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Procedia Computer Science 64 (2015) 1088 – 1098

Procedia Computer Science

Conference on ENTERprise Information Systems / International Conference on Project MANagement / Conference on Health and Social Care Information Systems and Technologies, CENTERIS / ProjMAN / HCist 2015 October 7-9, 2015

The Architecture Facet of Information Governance: The Case of Urbanized Information Systems

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Abstract

Nowadays, information is considered as one of the main intangible assets of modern organizations since it plays a critical role in their competitive advantage and survival. In particular, information underpins any decision within organizations at both the daily operational and the tactical and strategic decision levels. As a result, information quality, and security requirements are exacerbated, in order to maximize operational efficiency, and respect the constraints imposed by the ever-changing legal and regulatory environment. However, information is not yet managed with the same rigor or the same means as other organizations resources, including capital and human resources. Information governance has been proposed by many authors as a necessary prerequisite for the establishment of an information valorization process. Many information governance approaches and frameworks have been proposed by academics and practitioners. Nevertheless, outcomes of these solutions are below expectations. This paper has three objectives. First, it proposes a framework which considers information architecture as a driver of information governance. Second, it describes the architecture facet of information governance by presenting an information architecture model. Third, it demonstrates how urbanized information systems take into account the architecture facet of information governance.

Peer-review under responsibility of SciKA - Association for Promotion and Dissemination of Scientific Knowledge

Keywords: information; information governance; information architecture; information architectural dimension; urbanized information system; architecture rule

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Peer-review under responsibility of SciKA - Association for Promotion and Dissemination of Scientific Knowledge
doi:10.1016/j.procs.2015.08.564

1. Introduction

Information plays a critical role in modern organizations competitive advantage and survival. In particular, it underpins any decision at both the daily operational and the tactical and strategic decision levels. Nowadays, organizations are faced with huge amounts of information already generated by their own information systems applications like enterprise resource planning, customer relationship management, supply chain management, and other enterprise systems which capture data from every conceivable source[7]. Moreover, the digital revolution opens a new era in which voluminous information is used and shared both within organizations and beyond their boundaries. Such information can be structured or unstructured, internal or external, and originates from various sources: institutional, commercial (market, customers…), technical, financial, web, social networks… It may also take various forms like databases, text, images, sound, or videos. Therefore, information has a patrimonial dimension due to its role as one of the main intangible assets of modern organizations. It follows that information quality, and security requirements are exacerbated, in order to maximize operational efficiency, and respect the constraints imposed by the ever-changing legal and regulatory environment. However, information is not yet managed with the same rigor or the same means as other organizations resources, including capital and human resources. As highlighted by Davenport[7], organizations need enterprise-wide data strategy and governance to compete on their information assets. Adelman et al.[9] argue that organizations need a plan for improving the way they leverage their data assets in order to be able to turn data into information[1], and eventually into knowledge that will then contribute to business performance. In other words, to capture critical opportunities to leverage information to support strategy and organizational processes, organizations need to govern information assets as they govern other assets such as financial securities, cash, and human resources. Information governance has been proposed by many authors as a necessary prerequisite for the establishment of an information valorization process[2,3,22]. It aims at providing means of addressing the patrimonial dimension of information through the identification of information owners, consumers, and organizational actors responsible for information. It also allows organize actions around information within organizations in order to ensure its quality and safety throughout its life cycle. The ultimate objective of information governance consists in generating the greatest possible return on information assets. Many information governance approaches and frameworks have been proposed by academics and practitioners[2,3,4,5]. Nevertheless, outcomes of these solutions are below expectations. On the one hand, the attempts to tackle information governance problems have often resulted in only partial success since the proposed solutions are fundamentally static, while the governance problems are continuously changing. On the other hand, in many organizations, there is a confusion between information technology (IT) governance which focuses on IT systems and resources and information governance which relies on IT. Finally, the proposed solutions don't take into account all the dimensions of information governance, particularly the architecture dimension. This paper has three objectives. First, it proposes a framework which considers information architecture as a driver of information governance. Second, it describes the architecture facet of information governance. Third, it demonstrates how urbanized information systems take into account the architecture facet of information governance. Our paper is organized as follows. Section 2 is dedicated to the definition of information governance. In section 3, we present our information governance framework. Section 4 provides a synthetic description of our information architecture model. In section 5, we demonstrate how urbanized information systems take into account the architecture facet of information governance. Section 6 concludes this paper by describing lessons learned during the validation of the proposed framework and listing future research directions.

2. Information governance: definition and relationships with corporate and IT governance

Keasey et al.[6] state that governance refers to "the structures, processes, cultures and systems that engender the successful operations of the organizations". Therefore, governance is broader than management since it encloses both a managerial and a cultural dimension. In this section, we define the information governance concept prior to analyzing the relationships of information governance with corporate governance, and IT governance.

2.1. Definition of the information governance concept

Information governance and data governance are often used interchangeably. Nevertheless, these concepts are different although they have many commonalities. Indeed, information governance is based on a broad perspective of information issues, while data governance focuses on actual data elements collected from various sources. We notice that most published definitions of data governance apply to information governance. Information governance is a relatively new research area[13] without an established definition of this concept which encompasses best practices from many fields including data quality, strategic management, business process management, and risk management. Since the initial emergence of data governance as a critical and fundamental enterprise-wide discipline, the data governance community has published several definitions of this discipline. Most definitions take into account the conceptual (What?) and the physical (How?) aspects of information governance while some definitions describe the objectives (Why?) of this discipline, and focus on its organizational (Who? When? Where?) aspect. Wang et al.[11] noticed that establishing and maintaining trust in data quality is very important for data governance success. Weber et al.[2] have adapted the Weill's IT governance definition[4] to define the data governance concept. According to these authors, data governance refers to "the framework for decision rights and accountabilities to encourage desirable behavior in the use of data"[2]. They state that "to promote desirable behavior, data governance develops and implements corporate-wide data policies, guidelines, and standards that are consistent with the organization's mission, strategy, values, norms, and culture"[2]. Khatri and Brown[3] agree with Weber et al. that data governance refers to the set of decision rights and responsibilities related to data assets management. McManus[18] and White et al.[19] note that information governance provides an accountability framework setting out the basic principles and rules, management structure, as well as management methods and information accessibility, so it can be used effectively and efficiently in the organization. Furthermore, the organization's information governance system must meet legal, political, economic, and ethical requirements. Smallwood[20] provides an information governance definition which points out the contribution of IT to this discipline. He states that "information governance leverages information technologies to enforce policies, procedures and controls to manage information risk in compliance with legal and litigation demands, external regulatory requirements, and internal governance objectives". McLennan[21] defines information governance as "the activities and practices developed to control the use of information, including, but not limited to, practices mandated by law"[21]. He argues that "in a world in which information is increasingly seen as a top-level asset, the safeguarding and management of information is of concern to everyone"[21]. It follows from these definitions that the main goal of information governance consists in contributing to organizations competitive advantage by creating a holistic approach to manage important organizational information. Therefore, successful information governance includes: a) understanding the value of information assets, b) definition, approval, and communication of strategies, standards, policies, and procedures related to information governance, c) monitoring and conformance enforcement to the standards, policies, and procedures related to information governance, d) management and resolution of information related problems, and e) managing informational risks.

2.2. Information governance, corporate governance, and IT governance

Information governance is not independent of corporate governance and IT governance. On the one hand, the relationships between information governance and corporate governance have been analyzed by many authors. For example, Weill and Ross[5] have noted that while corporate governance aims at desirable behavior in exploiting the organization's key assets including information assets, information governance focuses specially on information assets. According to Wende[8], "data governance and IT governance are coequal and both have to follow corporate governance principles"[8]. This author argues that information governance is not a subset of IT governance but, for information governance to be successful, she recommends a "close collaboration among IT and business professionals who understand the data and its business purpose"[8]. On the other hand, in many organizations, there is a confusion between IT governance which focuses on IT systems and resources and information governance which relies on IT. As a result, information governance has been often carried out by IT experts who don't have a broad picture of the requirements and priorities of information stakeholders and don't consider that, from the business side point of view, information is only as valuable as the business processes, decisions, and interactions it supports.

Furthermore, many organizational actors conclude that since organization's IT side is responsible for IT infrastructure and applications that manage the information lifecycle, IT experts are also responsible for information governance. It follows that, within many organizations, information governance activities are relegated to finite tactical IT projects which rarely scale to add strategic value across the organization. According to Carr[10], IT is becoming a commodity and is not anymore a source of competitive advantage for modern organizations. However, this author acknowledges that his definition of IT doesn't include the information flowing in the computer systems and the organizational actors using them to support their activities. Therefore, combining IT with human talent and information governance can often lead to good quality information that results in business advantage for organizations. For its part, Fisher[12] noticed that many organizations wrongly consider data as a "technological problem" and continue to spend huge amounts of money to improve the quality of information using technology but often fail to reach this goal. In such organizations, the executives want to trust information, but they do not know how to achieve this goal. This author considers that information is every employee's and every executive's problem. According to Redman[14,15], two factors explain why organizations should manage information out of the IT department. First, information should be managed as close to the action as possible since the two most important moments of information lifecycle - its creation and its use – occur in business, not in IT. Second, information management is a matter of the business departments who have the most to lose or gain. Kooper et al.[17] confirm Redman's findings by pointing out the inadequacy of IT governance to manage the information lifecycle.

3. The proposed information governance framework

Regarding the implementation of information governance, most authors involved in this discipline agree that there is no single approach or framework suitable for all organizations[2,3]. Indeed, organizations are diverse in terms of structure, politics and policies, technology, and culture. Among the main information governance frameworks proposed in the literature, we quote those proposed by Wende[8], Weber et al.[2], Khatri and Brown[3], and Otto[13]. This author pointed out that the information governance frameworks proposed by academics and practitioners lead to isolated solutions since they don't take into account all the aspects of this discipline[13]. Meanwhile, Orr[16] presented a set of foundational requirements for data governance. According to this author, data governance must have six essential characteristics. First, it must be legitimate i.e. formally sanctioned and endorsed. Second, it has to span control both over data related to all lines of business, and over data processes including roles and responsibilities. Third, it must have adequate funding. Four, it must be close to executives in order to have administrative visibility. Five, the senior management must be involved in high-level decisions related to data governance. Finally, organizational actors involved in data governance must have skills and organizational position for commanding respect and attention[16]. Certainly, the proposed approaches and frameworks contribute to improving information governance within organizations. However, these solutions are incomplete. On the one hand, they neglect the governance aspects related to information architecture. On the other hand, they don't take into account the architecture principles and rules applicable to the information system that processes information and support its governance. In this section, we present a framework which considers information architecture as a driver of information governance and aims at increasing the business value of information managed by organizations. This framework rests on four pillars and four action levers. The pillars structure the framework by setting the information governance's goals and constraints, and should be periodically reviewed. The four pillars of the proposed information governance framework are: organization's policy and strategy, legal and regulatory compliance, information quality, and information security.

The organization's policy and strategy pillar denotes that the information governance strategy should be aligned on business strategy, sets goals and objectives assigned to the organizations repositories content management, and describes the organization's resources allocation rules and constraints. The legal and regulatory pillar describes the external or internal regulatory and legal constraints imposed on business and whose implementation impacts the information governance process. The information quality pillar defines the objectives and constraints related to the information quality at the organization level. The information security pillar lists the security requirements and constraints to be observed throughout the information governance activities.

The action levers are the means that enable the implementation of information governance within the organization. The four action levers of the proposed information governance framework include organization and business, architecture, methods and tools, and communication and change management.

The organization and business action lever describes responsibilities, roles, procedures and material and human resources provided to implement the information governance activities. The architecture action lever refers to enterprise architecture[23,24,25] and information system's architecture standards, principles and rules[26] used to build organization's repositories and integrate them in the organizational information system. These rules are related on the one hand, to information modeling, processing, usage, and exchange and on the other hand, to organization's repositories construction and maintenance. The methods and tools action lever describes the approaches, methods, and tools that support both information architecture implementation and information governance activities like monitoring, measurement, and conformance enforcement to architecture rules and standards, legal constraints, and information quality and security constraints. The communication and change management action lever describes the organization's transformation processes and actions to overcome resistance to change (communication, training sessions,...). Fig. 1 illustrates the information governance framework described above.

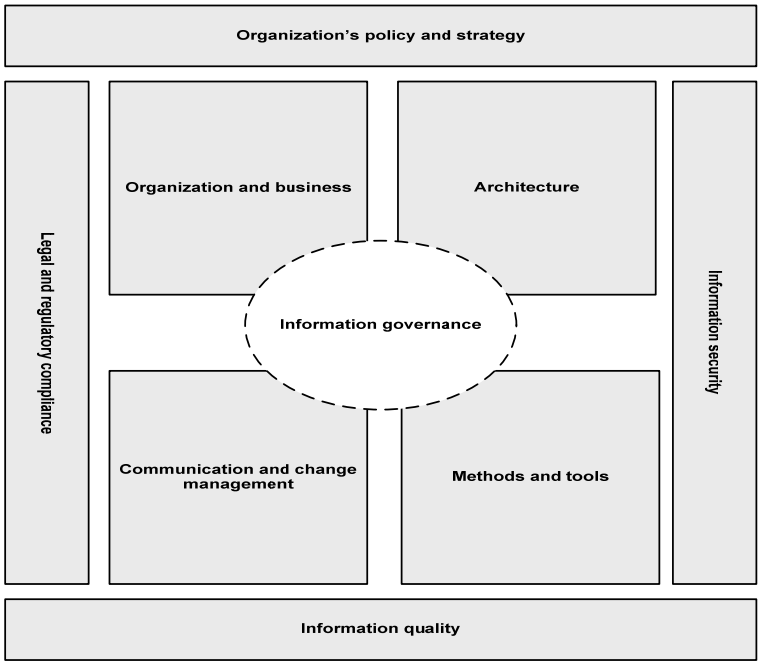

Fig. 1. The information governance framework

A preliminary analysis of the proposed framework shows that the four action levers cover all aspects of information governance. On the one hand, the second lever concerns the conceptual aspects (What?). On the other hand, the third action lever is related to the operational aspects (With what tools? How?). Finally, the first and fourth action levers are dedicated to organizational issues (Who? When? Where? With what resources?). Furthermore, this framework highlights the prerequisites for the information governance to be effective. In particular, the information architecture must be defined at the organization level and a set of methods and tools should be made available to support the governance process. As a result, although information governance is different from IT governance, the effectiveness of information governance depends strongly both on the information system architecture maturity and the IT maturity.

4. The information architecture model

The mission of information architecture is to establish and maintain an adaptable solution designed to facilitate the access, definition, management, security, and integrity of information across the organization. It also encompasses the activities of defining, structuring and documenting the information resource as well as maintaining its quality. This is generally done via a series of applications, models, infrastructure, and guidelines. Given the large number of ramifications of information and the diversity of its stakeholders both inside and outside the organization, the complexity of the information architecture is both structural and systemic[27,28,29,30,31]. The structural complexity of a problem results from its size and can be managed by breaking this problem into sub-problems. While the systemic complexity of a problem is related to the interactions between its components and can be managed using abstraction levels. Systemic analysis of the information architecture results in a multi-layered information architecture model which considers both structural complexity and systemic complexity of information. This model is based on three layers: an access and usage layer, a content layer, and an infrastructure layer. Each layer is characterized by a set of dimensions.

4.1. The access and usage layer

The access and usage layer encompasses all the non-technical functions to access, use, process, deliver and share information. The information access functions enable to retrieve information items as well as to create, read, update and delete information items. The information usage functions include analysis, basic formatting (grouping and breaking, simple grids, simple graphics…), mining, reporting, decisional publishing, restitution, and sharing. Information is accessed, used, and shared by individuals or applications. Furthermore, it is collected, processed, and delivered by applications either to individuals or to other applications. We note that information is generally accessed and used within the organization and in some cases beyond the organization's boundaries. In addition, information can be collected both from internal and external sources. Therefore, the access and usage layer is associated with the following architectural dimensions: information gathering dimension, information processing dimension, information delivery dimension, and information use dimension.

4.2. The content layer

The content layer deals with the design and the administration of information. It describes the information models, the functional content, the information design structures, the meta-data management, and the organization's repository. Information models are representations of information, activities, relationships, and constraints used in a business context. Basically, an information model permits visualizing the informational needs of organization's units. These needs are caught in the business areas and gathered as information literal items in a structured "business requirements" grid called "business model". There are three abstraction levels of information models: conceptual, logical, and physical. A conceptual information model is used to collect and analyze informational requirements without any operational or organizational constraints. It is derived in a logical information model which takes into account the organizational constraints. The logical information model is derived in one or several physical models for implementation purposes. Each physical model is optimized for a given implementation. We note that how information is modeled and designed inside an application can significantly impact the way an application runs and how other applications can access that information. For instance, for decisional purposes, there are specific logical information models. The functional content describes information required in the organization's business context through mapping the generic information components identified in the scope of organization's activities. It is generally structured with a high level of abstraction using a conceptual model. There are several information design structures including the relational schema, the star schema, the snowflake schema, the multidimensional schema, and the object-oriented class diagrams. Meta-data is needed to determine how information assets are organized. It pervades all the areas of information architecture. In particular, meta-data is used to describe data warehouse's content. Meta-data management defines the roadmap that points to the location and meaning of various information elements within the information architecture: legacy sources, data warehouses, datamarts, analysis environment… It is an important instrument of information governance since it allows to answer several questions related to the

information items definitions and valid values, information quality, information sources, information freshness, calculation rules, and responsibles for information items. The organization's repository provides a complete glossary for all information components, fields, owners, access methods, platforms, databases, and users within the organization. It offers a way to understand what information is available, where it is stored, its currency, and other important facts about information items. It can be used to construct an organization semantic dictionary, ensuring that all users adopt the same vocabulary. It follows that the content layer is associated with the following architectural dimensions: modeling dimension, functional content dimension, information design structures dimension, information delivery dimension, meta-data management dimension, and organization's repository dimension.

4.3. The infrastructure layer

The infrastructure layer presents the components of the platform that hosts the systems and components supporting information architecture as well as the infrastructure functions that manipulate information. The basic component of information architecture is information itself. An information item represents a business concept. Information systems use computers to organize information items in such a way that people can understand the results and can share them accordingly. There are several types of information including structured information, unstructured information like text, graphics, and image, and multimedia information composed of both structured and unstructured information. Furthermore, information can be analyzed from several perspectives. First, the "type of sharing" perspective identifies three categories of information: corporate information which is persistent and widely shared across the organization, workgroup information that is shared among a part of the organization using dedicated applications, and personal information which belongs to just one person and is usually stored in a local database. Second, the "type of usage" distinguishes operational information belonging to operational environment and mastered by one and only one application, and decisional information which comprises calculated information stored in the organization's decisional environment (Data warehouses, Datamarts). Finally, information can be split into the three categories according to "level of security" perspective: public information, internal information, and confidential information. Public information is freely available. Internal information is generally available within the organization and for its partners only. Confidential information includes regulated data requiring compliance with statutory or regulatory provisions. It may be highly sensitive and subject to stringent protection.

Information architecture is focused on information items designed and physically structured in a way that a computer can record them and process them to produce result with significance for users. For that purpose, information items are stored in databases. A Database Management System is a database component which manages information storage, structure, access, integrity, and security. Information architecture addresses recommendations in selecting, designing, and implementing adequate databases for information processing. There are several databases types which include operational databases for online transactional processing, decisional databases such as data warehouses and datamarts for online analytical processing, directory repositories dedicated to store especially identification information, and message warehouses for raw messages storage. It follows that the infrastructure layer is associated with the following architectural dimensions: storage dimension, and manipulation dimension. Fig. 2 illustrates the three-layered information architecture model described above.

The architecture facet of information governance, based on the information architecture model and the architecture rules set by the information system architecture, contributes to information governance through exerting governance actions on the eleven architectural dimensions listed above. In other words, the eleven information architectural dimensions may be considered as instruments provided by the architecture action lever to govern information. The use of these instruments is driven by many factors including the architecture principles and rules set by the information system architecture blueprints and guidelines, the organizational context, the organization's priorities and constraints, and the significance of each dimension for the organization.

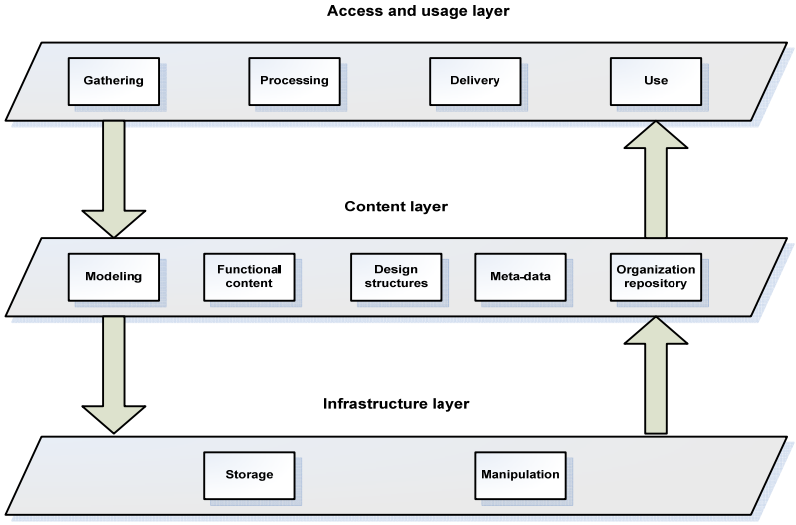

Fig. 2. The information architecture model

5. Urbanized information systems and information governance

As noted by many authors, information systems urbanization facilitates building agile information systems and high quality computer solutions needed by modern organizations to take into account continuous change and overcoming problems induced by external pressures[32,33,34,35]. In this section, we recall the characteristics of urbanized information systems and explain how such systems contribute to information governance.

5.1. Urbanized information systems

Information systems urbanization is based on the "information city framework"[32] which generalizes the use of the "city planning" metaphor by stating that – within a modern organization – an information system may be considered as a city whose inhabitants are the applications belonging to this information system. The "information city" framework results in the "Information City Plan" (ICP) which, together with the "global model of information systems architecture"[36], helps organizations build urbanized information systems.

The ICP allocates the information systems applications in many areas composed of districts which are in turn composed of blocks. On the one hand, two areas include the information systems applications supporting the organization's front-office activities: the "Inbound and Outbound flows Management area", and the "Party Relationship area". The "Inbound and Outbound flows Management area" is dedicated to the management of the informational flows exchanged by an organization and its external environment. This area describes the various technology channels used by an organization while exchanging information with external environment. The "Party Relationship area" supports the relationships linking an organization with its customers and partners whatever the communication channel. On the other hand, the information system applications supporting the organization's back-office are allocated to at least three areas: the "Business Intelligence" area, the "Support area", and at least one "Business area". Applications belonging to the "Business intelligence area" support the organization's decision-making processes. Applications belonging to the "Support area" help the organizational actors carry out the activities of the organization's support processes. Business processes are supported by applications which belong to the "Business areas". Finally, two areas are dedicated to applications that link the organization's front-office and back-office (the "Integration area") and applications that manage informational artifacts they share ("Shared information area"). The first area allows exchanges of informational flows and services between the back-office and the front-office applications. The second area contains information shared by all the applications of the organization's information system as well as the applications which manage shared information.

Furthermore, the "Global Model of Information System Architecture" is a multi-view model that results from a systemic analysis of the information system architecture where each view is represented by a layer dedicated to an enterprise architecture main concern[31,36]. This model relies on six interacting layers: the strategy layer, the business architecture layer, the functional architecture layer, the applicative architecture layer, the software architecture layer, and the infrastructure layer. The strategy layer defines the organizational problems to be solved and their organizational solutions. Such problems result from the organization's external and internal constraints. External constraints may be economic, political, social, legal, or related to the evolution of the technology. Internal constraints reflect the impacts of external constraints on the organization's components: structure, people, production technology, tasks, and information technology[29,37,38].

5.2. Contribution of urbanized information systems to information governance

Comparing an information system to a city emphasizes the problem of information system governance. Indeed, following the example of a city, the relationships between the applications which populate the information city must be managed. This means that the behaviors and responsibilities of applications as well as their information exchanges with individuals, other applications of the information system, or external information systems are governed by a set of architecture principles and rules related to the ICP, and the "Global Model of Information System Architecture". These rules apply both to the information managed by information systems applications and the infrastructure that support the information architecture. In the following, we describe how the urbanized information systems architecture principles and rules contribute to information governance.

First, the urbanized information systems architecture principles and rules contribute to the governance of the architectural dimensions of the access to information. Indeed, an application belonging to the information city behaves as a master of its own information and as a slave regarding informational artifacts belonging to other applications of the information system. In other words, an application can use, update or suppress information and artifacts it owns but can only use a copy of informational artifacts managed by other applications. Therefore, each application is the owner of the information it masters. As a result, the organizational actor or organizational unit responsible for an application is also responsible for the information it masters and the owner of this information. The architecture rules related to the "Global Model of Information System Architecture" confirm this finding. For example, at the level of the functional architecture layer, each information item is owned by one and only one elementary function. Since each application implements a set of elementary functions, this rule allows delineating the set of information items owned by each application.

Second, the urbanized information systems architecture principles and rules contribute to the governance of the architectural dimensions of information usage including information security. This is the case, for example, of the following architecture rules related to the ICP which stipulate that:

- Two applications belonging to two different ICP areas must use the integration area to exchange information,
- External information systems and individuals outside the organization can only use information made available by the applications belonging to the "Inbound and Outbound flows Management area",
- The short term operational reporting is realized and delivered by applications belonging to the ICP areas other than the "Business intelligence area",
- The medium term and the long term reporting is realized and delivered by applications belonging to the "Business intelligence area",
- The applications belonging to the "Business intelligence area" use information owned by the applications belonging to the other ICP areas but they don't provide any information to these applications.

Finally, the architecture principles and rules applicable to urbanized systems contribute to the information content governance. For example, since each information item must belong to the same ICP area than the application that owns it, the organization's information assets are divided into many information domains including business administration information, product administration information, business intelligence information, shared information, party management information, and inbound and outbound flows management information. This categorization of information assets helps the organization govern them. Indeed, each domain is associated with

specific management, quality, and security requirements. This is the case, in particular, of the shared information domain which encompasses organization's directories like products directory, employees' directory, partners' directory, and customers' directory. Given that information items contained in the directories are shared by all the information system application and may be confidential, they are generally subject to strict quality and security criteria.

6. Conclusion and future research directions

In this paper, we have presented a framework which takes into account the contribution of architecture to the governance of information. This framework - based on four pillars and four action levers - considers that information architecture is an important action lever for information governance. Moreover, it demonstrates that, although information governance and IT governance are different, information governance needs IT to be effective. To analyze the contribution of architecture to information governance, we have proceeded in three stages. Firstly, we have proposed a three-layered model of information architecture. Secondly, we have identified the dimensions of information architecture which provide instruments to deal with the architecture facet of information governance. Finally, we have analyzed the contribution of architecture to information governance in the case urbanized information systems.

We have validated this work in a French insurance company whose information system is partially urbanized. The main applications belonging to this information system fall into three categories: proprietary monolithic systems running in a mainframe environment, web applications running in an open environment, and ERP systems that can operate in one or the other of these environments. The application of our framework resulted in the following findings. First, we observed that the ICP is well known by the Information System Department employees. Furthermore, the information domains are well identified. Second, we have pointed out many architectural weaknesses which undermine the information governance efforts in this company. On the one hand, there is no enterprise repository shared by all the organizational actors and all the information system's applications. Moreover, information managed by the monolithic systems is often not modeled at the conceptual and logical levels. In addition, many non-standard modeling tools and languages are used, and the conceptual and logical models issued from these tools are not portable. On the other hand, there are many directories which contain redundant information. For example, since the merger of this company with another insurance company, there are two customers' repositories and two products' repositories which contain concepts that are not defined in the same way. Finally, information exchanges between applications are not standardized because of the multiplicity of proprietary data formats and the lack of a pivot language understandable by all applications. It follows that the incompleteness of information systems urbanization may negatively impact information governance. This validation confirmed that the framework presented in this paper has two important contributions. First, it demonstrates that information governance is ineffective if it doesn't take into account the architecture aspects. Second, it emphasizes that applying the architecture principles and rules related to information systems urbanization contributes to the effectiveness of information governance. However, this work should be completed by a deep analysis of the information architecture dimensions in order to define a set of metrics and an information governance maturity model. Indeed, as stressed by Soares39, metrics are useful to show and prove the value of an optimized governance and management of information assets. This is a first future research direction. Another research direction consists in continuing the validation of this work in other contexts more conducive to experimentation.

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