001. IEEE Computer Society Press.
4. Franco Arcieri, Mario Ciclosi, Fabio Fioravanti, Enrico Nardelli, and Maurizio Talamo. The Italian Electronic Identity Card: a short introduction. In *The National Conference on Digital Government Research (dg.o2004), May 24-26, 2004, Seattle, Washington, USA*.
5. Franco Arcieri, Fabio Fioravanti, Enrico Nardelli, and Maurizio Talamo. Inter-organizational E-Services Accounting Management. In *3rd IFIP conference on e-Commerce, e-Business, and e-Government (I3E-03)* Sao Paolo, Brasil. Kluwer Academic Publishers, September 2003.
6. Franco Arcieri, Fabio Fioravanti, Enrico Nardelli, and Maurizio Talamo. Reliable Peer-to-Peer Access for Italian Citizens to Digital Government Services on the Internet. In Roland Traunmüller, editor, *Electronic Government: Third International Conference, (EGOV'04),, Zaragoza, Spain, August 30 – September 3, 2004*, volume 3183 of *Lecture Notes in Computer Science*, pages 250–255. Springer-Verlag, 2004.
7. United States Federal PKI Operational Authority. Federal Public Key Infrastructure (FPKI) Architecture Technical Overview, 2005.
8. United States Federal PKI Policy Authority. X.509 Certificate Policy for the Federal Bridge Certification Authority, 2002.
9. Sokratis K. Katsikas, Stefanos Gritzalis, and Javier Lopez, editors. *Public Key Infrastructure: First European PKI Workshop: Research and Applications, EuroPKI 2004, Samos Island, Greece, June 25-26, 2004. Proceedings*, volume 3093 of *Lecture Notes in Computer Science*. Springer, 2004.
10. Sokratis K. Katsikas, Javier Lopez, and Günther Pernul, editors. *Trust and Privacy in Digital Business, First International Conference, TrustBus 2004, Zaragoza, Spain, August 30 – September 1, 2004, Proceedings*, volume 3184 of *Lecture Notes in Computer Science*. Springer, 2004.
11. OASIS. eXtensible Access Control Markup Language (XACML). `http://www.oasis-open.org/committees/xacml/`.
12. OASIS. Security Assertion Markup Language (SAML). `http://www.oasis-open.org/`.
13. United States General Accounting Office. Planned e-Authentication Gateway Faces Formidable Development Challenges, 2003. Report to the Committee on Government Reform and the Subcommittee on Technology, Information Policy, Intergovernmental Relations, and the Census, House of Representatives.
14. Ravi S. Sandhu, Edward J. Coyne, Hal L. Feinstein, and Charles E. Youman. Role-Based Access Control Models. *IEEE Computer*, 29(2):38–47, 1996.

# A Distributed Network Architecture for Robust Internet Voting Systems

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**Abstract.** Web-based Internet voting services cannot be provided in a reliable manner where a publicly visible website forms the basis of interacting with voters and collecting votes, as the service cannot resist a distributed denial of service attack. The problem is a profound one for all interactive web services, however, an Internet voting session is a well defined and quite simple interaction and an interactive service similar to web-based voting is proposed. This architecture uses a P2P web cache as the source of a Java voting applet. The applet interacts with the voter via their web browser to collect a vote. The applet then uses a common P2P file sharing network to deposit encrypted votes for collection by the electoral returning officer. The issues of how to authenticate voters and how to provide receipting in such an asynchronous system are described along with prememinary findings using a large P2P network established for this purpose. A successful demonstration of this approach may have implications for other mission critical web services which must collect information.

## 1 Introduction

The availability of the Internet to provide legally binding elections is of increasing importance as western and emerging democracies struggle to reach the growing electorate of mobile, Internet connected, "time-poor" citizens. We refer to Internet voting specifically as website voting, and this can also include polling, "e-consultation", online deliberative or direct democracy, and "e-participation".

Website voting is a form of remote voting where the voter is unsupervised and this new technique is used to supplement or replace traditional postal ("absentee") voting. There has been a dramatic increase in the use of postal voting in the 2004 US Presidential election where absentee requests in some states climbed over 30% [1].

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Unlike postal voting, Website voting provides a new basis for addressing problems such as vote formality, anonymity, verifiability and protection of the vote from observation and tampering. New solutions to these problems are possible because of an interactive interface to aide the voter, and more advanced techniques employ cryptography in the authentication, transport and storage of votes. Beyond website voting, the underlying Internet itself provides a fertile ground for creation of new transport and storage mechanisms. This paper introduces a non-website form of Internet voting which should improve the availability of polling whilst still providing a Web brower-based interactive service.

Current website voting systems are hampered by six obstacles which reduce the security and stability of the service:

1. strong identification of remote voters is not yet possible,
2. the security of the remote voter browser and computer is typically poor,
3. "e-banking" connections used to strengthen website voting can be intercepted,
4. the voting servers are typically vulnerable to certain kinds of attacks which attempt to overwhelm them,
5. voting systems are usually closed-source software and are not observable or auditable, and
6. votes stored on voting servers are vulnerable to insider tampering

The authors have previously executed controlled experiments in the public sector where voters used a website voting facility which was hardened against insider tampering [3], evaluated in [15]. This approach armed the voter's browser with a public key cryptography client that encrypted votes so that they could only be decrypted by the Electoral Returning Officer. This approach has also been used in other places since 2001 (for example see [8] and [10]). Without the ERO key, tampering (item 6) becomes practically impossible. In addition, the system provided a voter-verifiable inclusion service which was able to prove that a received vote had arrived unmodified before it was decrypted, an additional form of auditing (item 5).

The work of the authors has explored the use of signed, open-code voting applets that are created as emitted code from a compiler that transforms a formal election description into Java. Configuration and content of each election ballot is thus compiled into a single-use applet that is small enough to be effectively software code audited and signed. This further ameliorates item 5. This solution obstructs a host of attacks to the voting session (items 2 & 3) that may occur via the browser and/or via a compromised e-commerse channel. Finally, the voter's voting session being contained in a Java applet could allow the voter to disconnect from the Internet and so make remote observation much harder (item 2).

Providing strong identification methods to remote voters (item 1) will likely require the wider deployment of biometric devices. To date, the provision of non-identifying, single-use access credentials delivered by registered mail in tamper-proof envelopes has proven adequate. A random telephone survey after a large

Internet voting trial found no incidence of credential harvesting, nor were there reports of "spent" voting credentials [3].

The final open problem (item 4) of the vulnerability of a voting website to various traffic analysis attacks is the focus of this paper.

Current website voting systems are vulnerable because website voting still effectively mimics paper voting by being an inherently centralised process - remotely distributed voters submit to a central server. Currently, voting servers are particularly vulnerable because they cannot block any segments of the Internet as voters can be widely distributed on the network. As each voter is also given the website address, it is hard to keep the address secret.

Website voting techniques used to date do not provide any kind of defense against traffic-analysis attacks, of which the Distributed Denial of Service (DDoS) attack is prevalent and could arguably cripple any website voting system, or for that matter, any interactive website. Pure "informational" websites can be mirrored and cached but this is a purely passive replication of website content.

So far, there has only been one documented case of a DDoS attack against a Web voting system [17], but it is assumed that as voting pilots scale up, these services will come under increasing attack. In addition, the tools required to mount a DDoS attack on a voting server are commonly available for free on the Internet [9].

DDoS attack is a type of bandwidth attack where a large number of distributed and coordinated computers are used to make requests to the website. The volume of seemingly legitiate traffic overwhelms the service, which can no longer serve real users. The well known February 2000 attack against a number of world's largest e-commerce sites is an example of a DDoS attack [7]. More recently, mainstream media have reported commercially available criminal networks of compromised PCs numbering over 50,000 which can be directed to attack any Internet-mounted machine [13].

There has been significant research focus in the area of DDoS attacks, related to prevention [11], detection [4], attack source identification [16,12] and attack reaction [14]. However, no current techniques are adequate to ensure service availability during a specific period of time, such as during a legally binding election.

As long as the client/server model of the Web is used with voting servers widely accessible and highly visible, the risk of DDoS attacks against servers will remain. This risk is not ameliorated by faster networks, more powerful or more numerous clustered servers, firewalls or upstream routing policies, nor by improvements in the underlying Internet itself. Instead, so-called Internet overlay architectures which distribute traffic and effectively hide servers offer some promise.

Organisation of the paper is as follows. In section 2 we discuss the related work. In section 3, we de scribe the proposed architecture. In section 4 we describe our experimental design for evaluating the proposed system's suitability

for Internet voting. In section 5, we present some preliminary results and section 6 concludes the paper and discusses the directions for future research.

## 2 System Architecture

The proposed system can be viewed as a generalized messaging system which is able to deliver anonymous messages to a destination reliably, therefore the system is referred to as the Anonymous Messaging System (AMS). Internet voting is a special application supported by the system.

AMS is used to transport messages or votes in the context of Internet voting, through an Anonymous Peer-to-Peer Network (APN). It replaces a website voting server as the initial repository of the votes. It consists of the following components:

1. the e3 Secure Applet is the voting applet as described in [3]. It is compiled with the AMS Sender
2. The AMS Sender is a minimal Java implementation of the P2P network client. The Sender has a generalised interface that can be connected to other P2P networks.
3. The APN is a service provided by a number of established Internet-mounted computers, some of which are visible as seed nodes. The APN seed nodes are available to engage the AMS Senders from voter browsers
4. The AMS Receiver is an application which polls the APN for vote files.
5. The Staging Servers are the vote tabulation servers which connect to the AMS messaging services to periodically retrieve votes.

Fig. 1 shows an high level architecture of the proposed AMS system.

Voting with this system may occur in a number of ways, the most likley being:

1. Seed nodes of the APN which will be used by any AMS are chosen in advance. The IP addresses of these seed nodes are allocated at random and encoded into unique voter authentication credentials.
2. Voter authentication credentials are issued to voters via a non-Internet channel, such as registered paper mail, in-person etc.
3. The voter is instructed to access a voting applet created for the election. The applet is placed in a large P2P cache site such as Coral [6]
4. The applet boots in the voter's browser and requests the authentication credentials. It obtains the one- or a few- APN seed node IP addresses from the credentials.
5. The applet guides the voter through voting. At the close of the session, the applet uses the AMS Sender to contact the allocated seed nodes.
6. The voter's vote is encrypted by the applet. A unique name for the vote file is derived from the authentication credentials.
7. The applet may try more than one seed node address. It inserts the vote file and reports back to the voter that the file was lodged on the APN. It may insert more than one copy of the vote file.

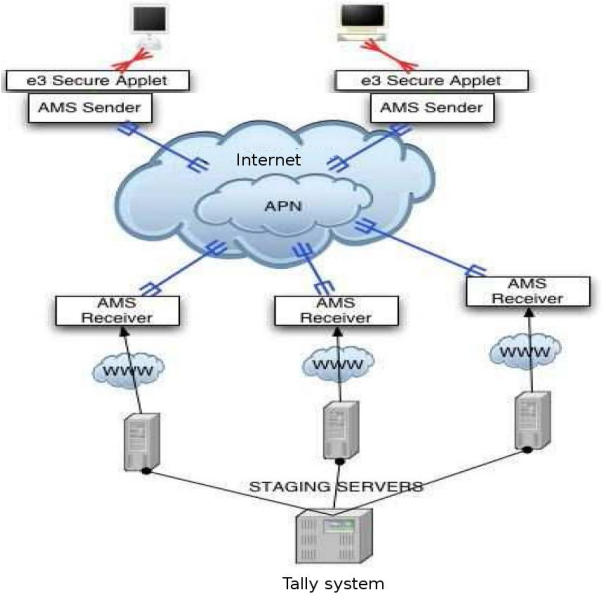


**Fig. 1.** Experimental System showing AMS Sender client, APN for carriage of votes residing on the Internet, AMS Receiver applications which poll the APN for votes and the back office Staging system which tabulates votes

8. The applet issues the voter a receipt which can be used with an existing receipt checking service which is available after polling [3].
9. AMS Receivers poll the APN with the same file names as are created from authentication details by the AMS Sender.

Distributing the task of collecting the vote over a number of hidden machines reduces the chance of a single failure affecting tallying. The AMS Receiver servers do not need to be registered with the DNS and their locations on the Internet are much harder to determine that that of the current website voting server. AMS Receivers can also be configured to collect overlapping lists of votes, each of which is also inserted in duplicate. This also provides some resistance against incomplete or failed vote insertions or any loss in the APN.

A collateral benefit of the APN is that it becomes much harder to find the voters. In a client/server arrangement, the client is connected directly to the server and so the machine Internet Protocol (IP) address of the client can be recorded. If a voter has a fixed-line DSL or cable connection to their home and their IP can be associated with their identity, then there is some likelihood that IP might provide for tying a voter to their voter by way of relating IP to time (from WWW logs) and time to vote in database logs. This becomes very difficult if there is an intervening APN.

A second benefit of this model is that most APNs have state. This means that if the entire electoral board is challenged, votes can be retrieved from the

APN directly if a court order can obtain the voter credential lists and the cryptographic key to decrypt votes. Whether actual voter identity it kept mapped to voter credentials depends on the jurisdiction of the vote. In the United Kingdom, voter credentials must ultimately be resolvable to votes, in Australia and the United States, this link must be destroyed.

## 3 Experimental Design

This section describes the experiments that evaluate the system. A series of simulations are being run on an academic network of shared computers called PlanetLab [2]. The existing P2P system chosen, FreeNet [5], was installed on PlanetLab nodes creating an isolated, dedicated P2P file sharing system. The experiment has six stages and a preliminary configuration stage.

All experiments measured the following as dependent variables:

- vote insertion latency (insert_time) – time between inserting the vote and the vote being placed in the P2P file system,
- vote harvest latency (fetch_time) – time taken for the receiver to retrieve the vote from the file system,
- total number of votes passed through the network and
- number of votes damaged or lost (vote_loss).

### 3.1 Stage 1 Configuration

The FreeNet application was installed on 25 PlanetLab nodes and this can easily be scaled to 460 nodes. The 25 node design chosen was that of a ring network with only seed nodes. The ring topolgy defines the initial setup of nodes and was chosen as the simplest way to set the network going. The network then forms its own connections via path discovery. The establishement of the inter-node connections should be reflected in better insertion and seek times.

The Preliminary stage establishes Freenet as a dedicated APN with no modification. All supporting software to simulate voting clients, vote harvesting services,and to capture statistical data was created in this phase.

### 3.2 Stage 2 Trials

The standard trial run in each case involves recording the time taken for a simulated voting client inserting votes for three hours to one FreeNet seed node. The following six trials establish and measure the effect of:

1. varying vote insertion density – in serial or parallel and bombarding the network,
2. background traffic on the network – simulating slow-down effects of loaded Freenet nodes,
3. changing the number of nodes between experiments – adding and removing nodes,

4. removing nodes during the experiment – simulating multiple node failure,
5. changing the number of vote harvesters and
6. changing the vote file size.

The experiments control for PlanetLab shared machine load by correcting measurements using weighted average of process wait times for PlanetLab nodes during runs. The experiments control for network loading by correcting measurements using weighted average of ping latency between PlanetLab nodes.

**Trial 1: Varying Vote Insertion Density in Serial or Parallel.** This experiment tests the premise that the relationship between insertion rates and insert_time is not super linear, that increases in fetch_time are not super linear, and that loss_rate is not affected by the volume of insertions or by bombardment to a certain volume. This experiment finds the limits of what the network can carry before fetch_time, loss_rate and insert_time become unacceptable.

**Trial 2: Background Traffic on the Network and Simulating Slow-Down Effects of Loaded Freenet Nodes.** This experiment tests the premise that various random network and CPU loadings on PlanetLab nodes does not affect mode insert_time, loss_rate or insert_time. This experiment determines if the network has some ability to perform under load.

**Trial 3: Changing the Number of Nodes.** This experiment tests the premise that increasing the number of nodes improves insert_time and fetch_time in a linear or super-linear manner and that decreasing the number of nodes causes insert_time and fetch_time to increase super linearly, loss_rate is unaffected by the number of nodes. This experiment is used to predict how many nodes would be needed for a given anticipated vote volume.

**Trial 4: Removing Nodes During the Experiment and Simulating Multiple Node Failure.** This experiment tests the premise that removing a number of nodes affects insert_time and fetch_time in linear or super-linear manner. Loss_rate is unaffected by the number of nodes. This experiment simulates whether the APN collapses altogether when a certain percentage of nodes is removed during the run.

**Trial 5: Changing the Number of AMS Retrievers.** This experiment tests the premise that increasing the number of AMS Retrievers improves fetch_time in a linear manner. This experiment determines if AMS Receivers polling the network in parallel has any kind cumulative effect on fetch_time delay.

**Trial 6: Changing the Vote File Size.** This experiment tests the premise that increasing the vote size affects insert_time and fetch_time linearly. The APN should segment the vote files when they get to a certain size. It is expected that the AMS Receivers should thus be getting larger vote files assembled for them in parallel at their freenet nodes.

## 4 Experimental Results

Results are preliminary at this early stage. The established testbed of 25 Freenet nodes on PlanetLab was increased to 250 as tests to insert files on the new network had a high rate of timeouts which have been attributed to deadlock. Secondly, as the test network is all seednodes, it was decided to only use 20% of the network for this task as this better represents the current live Freenet.

Encoding Freenet seednode addresses in voter login credentials with enough entropy to also make credentials unique and sparse enough was challenging and currently the voter would be required to enter 27 characters. The largest user-entered key approaching this is the Microsoft Windows Product Key at 25 characters. Userability assessment will determine if this is going to pose a problem.

Our early runs with the setup have seen automated insertion of votes in multiple copies, successfully accomodating failed seed nodes. The inserted votes were all retrieved off the network by a retriever service.

Metrics we can record do reflect the network traffic, insertion delays, vote traversal times and loss rates. The task at hand is now to execute the controlled trials.

## 5 Conclusion

The current work in progress introduces a new distributed architecture for Internet voting which shows promise in being able to better resist a Distributed Denial of Service attack than current World Wide Web-based Internet voting websites.

An experiment is under way which will seek to verify whether an Internet voting service can be provided via P2P methods. Specifically the experiment simulates Internet voting via a common file-sharing P2P network. The architecture also employs a P2P web cache as the source of a Java voting applet, which in turn acts as a minimal client for the P2P file sharing network. A third service which polls the file-sharing network collects vote files.

The experiment is taking place using the FreeNet on the PlanetLab, with an existing Java applet-based voting solution provided by the authors. The experiment will be completed in July 2005 and via various metrics will report on the reliability of the system and its potential for use in large scale, binding Internet elections.

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## References

1. California election news briefs. http://www.sanluisobispo.com/mld/sanluisobispo/9952988.htm, cited in 2004.
2. A. Bavier et al. Operating system support for planetary-scale network services. In *Proceedings of the 2004 First Symposium on Networked Systems Design and Implementation*, pages 253–266, 2004.
3. C. Burton. A virtual private network for internet voting. http://www.everyonecounts.com/downloads/Virtual-Private-Network.PDF, 2004.
4. C. M. Cheg, H. T. Kung, and K. S. Tan. Use of spectral analysis in defence against DoS attacks. In *Proceedings of the IEEE GLOBECOM*, pages 2143–2148, 2002.
5. I. Clarke, S. G. Miller, T. W. Hong, O. Sandberg, and B. Wiley. Protecting free expression online with freenet. *IEEE Internet Computing*, pages 41–49, Jan. 2002.
6. M. J. Freedman, E. Freudenthal, and D. Mazières. Democratizing content publication with coral. http://www.coralcdn.org/docs/coral-nsdi04.pdf, 2005.
7. L. Garber. Denial-of-service attacks rip the internet. *IEEE Computer*, 33(4):12–17, 2000.
8. K. Kim, J. Kim, B. Lee, and G. Ahn. Experimental design of worldwide internet voting system using pki. In *Proceedings of the 2001 SSGRR Conference*, L'Aquila, Italy, 2001.
9. S. Linford. Virus and dDoS attacks on Spamhaus. http://www.spamhaus.org/cyberattacks/, cited in 2004.
10. M. Maier. Youth parliament esslingen. living e-democracy first binding election to public office over the internet worldwide. http://www.jgrwahl.esslingen.de/paper.pdf, 2002.
11. K. Park and H. Lee. On the effectiveness of router-based packet filtering for distributed DoS attack prevention in power-law internets. In *Proceedings of the 2001 ACM SIGCOMM Conference*, pages 15–26, San Diego, California, USA, 2001.
12. T. Peng, C. Leckie, and K. Ramamohanrao. Adjusted probabilistic packet marking for IP traceback. In *Proceedings of the Second IFIP Networking Conference*, pages 697–708, Pisa, Italy, 2002.
13. Know your enemy: Tracking botnets : Using honeynets to learn more about bots. http://honeynet.org/papers/bots/, 2005.
14. U. Tupakula and V. Varadharajan. A proactical method to conteract denial of service attacks. In *Proceedings of the 26th Australasian Computer Science Conference*, pages 275–284, Adelaide, Australia, 2003.
15. Final evaluation report on the 1 may 2003 pilot scheme in stratford on avon. http://www.electoralcommission.org.uk/files/dms/Stratford_PartA_10218-8267__E__N__S__W__.pdf , 2003.
16. M. Waldvogel. Gossip vs. IP traceback rumours. In *Proceedings of the 18th Annual Computer Security Applications Conference*, pages –, 2002.
17. K. Zetter. Risky E-vote system to expand. http://www.wired.com/news/print/0,1294,62041,00.html, Jan. 2004.

# Electronic Voting: An All-Purpose Platform

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**Abstract.** It is generally considered that a key component of electronic government in the future will be electronic voting, as a means of facilitating the participation of citizens in elections and public debates. However, a long path has to be pursued before electronic voting, particularly if based on Internet, is accepted as a reliable system alternative to conventional methods. In this paper, we propose a new and simple platform, based on open software, which can be used primarily in small to medium sized communities, as a means to build confidence and experience for future larger elections. We try to provide adequate answers to multiple requirements, such as accuracy, democracy, privacy, verifiability and mobility. This can be done by establishing a distributed system which supports the different roles of a voting system and by using cryptography techniques in the interactions between these components.

## 1 Introduction

In recent years, electronic voting has attracted a significant attention [1], [2], but little progress has been made, in terms of establishing mature systems trusted by citizens. One of the reasons is that the level of security requirements is very high for major elections, such as presidential or parliament, and, additionally, this kind of elections has different rules and procedures, history and social perceptions within the various political systems around the world. One alternative to overcome this difficulty could be to promote the use of electronic voting in small, less important and less problematic elections or opinion polls. In this case, it is possible to prove that, in many cases, electronic voting is more secure and accurate, and less problematic than the traditional format used for voting. This can be the case of professional institutions, associations and public organizations with elected bodies, as well as referendum on local matters [3], [4].

Our work envisages to define an all purpose electronic voting platform, that could be used in a broad range of applications. One major objective is to allow

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rapid deployment with minimum configuration, together with simple use at all levels: infrastructure administrators, election commission and voters. In addition, to attain the desired level of performance, we propose a secure, scalable system based on open-source code and GNU Public License, as a means to achieve rigorous evaluation through public inspection.

This strategy of introducing electronic voting using credible open source approach and in a gradual way in citizens' democratic life, is a very strong point of our proposal, in order to acquire the adequate level of user acceptance, based on trust and usability. Furthermore, we will show that, along with accurate technology, the proposed solution incorporates clear and well perceived roles, at various levels, demonstrating the transparency of the overall system and its components, as a key requirement for user confidence.

## 2 Voting Requirements

As in any conventional election, there are a certain number of requirements that must be implemented [5]. In our system we will focus on the following, which depend strongly on the model for the voting system:

- *Accuracy:* There should not be possible to alter a vote, to eliminate a valid vote or to count an invalid one.
- *Democracy:* Each valid voter has the right to cast one, and only one, valid vote.
- *Privacy:* The voter, or anyone else, cannot prove which choice was made.
- *Verifiability:* There should be possibly to independently recount the votes.
- *Mobility:* A voter should be able to vote independently from his location. The system must be aware of voter origin which may imply different electoral circumscriptions.
- *Auditability:* The voting system should be validated by external observers.

## 3 Architecture of the Electronic Voting Platform (EVP)

The Electronic Voting Platform (EVP) is a distributed system with different components interconnected through a network (LAN, MAN, WAN), as shown in Figure 1. The voter accesses the EVP via the network, although physical presence or non-physical presence options are available.

A top level description of the roles of the EVP components is given as follows. The Authentication System (AS) is responsible for the voter authentication during the election, and for delivering an anonymous voting credential and the electoral ballot to the voter.

The Ballot System (BS) is responsible for receiving encrypted votes, validating the attached credential, checking it has not been used before, and distributing the validated votes to replicated Vote Collectors (VC).

The Vote Collectors accept the votes from the BS only, store randomly the votes and allow counting at the end of the election. At this point, the votes may be made publicly available for recounting.

The option for multiple VC's is an essential feature of the proposed system, to provide adequate geographic redundancy for the collected votes. Replication of the AS and BS components is also possible to account for scalability – in this case, the voters could be segmented according to electoral circumscription.

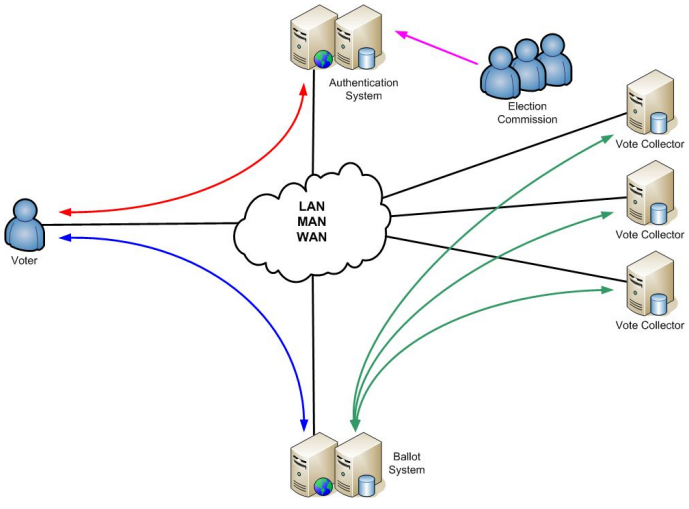


**Fig. 1.** Electronic Voting Platform

## 4 Operation of the Electronic Voting System (EVS)

The operation of the EVS requires the support of the voter registration, the initialisation of each component (AS, BS and VC) before the start of the election, the voting process itself and the ballot counting. All these actions are carried out under the control of the Election Commission (EC).

### 4.1 Voter Registration

Voter registration needs to be started well in advance of the election day, in order to determine which voters will be allowed to use the election right. One of the following scenarios could be adopted:

1. The voters need to be registered specifically for electoral purposes. In this case, usual registration techniques may be used either requiring physical presence of the voter or by electronic means, depending on the required authentication confidence.
2. The voters have already validated access to a system which can be used for electoral purposes.

This situation may be adequate to less critical elections, where voters are already registered in an organisation for other purposes, being able to access the system by electronic means in a controlled way, by a suitable authentication method.

### 4.2 Initialisation and Voting Process

Figure 2 represents the sequence of events for a complete initialisation and voting process. As it will be seen, the system adopts reliable asymmetric cryptographic techniques [6] and uses extensively secure communication channels.

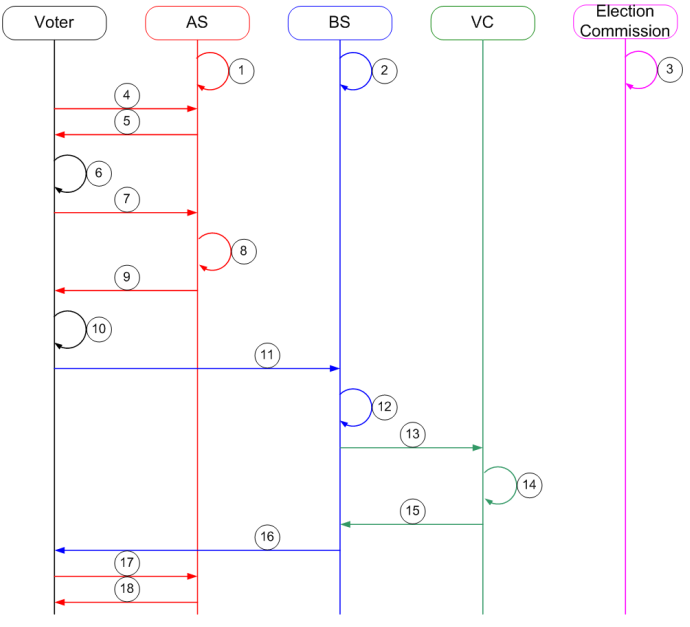


**Fig. 2.** Vote Sequence Diagram

Steps 1 to 3 refer to the initialisation phase. In steps 4 to 9, the voter obtains the credential and the election ballot from the AS. In steps 10 to 12, the voter submits the ballot to the BS. The replication of the votes in the VC's occurs in steps 13 to 15. Finally, steps 16 to 18 deliver success confirmation to the AS and the voter. Each step is described in detail as follows.

1. AS initialisation. This step will generate a public and private key pair for the AS (ASprvK, ASpubK), which will identify the AS from the beginning to the end of the election. The private key should never leave the AS and the public key is accessed by the voter and installed in the BS.

2. BS initialisation. Similarly, this step will generate a public and private key pair for the BS (BSprvK, BSpubK), which will identify the BS from the beginning to the end of the elections. The private key should never leave the BS. The public key is installed in the AS to be accessed by the voter and in the VC to validate the votes, as explained below.
3. Tiefgestelltes n im Text: EC initialisation. This step will generate a public and private key pair for the EC (ECprvK, ECpubK), which will identify the EC from the beginning to the end of the entire process, including vote counting. The private key should be split between several EC members ($ECprvK_n$, n=1...N) and the machine used for it generation should be sealed. The public key is installed in the AS to be accessed by the voter.
4. The voter accesses the AS (previously announced web site) and authenticates himself as a valid voter.
5. The AS, after validating the voter, sends him a client-side application and the public keys generated in the AS (ASpubK), BS (BSpubK) and EC (ECpubK)
6. The client-side application generates a public and private key pair to identify the voter (VprvK, VpubK).
7. The voter then sends its public key (VpubK) to the AS.
8. The AS stores the voter public key (VpubK) in its database. Then, it generates a hash of the combination of the voter username and a random number. Subsequently, signs the result with his private key (ASprvK) and adds the voter Electoral Circumscription Identifier (ECI) to form the credential (Cred). The credential is then ciphered with the voter public key (VpubK).

$$\text{Cred} = (\text{Sign}(\text{SHA-1}(\text{user, rand}), \text{ASprvK}), \text{ECI}) \ . \tag{1}$$

$$\text{EncCred} = \text{Ciph}((\text{Cred}), \text{VpubK}) \ . \tag{2}$$

9. The AS returns the encrypted credential (EncCred) and the correspondent electoral circumscription ballot to the voter.
10. The client-side application presents the unfilled ballot to the voter to enforce his right to vote. After the choice is made by the voter, the application deciphers the credential (Cred) with the voter private key (VprvK), ciphers the ballot and the ECI with the VC public key (VCpubK) to form the ciphered ballot (CiB), joins the credential and ciphers the result with the BS public key (BSpubK), forming the double ciphered ballot (dCiB).

$$\text{Cred} = \text{Deciph}(\text{EncCred, VprvK}) \ . \tag{3}$$

$$\text{CiB} = \text{Ciph}((\text{Ballot, ECI}),\text{VCpubK}) \ . \tag{4}$$

$$\text{dCiB} = \text{Ciph}((\text{CiB, Cred}),\text{BSpubK}) \ . \tag{5}$$

11. The voter then sends the above double ciphered ballot (dCiB) to the BS.
12. The BS deciphers the dCiB, validates if the credential is signed with the AS private key (ASprvK) and checks if it was not used before. Then, signs the CiB with the BS private key, forming the signed ciphered ballot (SiCiB) and flags the credential as already used.

$$(\text{CiB, Cred}) = \text{Deciph}(\text{dCiB, BSprvK}) \ . \tag{6}$$

$$\text{Validate(Cred, ASpubK)} \ . \tag{7}$$

$$\text{SiCiB} = \text{Sign(CiB, BSprvK)} \ . \tag{8}$$

13. The BS submits the SiCiB to the VC, or, preferably, to multiple VCs.
14. The VC validates if the SiCiB has been signed with the BS private key (BSprvK) and save it randomly.

$$\text{Validate(SiCiB, BSpubK)} \ . \tag{9}$$

15. Each VC confirms to the BS the reception of the ballot.
16. The BS confirms to the voter the reception of a ballot with valid credentials.
17. The voter confirms to the AS that has already finished the voting process.
18. The AS will confirm to the voter that he as completed the voting process, thus not being able to vote again.

### 4.3 Ballot Counting

The count of the ballots is a very critical task [7]. We must guarantee that the ballot count is, without any doubt, truly representative of the electors' choice. For increased reliability and verifiability, distributed replication of ballots [8] can be adopted, as already mentioned in the above section.

After the end of the election, the split private key is merged and made public. However, the BS private key (BSprvK) should be destroyed first, in order to avoid changing and (re)signing the ballots.

In this phase, as everything is made public in each VC, different applications can be used for ballot counting, ensuring transparency and accuracy of the counting process. Furthermore, ballots from all VC's may be merged, eliminating duplicates and overcoming possible sporadic losses of votes in specific VC's. Overall, we obtain a more reliable set of ballots for final counting.

The above applications do not need to be provided by the EVP, once there is enough and public information for anyone to confirm the elections results accessing all the stored votes in the multiple VC's. Although the same results should be obtained, obviously, the official result counting process should be conducted by the Election Commission and all the parties' representatives.

All this counting process is safe because the ballots can be validated and deciphered, but not changed once they are signed by the previously destroyed BS private key (BSprvK).

$$\text{Validate(SiCiB, BSpubK)} \ . \tag{10}$$

$$\text{(Ballot, ECI)} = \text{Deciph(SiCiB, Merged(CVprvK}_1\text{, CVprvK}_2\text{, .., CVprvK}_N\text{))} \ . \tag{11}$$

## 5 Proof of Voting Requirements

We have previously presented the voting requirements of a voting system. Now we will present how we achieve each one of them with the new proposed system.

*Accuracy:* This requirement is satisfied in three phases. The first one, when the ballot is deposited in the BS, it is impossible to change it, because it is ciphered

with the VC public key and the correspondent private key is not accessible. The second one, when the vote is deposited in the VC, it is impossible to deposit an invalid vote because a valid one must be signed with the BS private key, which has been previously destroyed, as explain above. The third one, when the votes are being counted with the VC private key made public, no extra votes may be created for the same reason.

*Democracy:* The AS only gives one valid credential to each voter. This credential is obtained trough a one time process of deposit of the voter public key. After that, the voter in the AS database will be flagged to make impossible to deposit a different one. However, if the same public key is used, the previous credential will be returned. The valid credential may be used only one time for ballot delivery. Each credential will be flagged in the BS database, not allowing ballot duplication.

*Privacy:* It is not possible to associate a voter with his credential, and subsequently with his ballot. This requirement is satisfied by the AS, since the credential contains no information regarding the voter [9].

*Verifiability:* As the ballots may be made public, as well as the EC private key (used to decipher the votes), anyone can recount the votes at any time after the end of the elections.

*Mobility:* The AS guarantees credential distribution to the voter independently of his location. The SiCiB created with the BS and stored in the VC will allow vote counting for the corresponding electoral circumscriptions, once it contains the ballot and the respective circumscription identifier.

*Auditability:* The EVP is Open Source (GPL) and ballot counting is totally open.

## 6 Conclusions

We have shown that our system is able to satisfy the main voting requirements and we hope that the release under the GPL license will allow a rapid evolution under public scrutiny. We point out that the separation of roles creates some kind of similarity between the Electronic Voting Platform and well established conventional elections, but adds some interesting functionalities.

We concentrated our study on the satisfaction of model dependent requirements, without forgetting the importance of technology and organisational measures. For instance, geographical separation of components may not be mandatory but it is highly recommended, as well as the use of physical and logical isolation trough the use of very restrictive access rules to each component.

We believe the major advantages of our system are not only the solid technical base, but also the potentiality to show to the voters why they can trust it. Before being concerned with large scale systems, we focused building a secure platform that can, and should, be first used in small, less problematic elections. Proceeding in this way, we can contribute to the involvement of citizens with information society technologies, allowing a gradual validation of the assumptions

of electronic voting systems towards usability and acceptability. We believe this is the only way we can aspire to have electronic voting systems introduced in social and political life.

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## References

1. Dini, G.: Electronic Voting in a Large-Scale Distributed System, Networks, Volume 38, issue 1, pages 22-32, John Wiley & Sons (July 2001)
2. Selker, T., Goler, J.: The SAVE system – secure architecture for voting electronically, BT Technology Journal, Volume 22, issue 4, pages 89-95 (October 2004)
3. Schryen, G.: Security Aspects of Internet Voting, Proceedings of the 37th Hawaii International Conference on System Sciences (January 2004)
4. e-Democracy: in Search of Tools and Methods for Effective Participation, Journal of Multi-Criteria Decision Analysis, Volume 12, issue 2-3, pages 93-100, John Wiley & Sons (April 2004)
5. Cranor, L.: Electronic Voting – Computerized polls may save money, protect privacy. ACM Crossroads (April 1996)
6. Schneier, B.: Applied Cryptography: Protocols, Algorithms, and Source Code in C, Second Edition, John Wiley & Sons (1996)
7. Franco, A., Petro, A., Shear, E., Vladimirov, V.: Small vote manipulation can swing elections, Communications of the ACM, volume 47, issue 10, pages 43-45 (October 2004)
8. Saltman, R.: "Accuracy, Integrity, and Security in Computerized Vote-Tallying," U.S. Department of Commerce, National Bureau of Standards Special Publication 500-158 (August 1988)
9. Chaum, D.: Security Without Identification, Transactions Systems to make Bib Brother Obsolete, Communication of the ACM, volume 28, issue 10, pages 1030-1044 (October 1985)

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