

Engineering The Extended Enterprise

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Abstract

Virtual and Extended Enterprises, frequently referred to as a Supply Chain are increasingly becoming a means of competitive advantage. However, most of the literature presents a case history with little attempt to generically apply the concepts of the extended enterprise to more complex industries. This paper presents an overview of the evolution from localized shop floor improvement through supply chain management to the concept of the extended enterprise. A description of the three categories of processes is presented with a view to their application in the engineering of the extended enterprise. A discussion then follows on the ownership of each of these processes.

Keywords: Supply Chain, Extended Enterprise, Enterprise Models

1. Introduction

In today's global competitive environment, each enterprise must continually improve. Today's manufacturing environment is characterized by dramatic and often unanticipated change. In this difficult and challenging environment, the manufacturing enterprise must develop and implement new and innovative strategies for competitive success. A single enterprise no longer can provide the maximum value to many of today's more demanding customers. An increasingly popular solution to maximizing value to the customer is the concept of the virtual enterprise. "The virtual enterprise is a temporary relationship with two or more participants which is formed, operated, and dissolved to accomplish specific short term goals and differ from existing inter-organizational models by the degree of shared accountability and responsibility of the participants and the structure by which companies contribute their competencies" [1]. Designed to be opportunity based, the virtual organization is a pragmatic tool for competitors who are seeking a strategic concept to use in a environment of change and uncertainty. The evolution to the virtual enterprise began in manufacturing and continued through to supply chain management and beyond.

Manufacturing witnessed a progression of initiatives aimed at improving various elements of the organization and then integrating them into a well-defined system. In the seventies, many companies focused on Total Quality Management (TQM). In the early eighties, many companies implemented factory automation in various "islands" on the factory floor. In the mid-eighties, these same companies were focusing on how to integrate these "islands of automation." Flexibility became a key component in the factory of the future. Flexibility was defined as the ability to respond to known or anticipated changes in product mix and quantity. Agility took this one step further as encompassing the ability to respond to unanticipated change. The next level of improvement was to extend beyond the factory to suppliers.

Supply chain management has had a similar progression over the years. In the 1980s, improvements focused on solving specific quality problems, generally at the first tier in the supply chain. The so-called "first tier" suppliers are typically comprised of independent suppliers making parts for integration into a final product by a large company. Shifting inventory risk from the large company to the supplier base was the primary strategy applied during this period. After identifying problems at the supplier level and interface problems between suppliers and large companies, suppliers typically improved through small increments in process control. In the early 1990s supplier development achieved marginal improvements through myopic project-driven plans characterized by limited joint problem solving, strategic partnering, information sharing, and process ratings capabilities with an emphasis on improving inventory management. This period was characterized by cross-functional teams of primes and suppliers

working to improve process capability and implement compatible systems interfaces with a limited contribution of suppliers' engineering knowledge to new product development.

Today, competitive pressures have greatly intensified to the point where supply chain initiatives must yield greater improvements than ever before. This challenge requires a holistic solution that takes into consideration all aspects of the entire supply chain from a systems view. Typically, supply chain efforts focus on a one-time design of the strategic level issues regarding the supply chain or alternatively, the design of operational level decision support for "optimizing" the supply chain. This paper addresses ownership of the various processes with a view to maximizing customer value.

According to the Second Annual IndustryWeek Census of Manufacturers almost a third of plants surveyed have greater than 98% on-time delivery. According to the same study, almost 80% report "customer participation in new-product development." [2]. The supply chain is a critical link in the interlocking chain of elements that must achieve breakthrough advancements including all aspects of the enterprise including design. Without a committed supply chain delivering "the right part at the right time and for the right price", many short-sighted companies continue to lose market share. An important component of lean and agile initiatives, supply chain improvements affect processes in factory operations, business systems, and engineering design in the interest of reducing costs, improving quality and shortening delivery cycles.

As an enterprise seeks to continually improve, it must continually widen the scope of improvement. A local optimum is really not an optimal solution at all. According to Goldratt, "A system of local optimums is not an optimum system at all; it is a very inefficient system." [3] This concept is described even more radically by Russell Ackoff, (as quoted by Martin) "If each part of a system, considered separately, is made to operate as efficiently as possible, the system as a whole will not operate as effectively as possible." [4] As the scope of the effort increases, so does the complexity. A common method for reducing complexity for analysis and design is to use models.

2. Models

A model is a representation of reality. Details that are unnecessary are not included in the resultant model. A model of the extended enterprise can provide useful analysis to aid in the initial as well as the on-going configuration of the extended enterprise. The model itself can be a useful communications tool to aid in developing a common understanding of any situation including that of the extended enterprise. Extendable enterprises are by their very nature, extremely complex. A model of the extended enterprise can greatly reduce this complexity. A model of a real system is a representation of that system in another medium, usually in a simplified form. The key to building useful models is to define the primary question that the model is intended to answer. Models can be descriptive or prescriptive in nature.

Models can also be classified as static and dynamic. Dynamic models tend to be descriptive. An estimate of the system performance is provided based on the values used for the set of decision variables. Static models attempt to provide a snapshot of dynamic systems. Static models generally portray the possible flow paths of objects through a system. This information is very helpful in determining what items participate in the process and the functions performed by the system. Although static representations can indicate the allowable system behaviors, they cannot depict the range of time-variant behavior generated as a result of resource availability or the number of items flowing through the process. To adequately predict the performance characteristics of dynamic systems, the time-variant behaviors of the system must be able to be defined and represented. Dynamic representations of systems attempt to capture and describe the behavior of the system over time under different operating conditions. Although the static system representations are capable of providing the vast majority of the information needed to construct a dynamic systems model, they do not possess the mechanisms needed to enact the process behavior constraints defined in their representations. Discrete-event simulation tools, in contrast, are capable of executing sets of system behavior roles and tracking the system's transition through a series of states. In this manner, a dynamic model can provide information about the state of the system at a given instance in time or can generate performance measures of the system over a given period of time. Dynamic models can be used iteratively to study system behavior under different operating conditions. Subtle changes in resource availability or system loading can have dramatic effects on the performance of the system. This range of potential behaviors is very difficult to represent with a static system model.

3. Extended Enterprise

In addition to the literature on supply chain, there is also substantial research on extended enterprises and virtual organizations. Goldman, et al., define the virtual organization as a "dynamic organizational tool for agile competitors [5]. They clarify their definition by stating that these virtual organizations are neither temporary or permanent. Research commonly referred to using three different terms can be gleaned for use in supply chains:: supply chain, virtual organizations (companies/enterprises), and extended enterprises. First, a description of the three categories of processes is presented and then this is tied to the extended enterprise.

Presley, et al. [6] propose that business processes may be placed into three categories: Category one processes are those processes which transform external constraints into internal constraints (set direction). Category two processes are those processes which acquire and make ready required resources (acquire resources). Category three processes are those processes which use resources to produce enterprise results (transform). By providing categories to organize processes, more holistic enterprise designs may be achieved. Figure 1 shows activities (boxes) arranged into business processes (ellipses). The business processes are organized into an enterprise represented by the larger box. At this high level of abstraction, the enterprise itself is represented as an activity that takes inputs and transforms them into outputs using available resources under the bounds of a set of constraints. Although the boundaries are shown in the figure as solid lines, the open nature of the enterprise could be represented by dotted lines. However, it is important when modeling to define these boundaries and identify those details beyond control.

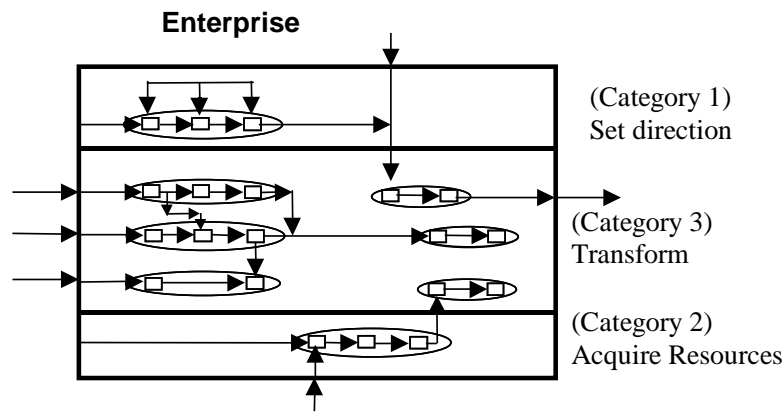


Figure 1: Three Categories of Processes

Frequently, the only activities or processes considered in general modeling and improvement activities are those listed as category 3, which transform inputs into products and services. Many supply chain models consider category 2 to some degree. However, it is important to consider all three process categories in an enterprise. Understanding the different process categories is vital in developing useful representations. Engineering the extended enterprise must consider all three of these categories. The frequently overlooked categories of setting enterprise direction and acquiring and preparing resources are more likely to be considered with a proper understanding of these categories.

The concept of an extended enterprise introduces a higher level of complexity when compared to the analysis of a single enterprise since an extended enterprise expands the scope to include additional processes performed by other enterprises. Defining and coordinating all of the business processes comprising an extended enterprise is significantly more difficult than coordinating the actions of a single business entity. The increased interaction between the various enterprise processes adds to this complexity.

The operation of a process oriented and highly flexible extended enterprise mandates that all activities, information, resources, and organizational issues be carefully integrated. Figure 2 shows that the enterprise consists of a set of business processes from category 1 which are collectively owned by each individual enterprise. The individual

enterprise models need only link to the details of category one processes. Category 2 and 3 processes relevant to the extended enterprise are included in all models.

The formation of each extended enterprise should be viewed as a temporary or transient state with the ability to form and dissolve based on dynamic market opportunities. This dynamic nature of the extended enterprise presents significant challenges to the understanding of the current status of an extended enterprise and greatly inhibits the analysis and improvement of such a possibly short-lived enterprise. These extended enterprise analysis approaches must represent the core business processes of each business entity participating in the virtual organization.

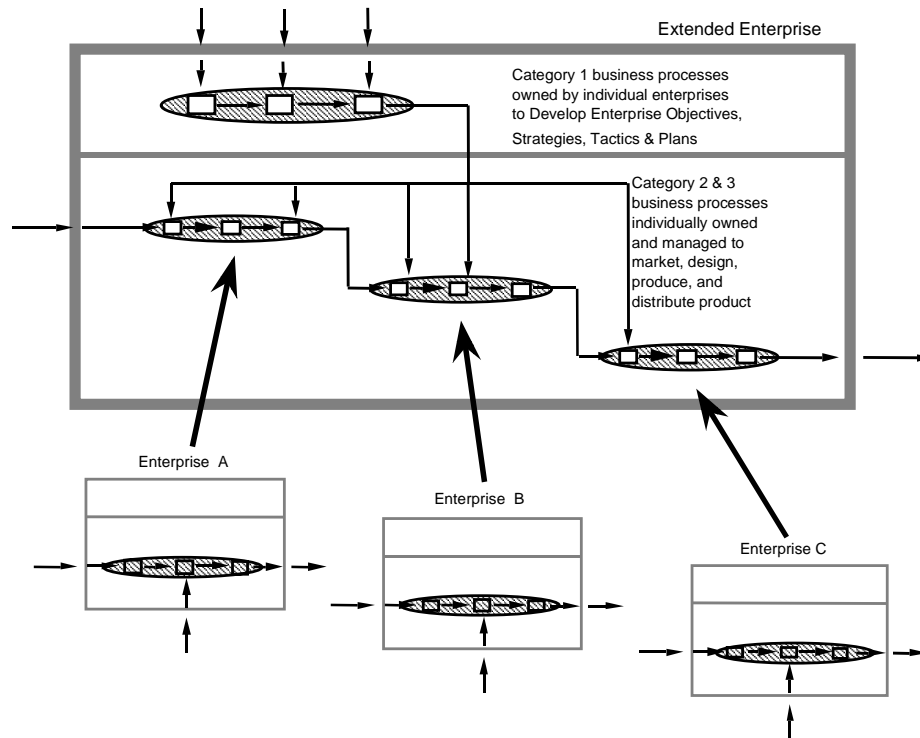


Figure 2: Extended Enterprise (adapted from [7])

4. Summary

Supply Chains, Virtual Enterprises, and Extended Enterprises all refer to similar aspects of the enterprise. Virtual and Extended Enterprises, frequently referred to as a Supply Chain are increasingly becoming a means of competitive advantage. However, most of the literature presents a case history with little attempt to generically apply the concepts of the extended enterprise to more complex industries. This paper presented an overview of the evolution from localized shop floor improvement through supply chain management to the concept of the extended enterprise. A description of the three categories of processes is presented with a view to their application in engineering of the extended enterprise. By facilitating each enterprise utilizing its core competency, customer value is maximized. By focusing on the three categories of processes, the extended enterprise nears its optimal configuration. By developing a model of the extended enterprise, the inherent complexity is reduced leading to common understanding enabling more complete analysis and design of the extended enterprise. All of these factors lead to a near optimal design of the extended enterprise.

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