An Enterprise Architecture Approach to Building a Service-Oriented Enterprise

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An Enterprise Architecture Approach to Building a Service-Oriented Enterprise

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Abstract—Several frameworks have been developed to assist the analysis of service management systems. However, most of these frameworks only capture limited aspects of a service-oriented enterprise. This paper first reviews several popular service management frameworks. An enterprise architecture approach that is commonly used in information systems planning has been adapted to integrate various service management frameworks and tools, as well as to support the planning and documentation of a service-oriented enterprise. The proposed service-oriented enterprise architecture (SOEA) includes the following aspects: service, process, people, information, and motivation. Each aspect can be viewed from a strategic, tactical, and operational level. The mapping of the conceptual constructs of existing service management frameworks to the proposed SOEA is discussed in detail.

Index Terms—Enterprise architecture, Service-oriented enterprise, Service science, Service management frameworks

I. OVERVIEW OF SERVICE MANAGEMENT FRAMEWORKS

SERVICE-ORIENTED architecture (SOA) has the potential to support service-oriented enterprise. However, most of the service analysis and design methodologies for building applications based on SOA are too technically oriented [2]. Researchers in the service management fields have identified several commonly used frameworks or tools that have been used in service management research and practices [8] [24]. These frameworks or tools include:
1) The service marketing triangle [4]: It defines relations and promises among companies, providers, and customers, as well as the marketing efforts among these entities: internal marketing between company and providers, external marketing between companies and customers, and interactive marketing between customers and providers.
2) Gap model of service and dimension of service quality [23]: The service gap model identifies and explains reasons for gaps in service quality. It is used to specify five dimensions for measuring service quality gaps.
3) The service profit chain [10]: It establishes a causal relationships among internal service quality, employee satisfaction, employee productivity and retention, external service value, customer satisfaction, customer loyalty, as well as revenue grow and profitability [11].
4) The evidence of service from a customer’s point of view [3]: It includes people, process, and physical evidence. The physical evidence is “the environment in which the service is delivered and in which the firm and the customer interact, and any tangible commodities that facilitate performance or communication of the service [24, p. 313].”
5) Service blueprinting [5]: A process modeling tool for analyzing service processes. Customer activities, activities that are visible and non-visible from customer’s viewpoint, and backend activities are identified explicitly in the service blueprint.

These frameworks were developed based on various disciplines such as quality improvement programs, operations management, and service marketing; hence, have different focuses on process, people (e.g., customer satisfaction), or performance (i.e., quality standard). These focuses represent the various dimensions of service management. Existing service frameworks have not incorporated all dimensions of service management. They also lack views from various stakeholders who are concerning with services.

In this paper, we have developed a service-oriented enterprise architecture (SOEA) serving as a supra-framework to integrate existing service frameworks to provide practitioners a tool to plan and design all aspects of a service-oriented enterprise. Section II of the paper reviews existing literature of enterprise architecture and defines the proposed framework. Several important dimensions of the proposed frameworks are described in detail in section III. Directions of future research are discussed in section IV to conclude the paper.

II. A SERVICE-ORIENTED ENTERPRISE ARCHITECTURE

We first review the history of enterprise architecture (EA) researches and applications, and then discuss the proposed service-oriented enterprise architecture. Business Systems Planning methodology, developed at IBM [22], identifies products/services across four stages of their lifecycle: requirement, acquisition, stewardship, and disposition. Business processes are identified and associated with processes/services and are cross-referenced with supporting resources such raw materials, facility, cash, and personnel. Business applications are identified via cluster analysis of the interactions between data and processes. The methodology has been extended in Information Engineering methodology as an Information Systems Planning tool which facilitates the creation of information (data) architecture, business systems architecture, and technical architecture [18]. However, these approaches are still considered to be more technical oriented. Recently the US federal government has developed a Federal
Enterprise Architecture (FEA) program under its e-Government initiative [14]. The FEA framework is derived from NIST’s Enterprise Architecture Model as a management tool that illustrates the interrelationship of enterprise business, information, and technology environments. FEA is business-driven and a set of FEA five reference models has been developed including two very business-oriented models: the Performance Reference Model and Business Reference Model [14].

Enterprise architecture was first proposed as an information systems planning tool by John Zachman [22]. The initial version of the architecture contains only Data, Function, and Network dimensions of an information system. Zachman and his colleagues have been extended to EA to six aspects of an enterprise from various stakeholders’ viewpoints and at different levels of details [19]. The enterprise architecture framework has been used effectively as an information systems planning tool to ensure consistency among various components of an enterprise. The six dimensions or aspects of Zachman’s framework and can be adapted to describe services in an enterprise:

1) Data (What): What data are needed to support the enterprise? To better support customer service, one have to capture, store, organize, filter, analyze, and deliver information to the frontline customer facing employees and managers to handle customer requests properly.

2) Function (How): This is the process dimension describing how service is performed or rendered.

3) Network (Where): The network dimension reflects the locations where the enterprise provides its services and the technical infrastructure that is required to connect operations in these locations together.

4) People (Who): This dimension includes employees, customers, managers, and suppliers. All of them need to be involved in developing a service-oriented enterprise.

5) Time (When): This dimension specifies when certain actions need to be done.

6) Motivation (Why): Organization strategies are translated into organization goals and key performance indicators. The performance measures via KPI will be used in evaluating processes and people.

We can describe each aspect from the perspective of different stakeholders, from most abstractive “conceptual viewpoint” to the most detailed “implementation view”. The 5W1H labeling of these six dimensions is a very useful in helping us to connect these dimensions together to develop a more integrated enterprise in which everyone know what information they need to have, how they should perform their tasks in the context of cross functional area business processes, where they operate, who are responsible for performing the work for whom, when these things need to be done, and why these things need to be done in the first place. A successful EA will help to transform all aspects of an organization by ensuring consistency among all six aspects of the architecture and support the viewpoints from the top level planner to the people who are implementing the design at the frontline.

However, most EA frameworks have not taken service-orientation into consideration. They have been used in information systems planning, although researchers agree EAs should not be limited to information technology (IT) planning and can be used for enterprise strategy planning. There are several frameworks that have been proposed to guide companies in planning and analyzing their services. However, these frameworks only cover one or two aspects of services in an enterprise. We believe that EA can be extended to integrate these major service science frameworks to ensure that they are consistent across various aspects and reflect the viewpoints of stakeholders at different levels. In our proposed service-oriented EA, we use three levels of abstraction in viewing these dimensions (aspects):

1) Strategic level: This is the view from both planner and customers. It is also the most abstract view that represents the big picture, long term goals, as well as macro-level and visionary thinking.

2) Tactical level: This is the designer’s view of the logical design of the systems across all dimensions.

3) Operational level: This is the implementer’s view and it is also most detailed view. It represents specific objectives, repetitive and very short term operations.

These three levels represent a continuum from most abstract to concrete view and reflect long-term to short-term concerns. Based on extensive literature review in service management, we have identified five major dimensions for service management: service, information, process, people, and motivation. A proposed Service-Oriented Enterprise Architecture (SOEA), depicted in Table I, is developed based on enterprise architecture practices and existing service management frameworks. The service dimension is created as a main object in SOEA. The Time and Network dimensions are integrated into other dimensions; hence they are not shown explicitly in the SOEA. In the following sections, we discuss some of the conceptual constructs and models in these dimensions and how they can be used to support a service-oriented enterprise.

III. COMPONENTS OF THE SERVICE-ORIENTED ENTERPRISE ARCHITECTURE

Each dimension of the SOEA is discussed in this section. Each cell in the SOEA framework contains one or more modeling tools or frameworks. Relationships across these dimensions are important for integration among various frameworks.
A. Service Dimension

Service has many unique features comparing to product; hence it requires different approaches to service management. Service can be broken down into service elements. Service strategy will help an organization to define high-level services for its customers based on its mission and business strategies. A more concrete service portfolio should be developed based on the service strategies. Based on ITIL Version 3 [15], service portfolio includes service in the pipeline (i.e., under design and development), operational services in the service catalogue currently offered to customers, and retired services that are obsolete. Service catalogue management is the activity to ensure that a service catalogue is produced and maintained properly so that it contains accurate information on all operational services [15].

Service listed at the tactic level can be decomposed into a collection of service elements to encourage shared services in order to increase the efficient resource utilization required for service provisioning. Some of the service elements can be implemented as Web services to enable distributed and component-based information systems under a service-oriented architecture [7].

B. Process dimension

At the strategic level of the SOEA, a business process model focusing on a chain of value added macro-level business processes. These processes can be classified into primary value activities and supporting value activities. The primary activities include: inbound logistics, operations (production), outbound logistics, marketing and sales (demand), and services (maintenance). The original value chain model is more geared towards manufacturing firms and need to be adapted to use for companies in service industry. The primary value activities include Marketing, Sales, Service Rendering, and Service Recovery. The service value chain framework extends the value chain analysis and emphasizes the interactions between the service purchasing and service rendering from the viewpoint of both service consumer and service provider [1]. Both information technology and human resource management activities are strategic functions for the development of the necessary infrastructures to support front-line employees and to enable the building IT-enabled services.

Customer management activities can be classified into two major categories: customer acquisition and customer retention.

A detailed multiple stages of customer lifecycle activity model from a service provider’s viewpoint [20]. As depicted in Figure 1, this model can be used as a template for service process modeling and for performance measure. Organizations perform the following activities according to the customer lifecycle:

1) Awareness: This is the first step in the lifecycle. It is the activity that makes customers and potential aware of the services provided by the organization.
2) Targeting: This process involves attracting appropriate customers to use the services provided by the organization.
3) Enquiry management: Manage and work on the leads generated by the targeting efforts. It involves activities that convert leads to customers.
4) Welcoming: At this stage, service providers offer orientation of service offerings and contact information for newly joined customer.
5) Getting to know: Through the use of services or products, companies obtain additional information about customers’ profiles and their usage patterns of the firm’s products or services. Customers also become more familiar with the firm’s offerings and processes.
6) Account management: This process involves the handling of typical business transactions and service rendering with customers.
7) Intensive care: It is the moment of truth when customers really need your assistance in major service events or service failures.
8) Pre-divorce/Divorce: This is the process that handles customers who are quitting from the firm.
9) Winback: It involves getting back customers who have left the firm.

At the operational level, a detailed process model for each major customer service encounter can be developed to support the process improvement efforts and to develop scripts and guidelines to for each activities in the process to ensure service quality standards. The service blueprint is a process modeling technique developed to support the modeling and analysis of service operations [5]: There are five components of a typical service blueprint:

1) Customer actions: Most process modeling technique does not take the customer actions into consideration.
2) Onstage/visible contact employee actions: The interaction between customers and the frontline workers are the
customer touch points that are the “moment of the truth” from the customer viewpoint.

3) Backstage/invisible contact employee actions: the backstage actions by contact employees are no less important than the onstage operations. However, they only play a background role and are enabled by operating supporting processes.

4) Support processes: This is the process that is at the background and used by employees at the backstage.

5) Physical evidence: The physical evidence is the physical environment and artifacts that may affect the customer’s impression on quality service.

In ITIL documents describe five service management processes. Service strategy represents the process of developing and defining policies and objectives. Continual service improvement represents learning and improvement of all service related processes. From the viewpoint of service portfolio management, we can describe services based on their service life cycle stages from the service provider’s viewpoint: Service design, Service transition, and Service operation [15].

Service strategy is the process that is driving the service design, service transition, and service operation while service improvement process applies to all other four processes.

1) Service strategy is how organizations position themselves in the marketplace in term of their service offerings. It provides guidance on how to design, develop, and implement service management as an organizational capability and a strategic asset. Service Strategy will be guiding and driving Service Design, Service Transition, Service Operation, and Continual Service Improvement.

2) Service design involves the design, development, and improvement of existing and new services, as well as service management processes. It is the process that converts strategic objectives into portfolios of services and service assets. Effective service design makes changes and improvements necessary to increase or maintain value to customers over the lifecycle of services, the continuity of services, achievement of service levels, and conformance to standards and regulations.

3) Service transition involves the development and improvement of capabilities for transitioning new and changed services into operations. It ensures that the requirements of Service strategy encoded in Service design are effectively realized in Service operation while controlling the risks of failure and disruption.

4) Service operation involves achieving effectiveness and efficiency in the delivery and support of services. It is critical to maintain stability in service operations while allowing for changes in design, scale, scope and service levels. Service operation covers issues such as managing the availability of services, controlling demand, optimizing capacity utilization, scheduling of operations and fixing problems.

5) Service improvement process is not limited to service operation. It involves creating and maintaining value for customers through better service design, transition, and operation by deploying principles and methods from quality management, process reengineering, and capability improvement.

Services pipeline includes services in the service design and transition stages while service catalog covers service in the transition and operation stages. The process framework provided in ITIL is very generic and can be used as a framework for managing service processes for various service industries. The process modeling and management frameworks presented in SOEA are complimentary to each other.

C. Information Dimension

We have developed a baseline data model, as depicted in Figure 2, according to our analysis of several service industries [9][13]. In order to reduce the complexity of the data model, the entity-relationship diagram does not show most of the attributes and many-to-many relationships are not decomposed into one-to-many relationships. The model illustrates key conceptual constructs required to support the management of information and knowledge about customers, service, and sales:

1) Service Area. Service category is the categorization of services to be sold. In our data model, the Service entity can be classified into various Category entities. A category can be refined into subcategories via the recursive relationship "has-subcategories." This information allows customers to drill down through a category hierarchy during their browsing to find services. The Service entity may be further characterized by various attributes. Customers often use these attributes as search criteria. Attributes for different types of services may vary. Domain experts may help to identify these attributes in their industries. Additional service configuration information is needed for companies selling customized services (e.g., a tour package) that have various optional service items (e.g., hotel stay, a visit to Disneyland, dinner). The Service entity can be related to the Cross-Sell entity and the Up-selling entity. The cross-selling and up-selling information can be entered manually based on employee's knowledge about services. Using market-basket analysis, we use customer’s service consumption data to generate cross-selling and up-selling information [12].

2) Customers Area. Target marketing and market
Segmentation relies on data about a customer's demographics consisting of location, lifestyle, and services purchased. For example, a company can use criteria such as recency (how recently customers have purchased a company’s service), frequency, and monetary value to segment its customers for target marketing [12]. Customers’ feedback regarding services is important information that a firm should collect from its customers. This information is captured via the Review entity between Customer and Service.

3) Sales Area. Sales data links customers to services. Service ordering records can be used as input to facilitate personalized interaction with customers. By capturing a marketing campaign via the Promotion entity and relating it to sales data, companies can analyze the effectiveness of marketing campaigns as compared to a non-campaign period. Sales data can be consolidated into a subject area of a data warehouse consisting of a service sale fact table and other factors defined as dimension that may affect the customer’s service purchasing decisions [12]. This is the first step towards transforming customer data into information and knowledge. We can then use data mining tools to analyze the information in the data warehouse to create patterns and rules that may explain customers' service purchasing behaviors and preferences.

D. People Dimension

People including customers and employees, are at the core of service delivery. Vargo and Lusch developed a service-dominant logic for economic activities and marketing [21]. Interactivity, integration, customization, and coproduction are the hallmarks of such a service-centric view. Customers are co-producers of service delivery experiences. Service providers and frontline workers who interact with customers should have specific personalities so that they are able to build rapport with customers during the service delivery. An enterprise should identify segments of customers for their service offerings as well as recruit and train its employees with a service-oriented attitude.

In a service-oriented enterprise, its business units are designed to support the frontline workers who interact with customers. Human workflow systems need to be streamlined such that clear responsibility and authority are defined. Companies should also tap into the flexibility and intelligence of their employees to provide personal and customized services. Finally, at the operational level, companies may use service teams to ensure that customer expectations are fulfilled.

E. Motivation Dimension

Motivation dimension includes service strategy at the highest level, service goals at the tactic level, and service quality (service performance measure) at the operational level. Service strategies are supported by service offerings and can be developed based on one of the three generic competitive strategies: cost leadership, differentiation, and focused market. Service goals are defined to ensure the successful implementation of service strategies. Eventually service quality is used to track the performance specific service process and service encounter.

Measuring the service quality is a very challenging task due to the subjective nature of customer satisfaction regarding services. Service performances should be defined from the customer’s perspective and should include both hard measures and soft measures [24]. SERVQUAL is a survey instrument developed along five quality dimensions (i.e., reliability, responsiveness, assurance, empathy, and tangibles) across a variety of service contexts [16]. It can be used to measure the customer gap which is the gap between customer expectation and customer perception based on the service gap model [23]. The customer service satisfaction gap may be caused by four provider’s gaps in service requirements, design, delivery, and communications [8]: (1) The communication gap: the gap between service deliveries promised and how these services are communicated to external customers. (2) The delivery (performance, conformance) gap: The gap between the customer-driven service design and standards and the service that actually delivered to customers. (3) The service design (design and standards) gap: The gap between service design and standards and the company perceptions of customer expectations. (4) The requirements (listening or market research) gap: The gap between expected services from customer viewpoint and the company perceptions of customer expectations. The performance measure of service quality should have a clear line of sight linking technical performance measure to service process performance, then connecting service process to customer results and business results, and eventually tying them to strategic goals and outcomes. Performance data should be collected as a byproduct of service encounters (instances of process execution). However, some
soft measures need to be collected via customer survey.

IV. CONCLUSION

Enterprise architecture has been defined as “the organizing logic for business processes and IT infrastructure reflecting the integration and standardization requirements of the company’s operating model [17].” It has been used by UPS in building a solid foundation for new services and by Washington D.C. government in supporting its customer-focused service delivery strategy. Enterprise architecture has become more business-driven comparing to IT architectures. The service-oriented enterprise architecture we proposed take a step further to focus on services as the core of an enterprise and provides a long-term and integrative view of a company’s service, process, information, and motivation for the planning, analysis, management, and implementation of services.

We have incorporated several important service management frameworks into the service-oriented enterprise architecture. Figure 3 is the meta-model for major constructs in SOEA. A meta-model represents the structure of the repository for all the service modeling frameworks and can be used to integrate various modeling tools. It can be used to provide a context for navigating all service related information and related modeling constructs [6]. Entities in this model represent views at different levels of abstraction while the relationships among various entities represent either the refinement of a model element or association of modeling constructs across multiple aspects of the SOEA. A few selected attributes of some entity types are displayed in the model.

We are working on detail mapping of existing service frameworks’ modeling constructs to the constructs identified in the SOEA meta-model. We are in the process of applying SOEA in assisting organizations in planning their transition to service-oriented enterprise including a government agency that is implementing an e-government initiative.

REFERENCES