

Organizational Interoperability and Organizing for Interoperability in E-Government

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Abstract

Interoperability (IOP) is considered a critical success factor to forge ahead in the online provision of public services. Interoperability frameworks shall give guidance to practitioners what to consider and to do in order to enable seamless interaction within the own public administration as well as with other public authorities and clients. Moreover, IOP frameworks serve the allocation of the own system into a standardized scheme to allow for the assessment of similarities and differences with comparable systems. The European Interoperability Framework (EIF) is one of the best known of such frameworks. Like many other frameworks it is designed as a multi-layer model distinguishing between technical, semantic and organizational IOP. For achieving technical IOP, there are acknowledged standards, and for semantic IOP, recognized concepts and methods are available, however, aspects and characteristics of organizational IOP are still very heterogeneous. Nevertheless, organizational IOP is seen as an important stake factor for the success of e-government projects.

In a research project at the Institute for Information Management, an Institute affiliated to the University of Bremen, the constituting factors for achieving organizational IOP are being extracted by empirical analyses of a range of IOP-good practice cases, and ordered in a way to provide for a more detailed classification of organizational IOP. In a first step, the aspects that are concerned with supervision of e-government projects and legalization (generally referred to as 'governance') have been defined as one dimension of organizational IOP. In a second step, those factors that deal with the functional and technical set up of organizational IOP have been defined in two dimensions; the first is concerned with the choreography and alignment of business processes, while the second deals with the coordination of tasks and processes to concretely develop the choreography and alignment of business processes by technical and functional aspects. I.e. this dimension is concerned with the provision of technical and functional infrastructures that provide for the interoperation of different back-offices' IT-systems. The sub-division of organizational IOP into these three dimensions that –in turn – are classified in various aspects will then allow to more precisely encircle the different areas of action for public authorities and

hence provide for identification of success factors for achieving organizational IOP.

Keywords

E-Government, Organizational Interoperability, Integration of Information Systems, Governance, Interoperation, Centralization, Standardization.

INTRODUCTION

There is wide agreement in administrative practice and research that the use of ICT will only lead to savings and improvements if business processes are reorganized in order to allow for a seamless exchange of data between all agencies involved. In many public services, several back-offices are involved in the service supply chain. The data-processing systems in the back-offices of these agencies have to be merged or linked up to allow for a smooth online service provision. A particular problem is that a great number of legacy systems in these back-offices exist that do not have the aspired interfaces but are linked with other systems and fulfill the local requirements of the respective agency. This means that reorganization cannot start from scratch. Rather there is a need for developing a strategy, which may provide a compromise between keeping local systems and still allowing for better data interchange. Referring to a Study of the European Commission on Back-office Reorganization one could generally say that better electronic public services can be achieved either by centralization of tasks and data or by standardization of data and workflows [10, 15]. In practice, the combination of both is prevalent.

In the Back-office Reorganization study it turned out that public services that have realized full or almost full centralization by integration of back-offices, high savings could be achieved. This means that tasks and data and their corresponding IT-systems were merged under one authority. A different concept, however, concerns those public services that – for various reasons – cannot fully centralize their tasks and data. Reasons are, e.g., legalization that explicitly forbids central data storage, or too many actors are involved with their own running systems, or personal sensitivities exist, etc. Hence, these authorities need to link up their IT-systems and processes in a way to allow for a smooth and efficient online service provision. This concept uses the standardization of data and functionalities and often appears in combination with the centralization of service-parts like,

e.g., a central directory with address data or data conversion services. If these centralized databases or functionalities are operated (but not maintained) by a third party, we speak of clearing services provided by a clearing house. Certainly, the more different IT-systems and actors are involved, the more complicated is the agreement on and the deployment of such standards. Providing for the linking of different IT-systems by use of standards and/or clearing, we call back-office integration by interoperability.

To sum up, efficient electronic public services may either be achieved by integration of back-offices through centralization or through standardization and/or clearing, i.e. through interoperability. This definition of integration and interoperability is also supported by the European Interoperability Framework which defines IOP as “the ability of information and communication technology (ICT) systems and of the business processes they support to exchange data and to enable sharing of information and knowledge” [8]. So, if no data are exchanged among ICTs, there will be no interoperability, but integration may have taken place by centralization. As achieving interoperability in practice is generally much more challenging and prevalent than centralization, the authors indeed honor the success of centralized public services but focus on interoperability in the present paper, in particular by developing a classification model for interoperability.

More precisely, this paper looks at the different layers of interoperability - namely the technical, syntactic, semantic and organizational layers – from a political and managerial point of view applying the concept of governance in order to find out how IOP is achieved and maintained for efficient e-government services. It starts with a review of different IOP frameworks in order to define what has to be made interoperable and then argues that for clarification of the term interoperability, the governance aspect of negotiation and establishment of standards, rules and institutional arrangements on the one side has to be separated from the technical and functional provisions as well as the organization and management of the provision and maintenance of interoperation on the other side. For all three dimensions empirical indicators are proposed and applied to cases of intergovernmental online services within the European Union in order to arrive at an empirically assessed taxonomy, on which future comparative empirically research could build and investigate, which institutional arrangements have been chosen for achieving IOP of different services or for similar services in different countries.

The cases which form the empirical basis of this research have been collected in a study on IOP for the European Commission within the MODINIS program [19]. More than 70 case descriptions have been collected and are available in an online database (<http://www.egov-iop.ifib.de>). For 32 of these cases, extensive descriptions have been produced in cooperation with the case owners and published on the Good Practice Framework of the European Commission

(<http://www.epractice.eu/cases>). Further analysis of these cases is subject of a research grant provided by the German Research Foundation (Deutsche Forschungsgemeinschaft), started in May 2008. In this paper, a preliminary operationalization of the organizational dimensions is presented in order to receive feedback by the expert community with regard to plausibility and usefulness for general discussions as well as for planning interoperability projects. Therefore comments to this paper are highly welcome and will be considered in the ongoing research heading for a refinement of the classification presented here.

REVIEW OF SELECTED INTEROPERABILITY FRAMEWORKS

The European Commission has launched a Communication with particular focus on Interoperability for Pan-European eGovernment Services [2]. But interoperability is also of great importance for the e-government development in each Member State. The periodic benchmarking study of e-government in Europe explains differences of progress between Member States to a large extent by differences in achieving interoperability within and between services at the same or on different government levels [3, 4].

The European Interoperability Framework (EIF), developed in the IDABC context (Interoperable Delivery of European eGovernment Services to public Administrations, Businesses and Citizens – see <http://ec.europa.eu/idabc/>) has established itself as a reference model for several national IOP programs of Member States. At present it is under review and a new version is expected by end 2008. Similar to the EIF, there are interoperability initiatives, frameworks or programs within the e-government plans of most Member States. They are summarized in the MODINIS Study on IOP mentioned above. Several international bodies have developed interoperability frameworks as well or give recommendations for successful achievement.

An IOP framework shall fulfill several purposes. It shall list measures or options that are suitable and necessary to create IOP among several information systems. In pragmatic respect, it shall support the practical planning of systems for several administrations by listing the topics that have to be coordinated, and the suitable standards and methods. Thus a communication basis for the developers is created; at the same time, it allows the allocation of tasks. In other words, it gives structure to a complex field, provides common terminology where similar things are termed differently, and suggests a classification in order to recognize similarities and differences. This is mainly achieved by assigning different standards for data exchange to three or four different layers of IOP:

- The European Interoperability Framework for Pan-European E-Government Services, which was developed within the EU program IDABC [8], differentiates the three levels of technical, semantic and organizational interoperability. The draft of the second version

that is currently under review covers also the levels of legal IOP and the political context [7].

- In a similar architectural model of the European Public Administration Network (EPAN), the level of structured customer contact and support is introduced and, besides the four levels, the aspect of governance is highlighted [5].
- In a white paper with the title "Standards for Business", the European standardization institute ETSI introduces the level of syntactic interoperability between the technical and the semantic interoperability [6].

An overview over these and other classifications is given by Peristeras and Tarabanis [16]. On the basis of a comparison of twelve different interoperability frameworks, Peristeras and Tarabanis suggest a concept of their own which they call "The Connection, Communication, Consolidation, Collaboration Interoperability Framework (C4IF)". The four terms characterize the functions or purposes, which the standards shall fulfill on the different levels of the mentioned framework concepts. The mostly technology-oriented studies, especially a comprehensive "Study on Interoperability at Local and Regional Level" within the MODINIS program of the European Commission [19] and the White Paper of the Fraunhofer Institute for Open Communication Systems [17], adopt the structure of three levels from the European Interoperability Framework. Moreover, the MODINIS Study on Interoperability has in addition assessed the information needs of stakeholders in interope-

rability [13] and discusses the barriers and success factors for achieving interoperability [19]. The Computing Technology Industry Association (CompTIA) has reviewed the EIF with regard to the experiences of the ICT industry and its requirements to organizational IOP in particular in B2G and G2G relations.

Considering the purposes of IOP frameworks to provide guidance for achieving IOP, such a classification is only a first necessary but by far not sufficient step, because it only refers to "What" has to be made interoperable by which technical means but not "How" these are enabled and "by Whom"; i.e. the actor or governance perspective is missing. And even regarding the "What" and "How" present knowledge about standards on the four layers is quite different (cf. Table 1).

While there are global standards and protocols for the levels of technical and syntactic interoperability and recognized concepts and methods exist for the semantic interoperability, very heterogeneous elements and aspects are assigned to the level of organizational interoperability, which are described only vaguely or which formulate requirements instead of options for action as at the other levels. Only the ICT Industry Recommendations to the EIF [20] that analyses the EIF from the viewpoint of the Computing Technology Industry Association go one step further and describe more precisely the options by defining the IOP layers more differentiated.

Level of interoperability	Aim	Objects	Solutions	State of Knowledge
Technical interoperability	Technically secure data transfer	Signals	Protocols of data transfer	Fully developed
Syntactic interoperability	Processing of received data	Data	Standardized data exchange formats, e.g. XML	Fully developed
Semantic interoperability	Processing and interpretation of received data	Information	Common directories, data keys, ontologies	Theoretically developed, but practical implementation problems
Organizational interoperability	Automatic linkage of processes among different systems	Processes (workflow)	Architectural models, standardized process elements (e.g. SOA with WSDL, BPML)	Still lack of conceptual clarity, vague concepts with large scope of interpretation

Table 1. Four Levels of Interoperability

Considering barriers and success factors, many experts agree that organizational interoperability constitutes the biggest challenge for the successful implementation of interoperable multi-level e-government systems. In the above-mentioned survey on information needs regarding interoperability, organizational interoperability was ranked highest [13]. However, compared to the layers of technical and semantic interoperability, for organizational interoperability

- the definitions are much more heterogeneous,

- the assigned issues are much more vague,
- there are almost no classifications of options available for solving these issues.

The following box quotes the definitions of organizational interoperability in selected frameworks. One can get the impression that the layer of organizational interoperability is filled with all those issues, which turn out to be necessary after interoperability has been achieved on the other layers below.

Definition of organizational interoperability in different framework concepts

IDABC EIF

Organizational interoperability is concerned with "defining business processes and bringing about the collaboration of administrations that wish to exchange information and may have different internal structures as well as aspects related to requirements of the user community" (p. 16).

IDABC EIF draft of v.2.0

Organisational interoperability concerns a broad set of elements of interaction, including business processes, business interfaces such as email, web portals, etc., business events within and between administrations, and "life" events, involving the external parties: businesses and citizens. This aspect of interoperability is concerned with how different organisations such as different Member State Administrations collaborate to achieve their mutually beneficial, mutually agreed eGovernment service-related goals. The partners need to reach detailed agreements on how their processes will interact (synchronize and cooperate) in order to deliver "public services where needed".

Organisational Interoperability in practice means the seamless integration of business processes and the exchange of information that they manage between the organisations. (from EIF v1).

Organisational Interoperability aims at addressing the requirements of the user community by making services available, easily identifiable, accessible and user-oriented. Organisational interoperability occurs when actors agree on the why and the when of exchanging information, on common rules to ensure it occurs safely, with minimal overhead, on an ongoing basis, and then draw up plans to do all these things, and carry them out.

EPAN

Organizational interoperability "is concerned with the coordination and alignment of business processes and information architectures that span both intra- and interorganisational boundaries... Coordination of business processes across organisational boundaries is essential if a single, aggregated view of a service from the customers' perspective is to be achieved. It is suggested that administrations could develop an exemplar scheme that would define standard approaches to each of the main requirements of any public service and use this exemplar to benchmark all other services; that common functionality could be provided on a shared basis through a broker service to reduce development, deployment and operational costs to the public administration and to each service fulfilment agency, and to ensure consistency of experience for users of services across all agencies in the public sector through the use of agreed standards across all services; that expenditure reviews could be undertaken to ensure that financial priority is given to those schemes that comply with the structured customer support services set out above and with interoperability standards; and that each administration could develop a central programme of organisation development assistance and funding to bring this change about" p. 5/6.

ETSI

"Organisation interoperability, as the name implies, is the ability of organisations to effectively communicate and transfer (meaningful) data (information) even though they may be using a variety of different information systems overwidely different infrastructures, possibly across different geographic regions and cultures. Organisational interoperability depends on successful technical, syntactical and semantic interoperability" (p. 6).

The definitions of organizational interoperability mix methods and standards for the technical linkage of business processes (process organization) with questions of the organization of support functions, which cannot be assigned to one layer only, but which apply to all layers of interoperability as cross-sectional aspects. Though the more differentiated definition of organizational IOP in the draft of the new EIF v. 2.0 this situation has not changed.

"WHO" ORGANIZES "WHAT" and "HOW"?

Compared to the other frameworks, the EPAN framework [5] provides greater conceptual clarity by separating the dimension of governance from the other layers and considering this aspect as a cross-cutting issue concerning all layers of IOP. Also the draft of the new EIF 2.0 now more clearly separates the governance aspect and, moreover, separates the legal and political aspects from organizational IOP. Also, the (above mentioned) ICT Industry Recommendations to the EIF [20] differentiate between those aspects that are based on legislation, regulations and court findings on the one side and the technical and functional aspects of IOP on the other. In other words, IOP frameworks should distinguish between "What" is standardized and "Who" develops and establishes these standards. In addition, from the analyses of the cases, a third aspect and dimension refers to "How" operation and maintenance of IOP standards is organized (cf. Fig. 1).

"What"

The technical and functional concepts to achieve organizational IOP refer to the alignment respectively coordination of business processes by standards for process modeling, architectures or choreographies. This meets the results of the empirical research of the MODINIS IOP Study cases as well as the classification by the ICT Industry Recommendations to the EIF [20]. According to the definition of technical, syntactic and semantic IOP which is confined to technical and functional standards, this aspect of organizational IOP also has to build on technical and functional standards. In order to avoid misunderstanding and to more clearly indicate the dimensions of organizational IOP, this "What" – dimension is named Business Process IOP. Foremost concepts and implementations (technologies) cover e.g. Service-Oriented Architectures by using standardized business process definition languages to enable the delivery of software processing as services. Practical implementations of such technical and functional concepts are Web services defined, e.g., in WSDL (Web Services Definition Language) or as BPML (Business Process Modeling Language).

"Who"

The aspect of "Who" organizes for IOP refers to the governance of e-government services. However, there is not one common governance structure for all layers of interoperability. Rather protocols at the technical layer are mostly

defined by national and international standardization committees including Internet working groups, while data formats, ontologies and so forth for creating semantic interoperability are - due to their more concrete relation to a particular context - mostly developed by industrial or sectoral organizations (industrial associations, professional bodies, local government associations, etc.); in public administration they are also provided by ordinances and legislation. Regulations concerning organizational interoperability are either negotiated by the administrations directly concerned or by superior administrative agencies or ordinances. However, this aspect of governance is not defined and structured in the EPAN document.

How

The means by which IOP is being established through the technical and functional concepts are more complex, as various combinations of standards (e.g. data exchange standards, ontologies) and technical infrastructures (e.g. directories, interfaces) exist. Interoperation can, e.g., be achieved by implementation of the same (standardized)

directories of services in different authorities or by a technical functionality that allows for the conversion of different data formats that are in use for the same service in cooperating back-offices. This means that the “How” aspect refers to the concrete standards, and infrastructures data are used to achieve IOP.

By analyzing data exchange in industry and retailing, we found that ordering and billing information are not exchanged directly between retailing and producers of brand articles, but via mediators providing certain services such as conversion of data formats, providing up-to-date directories, authentication or authorization services and many more. They can be called clearing houses generalizing from the inter-bank clearing [11, 12]. Similar is the situation in the evaluated e-invoicing good practice cases of the MODINIS Study where so-called Value Added Networks (VANS) centrally take over conversion and routing services. Many other services, which employ such intermediary infrastructure, could be named.

What has to be agreed and made available between whom and how?

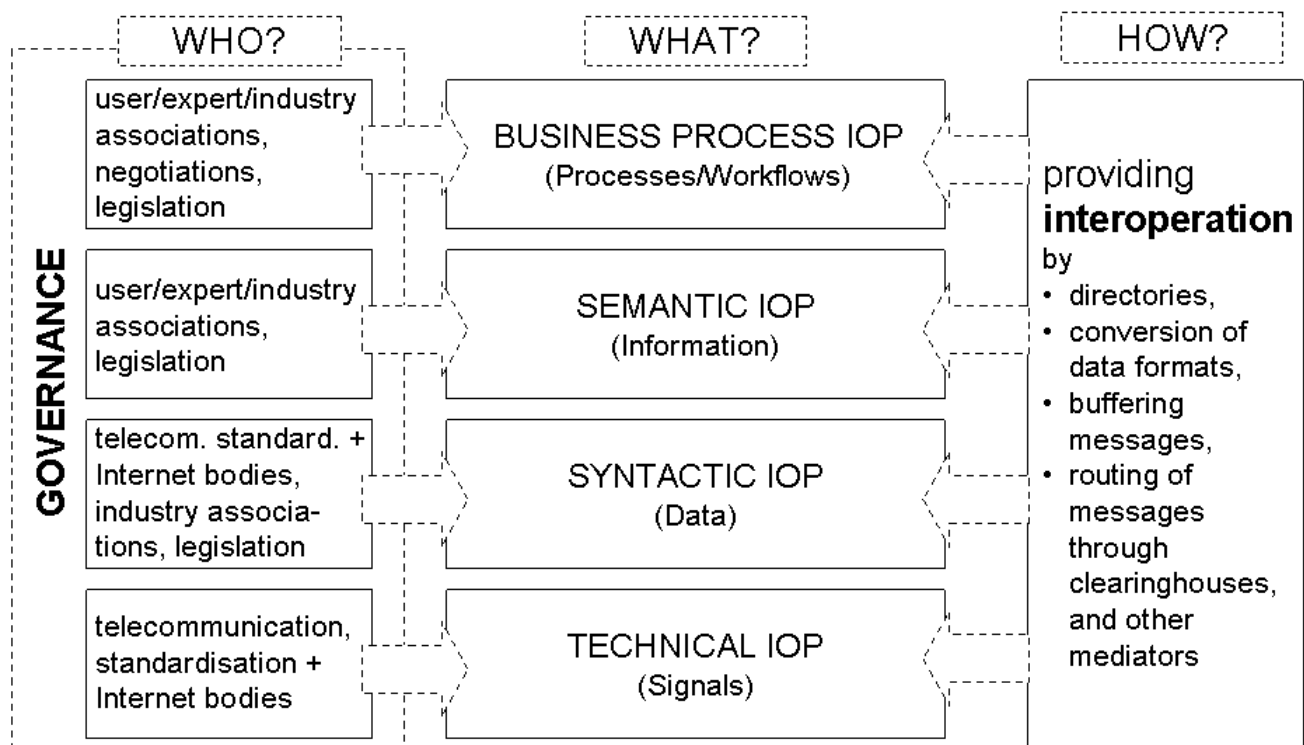


Figure 1 Layers of Interoperability, their Governance and Provision

To summarize this discussion, we suggest to differentiate between three dimensions of organizational interoperability, reserving the term business process IOP for technical standards for linking workflows and business and separating this from two cross-cutting aspects of governance of devel-

oping and establishing IOP on one side and providing its daily operation on the other (cf. Table 2).

Table 2. Organizational Interoperability

Organizational Interoperability		
Governance	Alignment of business processes	Interoperation

In the next two paragraphs we will propose sub-dimensions and empirical indicators, derived from the Good Practice case collection in order to differentiate relevant aspects and available options.

The Governance of Interoperability (“Who”)

At this moment there is no classification available on the different arenas where in particular semantic and organizational interoperability have been negotiated and decided. Some hints can be found in the TERREGOV organizational case studies [1]. There are different forms of governance for different areas of public administration and differences between Member States according to differences in constitutions and traditions of cooperation between administrative sectors and levels.

While the research on intergovernmental cooperation for achieving interoperability allows for deeper insight, it is mostly case-based and does also not provide a classification of the different forms of governance for achieving semantic and organizational interoperability. Also in e-government research, the governance aspect is mostly addressed very globally by referring to the three basic forms of market, hierarchy and networks as e.g. in the MODINIS IOP Study, or concrete constellations of individual cases are described.

When trying to apply the suggested governance forms to the 32 cases evaluated in detail in the MODINIS Study¹ we found that there was not only one governance structure in each case. Rather the planning and decision-making authority shifted in the course of three different phases of the development process.

Phase Dependent Governance

In a conceptualization phase we found the working groups and ad hoc committees mentioned by Scholl and Klichschewski [18] as well as staff units, mainly composed of experts from the respective application contexts and ICT specialists. The organizational forms in this phase can be distinguished by the degree of institutionalization and representation. Sometimes the IOP standards at the organizational and semantic level are elaborated in existing permanent institutions, sometimes by ad hoc groups put together for a particular IOP project (cf. Table 3). Representation refers to the extent to which the different sectors or levels of government, which will be affected by a standard, are represented in the respective working group (cf. Table 4).

¹ For the certain MODINIS good practice cases see http://www.egov-iop.ifib.de/iop_output.php

Table 3. Degree of Institutionalization

	Existing institution	New institution
Permanent	e.g. national Ministries in the e-enabled child benefit service in Ireland	e.g. Crossroads Bank for Social Security in Belgium
Temporary (ad hoc group)	e.g. the working group EDIAKT II in the standardized e-form exchange project in Austria	e.g. the OIO Data Standardization Committee in OIO-XML project in Denmark

Table 4. Degree of Representation

Representation degree	No participation of users	Participation of selected pilot users	All user groups represented
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Standards elaborated by such working groups are in most cases proposals, which have to be adopted, issued, recommended or made mandatory by authorized bodies. They need legitimization by law or ordinance, contract or agreement or just by the decision of an authorized and recognized board. In contrast to e-business, in the 32 European cases, almost all semantic and organizational IOP standards for nationwide services have been established by law or ordinance, while on the regional level contracts or agreements were most frequent (cf. Table 5).

Table 5. Legitimacy and Authorization

	Mandatory (Obligation)	Voluntary (Recommendation)
Law, Ordinance	e.g. use of the X-Meld standard in Civil Registration in Germany	e.g. standards for e-invoicing in Finland
Agreement, contract	e.g. use of EDIAKT II in the standardized e-form exchange in Austria	e.g. OIO-XML standards in Denmark

In a third phase, standards, which have been recommended or made mandatory, still have to be implemented and put into operation by assigning certain tasks to certain organizations or units. They can be public or private or public-private partnerships. In many cases tasks of control or supervision are assigned to boards or committees, in particular for promotion, diffusion, maintenance and updates of the respective standards, while tasks of operation are assigned to governmental agencies, joint ventures or private enterprises as service providers (cf. Table 6).

Table 6. Maintenance and Operation

	Public	Private	PPP
Mainten- ance	e.g. KoopA ADV for the X-Meld standard in Germany		e.g. e- invoice con- sortium in Finland
Operation	e.g. KoopA ADV for the X-Meld standard in Germany	e.g. e- invoice ser- vice provi- ders in Fin- land	

Organizing for Interoperability (“What” and “How”)

In contrast to the governance of IOP, providing interoperation directly concerns the technical and functional concepts and implementations.

As mentioned above, the way interoperation is provided and maintained follows different lines and should be considered as a separate aspect. If we conceive the provision of interoperation as a coordination problem organization theory offers two main strategies: centralization or standardization [14]. Organizations or networks of organizations may achieve coordination of tasks or processes either by giving authority to one unit, i.e. centralization, or by agreeing on standards, which all decentralized units have to apply [9].

Following this distinction, the next question is whether these two dimensions can be differentiated further in order to show different options within each of these dimensions. One idea is to look for what is standardized and what is centralized in interorganizational data exchange networks.

After analyzing the cases collected in the MODINIS study (see <http://www.egov-iop.ifib.de> for the individual case studies), the following distinction is proposed:

In order to achieve fully interoperable data exchange across governmental units, there is a need for

- (1) standardized directories (same directory is available in each involved unit) providing the address data for routing,
- (2) standardized data exchange formats on the syntactic layer,
- (3) standardized data keys or ontologies on the semantic layer,
- (4) common workflow definitions to describe the source and target processes of the exchange.

In order to support the application of these standards, we find intermediary units, which serve as central providers for

- (1) the routing of messages via a central directory,
- (2) the conversion of data exchange formats if there are more than one,

- (3) providing access to files of selected (master) data,
- (4) Maintenance of directory data
- (5) Workflow control (e.g. process control, validation, quality control, tracking and tracing)

It is obvious that in all cases, messages are exchanged between different organizations and that some kind of routing is necessary based on directories to find and determine the target address. Instead of each participating organization individually maintaining such a directory, it is much more efficient to have one central provider who maintains and updates this directory. In order to exchange data between automated processes, there is also a need to define the source and target workflow as well as data exchange formats. Examples are applications for social benefits, notice of change of address, or invoices. In some cases, standardization covers the syntax of the messages, e.g. XML schemes for an order, in other cases the meaning of certain data fields is standardized as well, e.g. a unique citizen or business number in an application form or a unique article number in an order or invoice. Again a central unit may maintain a database with this kind of reference data more effectively. And if there are several formats, it may provide a conversion service as well.

REFLECTING THE USEFULNESS OF THE OPERATIONALIZATION

From a pragmatic point of view, there is the question whether the presented dimensions of organizational IOP reflect reality and whether the classifications and kinds of measures on each of the dimensions cover the relevant items. These items shall allow for the support of the decisions that had to be taken by public authorities in order to provide for and guarantee interoperation and interoperability. Are there other measures, which should be considered? Are they still too general and should be differentiated further?

From a scientific or analytical point of view, there is the question whether this classification allows for identifying certain patterns and relations. One question in this regard is whether there is an order of the various kinds of action on each of the two sub-dimensions of interoperation (centralization and standardization). Do they have a cumulative structure, i.e. is there a rank order according to which a measure ranked higher only appears where all the measures ranked lower exist as well?

The analysis of these relationships between different measures and the search for patterns as well as the examination of the different governance aspects is subject to an ongoing research process, which has started in May 2008. Hopefully in the presentation on the conference some further findings will be presented and discussed. In any case we would like to discuss the concept of the three organizational dimensions of interoperability and the suggested operationalization with the expert community either to receive support for building the analysis of these propositions or to get sugges-

tions for changes in order to better meet the information needs of those working on interoperability and to whom the interoperability frameworks should provide guidance and support.

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