

# Business Process Oriented Information Systems

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## Abstract

Successful business performance is greatly dependent upon the coordination and optimization of the system of interdependent linkages within the value chain of a firm (Porter 1985). This issue has also been described as interdepartmental dynamics, a major component in the Market Orientation Theory (Jaworski and Kohli 1993). The minimization and optimization of interfaces and hand-offs is a key strategic thrust of many businesses today. What if the interfaces and hand-offs are built into the information systems used by the new organizations? Will a process oriented redesign of the work overcome the legacy of the software's structure? The system development paradigm of today is to define "functional" chunks of activities in the firm that will need information and transaction systems and develop the system as defined by these chunks. Interfaces and information hand-offs are then built into the system. This firmly imbeds the functional organization into the nervous system of the organization thus building roadblocks to a business process flow of information without hand-offs.

This paper describes a new paradigm for software development combining a business process view of the organization with object orientation to create a seamless business process oriented information system. This will result in a value added structure of the system and data that matches the way work is naturally performed in an organization rather than matching the authority structure. This is proposed to have a dramatic effect on the return on investment for information systems in an organization resulting in improved business performance.

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## INTRODUCTION AND PURPOSE

Successful business performance is greatly dependent upon the coordination and optimization of the system of interdependent linkages within the value chain of a firm (Porter 1985). This issue has also been described as interdepartmental dynamics, a major component in the Market Orientation Theory (Jaworski and Kohli 1993). The minimization and optimization of interfaces and hand-offs is a key strategic thrust of many businesses today. Information Technology has been clearly positioned as providing a new approach to this, management's oldest organizational problem: managing interdependence (Rockart, 1989). Significant information technology investments have been made during the past decade directed toward this goal. Since 1986, the marginal benefits of these investments have been only 80% of their incremental costs (Wilson, 1993). Significant process redesign or reengineering efforts have also been implemented with similar poor success records (Davenport, 1995). It is now clear that the key to achieving benefits is coupling the use of technology directly to business reengineering efforts. Technology helped increase business performance only when it was used to support new and better ways of conducting the business. Adaptivity of both the organizational processes and the supporting information systems was also very key to the limited successes encountered (Taylor, 1995).

The system development paradigm of today is to define "functional" chunks of activities in the firm that will need information and transaction systems and develop the system as defined by these chunks. Sales, Marketing, Manufacturing, etc. all define their "chunks" differently with a different language. Interfaces and information hand-offs are built into the system. This firmly imbeds the functional organization into the nervous system of the organization thus building roadblocks to a business process flow of information without hand-offs.

The organizational processes are designed by different practitioners with different backgrounds using different techniques to achieve different goals. The horizontal organization is the current vision of an organization built around business processes rather than internal functions (Byrne, 1993). The results of these divergent designs, I.T. and the business, create incompatibility, frustration and inefficiency in the interdependent linkages in a firm.

This paper describes a new paradigm for software development combining a business process view of the organization with object orientation to create a seamless business process oriented information system. This will result in a value added structure of the system and data that matches the way work is naturally performed in an organization rather than matching the authority structure. This is proposed to have a dramatic effect on the return on investment for information systems in an organization resulting in improved business performance.

## FUNCTIONAL V. BUSINESS PROCESS ORIENTATION

### *Functional Orientation*

Adam Smith, in 1776, described the concept that industrial work should be broken into its simplest task. This became the basic model of business for almost two hundred years (Hammer 1993). J.P. Morgan, Andrew Carnegie and J.D. Rockefeller began the restructuring of the railroads and American industry using the basic principles of Adam Smith and the new concept of management work or hierarchy. Twenty years later, Pierre S. duPont began the second evolution by restructuring the family business into the modern corporation. Alfred Sloan also began to redesign General Motors and further defined the business model. This institutionalized command and control, decentralization, central staffs, the concept of personnel management, budgets and controls. This model is our tightly defined, tightly controlled, functionally centered organization of today.

A hierarchy of skilled managers was necessary to coordinate the functional activities, manage the information flow and interface with the other functions in the organization. The better the focus and coordination of the company resources, the more profitable the business.

The functional view of the organization is best described by the organization chart (Fig. 1).

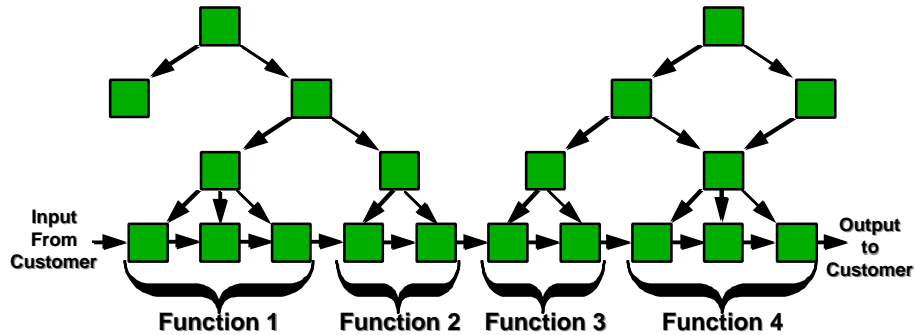


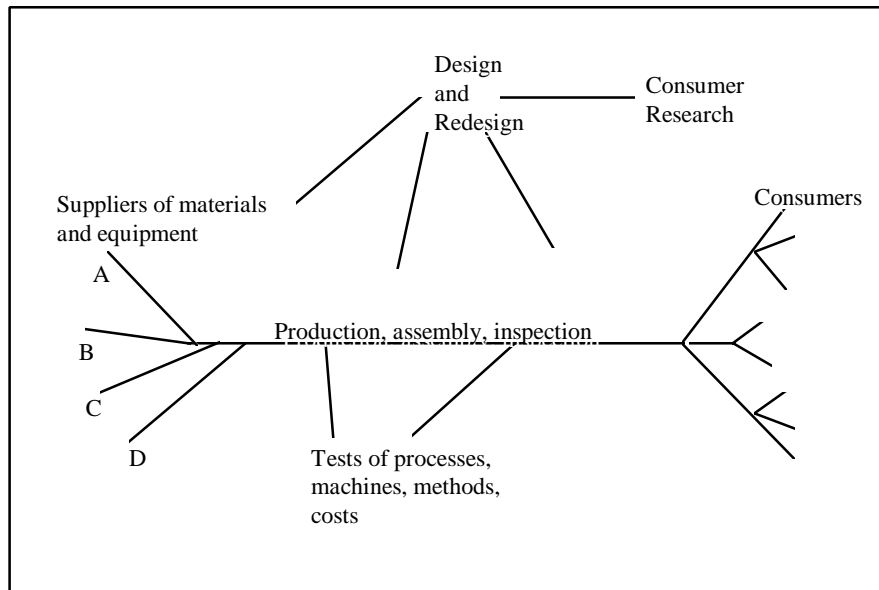
Figure 1. The Typical Organization Chart

This chart shows which people have been grouped together for operating efficiency and it shows reporting relationships. What is not shown is the what, why and how of the business (Brache, 1990). In functionally centered organizations, hand-offs between functions are frequently uncoordinated (Davenport, 1990). The greatest opportunity for performance improvements lie in the functional interfaces - the points where the “baton” is being passed from one function to another (Brache, 1990).

Too often, what’s being managed is the organization chart, not the business. Just as often, the information system is built reflecting the organization chart, not the processes that are operating in the company. When the organization chart changes, can and should the system respond? By the time a system is complete, using the traditional information engineering life cycle, is it still relevant?

#### *The Concept of Business Process Orientation*

Edward Deming developed the “Deming Flow Diagram” depicting the connections across the firm from the customer to the supplier as a process that could be measured and improved like any other process (Fig.2) (Walton, 1986).



Deming - *Out of the Crisis*

Figure 2. The Deming Flow Diagram

Thomas Davenport and James Short (1990) described a process orientation, as opposed to a functional orientation, in an organization as a key component in the “New Industrial Engineering: Information Technology and Business Process Redesign.” They defined a business process as a set of logically related tasks performed to achieve a defined business outcome that have customers and that cross organizational boundaries. Michael Hammer also presented the business process orientation concept as an essential ingredient of a successful “Reengineering” effort, a term used by Hammer to describe the development of a customer focused, strategic business process based organization enabled by rethinking the assumptions in a process oriented way and utilizing information technology as a key enabler (Hammer, 1993). Dr. Hammer offers Reengineering as a strategy to overcome the problematic cross functional activities that are presenting major performance issues to firms. Many firms have also begun to believe that the quality of their products and services can best be addressed by focusing on the improvements of the processes that create the products and services rather than the product and services themselves (Elzinga, 1994).

Several models have emerged during the last few years that have been presented as the high performance, process oriented organization needed in today and tomorrow’s world. Deming, Porter, Davenport, Hammer, Byrne, Short, Imai and Drucker have all defined what they view as the new model of the organization. According to each model’s proponent, the “building” of this model requires a new approach and will result in dramatic business performance improvements.

Porter suggests that the coordination and optimization of the system of interdependent linkages, defined as the “value chain”, could have a major impact on a firm’s performance (Porter, 1985). Hammer states that the identification and redesign of the problematic work that requires cooperation and coordination of several different departments within a firm will lead to business performance improvements (Hammer, 1993). The relationship between Interdepartmental Dynamics, as defined by the organization’s measure of *conflict* and *connectedness*, and Business Performance was clearly established by Kohli and Jaworski through a series of studies. Conflict was defined as the extent to which the goals of the different departments were incompatible and tension prevailed in interdepartmental interactions and

connectedness was defined as the extent to which individuals were networked to various levels of the hierarchy in other departments (Jaworski, 1993). Less conflict and more connectedness was shown to positively influence business performance. Each model fundamentally relies upon a process orientation that enables effective interoperability in building, maintaining and improving the model.

The models proposed all demand significant cross functional cooperation in order to build and operate them. They also clearly state that a *process orientation* or a *common process view* is essential to the model's performance and continuous improvement through the application of "process oriented tools". A process orientation involves elements of structure, focus, measurement, ownership, and customers (Davenport, 1993).

A process oriented organization must include multiple dimensions, as generally defined by a consensus of the models of Hammer, Deming, Davenport, Porter, Drucker and Imai. A successful process oriented organization must include (McCormack 1994) a:

1. *process view* of the business,
2. *structures* that match these processes,
3. *jobs* that operate these processes,
4. *management and measurement systems* that direct and assess these processes and
5. *values and beliefs* that are embodied in all components.

*Technology* that connects, enables and affects all other parts of a process oriented organization is also a major component in most of the models.

The process view of an organization is positioned by Brache as the starting point and foundation for designing and managing organizations that respond effectively to the new reality of cutthroat competition and rapidly changing customer expectations (Brache, 1990). The High Level Map (Fig.3) has been suggested as the process oriented version of the organization chart. Figure 4 shows the sub-processes that exist within the High Level Map. This "map" shows the processes that operate within and across a firm that create value for the customer and creates a framework for building the process orientation of the firm. The processes are defined by the market, customer focus and the firm's value proposition in that market and correspond to the natural business activities (Hammer, 1993).



A major stumbling block to creating this framework is that a common cross-functional language does not exist within a firm to identify these natural processes (McCormack 1995). This inhibits cooperation across functions in the building of the process view. Functional tasks are usually understood and identified but the processes that cross the “traditional” functional interfaces remain unidentified and therefore, not understood and optimized. This lack of a common language to describe the cross functional processes presents a major barrier to the identification of these natural processes. The identification, classification and optimization can be accomplished using the “process oriented” structure widely used in operations management (Melan, 1985) combined with the language development process of Pei (1965). This approach, used across the many functions in an organization, can be used to develop a “system of agreements” or language (Hayakawa, 1978). The cross functional, process oriented classifying and organizing of the related activities performed in a chain to understand and satisfy the customer could provide a framework for the application of “process oriented” tools and organizational techniques. This development of a cross functional process language provides an organization the “ability to cooperate” (Hayakawa, 1978) and enables the Reengineering, creation and continuous improvement of a high performance horizontal corporation. The language process, as outlined by Pei (1965), most importantly results in the building of common understanding, a system of agreements, and therefore the ability to cooperate, cross functionally, in the building and operation of the new model.

A horizontal process based organization view or map might also be shown as in Figure 5 and referred to as “The IT Enabled, Process Oriented Organization” (McCormack, 1995). This is an organization that is in synch with its processes, people, suppliers, customers and enabling technologies. This map incorporates the concept of core competency centers, suppliers and the enabling aspect of I.T. The value adding business processes are shown as horizontal processes connecting suppliers and customers.

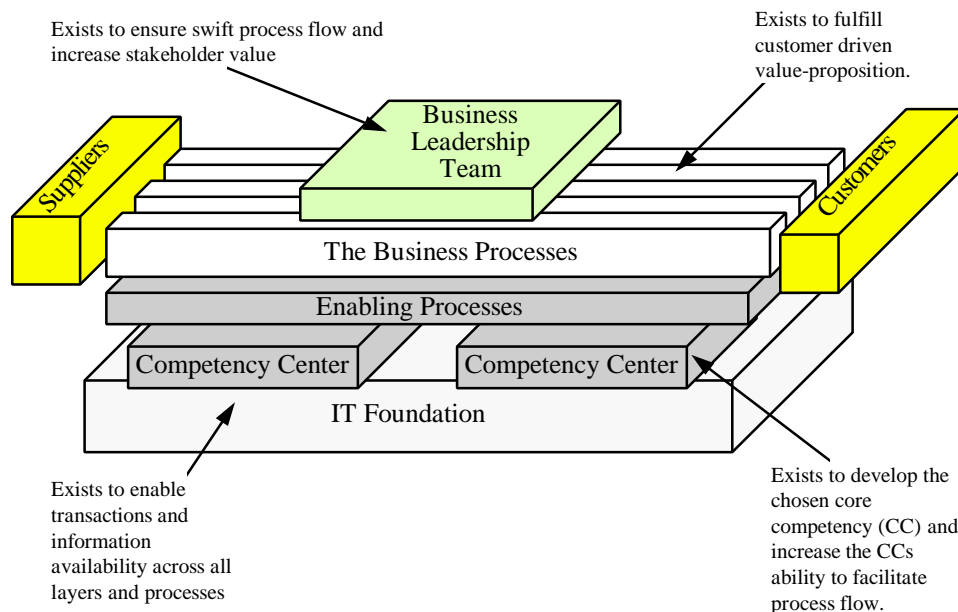


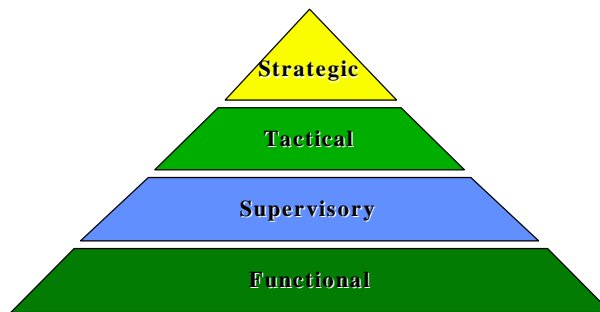
Figure 5. The IT Enabled, Process Oriented Organization

Should the new business process oriented organization’s information systems be constructed using this model and the language development process? Can a business’s process oriented organization work with a functionally oriented information system? If this is the responsive, adaptable, customer focused, operationally excellent company, can the current system development methods be successful?

## THE FUNCTIONAL DEVELOPMENT PARADIGM

### *Current Information Systems Development Methods*

Information systems have been described for many years using the pyramid as shown in Figure 6. Gore and Stubbe described the four levels of information systems as operational (functional), lower management (supervisory), middle management (Tactical) and top management (Strategic) (Gore and Stubbe, 1988).

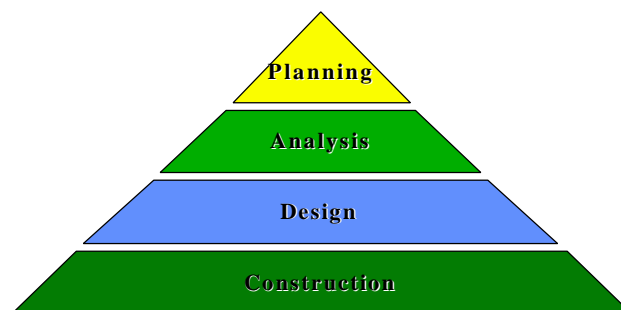


Source: Gore and Stubbe, *Elements of Systems Analysis* - 1988

Figure 6. The Information Pyramid

This fundamental structuring of information systems matches the organization chart and has been the starting point for most of the systems that we have today. It is still the predominate "view" of the systems profession. Information Engineering, a development discipline considered by many to best-in-class, uses the pyramid to categorize the activities and data required at each level of systems development (J. Martin, 1991). These levels are (Fig. 7):

1. Planning: The strategic overview of the functions and goals in an enterprise.
2. Analysis: The processes needed to operate the enterprise and their interrelation.
3. Design: The design of procedures for specified applications.
4. Construction: The design of detailed program logic.



Source: J. Martin, *Rapid Application Development* - 1991

Figure 7. The Information Engineering Pyramid

In the Planning phase of Information Engineering (I.E.), the business is organized and classified by the activities performed and the data required by these activities (Texas Instruments, 1988). This “chunking” most often reflects the organization chart since this is the predominant view of the business. In the design phase, the functional chunks are further decomposed and classified by the applications needed in that functional area. Sales needs a sales application, Marketing needs a marketing application, etc. By this method, the applications and the data are organized and constructed to reflect the functional organization, not the customer focused “flow” across the organization. This firmly embeds the interfaces and hand-offs into the system. Information systems design has long been oriented toward the broad functional organization structure making interrelationships between the individual functions difficult (Scheer, 1994).

*The Issue with this Paradigm*

This dichotomy between the software functions and data and the customer driven business processes invariably leads to incompatibilities and frustration (Taylor, 1995). This development paradigm results in imprisoned data within functions (Davenport, 1990). A study in 1991 of 33 valve manufacturing firms found that there was no relationship between total Information Technology (IT) capital stock and any measure of firm performance (Wilson, 1993). Rummler and Brache have suggested that the investments have resulted in functional optimization that sub-optimizes the organization as a whole (Brache, 1990). Figure 8 visually depicts their hypotheses of sub-optimization.

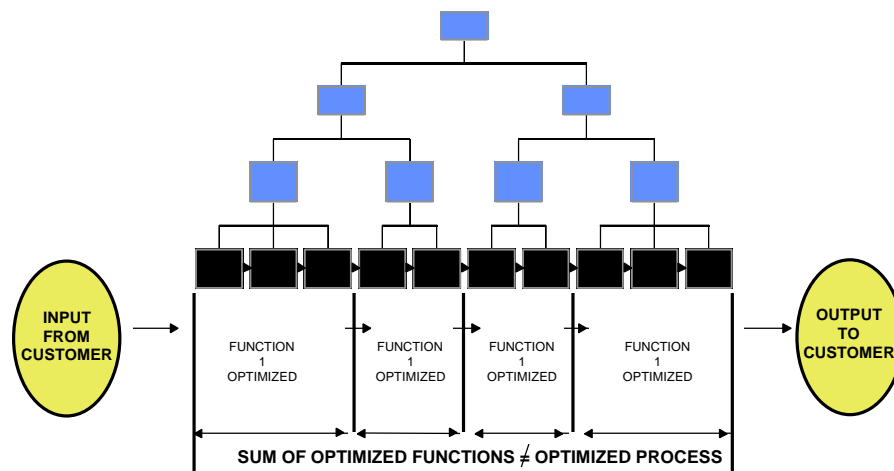


Figure 8. The “Silo” Sub-optimization Phenomenon

Not only is the function of current information systems sub-optimal due to the functional “silo” effect but the information about the business is also fragmented to the degree that business process information is often unavailable or so expensive to extract and combine that it is not done. This results in “information silos” that have created entire new technology markets, such as data warehousing and middleware, with the sole purpose of overcoming this problem.

The adaptability of the functionally developed system is greatly constrained by the design assumptions in the early phases of development. The I.E. development process relies on functional decomposition as a primary design technique. This process is based on breaking down a solution to a business problem, usually functionally defined, into smaller and smaller units of system functionality until the tasks can be carried out by relatively short segments of instructions that can be carried out by the computer (Taylor, 1995). Functional decomposition assures that the detailed structure of a business solution is woven into the fabric of the

application making integration difficult and structural revision often more difficult than starting over. For this reason, systems built with this paradigm are, by design, imbedded with the silo effect and are unable to change with a changing business environment thus institutionalizing by “coding in” obsolete business processes and practices. Function oriented data islands are created (Scheer, 1994). The functional “language” silos are also maintained thus further inhibiting cross functional or horizontal cooperation.

Porter's coordination and optimization of the system of interdependent linkages within the value chain of a firm is also greatly impaired resulting in high conflict and low connectedness as defined by Kohli and Jaworski. This high conflict and low connectedness results in a relative decrease in business performance (Jaworski and Kohli, 1993). This could be the reason that overall business performance was unaffected by the billions of dollars invested in information systems. A study of 20 companies that completed “reengineering” efforts found that if the redesign plans are sufficiently broad, as defined by horizontal and cross functional, then all the old support systems will become obsolete (Hall, 1993). Davenport suggests that had the model of the organization been process based from the start rather than functionally based, the systems would be more integrated thus enabling the natural business processes rather than impeding them (Davenport, 1990).

The software industry has responded to this problem by seeking faster ways to develop applications and developing “work around” integration tools such as middleware and data warehousing. Dr. David Taylor (1995), a recognized expert on systems development, has stated that

“... no reasonable degree of acceleration will allow the creation of new applications fast enough to meet the changing business requirements. ... the software silos that populate the landscape of our information systems are collapsing of their own weight, and building new silos faster is not the answer.”

## THE BUSINESS PROCESS / OBJECT ORIENTED PARADIGM

### *Starting with the Process Model*

Dr. Taylor proposes a solution to this dilemma. Engineer the business and it's supporting software as a single, integrated systems using what he calls *convergent engineering*. This approach suggests that the business design be implemented directly in the software with a minimum of translation or restatement. The goal of this new system development method, as stated by Dr. Taylor, is to construct software models that represent the structure and operations of a business as simply, naturally and directly as possible and build adaptivity into both organizational processes and their supporting information systems (Taylor, 1995). Davenport suggested that a process based model of the organization rather than a functionally based model, would be more integrated thus enabling the natural business processes rather than impeding them (Davenport, 1990). Beginning with a business process based model, as discussed earlier, would seem to fit the goal of “simply, natural and direct” but what can be used to make it an adaptive system? If the process based model is decomposed using the current I.E. paradigm, this would surely reduce the embedded hand-offs but could it be constantly and easily modified as the business environment and business processes change? Functional decomposition analysis methods, even using object technologies, have produced incomplete specifications and designs that are highly volatile and difficult to construct. This approach has also greatly limited software reuse and has led to redundant development of numerous partial versions of the same objects, thereby lowering development productivity and creating configuration nightmares (Firesmith, 1993).

## *Object Based Methods*

The early generations of computer languages were designed for communicating sequences of instructions to computers. Using these languages to replicate the complex, non-sequential interactions among the components of real-world businesses is an extremely difficult undertaking. By contrast, object technology was invented for modeling complex systems. With objects, it's actually easier to build models than to engage in conventional, sequential programming (Taylor, 1995).

Edward Yourdon defines object orientation as "a system built with object-oriented methods whose components are encapsulated chunks of data and functions, which can inherit attributes and behavior from other such components, and whose components communicate via messages with one another" (Yourdon, 1994). Taylor (1995) describes object-oriented technology as having three key mechanisms:

1. *Objects* that are software packages that contain related data and procedures.
2. *Messages* that are the means by which objects communicate.
3. *Classes* that are templates for defining the kinds of objects.
- 4.

This paper will not go into the various object-programming approaches but will concentrate on the "analysis" or "modeling" portion of object-oriented methods.

The central activity of "modeling" is a matter of representation not programming. Each real-world object or concept is represented by a software object that reflects all the information and behavior associated with that real-world object (Taylor, 1995). The building of the model begins with "chunking" related components into higher level units called classes. If this chunking follows the business process view, rather than the functional view, than the objects built by this strategy will more likely reflect the natural processes within the business. Building a working model of a business has proved to be an excellent way to gain agreement on how a business works. Defining and naming the components and their interactions requires explicit agreement on what is represented by these objects and interactions (Taylor, 1995).

Ivar Jacobson describes Object-oriented analysis as consisting of:

1. Finding the objects.
2. Organizing the objects.
3. Describing how the objects interact.
4. Defining the operations of the objects.
5. Defining the objects internally.

Jacobson states that the objects can be found as "naturally occurring entities in the application domain", typically occurring as a noun which exists in the domain (Jacobson, 1992). It is a typical interview "truth" that the way you ask the question shapes the answer. If the search for objects is organized in a functional way, functional objects are likely to be found and built. If the domain is defined in a horizontal, business process oriented way, then business process oriented nouns or objects will be found, organized into natural process classes and constructed.

This direct mapping enabled by object technology combined with classes that are naturally occurring in the business process is the synergistic strength of combining the approaches. This process also links very well with the language development process, suggested by McCormack, used to develop a business process oriented language (McCormack, 1995). This is the essence of the new development paradigm.

By combining objects into natural business process oriented classes, these objects are not likely to change unless a major process change occurs. The reusability is also increased between similar business process processes since the classification is driven by the process not

the individual programmer or user. All organizations are different depending upon the people “in charge” but the business processes seem to be the natural processes driven by the customers and the market.

## CONCLUSIONS AND IMPLICATIONS

### *Conclusions*

The Business Process Oriented / Object Oriented approach represents a way to merge the business process and system structures into a unified model that represents the critical, customer driven activities of a business. This natural way to view and build a systems will result in end users becoming integrated with the definition, construction and use of an enabling IT system. The construction of a business process “language” based upon business objects also greatly enhances cooperation and understanding horizontally through the business. Using this combination of the language process, business process and object-oriented methods to build a system also encourages the redesign and improvement of the processes as you build it. Taylor describes this as *analysis by design* and suggests that the impact of this not be underestimated (Taylor, 1995).

The impact should be efficient coordination and optimization of the system of interdependent linkages within the value chain of a firm and the minimization and optimization of interfaces and hand-offs. Since the “classes” of the business objects are defined as they naturally occur, they should be relatively stable and frequently reoccurring resulting in high reusability of objects and the resulting decrease in development times for systems. Maintenance, testing and troubleshooting should be reduced since the system will be easy to understand and the objects easily tested as they are built. The results of this new paradigm should be a value added structure of the system and data that matches the way work is naturally performed in an organization rather than matching the authority structure. This will have a dramatic effect on the return on investment for information systems in an organization resulting in improved business performance.

### *Implications*

As object-oriented standards mature, business process objects will be built and sold as we now sell applications. Since they are more business process oriented rather than problem oriented, as with applications, their use and reuse will be far greater and therefore, the cost will substantially decrease.

A significant barrier to this development approach is the level of business process orientation and understanding in firms today. The vast majority of firms have not described their natural business processes and therefore, do not have a business process oriented language nor do they have a business process map. Many firms have defined their activities within functions as business processes but, as pointed out by Jacobson, this does not enable the real integration of the work. This just imbeds the functions in another technology. Until the business process view becomes prevalent, this development method will not be deployed on any significant level. Since the business process view challenges the power structures of the status quo, it is not likely to change unless an overwhelming force, most likely market and competitive pressures, is applied. Niccolo Machiavelli noted in 1513 that “ There is nothing more difficult to take in hand, more perilous to conduct, or more uncertain in its success, than to take the lead in the introduction of a new order of things. For the reformer has enemies in all those who profit by the old order, and only lukewarm defenders in all those who profit by the new order.”

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