Business Process Model: An Objective Description

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(Abstract)
Standards developed by various organizations do not facilitate correct interpretation of business processes unless the standards are based on objective criteria of process decomposition and account for an integrative role of information. Aspiring to contribute to the emerging science of processes, the presented model of business and manufacturing processes is the first step to a formal objective systematic description of processes, and the ergo-transformation processes in particular. This step is vital for embedding some aspects of intelligence into software and hardware.

Keywords: business process, management and control of process, classification of processes, decomposition and integration of systems, information process, system description

INTRODUCTION

Business process analysis, as a way to improve enterprise efficiency, is as old as business. However, about 20 years ago, a new concept of reengineering (introduced in the articles and books by Thomas Davenport and James Short [6, 3] and Michael Hammer and James Champy [9, 10] started a movement that caused a paradigm shift in the analysis and design of business systems. Process approach, the essence of reengineering, became a standard in restructuring business organizations.

The final results of reengineering are still the subject of controversies; they are criticized, and the reasons for failures are widely discussed, including the self-criticism of the pioneer process engineers. Hammer and Champy [10] said, "Our unscientific estimate is that as many as 50 percent to 70 percent of the organizations that undertake a reengineering effort do not achieve the dramatic results they intended" (p. 200). Davenport [4] analyzed faults of reengineering while trying to answer a question, "How did a good idea go off the tracks so badly?" We have not attempted an exhaustive review of the broad wave of criticism because it has been already completed. Hundreds of articles, books, journal special editions, conferences, survival guides, and case studies have left almost no aspect of reengineering untouched. Two books, both entitled "Business Process Change" [8, 11] but written about ten years apart, discussed various techniques and methodologies, with suggestions about how to successfully implement process changes.

Trying to understand the reasons why an idea acclaimed by so many as being a great one brought such a disappointment, we concluded that the reasons for its failure are rooted in a non-objective approach to process analysis. A lack of objective classification of processes to discern various processes in a system is one of two major causes of this non-objectiveness. The other cause is a lack of objective criteria to explain vital inter-dependencies among processes. Without clear criteria, analysis and results depend on improvisation rather than a procedural description of elements and relations in a business system. Hammer and Champy [10] said, "… identifying the company's major processes is a crucial early step in reengineering," and they emphasized the "importance of understanding specific processes before attempting to redesign them" (p. 108 and p. 117). However, the authors and their followers have not offered any objective guidelines for identifying, decomposing, and describing these processes. Jang [12] emphasized the importance of "identify[ing] components of the business process, … subprocesses, … hierarchy of the components of the business process, … precedence relationship among the activities and information flows" (p. 213); however, they did not offer suggestions about how to accomplish the task objectively.

Currently, thousands of businesses all over the world are struggling to improve their business processes, and many attempts are being made to help organizations cope with business process improvement by developing standards. For instance, the Supply Chain Council developed the Supply Chain Operations Reference model (SCOR), defining top level supply chain processes [21]. The APQC (American Productivity and Quality Center) created Process Classification Framework (PCF), in which they classify processes as operating processes and management and support processes [19]. A group of researchers from MIT published a book called *MIT Process Handbook*, which describes more than 5000 processes and business activities [13]. The ISO 9001 2000 Quality Management System identifies 22 processes in the enterprise

[20]. Various business process standards were reviewed by Davenport [5].

All of these standards define, identify, decompose, and describe processes in the enterprise. However, they refer to processes from the general perspective of the enterprise by analyzing, describing, and suggesting improvements on the enterprise scale. Davenport [3] said, "… process perspective implies a horizontal view of the business that cuts across the organization" (p. 7). On this scale, according to Davenport, IBM identified 18 processes; Ameritech, 15; Xerox, 14; and Dow Chemical, 9.

In our opinion, to be useful, the large-scale perspective should be complemented with a more detailed approach that reveals the elements and structure of the complex entity that we call the enterprise process. We are looking at the enterprise process as a complex set of entangled, interwoven elementary processes. Davenport and Short [6] write, "Business activities should be viewed as more than a collection of individual or even functional tasks; they should be broken down into processes that can be designed for maximum effectiveness, in both manufacturing and service environments" (p. 12). Moreover, later, they add, "There are more detailed processes that meet the definitional criteria above. These might include installing a windshield in an automobile factory…" (p. 13).

In the presented approach, installing a windshield is a complex set of interwoven processes with a primary process and various supporting processes, including information processes. Even a simple process of going to a restaurant, analyzed in the *MIT Process Handbook* (p. 185), can be broken down into several interdependent elementary processes. We are going to show an objective breakdown of processes into elementary processes and other regularities.

It is understandable that, in the complex reality of enterprises, even to identify and distinguish the most critical primary processes from those supporting them may be a problem. A more detailed and systemic approach can help reveal all the vital elements of the complex enterprise process. The presented approach is based on an objective taxonomy of elementary processes and a deeper understanding of their interdependencies and association with related information processes. Starting with the anatomy of the business process and the role of information, we are able to explain some generic aspects of a business process, an information process, and information.

IDENTIFICATION, ANATOMY, AND CLASSIFICATION OF PROCESSES

Various definitions of a process can be found in many sources. Davenport [3] defines it this way: "A process is simply a structured, measured set of activities designed to produce a specified output for a particular customer or market" (p. 5). The ISO 9001 2000 specification defines a process as "an integrated set of activities that uses resources to transform inputs into outputs" and enumerates its components: "A process is made up of people, work, activities, tasks, records, documents, forms, resources, rules, regulations, reports, materials, supplies, tools, equipment, and so on - all the things that are needed to transform inputs into outputs". Other sources also emphasize activities as an integral part of process definition. Since most of these definitions concentrate on activities, they do not account precisely for their outcomes and purpose.

We define a process as an ordered set of successive and interrelated *changing states of material or information* that is being processed from input to output through the interaction of personnel and equipment. We call it the *ergo-transformation process* if the process is oriented toward a specified outcome and designed and controlled by people (since almost all processes in business are ergo-transformation processes, we use the names "process" or "e-t process" interchangeably).

A very supportive definition is given by Gackowski [7], who defines process as a partially ordered network of state transitions or transformations of factors, where factor is anything that affects the results of operation.

Business, entertainment, warfare, and information systems are closely interwoven e-t processes. It is impossible to identify, explain, and understand the interdependence of all these processes without clear criteria of their decomposition.

Similar to the Porter's Value Chain, we distinguish primary and supportive processes. Porter [14] categorizes activities into primary and support activities. Primary activities entail a creation of the product, its sale, and after-sale service. Support activities allow the primary or support activities of higher order to take place.

We apply objective, uniform disjoint decomposition criteria (see Table 1). First, we ask whether a process serves external or internal needs. If the product of the process goes to the outside world, it is a primary process. If the process only supports the other processes within the enterprise, it is a supportive process. Among supporting processes, we distinguish two types: auxiliary and information processes. Auxiliary processes support people, equipment and infrastructure in all processes. Information processes process data and deliver information that represents business reality and directly or indirectly serves controlling business activities.

Independently of the type, each e-t process can be described as a *"three-sequence structure,"* where the primary sequence consists of changing states of material (or information). The second sequence is the work of people. The third sequence is the functioning of equipment. Figure 1 depicts the process divided into sequences; a *three-sequence structure* should be recognized as the first rule in the process definition. Analysis of the three-sequence structure shows the unavoidable necessity of each sequence to be serviced by a specialized supportive process (or processes); e.g., people involved in the process require services from Human Resources (P_P); the equipment requires maintenance and repair (E_E).

Classification Criteria	Processes in the Enterprise		
	A. Primary Process	**B. Supportive Processes**	
Outcome destination	Servicing the outside world	Servicing the other processes inside the system	
Internal or external output	Products or services go to the outside world	Products or services of these processes do not go to the outside world	
		B1. Auxiliary Processes	**B2. Information Processes**
Relationship with other processes	Being serviced by Supportive Processes	Support of two sequences of the serviced process { 1) preparation of people for the process 2) maintenance of the equipment }	Support and control of three sequences of the serviced process { 1) changing states of material/information 2) work of people 3) functioning of equipment }

Table 1. Criteria and Classification of Processes in the Enterprise

This unavoidable necessity of each sequence, to be serviced by a specialized supportive process, is considered to be the second rule in process understanding. All three sequences are serviced by information processes.

MEANING OF INFORMATION IN OPERATIONS

Since information underlies all core processes (primary and supportive) of the enterprise, the analysis and design of an information system cannot be done in isolation from these core processes. We need to show how information underlies all processes in the system. Most problems and misinterpretations in understanding the role of information in enterprise processes originate from a different interpretation of information. Information has been discussed broadly in many works [1, 2, 7, 15, 16, 17, 18, and others]. The difficulty in explaining the phenomenon of information is rooted in the fact that it is an abstract category, referring to thinking semantics and the way the material world is reflected in our minds.

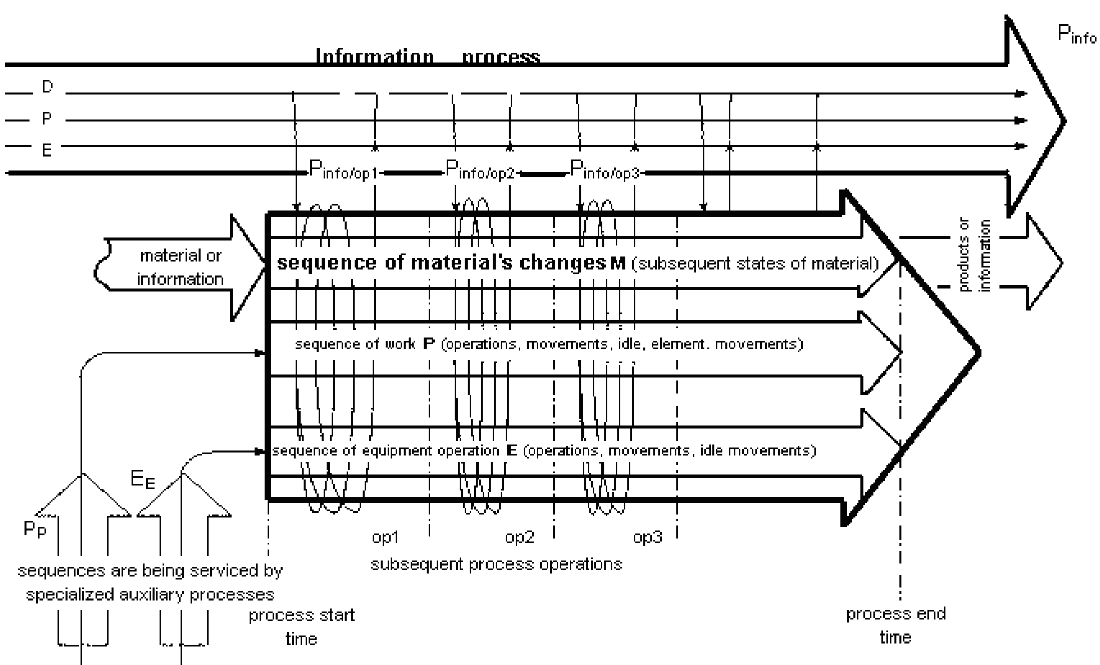

Figure 1. Three-sequence structure of the process and support from auxiliary and information processes

Information appears to be "*a result of confrontation*" between a picture in our mind of an existing object (i.e., image, vision, or projection) and the accumulated resources of symbols and models in our memory. In other words, information reflects the relationship of three objects: an existing object, the picture of this object in our mind, and accumulated resources in our memory. The materialized form of information (associated with material media) we call data; however, only this materialized form of information can be useful for computer processing. Any information process, with or without the aid of a computer, is similar to other material processes but involves processing a different type of material, i.e., information. A fundamental feature of the material process, the three-sequence structure, can be found in every information process.

Figure 1 illustrates the dependence of all e-t processes on information processes. Not going into details, we can see that the information process accompanies every stage of the serviced process. This unavoidable necessity for each process to be serviced by an information process is the third rule in understanding business process.

The information process, the same as any other e-t process, has stages that can be defined. We distinguish four major successive phases in the processing of information:

1. prospective determining of parameters and standards for the process that will be serviced by an information process;
2. planning of the serviced process;
3. retrospective recording of the real performance of the serviced process; and
4. current regulation of the serviced process.

Figure 2 illustrates these phases, dependency, and feedback between the servicing information process and the serviced process (for simplicity, the picture does not show external inputs and outputs). Four phases of an information process are considered to be one more rule in describing an organization's processes. For example, in manufacturing these four main phases of the information process can be identified as

1. preparation of the serviced process (e.g., market analysis, marketing, R&D, construction design of a product);
2. planning of the serviced process (production planning and scheduling);
3. data collection (production reporting); and
4. regulation (control) of the process.

INTERDEPENDENCE OF PROCESSES

Each e-t process in an organization requires service from supporting processes. All processes, except the primary process, are servicing other processes. The relation between processes may be expressed according to an objective criterion - the process may be a servicing one or one that is being serviced. The primary process is the only process within the system that does not service other processes (the primary process is servicing the outside world). The other processes are servicing ones, but each of them needs to be serviced by a set of supporting processes.

Using this criterion, Figure 3 presents an example of interdependence and the relations between primary, auxiliary, and information processes (for simplicity, the picture does not show external inputs and outputs). Both auxiliary processes of the second order, are servicing two sequences of the primary process. The first auxiliary process of the second order, consisting of three sequences (P_P, P, E), is servicing the sequence P (work of Personnel) of the primary process. The other auxiliary process of the second order, consisting of three sequences (E_E, P, E), is servicing sequence E (operation of Equipment) of the primary process.

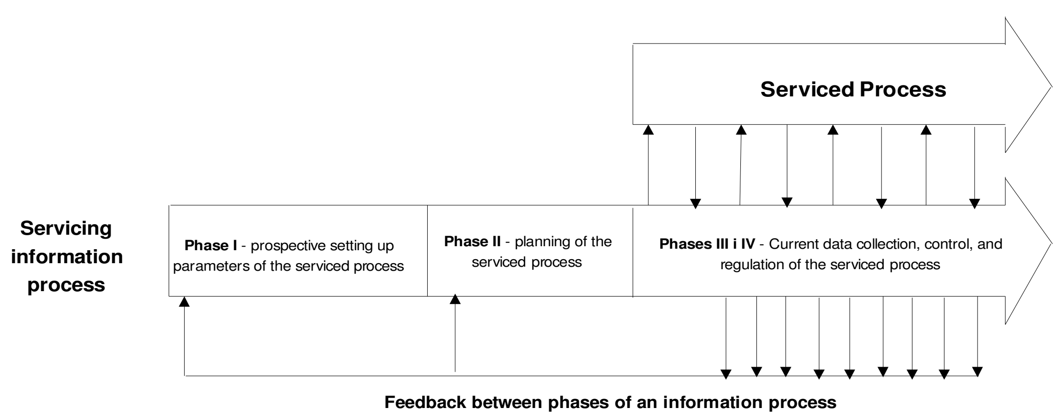

Fig. 2 Phases and the flow of feedback and control information between information process and the serviced process

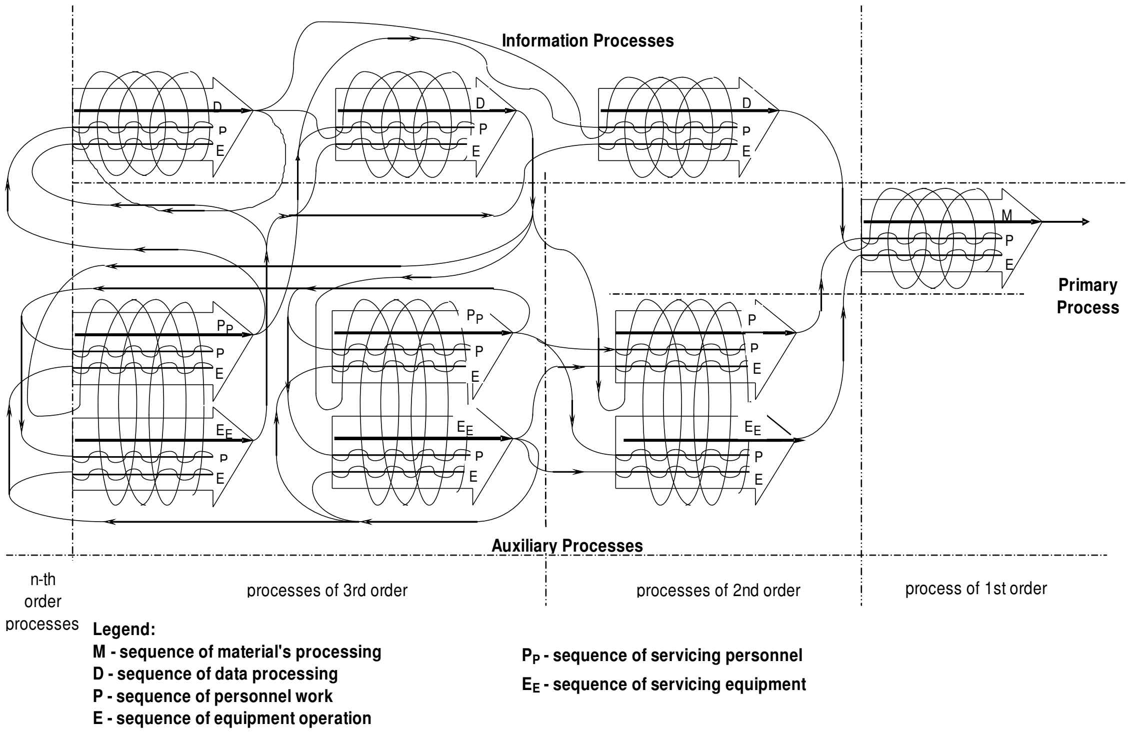

Fig. 3. An example of dependencies and relations between primary, auxiliary, and information processes.

The information process of the second order (D, P, E) is servicing the primary process. At the same time, these three processes of the second order are being serviced by the processes of the third order. Two auxiliary processes of the third order (those bottom, left-most in the figure) are servicing all three information processes and themselves.

In an actual system, we often observe a growing cascade of information and auxiliary processes. As we can see, the cascade of supporting processes always ends up with a self-servicing loop. It is an example, where auxiliary and information processes are self-servicing. As an example of a self-servicing loop, consider that a Human Resources department is hiring and training people for their own department. On the other hand, a repairman may not be able to fix his own equipment, adding one more loop to the cascade of auxiliary processes. It is a matter of the designer, necessity, or tradition to close up a process with the self-servicing loop. Cascading information processes allow distinguishing special kinds of processes that can be called information processes management. They are, briefly speaking, higher information processes that control other information processes of a lower order.

A real-life enterprise is a very complex object. Although our way of analysis looks complicated, it is manageable with available computer-aided techniques, protocols, and frameworks. We do not believe there is any simple solution for an ever-increasing complexity of developing and operating computerized systems.
It is a common expectation that artificial intelligence will support the management and control of the enterprise of the future. This requires an unambiguous objective-criteria-based description of the enterprise, including all of its processes. We do not have many choices about how to teach a computer the complexity of the real-life enterprise. Whatever methodology we choose, objective process and system description cannot be bypassed.

CONCLUSIONS

With the insight and understanding of business process, at any stage of its engineering, all factors contributing to its performance can be assessed to be subsequently measured, modified, eliminated, or added, if needed. Without a clear picture of processes and their interdependence, it is difficult to obtain full project support of management, workers, and staff.

Currently, thousands of enterprises are involved in reengineering their processes, and any constructive help may revitalize projects and save billions of dollars. In any economy, full understanding of business processes is critical for eliminating unproductive costs.

An objective analysis of processes should precede the design of how to create a value chain of processes that cooperate smoothly and profitably. Mergers, divisions, and restructuring require objective evaluation of all processes that are going to be changed, redesigned, linked, or removed.

A precise process description is the first and most important step in process improvement, however, the complex restructuring of the whole enterprise requires further analysis of all resources, including administration and production cells.

Based on multiple observations and verifications in practice, we realize that the process analysis presented in this article can be applied to manufacturing, financial organizations, insurance, military logistics, and other purpose-oriented enterprises, including even some exotic systems such as artificial life or self-healing computers.

An unequivocally defined set of processes, based on objective criteria, can be a starting point for an electronic backbone/framework that describes the enterprise.

Process description, leading to the system's description (and decomposition), is an unavoidable step in the description of a computer system for the computer, leading to the design of a self-aware/self-learning computer.

Description of a system, its environment, and communication with an artificial intelligence must be based on unambiguous criteria. Only a precise description can lead to embedding intelligence into software and hardware.

An unequivocal description of processes in a system should be the first step to an effective methodology of systems engineering.

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