

The architecture of information in organisations

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Over the last two decades competition amongst organisations including financial institutions has increased tremendously. The value of information is critical to competition in different organisations. In addition, the management of cost of delivery and cohesiveness of information flow and use in the organisations continue a challenge to information technology (IT). In an attempt to address these challenges, many organisations sought various solutions, including enterprise information architecture (EIA). The EIA is intended to address the needs of the organisation for competitive advantage.

This research article focused on the role of principles in the development and implementation of EIA. The article aimed to investigate how EIA could be best leveraged, exploited, or otherwise used to provide business value. The research brings about a fresh perspective and new methodological principles required in architecting the enterprise information.

Introduction

Enterprise information architecture (EIA) is one of the domains of enterprise architecture (EA). Other domains of EA include business, technical, infrastructure, application and service oriented architecture (The Open Group Architecture Forum [TOGAF]; Spewak 1992; Cook 1996; Zachman 1987). The different domains of EA are inter-related and depend on each other. This article focuses on the EIA, specifically, how principles are applied in the design, development and implementation of the domain. The EIA enables the management of change in information exchange, service and its strategic use in the organisation. According to Watson (2000), information architecture describes the structure of a system; categorises artefacts of the organisational systems; defines flow, value chain, usage and management. The EIA provides the framework (Burke 2007) for planning and implementing rich, standards-based, digital information infrastructure with well-integrated services and activities. The EIA is intended to provide categorisation, classification and definition of information required to perform the organisation's processes and activities, periodically. This argument is supported by other works including Yan and Bitmead (2003) and Oki *et al.* (1993). The EIA is also intended to manage and share information, and to ensure that the business is supported by applications and data as required by the organisation (Rafidah *et al.* 2007). The categorisation, classification and common definition of business information needs, and their associated functions, facilitates the system role definition and the modelling of optimal information flows. Furthermore, common terminology enables the consistent use of semantics of meaning across information systems and the entire organisation. This could be facilitated through the concept of reuse and mediation of local variations to a common ground. This ultimately helps the organisation to meet business objectives and goals by providing employees, stakeholders, partners and customers with improved access to quality information. This is carried out through the design, development and implementation stages as defined by the principles of the EIA.

Iyamu (2009) defined principles as 'guiding statements of position which communicate the fundamental elements, truths, rules, or qualities that must be exhibited by the organisation'. For the purposes of this article, this definition is adopted in the context of the EIA. The primary aim of the principles is to enforce and enable the organisation to take an incremental and iterative approach in transitioning to formal modelling. Dong and Agogino (2001) argued that principles influence immediate and consistent decision making in the organisation. The processes of design, development and implementation of the EIA is a challenge (Armour, Faisler & Bitner 2007), hence the formulation of principles.

The formulation of the EAI principles is guided by structured format. The format describes the attributes (such as name and rationale) of each principle. This is to ensure validity, completeness, comparability, relevance and consistency to the principle. Many formats and templates for formulating principles exist. According to Burke (2007), a principle constitutes name, statement, rationale and implication.

An obligatory passage point (OPP) could be adopted in the development and implementation of the EIA. OPP could help enforce the evaluation criteria discretely and comprehensively. OPP acts as a compulsory set of rules and regulations within a legal entity. Iyamu and Dewald (2010) refer to an OPP as a situation that forces actors (employees) to satisfy the interests that have been attributed to them by the focal actor (employer). The focal actor defines the OPP through which other actors must pass and by which the focal actor becomes indispensable. The principles of the EIA, could as such, be defined as the OPP through the implementation of individual performance contracts in which agreed upon tasks are carried out.

The research adopted the qualitative case study and interpretive approaches. A semi-structured interview method was applied in the collection of data. The data analysis and findings are presented in sections 3 and 4 respectively.

Research approach

A qualitative approach has been adopted in many studies such as Orlikowski and Baroudi (1991) in information systems primarily because of its suitability from a social perspective. Qualitative research was more suitable for this type of study as it allowed for the clarification from respondents to the research questions. Clarifications could instantly be sought to enrich the data. The qualitative research approach has been argued to be a very useful method in conducting complex research (Myers 1997). The approach is employed to help close interaction with interviewees and develop deeper understanding of the EIA situation in the organisation.

The author applied the case study method because it allows an in-depth exploration of the complex issues involved in this research (Yin 2003). Data sources included semi-structured interviews and documentation from the organisation where the research was conducted. The number of interviewees was based on saturation, implying a point where no new information was forthcoming during the interview process. The interviews were labelled CS01–CS09, to avoid disclosing the identities of the interviewees. The respondents were selected from various levels of the organisational structure within the Business and IT departments of the organisation. This was a key factor in achieving a true reflection of the design, development and implementation of EIA in the organisation.

The organisation researched in this study is a government institution. The organisation was reconstituted in 1994 immediately after the political shift in South Africa. At the time of the study the organisation had about 8000 employees of which 600 were contract workers at both senior and junior levels. The organisation was selected on the basis that it provided a good example of critical information in its processes and activities. The organisation also provided some evidence of information architecture design, development and implementation. The interviewees were selected from different units in both the business and IT departments. The

selection of interviewees was based on their years of service in the organisation and knowledge of the EIA. This was to ensure that the interviewee had enough understanding of the environment and the use of information. A total of 17 employees were interviewed. The interviewees included directors (2), IT architects (4), business analysts (2), project managers (2), IT managers (3), business managers (2) and a database administrator.

The author formulated interview questions, which were intended to understand how the EIA was currently designed, developed and implemented and its impact on the organisation. The questions included:

- What are the factors influencing the development and implementation of the information architecture in the organisation?
- How is information architecture designed, developed and implemented in the organisation?
- What are some of the contributions of the information architecture in the organisation?
- What are some of the challenges of the information architecture in the organisation?

This article focuses on the principles that enforce the requirements, design, development and implementation of the EIA in the organisation. In such a context, an interpretive research approach (Walsham 2006) was appropriate in order to understand the adaptation and influences from the perspective of a sociotechnical context within the organisation.

Data analysis

For interpretation purposes the unit-based approach was used for the data analysis. This is primarily because it allows for analysis of a unit-by-unit basis in the study. The data collected from the case study was analysed at two levels, namely, macro and micro interconnected levels. The macro level (executive level) addresses the importance of information architecture to the organisations as well as the relationship between technical and nontechnical actors in the design, development and implementation of information architecture in the organisation. At the micro level (middle management and lower level), the impact of principles on the design, development and implementation of information architecture in the organisations was analysed. The remainder of this section presents and discusses the analysis of the data.

Information architecture provided a standard based design, development and implementation methodology that assisted IT to respond to the rapid changes in the processes of the organisation's business in the shortest time possible. Through principles, the EIA was used to achieve the translation of functional requirements to the selection of services, standards, components, configurations, phasing and the acquisition of products. In the organisation, an EIA approach was well received and appreciated more than other disciplines such as project management and systems analysis. Project management and systems analysis based

approaches have been widely adopted over the last three decades in trying to solve the same problems, yet many of the challenges remain. Hence, there is a need to explore other approaches such as the EIA.

The EIA was used to provide an initial classification and definition of the information required to perform the goals and functions of the organisation. A framework was employed to manage and share information, and to ensure that the business was supported by applications that provided the needed data. Classification and common definition of business information needs and their associated functions were guided by the EIA principles. It facilitated system role definition and the modelling of the optimal information flow. In addition, the EIA was adopted to provide common terminology, which was intended to enable consistent semantic meaning across information systems and organisations by facilitating concept reuse and mediation of local variations to a common ground. This ultimately, was to help the organisation to meet its objectives and provide stakeholders with improved access to quality information. The majority of the interviewees agreed that this was the case and it was emphasised by one of the employees of the organisation:

'I would consider it to be a success due to the recognition it receives from across the organisation as bringing about important input in the information sharing, security and technology acquisition process of the organisation. However this success can be better measured by use of a capability maturity model.'

(Interviewee; CS04)

The organisation adopted a model as recommended by TOGAF for the creation of principles. The model illustrated in Box 1 was used in creating principles, which extend beyond organisational boundaries to external sources and targets including other government institutions. This was understood to enable rapid business decision-making and information sharing within the organisation, with suppliers, partners and customers.

The principles were intended to provide guidelines and rationales for constant examination and evaluation of information in the areas such as design, accessibility, security, use and maintenance. Some employees affirmed that the principles as applied guided the development and implementation of the information architecture in the organisation. Generally, the principles were derived from the vision of the organisation and an intensive discussion (in the form of a workshop) with senior IT and business

BOX 1: Format for creating principles.

Name: A name that majority can relate to, and reflects the intention and essence of the objective of the organisation. It is recommended to avoid ambiguous wording.

Statement: This is to communicate the fundamental rule as set by the organisation. The statement must be clear and unambiguous.

Rationale: Primarily to highlight the potential benefits for the organisation in adhering to the principle.

Implications: Highlight the potential implications on the business and information technology for executing the principles. This includes impact and consequences of adopting the principle.

management. They were later validated within the structures of the organisations. The principles were viewed as a starting point for subsequent decisions that affected the EIA in the organisation.

In the organisation, the EIA encouraged decision makers to explore externalisation, optimise information value chains, plan application portfolios, increase the velocity of information across the organisation and further evolved the enterprise architecture.

The EIA was treated as a business-strategy-driven set of artefacts that describes and model the information value network (e.g. information flows, business events and linkages) of the organisation. The EIA was sponsored and endorsed by senior management in IT and business departments. It extended beyond the organisational boundaries to external sources. In addition, it was targeted to enable rapid business decision-making and information sharing. The EIA included rationale and implications such as:

- a catalogue of authentic sources of information (e.g. public and private company databases, information regarding foreign offices and news media)
- classes of relevant business information and their value to the government and the organisation in particular
- information governance processes that supported policy development and information management principles and practices, which were intended to address security access, privacy, confidentiality, information quality, integrity, authenticity, archival cycles, business continuity planning, and ownership of information and processes
- information management deliverables that address roles, responsibilities and organisational structure for managing information content and delivery (e.g. information management and ownership).

The design, development and implementation of EIA aimed to establish the value and importance of using information effectively across the various units of the organisation, as well as the need to achieve collaborative excellence with external partners and customers (citizenry). The EIA approach was employed to gain consensus between the senior and middle management levels in the organisation, within the rationale and implications of the associated principles. Some of the elements considered include:

- strategic versus nonstrategic information, especially in terms of security
- the use and definition of common terms (e.g. service, consumption, citizens, etc.)
- who had the information and in what form and capacity
- who owns and manages information and how it should be leveraged
- who will be responsible for the cost of developing IT systems that will create and deliver information to the users and clients in the organisation and outside the organisation
- what metrics will be used to measure information sharing success (e.g. security, intelligence, revenue increase, cost decrease and reduced service delivery times).

An employee who thought otherwise stated as follows:

'The effective management and exploitation of information through IT is one key to business success, and the indispensable means to achieving the goals and objectives of the organisation is supposed to address this need by providing a strategic context for the evolution of the IT system in response to the constantly changing needs of the environment.'

(Interviewee; CS03)

The EIA was required to encourage decision makers both in the business and within IT to explore externalisation, optimisation of information value chains. This includes planning of application portfolios and incremental use of the velocity of information across the organisation in an iteration process. As a result, the development of the EIA conveys a logical sequence, which was based on relationships and dependencies of the elements within the scope, rather than a linear sequence of events. The rationale for the logical sequence in developing the EIA was as follows:

- as the model was essentially business-driven, the enterprise business architecture (EBA) had to first model the impact of business visioning on the operations of the business
- because the EIA focuses on how information could best be leveraged, exploited, or otherwise be used to provide business value, it was dependent on a certain amount of EBA modelling to determine how and where the business could derive its value
- the approach to enterprise technical architecture (ETA) depended on the business strategies and business information requirements, so this dependency placed it logically after EBA and EIA.

The focus of the study was on the EIA. However, without some analysis on other related domains, there would have been some disconnect in terms of the analysis as well as the findings leading to the results of the study.

In the organisation a four-domain approach as illustrated in Figure 1 was adopted. The arrows in Figure 1 illustrate the function of EBA that led to the development and implementation of EIA. In terms of the ETA and the other architecture disciplines, EBA, EIA, and EAA were also interdependent as they each evolved and new opportunities and requirements were identified.

In the organisation, the EIA was designed to depend on the EBA. As such, it was difficult to embark on the development of the EIA without first establishing the EBA. The EBA defines the real time information that passes between the key processes and the integration requirements. This was enabled by the underlying application and technical architectures across the units of the organisation.

The EBA was used to express the organisation's key business strategies and tactics, and their impact and interaction with business functions, processes and activities. Typically, it consisted of the current-state and future-state models of the functions, processes and information value chains of the organisation. The EBA led to the development of the EIA,

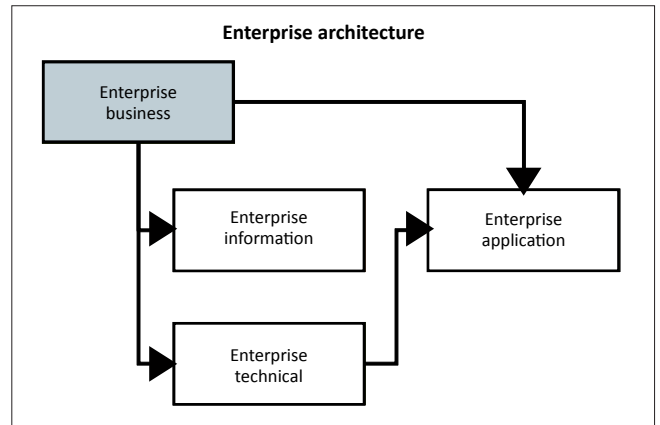


FIGURE 1: Relationship of enterprise application domains.

ETA and the enterprise application architecture (EAA). It defined the business design for sustainability and objectivity; those were the principles for its design. Hence, the EBA was intended to establish the foundations and details in the development of the EIA.

The development of the EIA began with the establishment of an overall information ecology in the organisation. Primarily it was intended to address the value proposition of the information and the processes and activities of the organisation.

Application portfolio decision-making was guided by the principles of both EBA and the EIA. This was used to identify the needed functionality and opportunities for reuse, also used to conceptualise the ETA architecture principles. The principles influenced the selection, design and implementation of software packages, application components and business objects.

Information architecture was intended to address the policy, governance and information products necessary for information sharing across the organisation, external partners and clients. This includes information management deliverables that address information management roles and responsibilities, information quality and integrity, data definition standards, data stewardship and ownership, and information security access. These objectives were within the scope of formulated principles. The principles were based on the vision of the organisation including the strategies of each of the units in the organisation.

Not all types of principles were necessarily identified in earlier paths through to the model. The basis for many principles was best practice-approaches that have consistently been demonstrated by diverse organisations to achieve similar results. Therefore, the degree to which the organisation could establish principles in the EIA was dependent on its process and capability to identify and apply best practice in each area.

The results from the analysis are articulated and presented in the next section.

Results

The focus is on how the EIA was designed, developed and implemented through a set of principles. The principles of the EIA provided guidance to the designers, developers and implementers of the EIA. The principles for each of the components of information architecture were derived from the organisation's vision and requirements. For each principle there was rationale that was documented along with other elements such as the statements of intent, repercussion for the intent and allocation of accountability.

Design principles

The EIA provided fundamental principles that assisted the organisation in achieving successful information. The factors included external partners and clients; a shared vision, change, evolutionary planning, classification and declassification, citizen empowerment, collaboration, problem coping, analysis, and restructuring organisational norms. These factors supported the implementation of processes and functions. Principles, which included interactive and interwoven, were formulated in order to achieve the objectives of the organisation. It began with the design principles.

The design principles guided the boundaries and limitations including the rationale and implication of the EIA in the organisation. It was based on both the short and long-term strategic intentions of the organisation. Table 1 depicts the guiding phenomena within which the design principles were formulated. The organisation customised the TOGAF format by adding the 'Ownership' column.

Some of the principles that were formulated and enforced as obligatory passage point (OPP) are as follows:

- information must be valued as an asset, leveraged across the information value chain to enhance competitive advantage and accelerate decision making in the organisation
- information must be shared to maximise the effectiveness of decision making throughout the organisation and to external partners, for citizens and other government departments
- the information value chain must continuously be identified and exploited within the organisation and the country in general
- the security of the categories of information must take priority above all requirements within the organisation and shared service with other organisations
- accessibility of information must be reviewed as frequently as possible
- data and information management must be unified across the organisation

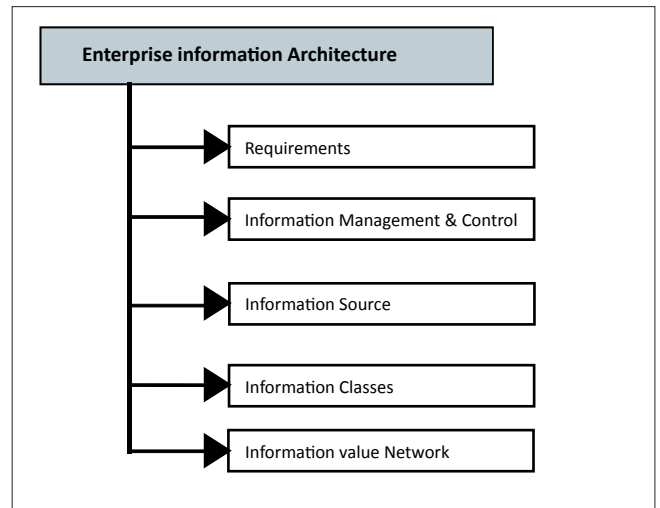


FIGURE 2: Enterprise information architecture design components.

- the organisation's data must be managed throughout its lifecycle by the appointment of data stewards and the definition and implementation of data management roles
- the interfaces across separate logical boundaries must be message-based and extend across the value-chain to employees, partners and customers
- the organisation's data must have accessible metadata which describes the definition, security classification, function class, ownership and stewardship
- leverage the business intelligence environment to accelerate decision-making and reduce development complexity.

Until the design is developed and implemented, it remains theoretical as to which adds no actual value to the organisation. This makes the next section, development principles, very critical.

Development principles

The aims and objectives of the EIA in the organisation included the reduction of integration complexity, control of duplication and replication, validation and correction at source, standards for information accessing and data isolation.

Based on these aims and objectives, the EIA was designed to address them in five categories as depicted in Figure 2.

As revealed in this study, each of these categories is explained in the following section (illustrated in Figure 2).

Requirements for information architecture

The principles to develop and implement an EIA were derived from the requirements and vision of the organisation.

TABLE 1: Design principles.

Design principles	Statement	Rationale	Implication	Ownership
Description	Indicate its identity, which it could be associated with.	Justification, expression of the value to the organisation.	For each principle, there must be an adopted standard, sometimes derived from best practices.	Each principle is allocation to individual or unit for execution and monitoring purposes.

The principles were formulated to legalise the scope and boundaries of each of the technical and nontechnical artefacts. In addition, the intended deliverables were also formulated to address roles, responsibilities and organisational structure for managing information content, including storage dissemination and delivery.

Information management and controls

The management and control of information required principles to ensure boundary and consistency across the organisation. The 'Management and Control' are statements of governance, monitoring, effectiveness and efficiency of information use, storage and ownership in the organisation. The principles were intended to address security access, privacy, confidentiality, quality, integrity, authenticity, archival cycles, business resumption planning, and ownership of information in the organisation.

Information sources

Within set principles, a catalogue of authentic information sources, such as the organisations' own databases, commercial databases, news media and government gazettes were used to establish the origins of authentic information on, about and for the organisation. It also formed the basis of input for the next step (information classes – as discussed later in the article), which obtained classes of relevant information and established their value to the organisation.

Information classes

There was a need for the classification of information in the organisation, primarily because it was the organisation's core business. The intention was to improve on information accessibility and manageability. This helped the stakeholders, including architects to understand the value of each category. Based on the requirements, information was classified according to the following criteria:

- functions (operational, managerial and strategic)
- business operations concerned with the operational (transactional) processing within the administration
- business management concerned with measurement (keeping score) and management of the administration
- business strategic in terms of planning for the future and identifying competitive opportunities.

Information value network

The information value network was one of the focal components of the principles of EIA in the organisation. An objective of the EIA was to define the sources of high-velocity information and ensure its availability and usage by the key business processes, enabled by the underlying EAA and ETA. High-velocity information was shared within the information value network of customers, suppliers, and partners in near real time, at both the transactional and decision support levels. This was to maximise operational effectiveness, efficiency, service delivery and high performance and competitive advantage.

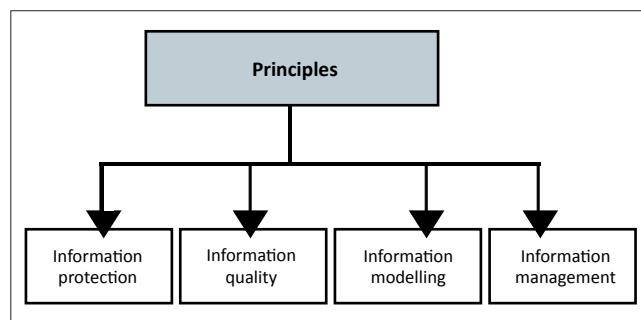


FIGURE 3: Enterprise information architecture implementation principles.

The value of information could be determined by different means, typically, the competitive advantage gained by the use of the information product. There were essentially three dimensions of information value, namely, (1) velocity, (2) density and (3) reach. Moving along one or more of these dimensions could have increased the value of information in the organisation.

Methods and tools such as 'information value network analysis' were used to diagnose problems or uncover opportunities to leverage information technology to create high value, low cost linkages with external parties and across the lines of business (LOB). The information value network describes the linkages in the network and the value of information across the business value chain. Seeing as information was an artefact of business processes, it surrounded and supported the physical value chain.

Principles were formulated to address the components of the EIA. Table 1 is an example of a template, which was used to record the design principles. This template could be populated and used to support strategic analysis over time.

The implementation of the entire design is summarised in four areas and enforced through a set of principles.

Implementation principles

The final phase of the EIA as a project was a gap analysis. This was conducted across all the categorised areas to determine corrective action, develop prioritised migration plans and finally draw up an implementation plan. The implementation enables the organisation to change current state to future state, as was defined during the project.

The primary and key components were implemented with the principles of the EIA and illustrated in Figure 3.

Information protection

Information shared across the organisation was regarded as corporate information and therefore demarcated to be managed accordingly. As revealed in the study, information accessibility and protection were a high priority in the organisation. Principles were therefore formulated to address ownership, security and accessibility classification, privacy, archival and recovery. This was intended to ensure the continuity of processes and activities in the organisation.

Information quality

The quality of information was based on business requirements. The quality of information was also principled to be governed in accordance to the requirements and vision of the organisation. The principles concentrated on the metadata, integrity, authenticity, classification and criticality of the organisation's information.

Information modelling

The principle stated '... an information model represents information in an understandable simplified format'. Information was to be modelled according to the principles of the EIA and the application development guidelines of the organisation.

Information management

The information management principles defined the roles, responsibilities and organisational structure required to implement the architecture of information in the organisation. It also defined, *inter alia*, the role that users play as custodians of information, the role of the IT department, and the roles of the Information Architect in ensuring that this principle was understood, adhered to, and effectively applied. There was an emphasis on the information architects as the domain owner.

Migration planning principles

The architects and other stakeholders in the organisation acknowledged positioning strategy and movement from one architectural phase to another as a very complex issue. It was much more complex than simply bringing in a new vendor or independent consultant to provide theoretical underpinning and advisory guidance.

One of the key decision processes involved with architectural planning was the need to have a future target. Shorter-term goals could then be defined as stepping-stones to the strategic goal. The problem here, again, was that historically, information technologists have not been very accurate in predicting product directions and timing. The migration principles were formulated based on the context of the organisation. During the implementation, gaps were identified and analysed for possible opportunities and solutions.

Measurement and validation

The principles of measurement and validation were an integral component of the overall EIA in the organisation. They were a set of obligations for the management,

BOX 2: Architecture conformance checklist of principles.

1. Organisation planning: The component ensures the alignment of requirements and vision with the information architecture. It specifies the core information areas, dependencies, implication, rationale and ownership.
2. Business analysis: It ensures that the business analysis addresses the business model including the impacts, duplications and change management. It ensures that the business information conform guidance such as protection, ownership, accessibility and classification as defined in the Information Management Principles.
3. Systems analysis: The systems analysis component covers the systems model. It ensures conformance to modelling guidelines, quality in terms metadata, integrity, authenticity and classification as defined by the respective principles.
4. Systems design: This ensures the adherence information architecture principles and information policies, standards, management roles and responsibilities.

administration, practices of information storage and usage in the organisation. The measures included a conformance checklist, the iterative process and domain architect who oversee the processes and activities within the scope of the EIA.

There were four main components, namely (1) Enterprise Planning, (2) Business Analysis, (3) Systems Analysis and (4) Systems Design, which constituted the Information architecture conformance checklist in the organisations. These components were a defined set of principles, within the organisational meaning and value, as described in Box 2.

Gap analysis

The gap analysis assessed the current state of the information architecture against the desired state as reflected by the drivers (business requirements). This assessment was an iterative and ongoing process and was reflected by a conformance checklist and an accompanying action plan as depicted in Box 2. These assessments were to be stored and managed within the agreed principles. Table 2 provides an example of the gap analysis.

There were a large number of constraints that had to be overcome to achieve full implementation of the EIA. As revealed in the study, some of these constraints include:

- the inherited technological environment that existed at the initiation of the process
- new technologies constantly emerging that must be accommodated
- immediate concerns such as providing information technology support for a new headquarters building
- the fact that any information systems architecture is always in transition and is ever changing and evolving.

Findings

From the results and analysis of the data, five factors were found to be key in the approach to deploying EIA through principles. The factors are presented as follows.

TABLE 2: Gap analysis.

Gap analysis.	Requirement (future state)	Action plan	Deliverables	Roles and responsibility
Description	Eradicate uncontrolled data duplication and redundancy	Project to be initiated	Project scope and migration plan	Project manager information architect

The criticality of principles

Within the domains of EA, fundamental principles were provided to assist in achieving change. This includes developing a shared vision, evolutionary planning, and provision for innovations, empowerment and regular training of employees, analysis, and restructuring organisational norms to support implementation and ongoing learning and processes of EA. These principles must be interactive and are interwoven throughout the process of Enterprise Architecture. According to one of the senior managers:

'The principle that we formulate help us to be consistent [sic], in fact it leads to the development and deployment of consistent, multiple software- and technology-based changes in the business, and amalgamation of both the IT and the business.'

(Interviewee; CS01)

Iterative process

Within the scope of the EIA, principles were articulated to address the information aims and objectives of the organisation in an iterative process. Some of the primary objectives included encouraging decision makers to:

- explore external trading and partnerships
- optimisation of information value chains
- plan application architectures and systems portfolio
- increase information velocity across the organisation.

Through the iterative approach, EIA was intended to identify the information flows for optimisation (increased velocity, density and reach) as well as the information entities. This was to define and consistently use information across the value chain. The intention was to increase the value of information across the organisation and the external transactions.

Thus, the EIA defined the sources of information and ensured the availability and usage of this information by the key business processes, and enabled the underlying application and technical architectures. Similar to the EBA domain, it was expected to provide guidance for business operations impacted by particular business strategies. The EIA was also expected to provide guidance concerning the organisation information assets to knowledge workers, information processors, IT application developers, infrastructure managers, and executives.

Information architect

Within the boundaries of set principles, the information architect's focus was on the construction of information models to meet business requirements and engineering 'out' gaps where business-critical, high-velocity information was not reaching customers, suppliers, and partners. The EIA models provided guidance concerning the organisation's information assets to knowledge workers, information processors, IT application developers, infrastructure managers, and the executives. However, there was a serious concern in terms of the availability of skilled information architects. The head of the architecture team explained:

'One of the primary objectives is to reduce cost. It could be used to achieve significant organisational advantage over competitors in a competitive marketplace. If we have qualified architects, we are expected to put in place process effectiveness and efficiencies arising from the eliminations of non-value adding and redundant tasks, streamlined information flow, systems placement, and business restructuring.'

(Interviewee; CS06)

Ownership

Data, storage, process, infrastructure and collaboration, were the principles of information architecture, which were allocated to individuals and units in the IT department. Through the irreversible nature of the OPP, the formulated principles were enforced. Primarily, it gave power to those people whom the design, development and implementation tasks were allocated. The OPP made each principle in all units irreversible by individuals or groups, irrespective of their positions in the organisation.

Stock of knowledge

The stock of knowledge was not necessarily as valuable as it was difficult to translate its value to usefulness in some cases and units in the organisation.

The role of the EIA was often misunderstood. It was difficult to differentiate between business analyst and information architects. As a result, the allocation of task, roles and responsibilities became a challenge to manage.

Conclusion

Enterprise information architecture (EIA) offers tangible benefits to the enterprise and those responsible for evolving the enterprise through its principles. The primary purpose of the principles is to *inform, guide, and constrain* decisions for the enterprise, especially those related to information flow. The true challenge of enterprise engineering is to maintain the information as a primary authoritative resource for enterprise IT planning. This goal is met via enforced EIA principles, which add value and utility of the information to the Enterprise Architecture.

The benefits as emphasised are of paramount importance to business and IT managers in organisations as well as in the academic domain. The study contributes to the body of knowledge through its empirical evidence. In addition, the findings open opportunity to researchers for further research areas, such as social construction of information, semiotics integration of information architecture into business strategy and the ontology of information architecture.

Applying EIA objectives through its principles within the context of a specific business enterprise enables an organisation to create a joint business and IT planning and execution processes. The integration of business and IT planning could result in faster time to market, increase customer intimacy, and improve operational efficiency through the set principles.

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