

Adoption of Interoperability Standards in Government Information Networks: An Initial Framework of Influence Factors

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ABSTRACT

Increasingly, electronic governance involves multi-organisational ICT-enabled networks. A crucial requirement for such “Government Information Networks” is that the systems of their various partner organisations are interoperable. However, Government Information Networks often fail to achieve interoperability (IOP) due to lacking adoption and compliance with the necessary standards by the partner organisations in these networks. This paper therefore develops a theoretical framework on the determinants for the adoption of IOP standards by organisations in Government Information Networks. Based on a review of the relevant literature and interview data from two cases of Government Information Networks in the Netherlands, the paper identifies relevant determinants and conceptually groups them into six determinant constructs. For each of these constructs, relevant sub-constructs are specified. By identifying key adoption determinants, the framework provides a useful analytical lens for practitioners and researchers working on IOP in government.

Categories and Subject Descriptors

E.0 [Data – General]: Data Standards; H3.5 [Information Storage and Retrieval – Online Information Services]: Data sharing; H3.7 [Information Storage and Retrieval – Digital Libraries]: Standards

General Terms

Management, Design, Human Factors, Standardization, Theory

Keywords

e-Governance, Government Information Networks, Interoperability, Interoperability Governance, Standards Adoption

1. INTRODUCTION

For at least two decades, public administrations have increasingly been moving towards a network production of public services and governance by networks. Increasingly, this trend has been supported by Information and Communication Technologies (ICT), particularly due to their ability for storing, processing, and

especially sharing information electronically. The resulting multi-organisational ICT-enabled policy networks, collaboration networks and governance networks are called “Government Information Networks” [1].

A crucial requirement for efficient information exchange in these networks is that the various partner organisations are interoperable [cf. 2]. IOP can be broadly defined as “the ability of disparate and diverse organisations to interact towards mutually beneficial and agreed common goals, involving the sharing of information and knowledge between the organisations, through the business processes they support, by means of the exchange of data between their respective ICT systems” [3]. Essentially, IOP necessitates the adherence to a common set of technical, semantic and organisational standards and agreements to ensure seamless communication [cf. 4, 5].

However, Government Information Networks often fail to achieve IOP [cf. 6, 7], mainly because this necessity for IOP standards adoption confronts organisations with the challenge and costs of undergoing changes in administrative, legal, operational, technical, semantic, and cultural dimensions [2]. Therefore, this paper aims to investigate under which conditions organisations are more likely to adopt IOP standards. To this end, it develops a theoretical framework on the determinants of IOP standards adoption by organisations in Government Information Networks.

2. RELATED WORK AND THEORY

The innovation diffusion theory has in the past been used to study the adoption of e-governance applications, identifying adoption determinants such as the perceived attributes of the innovation, attributes of the organisation, and attributes of the external environment [cf. 8, 9]. In addition to innovation diffusion theory, technology acceptance theory has also been used to study the adoption of e-governance. However, this research mostly focuses on adoption of e-governance services by citizens and businesses, and only few studies investigated the adoption of e-governance by government organisations and their employees [cf. 10, 11].

There also is a considerable body of literature on standards and IOP, mostly concerning the private sector context, but also regarding IOP in public service networks. There are also various lists of published standards [cf. 12, 13] and accounts of their adoption by governments. However, this literature is concerned rather with standard-setting and the degree of adoption. When it comes to the motivation for adopting standards, only a very small number of studies have specifically studied the factors influencing the adoption of IOP standards in the public sector [6, 14-17].

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Thus, existing research at most provides initial guideposts to analyse the organisational adoption of IOP standards in Government Information Networks. The theoretical framework presented in this paper aims to address this gap.

3. METHODS

The methodological approach for this paper is based on a literature review and exploratory qualitative case studies. First, an initial list of determinants was deductively drawn from the concepts identified in 147 studies in related fields of study.¹ Where two or more items from this list were referring to the same concept, they have been collated into a joint determinant, labelled and defined by the researcher. This procedure has been repeated several times, resulting in an initial framework of six main determinant constructs, presented in section 4.

This preliminary theoretical frame was subsequently validated and enriched by inducing from case study data additional concepts that were not yet covered in the theoretical framework. For this inductive approach, 37 semi-structured interviews have been conducted in the period from January until September 2011 with key informants from two Government Information Networks in the Netherlands: The Digital Client Dossier (Digitaal Klantdossier, DKD) and Studielink. Both cases concern electronic dossiers of data held by multiple organisations, either in the social security sector (DKD) or in the higher education sector (Studielink). The data analysis was based on the qualitative coding of the interview transcripts, using the software atlas.ti. Qualitative coding can be described as the “tagging” of interview segments with conceptual labels (“codes”). These codes were used to collect the interview segments that conceptually reflected a code (“codings”), and to identify new determinants.

4. FINDINGS: AN INITIAL FRAMEWORK

Based on the relevant literature and the case studies, this section constructs a theoretical framework on the adoption of IOP standards in Government Information Networks. The identified determinants are grouped into six constructs shown in figure 1.

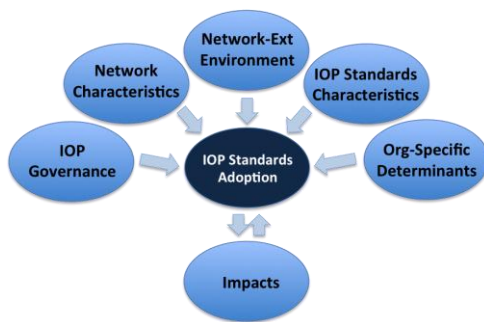


Figure 1. Theoretical Framework

In the following, a number of sub-constructs was identified for each of them. For each construct and its sub-constructs, the expected effect on standards adoption is proposed. All inductively identified determinants are marked with an asterisk (*). All determinants are summarised in table 1.

¹ Due to space limitations, the reviewed studies that served as source for the identified determinants cannot be referenced here. An expanded framework with multiple levels detailing the components of each construct, including the full list of sources, will be presented in a forthcoming publication.

The *IOP Governance* construct can be defined as those determinants that pertain to the manner by which decision-making on the IOP architecture in a Government Information Network is governed by means of institutions, authority structures and guidance. Its major sub-constructs are specified as *Decision-Making Centralisation*, *Enforcement*, and *Guidance*. *Decision-Making Centralisation*, can be conceptualised as the distribution of decision authority among partner organisations in the network, determining the ownership given to them by involving them in the procedures of making strategic decisions with regard to the governance of the network’s IOP architecture. Because effectiveness of network governance is determined in dependence on how it matches other network contingencies (in particular *Network Characteristics*), the effect of *Decision-Making Centralisation* can be positive or negative. *Enforcement*, the second sub-construct for *IOP Governance*, covers those determinants that refer to the mechanisms used for compelling adoption and compliance with the network’s IOP standards. Like the previous sub-construct, the effect of *Enforcement* can be either positive or negative, depending on other contingencies. *Guidance* is the third sub-construct for *IOP Governance* and refers to all guidance provided from actors outside of the organisation, such as leadership and effective communication mechanisms. The more guidance is provided to organisations, the easier the adoption of IOP standards becomes, suggesting a positive effect on adoption.

The *Network Characteristics* construct captures all determinants that pertain to the characteristics of the Government Information Network. Its major sub-constructs are specified as *Network Complexity*, *Trust*, *Mimetic Dynamics*, *Interaction** and *Information Infrastructure*. *Network Complexity* captures the features of the network that make it difficult for partner organisations to align with each other, such as network size, heterogeneity and interdependence of partner organisations. Since higher complexity implies more necessary adjustments in order to standardise, a negative effect on standards adoption is proposed. *Trust*, the second sub-construct for *Network Characteristics*, refers to the expectation of reciprocal respect of agreements. Since higher trust is associated with less risk from collaborating with others, a positive effect on standards adoption is proposed. *Mimetic Dynamics*, the third sub-construct, refers to network characteristics that create opportunities for imitation among network partners, such as homophily and frequency of interaction in the network. As *Mimetic Dynamics* imply that organisations tend to move closer together, the proposed effect of this sub-construct is positive. *Interaction Complexity**, the fourth sub-construct, was inductively identified from the interviews and refers to complexities in the interaction during the adoption process, such as the Duration or Unresolved Conflicts during the adoption process. Its proposed effect is negative, since more complex interaction makes reaching agreements on standards more difficult. The final sub-construct, *Information Infrastructure*, denotes those factors pertaining to the domain-level arrangement of technology, facilities, staff and procedures supporting the handling of information. A positive effect is proposed for this sub-construct, since a more developed information infrastructure means that more resources are available for adopting IOP standards.

The *Network-External Environment* construct covers those determinants pertaining to the wider environment, beyond the immediate network-level. The sub-constructs identified are *Political Pressure*, and *Policy/Institutions Support*. *Political Pressure* refers to the political dynamics and power relations in the wider (inter)national environment of the network. Since the

pressure from stakeholders is an important influence for public organisations, the effect of *Political Pressure* on IOP standards adoption is expected to be positive. *Policy/Institutions Support* refers to the degree to which the (inter)national institutional and policy infrastructure supports e-governance and IOP initiatives, such as the legal and budgetary Framework. Since more institutional support means that IOP standards adoption faces less administrative barriers, the effect of this sub-construct on adoption is proposed to be positive.

The *Standards Characteristics* construct covers those determinants relating to the general characteristics of the IOP standards. It consists of four sub-constructs that were identified as a result of the inductive coding. *Customisability** refers to the degree to which the IOP standards allows some room for flexibility in implementation for the organisations. Since it implies that organisations are less constrained by IOP standards adoption, the effect of this sub-construct on adoption is proposed to be positive. *Maturity** concerns the degree to which the IOP standards are free from uncertainties such as technical problems. This is proposed to have a positive effect on adoption, since it means that there is less uncertainty involved for adopting organisations. *Correction Mechanisms** pertains to the existence of mechanisms to detect and correct faulty data, and has a proposed positive effect on adoption for the same reason as *Maturity*. *Trialability* refers to the possibilities to try out and experiment with the IOP standards. Whilst trying out a standard might possibly also highlight difficulties in adoption, *Trialability* reduces uncertainties and has in the innovation diffusion literature usually been associated with a positive effect on adoption.

The *Organisation-Specific Determinants* construct describes those factors pertaining to the characteristics of individual organisations, and includes the sub-constructs *Organisational Capacity* and *Organisational Needs**. *Organisational Capacity* can be conceptualised as the existence of internal support capacities and resources needed for the adoption of IOP standards, such as financial resources or human resources. Since having higher capacities might enable an organisation to resist pressures to adopt IOP standards more easily, it may have a negative effect on adoption. However, it might also imply a positive effect since more resources can be mobilised for standards adoption. Hence, the overall effect of *Organisational Capacity* can be either positive or negative. The second sub-construct for *Organisation-Specific Determinants* is *Organisational Needs**. It was identified inductively and refers to an organisation's need for IOP, for instance due to major strategic shifts. The effect for this sub-construct is proposed as positive, since a higher need for IOP implies that an organisation is more likely to deploy its resources to IOP standards adoption.

The *Impacts* construct concerns the consequences from IOP standards adoption, both positive and negative. Impacts from adoption can be a determinant of future adoption-related behaviour (e.g. compliance). The sub-constructs for *Impacts* are *Internal-Operations Outcomes*, *External-Relations Outcomes*, *Return-on-Investment Outcomes*, *Network-Level Outcomes*, and *Adoption Efforts*. *Internal-Operations Outcomes* are those outcomes that pertain to the impacts from adoption on the adopting organisations' internal operations. On the one hand, adoption might imply constraints on organisations' operations, and might thus have a negative effect on their intention to adopt IOP standards. On the other hand, adoption can just as well imply enhancements of internal operations, and therefore contribute positively to organisations' adoption of IOP standards. Therefore,

the proposed effect for *Internal-Operations Outcomes* can be either positive or negative. The second sub-construct, *External-Relations Outcomes*, pertains to the effects from adoption on an organisation's external relations, such as power vis-a-vis other stakeholders or the organisation's reach in terms of partnerships. *External-Relations Outcomes* can also have both positive and negative effects. Whilst an increase in the organisation's partnerships might positively contribute to its adoption intention, adoption might also decrease its political power and therefore have a negative effect. *Return-on-Investment Outcomes**, the third sub-construct, has been identified from the data. If returns on the investment made for adoption are materialising relatively soon, and are distributed equally, the effect of *Return-on-Investment Outcomes* on IOP standards adoption is expected to be positive. The next sub-construct, *Network-Level Outcomes**, has also been identified from the data and refers to the outcomes of the network as a whole in terms of reaching its objectives. The effect of this sub-construct on standards adoption can be expected to be positive. The final sub-construct, *Adoption Efforts*, describes the efforts made by organisations during the adoption process, such as technological or organisational costs incurred. As these efforts imply costs for the adopting organisations, this sub-construct is expected to negatively affect the adoption of IOP standards.

Table 1. Main determinants with sub-constructs

Main determinant	Sub-construct
IOP Governance	Decision-Making Centralisation (+/-)
	Enforcement (+/-)
	Guidance (+)
Network Characteristics	Network Complexity (-)
	Trust (+)
	Mimetic Dynamics (+)
	Interaction Complexity* (-)
	Information Infrastructure (+)
Network-External Environment	Political Pressure (+)
	Policy/Institutions Support (+)
IOP Standards Characteristics	Customisability* (+)
	Maturity* (+)
	Correction Mechanisms* (+)
	Trialability* (+)
Organisation-Specific Determinants	Organisational Capacity (+)
	Organisational Needs* (+)
Impacts	Internal-Operations Outcomes (+/-)
	External-Relations Outcomes (+/-)
	Return-on-Investment Outcomes* (+)
	Network-Level Outcomes* (+)
	Adoption Efforts (-)

5. VALIDATION

In this section, an initial validation of the model is presented based on the coding of the interview data. Figure 2 shows the co-occurrences of all codings for each determinant construct with the codings for the code "Intention to adopt and comply" (these are aggregate figures combining all their sub-constructs). A co-occurrence is an instance where two codes were applied to the same text segment, and thus can give an indication about the existence of a theoretical relationship between these codes. As figure 2 shows, all determinants show a substantial amount of co-occurrences with the intention to adopt and comply with the IOP standards, thus providing an initial validation of the relevance of the constructs specified in the model. (The total amount of

codings for intention to adopt and comply is 180. Co-occurrences with the determinants can yield higher numbers, since each sub-construct's co-occurrences are counted). The figure also gives an indication about the determinants' relative relevance regarding adoption, suggesting that *IOP Governance* and *Impacts* have the highest relevance for the interviewed stakeholders. *Organisation-Specific Determinants* and *IOP Standards Characteristics* have the relative lowest relevance, and *Network-External Environment* and *Network Characteristics* range in the middle.

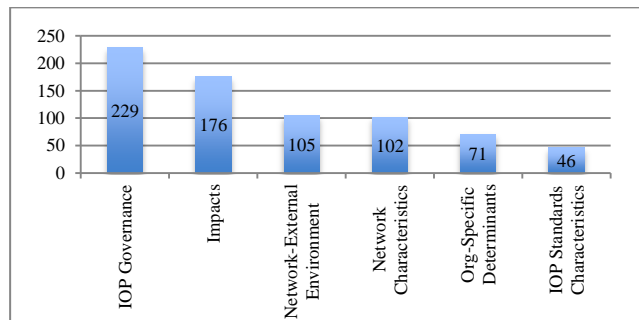


Figure 2. Co-occurrences of determinants and codings for Intention to adopt and comply

6. CONCLUSION

This paper combined a deductive and inductive approach to develop an initial theoretical model, showing that organisations' intention for IOP standards adoption in Government Information Networks is determined by six main determinant constructs: *IOP Governance*, *Network Characteristics*, *Network-External Environment*, *IOP Standards Characteristics*, *Organisation-Specific Determinants* and *Impacts*. Together with their sub-constructs, these provide a useful analytical lens for both practitioners and researchers working on IOP in government.

For practitioners that are in charge of governing IOP, the identified determinants provide a useful "checklist". For instance, it could be used as a framework for monitoring partner organisations' likeliness of adopting specific standards. It could also serve to assess the feasibility of diffusing a standard, and to identify key barriers. It thus allows to tailor an IOP governance strategy to the specific context of a particular network.

The presented framework also provides a much-needed basis for further research. Whilst the case study approach allowed some empirical validation of the framework, future studies should validate the listed determinants by investigating other cases as well, in particular in other policy sectors and countries. Moreover, since the framework only provides a catalogue of determinants, future work should measure their actual effects. Qualitative research could help to identify the precise causal pathways through which they operate, and quantitative research could investigate the (relative) strengths of these causal relationships. The presented framework can provide a useful basis for this work.

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8. REFERENCES

- [1] Janowski, T., Pardo, T. A. and Davies, J. Government Information Networks - Mapping Electronic Governance cases through Public Administration concepts. *Government Information Quarterly*, 2011, 1-10.
- [2] Bekkers, V. The governance of back-office integration. *Public Management Review*, 9, 2007, 377 - 400.
- [3] Commission of the European Communities. *Towards interoperability for European public services. COM(2010) 744 final*. Brussels, 2010.
- [4] EPAN. Key Principles of an Interoperability Architecture. Technical Report. Brussels, 2004.
- [5] Gottschalk, P. Maturity levels for interoperability in digital government. *Government Information Quarterly*, 2009, 75-81.
- [6] dos Santos, E. M. and Reinhard, N. Electronic Government Interoperability: Identifying the Barriers for Frameworks Adoption. *Social Science Computer Review*, 30, 2012, 71-82.
- [7] Commission of the European Communities *COM(2010) 245 final/2. A Digital agenda for Europe*. Brussels, 2010.
- [8] Akbulut, A. Y. An Investigation of the Factors that Influence Electronic Information Sharing between State and Local Agencies. Louisiana State University, 2003.
- [9] Ahn, M. J. Adoption of E-Communication Applications in U.S. Municipalities: The Role of Political Environment, Bureaucratic Structure, and the Nature of Applications. *The American Review of Public Administration*, 41, 2010.
- [10] Gupta, B., Dasgupta, S. and Gupta, A. Adoption of ICT in a government organization in a developing country: An empirical study. *The Journal of Strategic Information Systems*, 17, 2008, 140-154.
- [11] Zhan, Y., Wang, P. and Xia, S. Exploring the Drivers for ICT Adoption in Government Organization in China In *Proceedings of the Fourth International Conference on Business Intelligence and Financial Engineering (BIFE)*, 2011.
- [12] World Wide Web Consortium (W3C) *W3C Standards: All Standards and Drafts*. Retrieved 2 September 2013, from <http://www.w3.org/TR>.
- [13] International Organization for Standardization (ISO) *ISO Standards Catalogue*. Retrieved 2 September 2013, from http://www.iso.org/iso/home/store/catalogue_ics.htm.
- [14] Scholl, H. J. and Klischewski, R. E-Government Integration and Interoperability: Framing the Research Agenda. *International Journal of Public Administration*, 30, 2007, 889-920.
- [15] Hellman, R. *Organisational Barriers to Interoperability*. eChallenges e-2010 Conference, 2010.
- [16] Parasie, N. Adoption of E-Government Standards: Increasing Interoperability in the Public Sector. VVB Lauferweiler Verlag, Giessen, 2010.
- [17] Veit, D. and Parasie, N. *Common Data Exchange Standards: Determinants for Adoption at the Municipal Level*. 6th Americas Conference on Information Systems, 2010.