

THE ROLE OF PRINCIPLES IN THE DEPLOYMENT OF ENTERPRISE INFORMATION ARCHITECTURE

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Abstract: Many organizations strive to develop strategy which could holistically unify impact of information across the organization. Information is increasingly critical in the operations of organizations' processes and activities including its role in maintaining competitiveness. Management of, cost of delivery and cohesiveness of information flow in the organizations is continually prevalence in Information Technology (IT) challenges. Most IT managers find themselves with the challenge of integration, consolidation, categorization, classification and management of information usage and sharing. Due to these widely shared solutions, over the last decade and across the globe, organizations have attempted to seek various solutions, which include Enterprise Information Architecture (EIA). This paper examines how EIA can best be leveraged, exploited, or otherwise used to provide business value, through sets of principles. The research brings about a fresh perspective and new methodological principles required in the deployment of information architecture in an organization.

1 INTRODUCTION

Enterprise Information architecture (EIA) is one of the domains of Enterprise Architecture (EA). Other domains include Business, Technical, Infrastructure, Application and Service Oriented architecture (Armour et al, 2007). The domains are interrelated and depend on each others, to an exponential degree. This paper focuses on the domain of EIA, how principles are used in the architecture. The EIA enables the management of change on information exchange, service and its strategic use in the organization. According to Watson (2000), Information architecture describes the structure of a system; categorises artefacts of the organizational systems; defines flow, value chain, usage and management. EIA provides the framework for planning and implementing rich, standards-based, digital information infrastructure with well-integrated services and activities (Burke, 2007). EIA is intended to provide categorization, classification and definition of information required to perform the

organization's processes and activities, periodically. This argument is supported by other studies, such as Yan and Bitmead (2000). 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 organization (Rafidah et al 2007). The categorization, classification and common definition of business information needs and their associated functions, facilitates system role definition and the modeling of optimal information flows. In addition, common terminology enables consistent semantic of meaning across information systems and the entire organization. This ultimately helps an organization to meet business objectives by providing employees, stakeholders, partners and customers improved access to quality information. These are carried out through the design, development and implementation stages as defined by the principles of EIA.

According to Iyamu (2009), "*principles are defined as guiding statements of position which communicate the fundamental elements, truths, rules, or qualities that must be exhibited by the*

organization” For the focus of this paper, this definition is adopted. The primary aim of the principles is to enforce, enable the organization to take an incremental and iterative approach to transitioning to formal modeling. Dong and Agogino (2001) opined that the principles influence immediate and consistent decision in the organization. The processes of design, development and implementation of EIA is a challenge, hence the formulation of principles. Formulation of principles is guided by format. This is to ensure validity, completeness, comparability, relevance and consistency. Many formats and templates for formulating principles do exist (Zachman, 1996)

In order to holistically and objectively develop and implement EIA, principles could be applied as Obligatory Passage Point (OPP) and evaluation criteria discretely and comprehensively. OPP act as compulsory set of rules and regulations within a legal entity. Callon (1986) refers to an OPP as a situation that has to occur in order for all the actors to satisfy the interests that have been attributed to them by the focal actor. The principles of 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. Semi-structured interview method was applied in the collection of data. The data analysis and findings are presented in sections 3 and 4, respectively.

2 RESEARCH APPROACH

Qualitative approach has been adopted in many researches in information systems. This is primarily because of its suitability from the social perspective. Qualitative research was more suitable for this type of study as it allowed for clarification from respondents to the research questions. Clarifications could instantly be sought, to enrich the data. Qualitative approach, it has been argued, is a very useful method in conducting complex researches (Myers, 1997). This enable the researcher, through close interaction with interviewees, developed a deeper understanding of the EIA situation in the organization.

Case study method was adopted because it allows in-depth exploration of the complex issues involved in this study (Yin, 2003). Data sources included semi-structured interviews and documentation. The number of interviewees was

based on saturation, a point of where no new information was forthcoming. The respondents were selected from the various levels of the organizational structure within the Business and IT departments. This was a key factor in achieving a true reflection of the design, development and implementation of EIA in the organization.

The organization used in the case study is a government institution. At the time of the study, the organization had about 8,000 employees of which 600 were contract workers at both senior and junior levels. The organization was selected on the basis that it provided a good example of where information is very critical and was treated as its core business. The organization also provided some evidences of information architecture design, development and implementation. The interviewees were selected from different units in both business and IT departments. The selection was based on individual years of service in the organization and knowledge of the subject.

The researcher formulated interview questions which were intended to obtain information from the participants on how EA was designed, developed and implemented and its impact on the organization. This paper focuses on the principles, which enforces the requirements, design, development and implementation of EIA in the organization. In such a context, an interpretive research approach was appropriate in order to understand adaptation, influences from the perspective of socio-technical context within the organization.

3 DATA ANALYSIS

Interpretively, 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 a study. The data collected from the case study was analyzed at two, macro and micro interconnected levels. The macro-level addresses issues of information architecture importance to the organizations as well as, of the relationship between technical and non-technical actors in the design, development and implementation of information architecture in the organization. At the micro-level, the impact of principles on the design, development and implementation of information architectures in the organizations was analyzed. The remainder of this section discusses the analysis of the case study.

EIA provided a standard based design, development and implementation methodology that

helped IT to, as quickly as possible, response to the rapid changes in the processes of the organization’s business at the time. Through principles, 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 organization, this approach was much more received and appreciated than the project management and systems analysis disciplines. The difference was that there were specializations, unlike the project management method, as deployed in the organization.

The EIA was used to provide an initial classification and definition of the information required to perform the goals and functions of the organization. It was the beginning of a framework 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 modeling of optimal information flow. In addition, EIA was adopted to provide common terminology, which was intended to enable consistent semantic meaning across information systems and organizations by facilitating concept reuse and mediation of local variations to a common ground. This ultimately was to help the organization to meet its objectives and provides stakeholders with improved access to quality information.

The model as shown in Table 1 below was used in creating principles, which extended beyond organizational boundaries to external sources and targets including other government institutions. This was understood to enable rapid business decision-making and information sharing within the organization, with suppliers, partners and customers.

Table 1: Format for Creating Principles.

Name	A name that majority can relate to, and reflects the intention and essence of the objective of the organization. It is recommended to avoid ambiguous wordings.
Statement	This is to communicate the fundamental rule as set by the organization. The statement must be clear and unambiguous.
Rationale	Primarily to highlight the potential benefits for the organization in adhering to the principle.
Implications	Highlight the potential implications on the business and IT for executing the principles. This includes impact and consequences of adopting the principle.

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 organization. The principles were generally derived from the vision of the organization and an intensive discussion with senior IT and Business managements, and then validated in discussions and documentations across the structures of the organizations. The principles were viewed as a starting point for subsequent decisions that affected the EIA in the organization.

In the organization, EIA encouraged decision makers to explore externalization, optimize information value chains, plan application portfolios, increase the velocity of information across the organization and evolved the enterprise architecture.

The EIA was treated as a business-strategy-driven set of artifacts which described and model the information value network (*information flows, business events, linkages*) of the organization. It was sponsored and endorsed by senior management in IT and business departments. It extended beyond the organizational boundaries to external sources, and it was targeted to enable rapid business decision-making and information sharing. It also included rationale and implications such as:

- i. A catalogue of authentic sources of information. Examples include public and private companies databases;
- ii. Classes of relevant business information and their value to the government and the organization in particular;
- iii. 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, business resumption planning, and ownership; and
- iv. Information management deliverables that address roles, responsibilities and organizational structure for managing information content and delivery.

The design, development and implementation of EIA strived to establish the value and importance of using information effectively across the various units of the organization, as well as the need to achieve collaborative excellence with external partners and

customers (citizenry). The organization attempted to use the EIA approach to gain consensus between the senior and middle management levels in the organization, within the rationale and implications of the associated principles:

- i. What was strategic versus non-strategic information, especially in terms of security;
- ii. The use and definition of common terms;
- iii. Who had the information, in what form and capacity, who owns and manages it, how it should be leveraged;
- iv. Who will be responsible for the cost of developing IT systems that will create and deliver information to the clients;
- v. What metrics will be used to measure information sharing to a success?

EIA was required to encourage decision makers both in the Business and IT to explore externalization, optimization of information value chains, planning of application portfolios, incremental of the velocity of information across the organization in an iteration process. Hence the development of 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 EIA was as follows:

- i. As the model was essentially business-driven, the EBA had to first model the impact of business visioning on the operations of the business.
- ii. Because the EIA focuses on how information could best be leveraged, exploited, or otherwise used to provide business value, it was dependent on a certain amount of EBA modeling to determine how and where the business could derive its value.
- iii. The approach to 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 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 organization, a four domain approach was adopted. The function of EBA led to the development and implementation of EIA. The ETA and the other architecture disciplines - EBA, EIA, and EAA were also inter-dependent as

they each evolved, and new opportunities and requirements were identified.

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

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

The development of EIA began with the establishment of the overall information ecology in the organization. Primarily, it was intended to address the value proposition of the information of and about the processes and activities of the organization. Application portfolio decision making was guided by the principles of the EBA and EIA. This was used to identify needed functionality and opportunities for reuse and by ETA architectural principles. The principles impacted the selection, design and implementation of software packages, application components, and business objects.

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

Not all types of principles were necessarily identified in earlier paths through to the model. The bases for many principles were best practice - approaches that have consistently been demonstrated by diverse organizations to achieve similar results. Therefore, the degree to which the organization could establish principles in EIA was dependent on

its process and capability to identify and apply best practice in each area.

4 RESULTS

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

4.1 Design Principles

EIA provided fundamental principles that assisted the organization in achieving successful information. The factors included shared vision, change, evolutionary planning, classification and declassification, citizen empowerment, collaboration, problem coping, analysis, and restructuring organizational norms. The factors supported the implementation of processes and functions. To achieve the primary objectives, principles which included interactive and interwoven were sought. It began with design principles.

The design principles guided the boundaries, limitations including the rationale and implication of EIA in the organization. It was based on both the short and long terms strategic intentions of the organization. Table 2 depicts the guiding phenomena within which the design principles were formulated.

Table 2: Design Principles

Statement	Rationale	Implication	Ownership
Indicate its identity, which it could be associate	Justification, expression of the value to the organization	For each principle, there must be adopted standard.	Each principle is allocation to individual or unit for execution and monitoring purposes.

Until the design is developed and implemented, it remain theoretical which adds no actual value to the organization. The development is discussed next.

4.2 Development Principles

The objectives of EIA in the organization 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 objectives, the EIA was designed to address them in five categories as depicted in Figure 1 below.

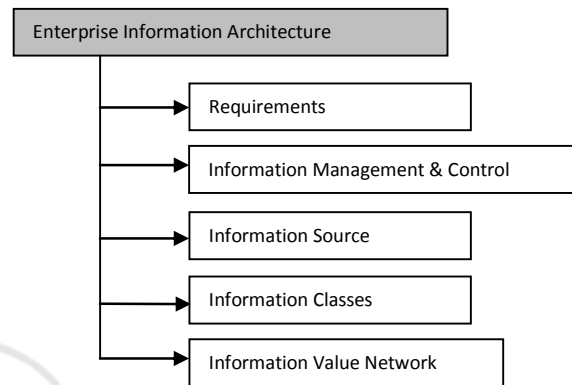


Figure 1: EIA Design Components.

4.2.1 Requirements

The principles to develop and implement EIA were derived from the requirements and vision of the organization. The principles were formulated to legalize the scope and boundaries of each of the technical and non-technical artifacts. In addition, the intended deliverables were also formulated to address roles, responsibilities and organizational structure for managing information content, including storage dissemination and delivery.

4.2.2 Information Management and Controls

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

4.2.3 Information Sources

Within set principles, a catalogue of authentic information sources, such as the organizations’ and commercial databases, research companies, news media and government gazettes were used to establish the origins of authentic information on, about and for the organization. It also formed the basis of input for the next step, which obtained classes of relevant information and established their value to the organization.

4.2.4 Information Classes

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

- i. Functions (operational, management, strategic);
- ii. Business Operations - concerned with the operational (transactional) processing within the Administration;
- iii. Business Management - concerned with measurement and management of the Administration; and
- iv. Business Strategic - planning for the future and identifying competitive opportunities.

4.2.5 Information Value Network

The information value network was one of the focal components of the principles of EIA in the organization. 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 transaction and decision support levels. This was to maximize operational effectiveness, efficiency, service delivery and high performance and competitive advantage if we may.

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 (*velocity, density and reach*) and moving along one or more of these dimensions could

have increased the value of information in the organization.

Methods and tools such as “information value network analysis” were used to diagnose problems or uncovered 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. Since information was an artifact of business processes, it surrounded and supported the physical value chain.

Principles were formulated to address the components of the EIA. Table 2 is an example of a template, which was used to record the design principles. This template could be populated and used to support strategic analyses over time. The implementation of the entire design are summarized into four areas and enforced through a set of principles accordingly.

4.3 Implementation Principles

The final phase of the EIA as a project was the gap analysis. This was conducted across all the categorized areas to determine corrective action, development of prioritized migration plans and finally drawn up implementation plan. Carrying out the projects in the implementation plans transitioned the organization from the current state to future state as was defined during the project.

The primary and key components were implemented with the principles of EIA. This is depicted in Figure 2; they are briefly described immediately after the figure.

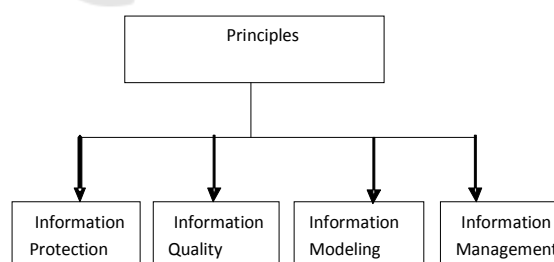


Figure 2: EIA Implementation Principles.

i. Information protection

Information shared across the organization was regarded as corporate information and therefore was principled to be managed accordingly. As revealed in the study, information accessibility and protection were of high priority in the organization. As such,

principles were formulated to address ownership, security and accessibility classification, privacy, archival and recovery. This was to guarantee, to exponential degree, continuity in the businesses of the organization.

ii. Information Quality

The level of 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 organization. The principles concentrated on the metadata, integrity, authenticity, classification and criticality of the organization’s information.

iii. Information Modeling

The principle stated as follow: an information model represents information in an understandable simplified format. Information was intended to be modeled according to the principles of EIA, and the application development guidelines of the organization.

iv. Information Management

The information management principles defined the roles, responsibilities and organizational structure required to implement the architecture of information in the organization. It also defined, *inter alia*, the role that users play in being 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 was effectively applied. There was an emphasis on the information architects being the domain owner.

4.3.1 Migration Planning Principles

Positioning strategy and movement from one architectural phase to another was acknowledged 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.

Certainly, 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. Of course the problem here, again, was that historically, information technologists have not been all that accurate in predicting product directions and timing. As such, the migration principles were formulated based on the context of the organization. During the implementation, gaps were identified and they were analyzed for possible opportunities and solutions.

4.4 Measurement and Validation

The principles of measurement and validation were an integral component of the overall EIA in the organization. They were a set of obligation for the management, administration, practices of information storage and usage in the organization.

The measures included 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 Enterprise Planning, Business Analysis, Systems Analysis and Systems Design, which constituted the Information architecture conformance checklist in the organizations. These components were defined set of principles, within the organizational meaning and value.

4.4.1 Gap Analysis

The gap analysis assessed the current state of the EIA against the desired state as reflected by the drivers. This assessment was an iterative and ongoing process and was reflected by a conformance checklist and an accompanying action plan as depicted in Table 3. These assessments were to be stored and managed within the agreed principles. Table 3 provides example of the gap analysis.

Table 3: Gap Analysis

Requirement (Future State)	Action Plan	Deliverables	Roles & Responsibility
Eradicate uncontrolled data duplication and redundancy	Project to be initiated	Project Scope Migration plan.	Project Manager Information Architect

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

- i. The inherited technological environment that existed at the initiation of the process;
- ii. New technologies constantly emerging that must be accommodated; and
- iii. The fact that any information systems architecture as always in transition is ever changing and evolving.

5 FINDINGS

From the results of the analysis, five factors were found to be critical in the deployment of the EIA approach. The factors are discussed as follows:

5.1 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 organizational norms to support implementation and ongoing learning and processes of EA. These principles must be interactive and are interwoven throughout the process of EA.

5.2 Iterative Process

Within the scope of EIA, principles were articulated to address the information aims and objectives of the organization in an iterative process. Some of the primary objectives included encouraging decision makers to: Explore external trading and partnerships; Optimization of information value chains; Plan application architectures and systems portfolio; and Increase information velocity across the organization.

Through the iterative-ness, EIA was intended to identify the information flows for optimization (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 organization 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 organization information assets to knowledge workers, information processors, IT application developers, infrastructure managers, and executives.

5.3 Information Architect

Within the boundaries of set principles, information architects' focus was on 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 organization 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.

5.4 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 irreversibility nature of the OPP, the formulated principles were enforced. Primarily, it gave power to those 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 organization.

5.5 Stock of Knowledge

The stock of knowledge was not necessarily valuable as it was difficult to translate its value to usefulness in some cases and units in the organization. The role of EIA was often misunderstood. It was difficult to differentiate between business analyst and information architect. As a result, allocation of task, roles and responsibilities became a challenge to manage.

6 CONCLUSIONS

Enterprise Information Architecture (EIA) offers tangible benefits to the enterprise and those responsible for evolving the enterprise through its principles. The primary purpose of 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 emphasized above are of paramount importance to business and IT managers in the organizations as well as academic domain. The study, through its empirical evidence, contributes to the body of knowledge. In addition, the findings are opportunity to researchers for further research work.

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