

Information Integration or Process Integration? How to Achieve Interoperability in Administration

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Abstract. IT managers in administration must decide how to contribute to cross-organisational integration and what strategy and means to choose for achieving interoperability. Comparing the frameworks and guidelines provided by central European and U.S. governmental units, we find information integration and process integration as prominent concepts to guide interoperability efforts, but they seem to point to different directions. This paper aims at contrasting the different characteristics of both approaches and concludes with recommendations according to the intended organisational scope of integration. To be successful in these efforts it is important to understand that (a) interoperability requires a guiding vision of integration, (b) each type of integration points to a different set of interrelated ideas, assumptions and technical means, and (c) integration implies a strategic commitment to explicit forms of cross-organisational cooperation and their implementation.

1 Introduction

To fulfil the many promises of e-government, organisational and technical performances of different administrative units need to be interrelated. This requires *cooperation*, pointing to a common cross-organisational strategy and its implementation, as well as *interoperability*, pointing to the technical means which enable IT systems to exchange messages in order to realise machine performance across system borders. Given these two enablers, *integration* is the result of both cooperation and interoperability between administrations and their partners. Within this article, integration denotes a state of readiness (or the effort to reach this state) to provide services (information, transactions, production etc.) which are only possible through successful incorporation of informational or functional elements which had been isolated before.

Within the e-government discussion, integration is related to several concepts – each of these meant to put in the foreground the main objective of integration. One of these is the concept of life-event, i.e. an integrated way of dealing with concerns related to a certain situation in the life of a citizen (e.g. marriage, moving home) or a business (e.g. start up). This vision of integration has sparked many projects and research on how to realise e-government websites based on “life-events” or “one-stop-government” (cf. [17]). But it soon became clear that prospects for this kind of integration are very limited unless the different providers contributing to the overall

performance are able to achieve a higher level of integration than is given today (cf. [24]). Another stream of discussion (eg [16]) highlights administrative efficiency and effectiveness, concluding that improvements in these areas are only possible through an increased integration of performance by administrative units and their IT devices.

Given these drivers for integration, IT managers on all levels of administration now have to decide how to contribute to cross-organisational integration and what strategy and means to choose for achieving interoperability. To guide this effort, two prominent concepts seem to point to different directions:

- *information integration* aims at facilitating information flow, i.e. providing access to structured informational resources across technical and organisational borders in order to enable new services based on a virtually shared information environment
- *process integration* centres around interrelating steps and stages of process performance across technical and organisational borders in order to enable new services based on an overarching monitoring and control of process flow.

In practice, these two integration approaches seem to largely overlap or supplement each other without providing a clear understanding of the implications of following or prioritising one of them. Does one approach depend on the other or are they separate paths to follow? Do they require different or similar activities and instruments?

This paper examines information integration and process integration more closely by analysing the underlying assumptions and perceptions of “things” to be integrated. The aim is (a) to point out the interdependencies between the concepts, their underpinnings, technical means and consequences for any interoperability strategy, and (b) thereby to contrast the different characteristics of information and process integration and to foster a better understanding of the potentials and limitations of each approach.

This contribution is organised as follows: Section 2 points to the differences between the interoperability guidelines provided by central European and U.S. governmental units with respect to information and process integration. In section 3, information and process integration are contrasted within three dimensions: administrative cooperation, conceptual deconstruction and modelling, and systems development. In section 4, the two approaches are contrasted by certain characteristics in order to sum up the findings and to provide some guidance also for practitioners.

2 E-government interoperability frameworks and architectures

During the last few years, facing increasing demands on interoperability and integration, central governments around the world have started initiatives to provide comprehensive frameworks in order to provide guidance to activities on the local and regional level and to prevent from investments which do not contribute to interoperability. In consequence, local actors now find themselves surrounded by an increasing variety of artefacts such as e-government guidelines, frameworks, architectures, standards, components and tools – all of these introduced with the threat of causing major disadvantages (e.g. additional cost, interoperability gaps, insufficient service performance) if not being used.

Comparing the guidelines provided by the European Commission (EC) with those issued by the U.S. federal government reveals that the visions to guide interoperabil-

ity efforts refer differently to information and process integration. The EC has issued several documents centred around e-Government interoperability, namely the European Interoperability Framework [7], the Architecture Guidelines [8] for administrative networks and a position paper (“Linking up Europe”, [9]) on the importance of interoperability for e-government services. The scope of this endeavour is to supplement the national efforts in this field and to support the provision of user-centred e-government services on the European level. In these documents the EC clearly highlights process integration and service interoperability as the guiding vision:

- The Architecture Guidelines are designed to fulfil generic business requirements: “Trans-European networks are established to support business processes that involve independent partner organisations. Business types and requirements are wide ranging, yet common business requirements can be identified and classified based on the substantive commonality of the underlying processes.” ([8], p. 7)
- The EC [7, 9] distinguishes between three main areas: organisational, semantic and technical interoperability. For the organisational level it recommends a demand driven approach and the connection of business processes through “business interoperability interfaces”, supported by distinct service level agreements. Aspects of information and data integration are then covered within subordinate levels.

The Federal Enterprise Architecture (FEA) [10], issued stepwise by the FEA Program Management Office (a U.S. federal agency established for that purpose), also incorporates a layered approach. The collection of interrelated reference models (Performance, Business, Service Component, Data & Information, Technical) is designed to implement a “business and performance-driven approach” which is supposed to “transform the Federal Government to one that is citizen-centred, results-oriented, and market-based” (ibid.). Compared to the EC approach, the FEA focuses on results rather than on the processes producing those outputs. For example, the FEA incorporates

- a distinct reference model (or framework) to measure the performance of major IT investments and their contribution to program performance;
- the Business Reference Model as a function-driven framework for describing the business operations, while the next subordinate reference model classifies service components with respect to how they support business and/or performance objectives. Only one out of those six service classes deals with process automation, and one more with supporting cross-organisational business management.

In comparison, the EC approach clearly emphasizes the intermediation of cross-organisational processes and citizen-centred services, while the FEA focuses on the products of functions and services within and across agencies, all of which are to be integrated on the informational level. In their analysis of e-government architectural frameworks, Pardo et al. use the term “interorganisational information integration” [21] to denote the intergovernmental integration effort currently underway in the U.S., claiming that governmental leaders increasingly recognize its critical importance.

All in all, the two approaches introduced above follow different priorities and guiding visions, respectively. But they had made their choice without providing the reader (e.g. IT managers in administration) with any rationale on benefits and drawbacks. Therefore, the following section draws on the literature to contrast information and process integration as to approaches to achieve interoperability each of which interrelating distinct perspectives on administrative cooperation, conceptual deconstruction and modelling, and systems development.

3 Information integration versus process integration

As definitions of information and process integration may vary, this contribution builds on notions taking into account both the organizational and IT perspective. Information integration centres around facilitating the flow of information, i.e. providing access to structured informational resources across technical and organisational borders, in order to enable new services based on a virtually shared information environment. Jhingran et al. [12] describe information integration one of the forms of integration, “wherein complementary data are either physically (through warehousing tools) or logically brought together, makes it possible for applications to be written to and make use of all the relevant data in the enterprise, even if the data are not directly under their control” (p. 555). While integration is considered to be the driving force of this decade of IT spending, the task of information integration has become even more complex due to the heterogeneity and distribution of relevant data as well as the demand for increased speed of information processing (e.g. for business intelligence). The above authors as well as many others distinguish information integration from other forms such as portal, business process and application integration. However, these perspectives are distinct because of their optimisation focus while the same data is relevant for all forms of integration. As Roth et al. [22] point out, “enterprise applications require a new information integration platform that combines the advances in enterprise data management over the past 30 years into a single unified interface” (p. 565).

Process integration aims at interrelating steps and stages of process performance across technical and/or organisational borders. On a general level process may be described as an “organizational form, that encapsulates the interdependence of tasks, roles, people, departments, and functions required to provide a customer with a product or service” ([5], p. 13). These interdependencies come into focus through analysis, modelling and design of flows (of material or data) interconnecting the above elements. However, it is important to note that “integration is concerned with the process itself, not with its output” ([3], p. 2). Areas of discussion relevant for e-government are business process integration, (cross-organizational) workflow management and Web services. Focusing on the value for the process client (e.g. a citizen using an e-government service) process integration comes into focus from the corner of service integration. Service providers seek for an overarching monitoring and control of process flow in order to enable new services (e.g. for life event management).

Both integration strategies are related to assumptions and perceptions of “things” to be possibly integrated. In the e-government literature we find research focusing on management/integration of information exchange (e.g. [6, 11, 13, 14, 21]) as well as on processes management/integration (e.g. [1, 2, 4, 15, 20, 23, 25]). Most of these contributions focus on conceptual aspects and/or practical challenges in relation to specifics of public administration; they are based on interrelated perspectives of the cooperation of actors (individual or institutional), conceptual deconstruction and/or modelling and systems development (although technical aspects are treated only marginally). As the authors explicitly draw on related concepts and theories (mainly from business computing) or implicitly make assumptions to support their arguments, these contributions quite consistently comply with the following distinctions between information and process integration (see also table 1 for overview):

Cooperation between administrations

Striving for information integration, information primarily appears as a shared resource which, at the workplace, is to be obtained/retrieved, processed, delivered and archived. The client is someone who supplies and receives information (or data; mostly there is no clear distinction). Cooperation among actors is based on exchange of information within a virtually shared information system. Among the major obstacles for cooperation are unresolved issues concerning security, access and ownership of information.

Striving for process integration, workplace activities are regarded as contributions to overarching process in which the client is also involved. Cooperation means to coordinate activities and/or performance among the actors involved. Among the major obstacles for cooperation are unresolved issues concerning ownership and control of the overall processes.

Conceptual deconstruction & modelling

Within information integration, the guiding vision is to achieve an interorganisational information flow between information producers and consumers (which may be organisations, humans or machines). Critical aspects of analysis and modelling include

- data definitions and information models (which may include process related data),
- classification of administrative information (e.g. through thesaurus or ontologies),
- quality of information (reliability, access rights etc.).

Within process integration, the guiding vision is to achieve an interorganisational workflow between process participants (which may be organisations, humans or machines). Critical aspects of analysis and modelling include

- identification and classification of performing entities according to role, function or service within their organisational structure (e.g. front office versus back office),
- description and representation of items to be processes and shared,
- indicators for process control (e.g. conditions, events, service levels),
- process models (business processes, workflows, with reference to informational resources) and process reference models (e.g. classification/types of administrative processes).

Concepts & challenges	Information Integration	Process Integration
Cooperation in administration	<ul style="list-style-type: none"> • cooperation as exchange of information as shared resource • client receives/supplies information (data) • unresolved: access, ownership 	<ul style="list-style-type: none"> • cooperation as coordination of contribution to overarching process • client involved in process • unresolved: control, ownership
Conceptual deconstruction & modelling	<ul style="list-style-type: none"> • guiding vision: interorganisational IS & information flow • critical aspects: data definition, information models & classifications, quality of information 	<ul style="list-style-type: none"> • guiding vision: interorganisational workflow & process management • critical aspects: process control, modelling of performance entities, work items & processes
Systems development	<ul style="list-style-type: none"> • interoperability of any IS components • use of XML, RDF/S, OWL, meta-data 	<ul style="list-style-type: none"> • interoperability of functional components • use of XML, SOAP, WSDL, UDDI, WSI

Table 1. Different concepts and challenges in information and process integration.

Systems development

The interoperability requirements deriving from information integration call (in principle) for the exchange of informational resources (according to given information models) between any given distributed information systems components. To achieve this, it is recommended to build IT architectures and infrastructure standardisation on the application of XML, RDF/S, OWL (cf. www.w3c.org) and the use of standardised metadata.

The interoperability requirements deriving from process integration call (in principle) for the linkage of functional components (according to given process models) across systems borders. To achieve this, it is recommended to build IT architectures and infrastructure standardisation on the application of XML, SOAP, WSDL, UDDI, WSI (cf. www.w3c.org).

4 How to choose interoperability strategies

To sum up, the difference between information integration and process integration may be characterised as follows:

- *Information integration* relates to the vision of interorganisational information systems. The main task to be accomplished is information resource design. Abstractions shared among partners mainly describe syntax and semantics of data as well as access control (location, naming, access rights etc.) and quality of information. The scope of partnership is mostly multilateral with the potential to engage in relations with new partners any time, even on a global scale.
- *Process integration* relates to the vision of interorganisational process networks. The main task to be accomplished is business process (re-)engineering. Abstractions shared among partners mainly describe performance entities, work items, processes and process control. The scope of partnership is mostly limited to peer-to-peer relations within a group of known business partners.

All in all (see also table 2), process integration (compared to information integration) needs more planning operations, therefore it requires a higher intensity of cooperation and financial investment. For the same reason, the potential for integration is higher and the state of readiness for new services may be more advanced and rewarding.

Information Integration	Characteristic	Process Integration
interorg. information systems	<i>vision of integration</i>	interorg. process networks
information resource design	<i>basic strategy</i>	business process reengineering
multilateral, global	<i>scope of partnership</i>	peer-to-peer, limited members
syntax & semantics of data, access control, information quality	<i>shared abstractions</i>	performance entities, work items, processes & process control
lower	<i>integration potential</i>	higher
lower	<i>intensity of cooperation</i>	higher
lower	<i>investment</i>	higher

Table 2. Different concepts and challenges in information and process integration.

In practice, IT managers in public administration make their choice of interoperability strategy according to a number of factors such as a given e-government strategy, service demands and requirements, investment frame, legacy systems and infrastructure, available know-how etc. As the interoperability frameworks suggest (see section 2), information *and* process integration both should be taken into account somehow – but how to set the priorities? Should we prefer rather the European or the U.S. approach? Having analysed the characteristics of both, some advice can be derived according to the intended *organisational scope of integration*. From that angle, three types of scope require different strategies:

1. *Within a single organisation*: information and process integration may both be followed together under the auspices of enterprise application integration (EAI); the main idea is to achieve unrestricted sharing of data and business processes throughout the networked applications or data sources in an organisation through establishing an adequate middleware infrastructure [18]. This applies mainly to large communes or large administrative units on the federal or transnational level.
2. *Among a stable group of partners*: a rather small network with stable relationships is the most rewarding setting for the integration of processes which are an essential part of the cross-organisational cooperation. Typical e-government settings are larger cities and their neighbouring communes (horizontal cooperation) or high-frequency processes involving local governments and federal agencies (vertical cooperation). Within these settings, the exchange of information is embedded in the process management.
3. *Open to global partnerships*: if cooperation is mainly based on encounters, without stable partner relations, the investment for process integration usually does not pay off and instead information integration is the most important guiding vision for interoperability. Given the large number of more or less independent administrative units within each country and throughout the world, the successful exchange of information between any administrations (with different IT systems and infrastructures) will be the most important interoperability scenario for the coming years. Within this setting, cross-organisational process management must be transformed into an information integration task (e.g. through establishing open process interfaces and applying global standards for process description).

With the specification and standardisation of web services and semantic web concepts, there are now new technical options for achieving interoperability. Some authors (e.g. [19]) already foresee the next generation of application integration without being limited to single organisations or small networks.

Of course, these options are relevant also for e-government: in the future, information and process integration both will lead to application integration on a large scale and provision of integrated services for citizens and others will be achieved on the basis of service-oriented architectures spanning across the whole domain of e-government. However, in comparison to the business sector, public administration is only just beginning to achieve internet-based interoperability, and everyone involved has to learn step by step. To be successful in these efforts it is important to understand that (a) interoperability requires a guiding vision of integration, (b) each type of integration points to a different set of ideas, assumptions and technical means, and (c) integration implies a strategic commitment to explicit forms of cross-organisational cooperation and their implementation.

5 References

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