Annals of Process Engineering and Management

www.apem.reapress.com

Ann. Proc. Eng. Manag. Vol. 2, No. 1 (2025) 1–9.

Paper Type: Original Article

# Design of an Enterprise Architecture (EA) Model for Iranian Electricity Distribution Companies Based on IEC 61968 Standard and Value Stream Management (VSM)

**Mostafa Yousefzadeh[1,*], Sadegh Saffar Khorasani[1], Reza Behnood[1], Hamid Hassan Nejad[1]**

[1] Mashhad Electricity Distribution Companydept, Mashhad, Iran; m.yoosefzade57@gmail.com; s.s.khorasani@gmail.com.

**Citation:**

| | |
|---|---|
| *Received: 17 July 2024*<br>*Revised: 21 October 2024*<br>*Accepted: 10 December 2024* | Yousefzadeh, M., Saffar Khorasani, S., Behnood, R., & Hassan Nejad, H. (2025). Design of an enterprise architecture (EA) model for Iranian electricity distribution companies based on IEC61968 standard and value stream management (VSM). *Annals of process engineering and management, 2*(1), 1-9. |

## Abstract

Enterprise architecture is an integrated and comprehensive approach that analyzes an organization's various aspects and elements (System) from an engineering perspective. It includes a set of documents, models, standards, and implementation measures for the transformation from the current state to the desired state, centered on information technology. It is implemented in a repeatable cycle and is continuously updated and developed. In addition to the analysis and development of business architecture (Structure, processes, and services), information technology architecture (Information, software, network, and security) is also necessary. The combination of these analyses and maps, aligned, balanced, and integrated, describes the organization's architecture. The need for enterprise architecture can be evaluated in the need for the design and development of complex information systems, the emergence of information systems for specific purposes, and the importance of organizational flexibility in the face of external pressures such as business change, changes in organizational missions and structures, and rapid technological changes. Despite research achievements in this field, the lack of a successful example of enterprise architecture implementation in electricity distribution companies has led to the less-than-maximum realization of architecture plan goals in companies. Therefore, considering the experiences gained in the path of establishing enterprise architecture in Mashhad Electricity Distribution Company, a proposed model for establishing enterprise architecture was investigated and evaluated. Implementing one phase of the model in the main processes of the customer sector has resulted in achievements such as a 44% improvement in the provision of relocation services to customers.

**Keywords:** Enterprise architecture, Value stream management, IEC 61968 standard.

## 1 | Introduction

The term "architecture" is not unfamiliar to engineers and those familiar with engineering fields. Architecture is reminiscent of a comprehensive and holistic plan and vision of the structure and behavior of an entity that has properties such as complexity and dynamism, and its preparation and maintenance require special attention to integrity, comprehensiveness, flexibility, and interoperability. The word "architecture" is mainly heard in fields related to building sciences, where the architect, with a comprehensive view of all factors

Corresponding Author: m.yoosefzade57@gmail.com

affecting the building and benefiting from the best design experiences, draws a plan of how to construct the building using primary building blocks. In addition, the architect is present throughout all design and construction stages and controls all aspects. In the information and communication technology field, this concept initially became important in the hardware domain, when the issue of using prefabricated parts was considered, and the question of what combination and synthesis of existing elements could design a new system. The subject of architecture was also raised as one of the important topics in the field of hardware. This topic gradually entered other areas of information and communication technology, and wherever it was necessary for structure and behavior to be considered, architecture was considered.

## 2 | Enterprise Architecture

Enterprise architecture is a new approach to creating coordination and alignment between processes, data, the role of people, systems, technologies, and organizational goals and strategies. Suppose we want to have a comprehensive definition of enterprise architecture. In that case, enterprise architecture is a strategic information asset base that defines the business mission, the information technologies needed to accomplish that mission, and the processes of transferring and deploying new technologies to align with organizational changes. Enterprise architecture is a new approach to aligning organizational strategies with that organization's information and communication technologies. Enterprise architecture includes the current state architecture, the desired state architecture, and a specific plan called the transition plan, which specifies how to get from the current state to the desired state of an organization [1].

In discussing enterprise architecture, first, the components and parts of the organization must be accurately identified. The relationship between these components and parts of the organization and the external environment is the next step in achieving this. The complexity of organizational structures has increased, so it is not enough to mention what tasks should be performed by whom (In other words, defining people's job descriptions). Instead, if we look at the issue with a systems view, creating coordination and alignment between processes, data, the role of people, systems, and technologies used with organizational goals and strategies is very important. The main goal of enterprise architecture is to reduce operating costs, increase revenue capacity, facilitate the transfer, maintenance, and development of technical systems, and prevent reduced efficiency and flexibility of organizations. In summary, the necessity of enterprise architecture in large organizations, the need for the design and development of complex information systems, the emergence of information systems for specific purposes, and the importance of organizational flexibility in the face of external pressures such as business change, changes in organizational missions and structures, and rapid technological changes can be evaluated.

## 3 | Value Stream Management

Toyota invented Value Stream Management (VSM), an important method for identifying the root causes of waste and determining corrective actions to eliminate them. The value stream encompasses all the activities required to fulfill customer needs from the request stage to delivery and after-sales service, as shown in *Fig.1* [2].

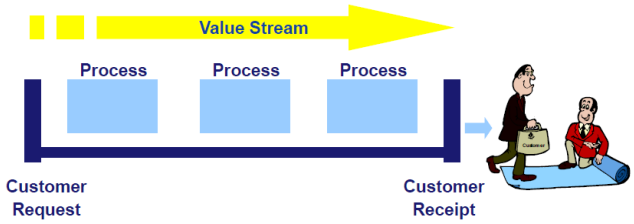


**Fig. 1. Service value stream.**

The value stream map is a simple tool for seeing what is currently happening in the value stream (Current state map). Or what is going to happen (Future state map)? VSM is a process for measuring, understanding,

and improving workflow and the interaction of dependent activities to keep the company's cost, time, and service quality as competitive as possible. In a part of the American Productivity and Quality Center (APQC)[1] Process and Performance management conference in 2019, three benefits of value stream mapping were discussed: 1) it provides a mutual understanding of how things work today, how things will work in the future, and how to move forward, 2) it highlights timeliness and problem areas for the customer throughout all stages, and 3) it helps identify and eliminate waste and problems in the organizational structure [3], [4]. In the future state map, the relevant activities of the current situation are examined. As the first goal of drawing the desired flow map, the activities are divided based on having value or being worthless.

The value of activities from the customer's point of view is categorized based on non-value-added: The customer is not willing to pay for the activities, and they should be eliminated. For example: Rework, poor quality service, etc.

Value-added: The customer is willing to pay for these activities, such as selling subscriptions.

Value-added for the organization: The customer is not willing to pay for these activities, but organizations consider these activities necessary, such as preventive maintenance.

VSM requires a practical method for preparing a map of work processes and the dependent relationships between these processes. Therefore, the steps of value stream mapping in services, according to the service VSM cycle, are as follows:

## 3.1 | Development of Service Value Stream (Current State)

Customer and supplier needs and problems are documented. The main processes are identified and mapped based on their sequence, and then the metrics and standards of each process are selected. The results of the value stream visit are recorded. The value stream is executed step by step, and the resulting information, including workflow and inventory information, the number of employees and deployed technologies, etc., is documented. Finally, after determining the work priorities of each process, the system metrics are calculated, and the required single times in the stream are documented. All processing time, waiting time, and overall completion and correctness percentage information are estimated and validated.

## 3.2 | Development of Service Value Stream (Desired State)

We need to analyze the current situation to prepare the future state map. First, the following questions must be answered:

- *What does the customer need?*
- *What steps create value, and what steps lead to waste?*
- *How will workloads and activities be balanced?*
- *What improvements in the process are necessary to achieve the future state?*

Customer needs are defined, movement is created in the work (Workflow, information flow), and product quality and reliability are improved [5]. Identify the applicable funding agency here. If none, delete this text box.

## 3.3 | Improvement Measures

Identifying improvement projects, improvement actions and activities, and determining their resources.

[1] APQC is the world's foremost authority in benchmarking, best practices, process and performance improvement, and Knowledge Management (KM).

# 4 | IEC 61968 Standard

The International Electrotechnical Commission (IEC) 61968 standard includes a series of developing standards that attempt to describe the exchange of information and communication between power distribution systems. These standards are being developed by working group 14 of IEC technical committee 57. This series of standards covers the scope of communication between software and integrating software systems that require collecting various data. These standards guide the creation of a suitable platform for data communication between different software. This series of standards attempts to define the interfaces required for all the main elements in the architecture of electrical energy distribution management systems. These standards also provide methods for intermediary (Inter-program) systems that provide the services required for these communications. The parts of this standard are as follows:

I. 61968–1 interface architecture and general requirements [6]
II. 61968–2 glossary [7]
III. 61968–3 interface for network operations [8]
IV. 61968–4 interface for records and asset management [9]
V. 61968–5 interface for operational planning and improvement
VI. 61968–6 interface for maintenance and construction [10]
VII. 61968–7 interface for network expansion planning [11]
VIII. 61968–8 interface for customer services [12]
IX. 61968–9 interface for meter reading and control [13]
X. 61968–10 interface for external business operations to distribution management

# 5 | Problem Statement

Various organizations, especially leading and rapidly changing organizations such as Mashhad Electricity Distribution Company, face numerous problems in implementing enterprise architecture. These include processes' non-compliance with their systemic workflow, their complexity and very big changes, and the incorrect implementation of the process management cycle, which is the first step in designing business architecture. These are among the most critical challenges identified by Mashhad Electricity Distribution Company.

# 6 | Method (Enterprise Architecture Deployment Model)

The enterprise architecture approach to creating or re-creating an organization based on information technology is to present a model called the enterprise architecture pyramid, *Fig. 2*, which has four main layers as follows:

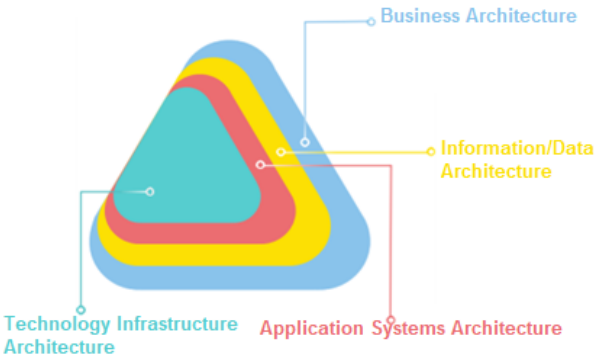


**Fig. 2. Enterprise architecture pyramid.**

## 6.1 | Business Architecture Layer

The highest layer of the enterprise architecture pyramid is the business architecture. This architecture defines the organization's strategy, structure, governance, and main work processes. Topics such as business strategies, organizational technology, policies, scope, and decision-making regarding information technology business paradigms such as e-business, etc., are examined at this level. Other topics of interest at this level include organizational structure, business processes, planning and control systems, administrative and managerial mechanisms for achieving organizational strategies and goals, and modeling the relationships between them.

## 6.2 | Data/Information Architecture Layer

The second level of the enterprise architecture pyramid is the data and information architecture. This layer introduces the main types of data required, the necessary resources to manage this data, and their logical and physical structure to support the business. Properly defining this architecture will effectively and efficiently support the storage, retrieval, and transfer of organizational data.

## 6.3 | Application Systems Architecture Layer

The third level of the enterprise architecture pyramid is the application systems architecture. The sequence of application systems implementation, implementation schedule, cost-benefit analysis, and a clear path for transitioning from the current state to the desired state are examined at this level. This level refers to the type of architecture used to describe two main aspects of the organization, namely processes and locations. Application systems, using the services provided by the information technology architecture, acquire essential features such as the ability to work together and manageability security. This layer includes the application systems needed to achieve the functions defined in the upper layers. Systems such as ERP, CRM, MIS, SCM, etc., are considered in this layer.

## 6.4 | Technology Infrastructure Architecture Layer

The lowest layer of the enterprise architecture pyramid is the information technology architecture. The hardware, software, and communication infrastructure required to implement information systems and information flow and operations are determined at this level. It also includes defining each component's functions and main tasks, identifying and defining the necessary interfaces along with the governing standards, and determining how to interact between different information technology components. The information technology architecture supports the integration of application systems. It also provides the necessary infrastructure and standards for information exchange between application systems.

Accordingly, the solution model in *Fig. 3* is presented to address the challenges of enterprise architecture implementation. It assumes that the prerequisites for enterprise architecture deployment include sufficient political and financial support from leaders or senior managers, establishing commitment and cooperation among stakeholders, and accurate identification, review, and adjustment of laws and regulations in the organization.

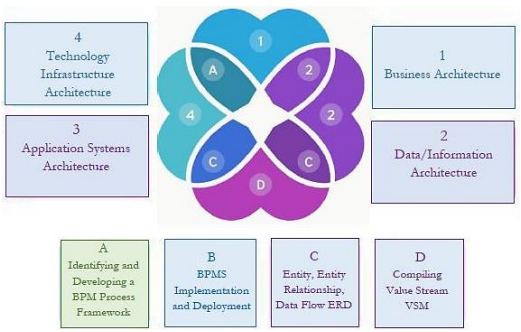


**Fig. 3. Enterprise architecture deployment model.**

The first step in deploying enterprise architecture based on the layers of the enterprise architecture pyramid is to deploy the business architecture layer. Accordingly, the proposed enterprise architecture deployment model shows the implementation priorities and in the following, the steps and activities related to each layer of the enterprise architecture pyramid (Layer 1) business architecture, Layer 2) information/data architecture, Layer 3) application systems architecture, and Layer 4) technology infrastructure architecture) are briefly described.

**Phase A.** Based on the business architecture layer, the content framework of important products in the company's processes is developed, as shown in *Table 1*.

**Table 1. Phase A activities.**

| Activities |
|---|
| Identifying macro and process groups and processes based on the APQC model |
| Identification of processes, activities and tasks (Operational and main) through IEC61968 |
| Identifying processes, activities, and tasks (Support) through APQC and field analysis |
| Identify process inputs and outputs and process strategy objectives |
| Preparing a process map and framework (AS-IS, TO-BE) |
| Determining process maturity |
| Process modeling (Business level) BMPN |

**Phase A outputs:**

I. Stakeholder identification

II. Role and responsibility identification

III. Organizational unit function identification

IV. Process identification

V. Organizational unit function breakdown diagram

VI. Process flowchart

**Phase B.** In this phase, based on the overlap of the business architecture and information/data architecture layers, the baseline (Current) and target (Desired) states of the value stream are developed based on the activities in *Table 2*.

**Table 2. Phase B activities.**

| Activities |
|---|
| Validation of core and valuable processes (Determining the added value of each activity) |
| Preparing a value chain map and work measurement (Work management) |
| Developing job descriptions, responsibilities, and authorities for each value stream - BPM governance |
| Identifying bottlenecks and prioritizing solutions to address them |
| Developing process improvement measures based on the implementation of (QCC-KSS-5S) systems5S: Tidiness System, KSS: Kaizen suggestion system, QCC: Quality control loops |

**Phase B outputs:**

I. Service identification

II. Matrix of organizational unit function and process

III. Matrix of process and service

IV. Service value chain diagram

V. Inter-organizational interaction diagram

**Phase P (Phase C).** In this phase, based on the information/data architecture layer, objectives such as designing the desired architecture of the organization's information and data that supports the business architecture and is aligned with the architecture vision and identifying the existing information and data architecture to extract the path to the desired state are pursued. Implementation of this phase requires the activities in *Table 3*.

**Table 3. Phase P (Phase C) activities.**

| Activities |
|---|
| Identifying information fields, data, data flows, and entities |
| Shaping the database structure |
| Developing indicators for activities and tasks (Time - cost- quality - performance, etc.) |
| Defining data maturity and data governance |
| Relationship between entities (PROCESS - group - macro) |
| Developing KPIs - key performance indicators for the process, group and macro process |
| Developing a data architecture map (ESB - Data lake - SOA) |
| Developing SKPIs - strategic key performance indicators for process, group and Macro process |

**Phase P (Phase C) outputs:**

I. Information entity identification

II. Database identification

III. Matrix of entity and function, process, service

IV. Conceptual diagram and logical diagram of entity relationships

V. Process flowchart

**Phase T (Phase D).** Application sof tware in the organization is responsible for the mechanization of process and service flow and the mechanized recording of organization information. Therefore, application software architecture intensely depends on the business infrastructure, information, and data architecture, and it receives their primary input. On the other hand, this phase also overlaps with the infrastructure architecture layer, and aspects such as hardware, network issues, infrastructure services, platforms and servers, the process and roles of ICT operations management, and security issues that are considered in all architecture domains are more prominently addressed in this domain. Effective implementation of this phase requires proper execution of the activities in *Table 4*.

**Table 4. Phase T (Phase D) activities.**

| Activities |
|---|
| Selecting the right tool and effectively implementing the change management process for short-term and long-term solutions. Optimizing existing systems and selecting the right BPMS. |
| Developing capabilities in deploying BPMS systems and other required systems by undergoing sufficient training |
| Deploying unsystematic processes into new tools using BPMS systems |
| Establishing strategic processes based on the Pain & Gain matrix in the BPMS system |
| Deploying all processes in the BPMS system |
| Determining hardware requirements, communication network, infrastructure services and servers |

**Phase T (Phase D) outputs:**

I. Application software identification.

II. Software service identification.

III. Infrastructure service identification.

IV. Security control identification.

V. Inter-software exchange matrix (Entity, function, organizational unit).

VI. Application software interaction diagram.

VII. Infrastructure services and application software matrix.

VIII. Communications (Network) architecture diagram.

IX. Data center/server room diagram.

## Acknowledgment

In addition to helping the successful implementation of enterprise architecture deployment using international models such as the APQC process framework for classifying processes and activities, the IEC61968 standard for information exchange and communication between electricity distribution systems, and the use of VSM to identify wastes and their root causes by understanding and improving workflow and the interaction of dependent activities to keep the company's cost, time, and service quality as competitive as possible, the proposed model leads to faster deployment of enterprise architecture in the organization. For example, focusing on the "time to provide meter relocation service" led to significant reductions in customer service time and increased satisfaction through small changes in the order of activities.

## Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

## Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

## References

[1] The state council of information technology of Iran & Electronic government development commission. (2016). *Enterprise architecture framework and methodology*. The State Council of Information Technology of Iran. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://soea.sbu.ac.ir/wp-content/uploads/2024/03/IEAF_FM_V1.pdf

[2] Kalsaas, B. T. (2002). *Value stream mapping: An adequate method for going lean?* [presentation]. Department of industrial economics and technology management, norwegian university of technology and science, nofoma the 14th international conference. https://www.academia.edu/4178938

[3] American productivity & Quality center. (2019). Value stream mapping and end-to-end process improvement at vanguard. *American productivity & quality center (APQC) process and performance management conference*. American productivity & Quality center. https://www.apqc.org/resource-library/resource-listing/value-stream-mapping-and-end-end-process-improvement-vanguard

[4] American productivity & Quality center. (2019). Value stream mapping with the vanguard group. *American productivity & quality center (APQC) 2019 process and performance management conference*. American productivity & Quality center. https://www.apqc.org/resource-library/resource-listing/value-stream-mapping-vanguard-group?

[5] National Iranian productivity organization. (2022). *Evaluation of the productivity of government companies subject to article 10 of the executive regulations of paragraph (18) of the budget law of 2022 directive 2022*. https://rc.majlis.ir/fa/law/show/1746839

[6] International electrotechnical commission TC 57 working group 14. (2020). *IEC 61968-1– application integration at electric utilities – System interfaces for distribution management*. International electrotechnical commission. https://webstore.iec.ch/en/publication/32542

[7] International electrotechnical commission TC 57 working group 14. (2011). *IEC TS 61968-2: Application integration at electric utilities — system interfaces for distribution management — Part 2: Glossary*. International electrotechnical commission. https://webstore.iec.ch/en/publication/6201

[8] International electrotechnical commission TC 57 working group 14. (2021). *IEC 61968-3: Application integration at electric utilities – system interfaces for distribution management – Part 3: Interface for network operation*. International electrotechnical commission. https://webstore.iec.ch/en/publication/67251

[9] International electrotechnical commission TC 57 working group 14. (2019). *IEC 61968-4: Application integration at electric utilities – system interfaces for distribution management – Part 4: Interfaces for records and asset management*. International electrotechnical commission. https://webstore.iec.ch/en/publication/61452

[10] International electrotechnical commission TC 57 working group 14. (2015). *IEC 61968-6: Application integration at electric utilities — interface for maintenance and construction*. International electrotechnical commission. https://webstore.iec.ch/en/publication/22834

[11] International electrotechnical commission TC 57 working group 14. (2025). *IEC 61968-7: Interfaces for network extension planning*. International electrotechnical commission

[12] International electrotechnical commission TC 57 working group 14. (2015). *IEC 61968-8: Application integration at electric utilities – system interfaces for distribution management – Part 8: Interfaces for customer operations*. International electrotechnical commission

[13] International electrotechnical commission TC 57 working group 14. (2024). *IEC 61968-9: Enterprise business function interfaces for utility operations – Part 9: Interfaces for meter reading and control*. International electrotechnical commission. https://webstore.iec.ch/en/publication/75041