



**MARMARA UNIVERSITY  
INSTITUTE FOR GRADUATE STUDIES  
IN PURE AND APPLIED SCIENCES**



**BUSINESS PROCESS REENGINEERING  
VIA SIMULATION TECHNIQUE AND  
A CASE STUDY**

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MELTEM DİNÇKAN

**MASTER THESIS**

Department of Industrial Engineering

**ADVISOR**

Assoc. Prof. Dr. Özalp VAYVAY

**ISTANBUL, 2013**

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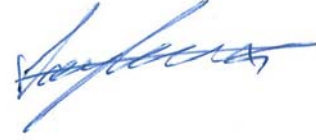
Meltem DINÇKAN, a Master of Science student of Marmara University Institute for Graduate Studies in Pure and Applied Sciences, defended her thesis entitled “**Business process reengineering via simulation technique and a case study**”, on July 9, 2013 and has been found to be satisfactory by the jury members.

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**June, 2013**

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## ÖZET

### **SİMÜLASYON TEKNİĞİ İLE İŞ SÜREÇLERİNİN YENİDEN TASARIMI VE BİR UYGULAMA ÇALIŞMASI**

Küreselleşme ve artan rekabet pek çok organizasyonu yaratıcı ve yenilikçi olmaya ve değişime dayalı yaklaşımlar benimsemeye zorlamaktadır. İş Süreçlerinin Yeniden Tasarımı veya diğer adıyla Değişim Mühendisliği, bu değişim dünyasında son zamanlarda oldukça dikkat çeken en popüler değişim yönetimi yaklaşımlarından birisidir. Literatürde başarılı ve başarısız örnekleri görülse de, değişim mühendisliği iş çevrelerince doğru ve dikkatli uygulandığında, dramatik gelişme ve organizasyonel rekabet avantajı elde etmeyi sağlayan önemli bir yönetim aracı olarak görülmektedir.

Bu tez çalışmasında, simülasyon tekniği kullanılarak özel sektörde faaliyet göstermekte olan bir firmanın, mevcut iş süreçleri üzerinde çarpıcı gelişmeler yaparak iş süreçlerinin yeniden tasarlanması amaçlanmaktadır.

Bu bağlamda, öncelikle konuyu iyice kavrayabilmek için literatür araştırması yapılmıştır. Sonrasında, literatürdeki farklı yeniden yapılanma metodolojileri ve süreçlerde değişim aracı görevi gören ve değişimi mümkün yeniden yapılanma katalizatörleri irdelenmiştir.

Uygulama kısmında, özel sektörde faaliyet göstermekte olan bir firmanın simülasyon aracılığı ile tedarik zinciri süreci incelenmiş ve buna istinaden Micro Saint Sharp simülasyon programında ilgili sürecin modeli oluşturulmuştur. Mevcut durumda ve yeniden yapılanma sonrasında performansı izleyebilmek amacıyla birtakım performans ölçütleri belirlenmiştir. Bunlardan başlıcaları, talepleri karşılama yüzdesi ve siparişin alınmasıyla verilmesi arasında geçen süredir.

Talep değişkenliği, firma tarafından sistemin temel problemi olarak bilinmektedir. Bu nedenle, talep değişkenliğinin sistem üzerindeki etkisi araştırılmıştır. Yapılan değerlendirmeler sonucunda, talep değişkenliğinin sanılanın aksine sistemin performansına önemli ölçüde etki etmediği görülmüştür. Esas problemin, sistemin işleyişindeki operasyonel süreç/lerden kaynaklandığı tespit edilmiş ve bu yönde bir çözüme gidilmiştir.

Çözüm aşamasında, sistemin en kritik süreçlerinden biri olan sipariş planlama süreci otomatize hale getirilerek yeniden yapılandırılmıştır. Bu aşamada temel, pratikte uygulanması kolay bir çözüm önerisi sunulmuş ve model üzerinde uygulanmıştır. Yeniden yapılanma sonrasında talepleri karşılama yüzdesinde %91, siparişin alınmasıyla verilmesi arasında geçen sürede ise %56 oranında bir iyileşme elde edilmiştir.

**Haziran, 2013**

**Meltem DİNÇKAN**

## **ABSTRACT**

### **BUSINESS PROCESS REENGINEERING VIA SIMULATION TECHNIQUE AND A CASE STUDY**

Globalization and increased competition compels most organizations to become innovative and adopt approaches based on change. Business Process Reengineering is one of these most popular change management approaches which have attracted great attention in this world of change recently. Even though there have been successful and unsuccessful cases stated in the literature, Business Process Reengineering has been touted as a vital management tool in order to achieve dramatic improvements and organizational competitiveness by business circles if it is implemented properly and carefully.

In this thesis study, by using simulation technique, business process reengineering is aimed by achieving dramatic improvements on the available business processes of a company in private sector.

In this context, first of all in order to grasp the topic completely, literature research was done. Then, different Business Process Reengineering methodologies from the literature as well as enablers of Business Process Reengineering which make change feasible and act as vehicles for processes to change were studied.

In the application section, supply chain process of a company operating in the private sector has been investigated by means of simulation and based on this, modeling of the related process has been created using Micro Saint Sharp simulation program. In the current state and after reengineering, several performance measures have been defined in order to be able to monitor the system performance. Major ones of those are the percent of responding demands, and the lead time, which is the time between the placement and receiving of the order.

The demand change is known as the fundamental problem of the system by the company. So, the effect of the demand change has been investigated on the system. After the assessments made, it has been seen that the demand change, contrary to the assumptions made, does not have significant effect on the system performance. It has

been determined that the main problem arises from the operational process/es in the system and solution toward this direction has been created.

At the solution stage, order planning, which is one of the most critical processes of the system has been automatized and so redesigned. At this stage, a fundamental and easy to apply solution proposal practically has been presented and implemented on the model. After reengineering, improvements of 91% and 56% have been achieved in responding demands and in the time between the placement and receiving of the order respectively.

**June, 2013**

**Meltem DİNÇKAN**

## **SYMBOLS**

**hr** : Hour

**P<sub>i</sub>** : Deviation parameter for project sales demand in demand change

**R<sub>i</sub>** : Deviation parameter for retail sales demand in demand change

**μ** : Mean

**σ** : Standard deviation

## **ABBREVIATIONS**

<b>ABC</b>	: Activity Based Costing
<b>BPR</b>	: Business Process Reengineering
<b>CAD</b>	: Computer Aided Design
<b>CEO</b>	: Chief Executive Officer
<b>CIM</b>	: Computer Integrated Manufacturing
<b>CSCMP</b>	: Council of Supply Chain Management Professionals
<b>DFD</b>	: Data Flow Diagrams
<b>EDI</b>	: Electronic Data Interchange
<b>EIS</b>	: Executive Information Systems
<b>FIFO</b>	: First-In First-Out
<b>IDEF0</b>	: Integrated Definition Method
<b>IT</b>	: Information Technology
<b>MRP</b>	: Material Requirements Planning
<b>MTO</b>	: Make-to-Order
<b>m.u.</b>	: Monetary Unit
<b>OOA</b>	: Object Oriented Analysis
<b>Prince2</b>	: Process based Project Management
<b>QFD</b>	: Quality Function Deployment
<b>ROP</b>	: Reorder Point
<b>SAP</b>	: Systems, Applications and Products in Data Processing
<b>SCM</b>	: Supply Chain Management
<b>TQM</b>	: Total Quality Management

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# **CHAPTER 1**

## **INTRODUCTION**

In today's ever-changing world, the business environment throughout the world is also going through a continuous and rapid change. In this challenging world increasingly driven by customers, change and competition, companies vigorously look for new ways to make their businesses more efficient and competitive. They analyze their current systems, processes and try to find new solutions to their business problems. Recently, we witness that some of the most successful companies in the world, seem to have come up with an amazing solution to their business problems: Business Process Reengineering (BPR).

In a world increasingly driven by the three Cs: Customer, Competition and Change, companies are on the lookout for new solutions for their business problems. In this context "reengineering is the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance such as cost, quality, service and speed" (Hammer and Champy, 1993).

Nowadays, globalization and increased competition compels most organizations to become innovative and adopt approaches based on change. This is the starting point of this thesis. The objective of this thesis study is to redesign business processes of a company in private sector by achieving dramatic improvements on the available business processes by using simulation technique. System simulation is useful in measuring the performance and predicting the effect of change on the system.

In this context, supply chain process of the related company will be analyzed and an application of reengineering will be achieved by commenting revealed results from the data which was obtained as a result of this analysis.

A supply chain is a complex and dynamic structure. The Council of Supply Chain Management Professionals (CSCMP) define supply chain management as follows: "Supply Chain Management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics

management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies. Supply Chain Management is an integrating function with primary responsibility for linking major business functions and business processes within and across companies into a cohesive and high-performing business model. It includes all of the logistics management activities noted above, as well as manufacturing operations, and it drives coordination of processes and activities with and across marketing, sales, product design, finance and information technology.”

There is general awareness that organizations can not compete as isolated entities; it is obvious that working together in networks would be a lot easier. The supply chain, as a network, is expected to provide the right products and services on time, with the required specifications, at the right place and to the right customer. Nowadays, supply chains are facing numerous changes that are contributing to increasing their complexity, such as the globalization of businesses and the adoption of some business philosophies as lean, efficient consumer response, and quick response programs (Carvalho et al., 2012).

This study is expected to aid companies that strive to redesign their business processes in order to accomplish dramatic improvements in performance. Thus, in ever-changing and developing world as companies gain a competitive advantage; quality, productivity, profitability and customer satisfaction will increase.

## **CHAPTER 2**

### **LITERATURE REVIEW**

In today's highly competitive and constantly changing market place, in order to thrive and operate successfully; it is inevitable for companies to give up obsolete ways of doing business and adjust to change. In recent years, we have been witnessing a management concept called "Business Process Reengineering" which has become commonplace among companies which seek for adapting rapid external changes and changes in the marketplace (Ozsoy, 2007).

BPR has been practiced as a formal discipline since the early 1920's. Then it was known as "Methods and Procedures Analysis" always searching for new ways of restructuring work flows or improving business organization (Strassmann, 1995).

BPR has been studied extensively since its initial widespread application in the late 1980s (Xiang, 2010). For almost a decade now there has been considerable discussion in the literature on BPR and today there still remains considerable confusion, particularly amongst managers, as to exactly what constitutes BPR and how it is different from other change initiatives such as Total Quality Management (TQM) (O'Neill and Sohal, 1999).

As it has been mentioned, BPR focuses on redesigning work processes to enhance productivity and competitiveness. The demand for a new approach to company restructuring has been fueled by the awareness, that many of the existing business logic is built on premises of considerable age. These existing processes were first designed as a set of sequential manual procedures, and then automated parallel with the accelerating development of technology. However, this automation did not change the strong efficiency orientation pushing for optimizing procedures or functions and a maximum level of control; neither did it address the organizational externalities, such as customer demands. As organizations grew, more people were added and procedures were quick-fixed, while the organization of work still followed the original logic.

The development and application of information technology seemed to be a solution to that problem but, in fact, it was very often used to achieve short-term improvements of existing, and fragmented, processes.

Due to the global changes in economy, markets are globalized, customer requirements change and competition is intensified, new approaches had to be developed for coping with environmental dynamics and the required flexible organizational change. In 1991, Michael Hammer, a former MIT professor in computer science published an article in the Harvard Business Review, emphasizing the need for fundamental organizational change and for the first time using the term Business Process Reengineering.

Since then, the concept has been widely spread and applied, the publications of books and especially journal articles increases enormously and more and more conferences are hold on the topic (Simon, 1994).

## **2.1. Definitions of Business Process Reengineering**

BPR has been given a wide variety of names, including business process redesign, process innovation, and organizational transformation. However, regardless of the name, the concepts are basically same.

BPR is one of today's newest management trends. There are several definitions or explanations of BPR in the literature. The following definitions of BPR have been offered:

- Reengineering is the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service and speed (Hammer and Champy, 1993).
- Reengineering is only part of what is necessary in the radical change of processes; it refers specifically to the design of the new process. The term process innovation encompasses the envisioning of new work strategies, the actual process design, activity and the implementation of the change in all its complex technological, human, and organizational dimensions (Davenport, 1993).

- BPR is a methodical process that uses information technology to radically overhaul and dramatically improve business processes, and thereby attain major business goals (Alter, 1990).
- BPR is overhauling business processes and organization structures that limit the competitiveness, effectiveness, and efficiency of the organization (Senn, 1991).
- BPR is the analysis and design of work flows and processes within and between organisations (Davenport and Short, 1990).
- Talwar (1993) has focused on the rethinking, restructuring and streamlining of the business structure, processes, methods of working, management systems and external relationships through which value is created and delivered.
- Petrozzo and Stepper (1994) believe that BPR involves the concurrent redesign of processes, organisations, and their supporting information systems to achieve radical improvement in time, cost, quality, and customers' regard for the company's products and services.
- Lowenthal (1994) describes the fundamental rethinking and redesign of operating processes and organisational structure, the focus is on the organisation's core competencies, to achieve dramatic improvements in organisational performance, as BPR's essential components.

Within the definition of Michael Hammer and James Champy, we can grasp four important key words: fundamental, radical, dramatic and processes.

**\* Fundamental:**

Two questions are considered as being fundamental and are addressing the companies' justification of existence: What are we doing? and Why are doing so? As Hammer points out, forcing people to question the way they do business leads to rules turning out to be obsolete, erroneous and inappropriate. Reengineering means starting from scratch, no assumptions given and no current fact accepted and determines firstly what a company has to do, and secondly how to do it (Simon, 1994).

**\* Radical:**

Radical redesign of business process means getting the root of things , not improving existing processes or procedures, not making superficial changes. According to

Hammer, radical redesign means disregarding all existing structures and procedures and inventing completely new ways of accomplishing work (Ozsoy, 2007).

**\* Dramatic:**

For the keyword dramatic, Hammer and Champy stated that “Reengineering is not about making marginal or incremental improvements but about achieving quantum leaps in performance”.

They discussed that there are three possible situations that a company needs reengineering. The company may be in a desperate situation. It needs dramatic improvement to survive. Then the company may be doing quite well, but the management has the foresight and is expecting threatening real and serious problems and competitions in the very near future. Reengineering for dramatic improvement is necessary for protecting the company’s foundation of success. Finally, the company may be doing quite well, and no problem is expected. But then, the ambitious management of the company wants to do even better, and to make it even more difficult for others to enter into the competition. Only dramatic improvement in reengineering can meet these ambitious and aggressive goals (Chan and Choi, 1997).

**\* Processes:**

Process is the most important key word, collection of activities taking multiple inputs to create an output that is of value to the customer (Kiefer, 2004). Process-orientation is considered as being the most important aspect of BPR. Hammer claims, that most companies are focused on tasks, people and structures rather than processes (Simon, 1994).

BPR involves reengineering processes to achieve radical improvements in cost, time, responsiveness, performance, quality, etc. and these reengineered processes should provide the company with dramatic improvements in cost, response time, and performance, as well as reflecting the company’s overall strategy (Browne and O’Sullivan, 1995).

## 2.2. The Need for BPR

There are many reasons why people reengineer. There are many driving forces that contribute in choosing this method. There are other factors that lead a company down the road for implementing. A major trend for change is the need to improve. Corporations today must break through existing paradigms and use them as a frame of reference for establishing new ones. This can be expressed through new rules, policies, procedures, structures, values and beliefs. The first step towards success is recognizing the need for change (Vissicchio, 1996).

Many companies embark on reengineering in order to deal with an existing and/or potential crisis. Business has realized that increased competition will be the dominating issue of at least the next decade. Responding to growing pressures is an effective driver of the reengineering process (Jeong, 1995).

The change agents:

- Explosion in development of technology
- An organization based increasingly on knowledge (system and employee level)
- Economic shifts and crises that may be classified as shock levels
- Social trends whereby customers have expressed greater, clearer, and more demanding needs
- Workgroups including a focus on team work
- The virtual corporation that changes the scope of the firm
- World politics effecting new rules and opening of trade possibilities
- Competition, particularly resulting from deregulation
- Globalization of competitive forces
- Reduced product life cycles and rapid new product development

are forcing companies to consider reengineering. The most important response to a question of survival is to be competitive. Reengineering may allow this. The response to the question of why reengineering, lies in the reality of global competition. Firms must survive and occasionally in order to do so some will have to reengineer their processes. Through reengineering, these firms will then respond by creating their niche, delighting customers, being quick to market, offering fair value for the price (Laframboise, 1995).

### 2.3. Characteristics of BPR

BPR is an aggressive idea on innovating a business process or system. It encompasses change in systems, polices, organization structures, and responsibility of workers to provide a valuable business process in dealing with customers, suppliers, products and services. In contrast to the traditional automation and long-term continuous improvement programs, BPR seeks to gain dramatic improvement in performance within a short period (Chan and Choi, 1997).

Earlier there was reference to the fact that BPR incorporates many of the characteristics of previous quality approaches. The characteristics of one BPR model might be described as combining attributes that are more contemporary with those that are more traditional in business management. Earl (1994) suggests that BPR is not totally new but is a result of an evolution in business quality programs. He uses the following star diagram to highlight the characteristics of the two contributing sets of attributes:

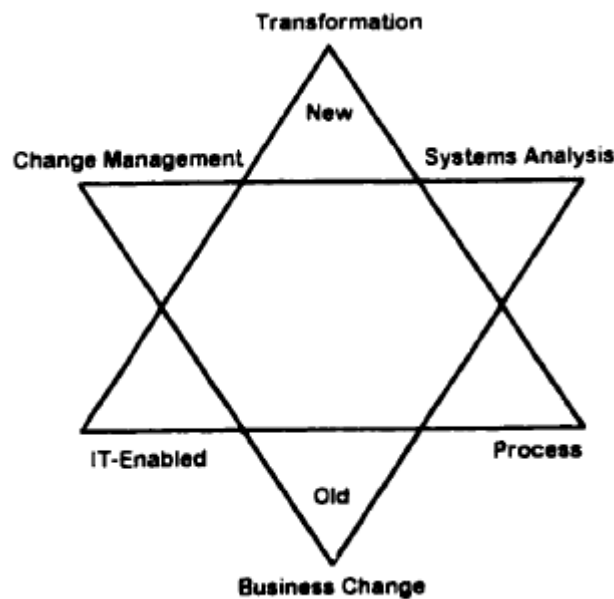


Figure 2.1. New Model vs. Old Model (Earl, 1994)

Earl's (1994) three contemporary (new) characteristics include:

- **Transformation** which suggests that reengineering is the desire of a company to move away from the usual way of doing business. This encourages a quantum

leap in performance as measured by the four repeatedly suggested metrics of cost, quality, time and satisfaction.

- **Process** which is a horizontal organization of the tasks and roles that people formerly undertook in departments, with the objective of a better performance for the internal or external customer. Although a process focus is also a characteristic of TQM, in BPR, there is a greater emphasis on cross-functional process change, hence requiring some restructuring. A focus on process also encourages teamwork.
- **IT-Enabled** which, as most contributors suggest, is a crucial attribute.

Earl's (1994) three traditional (old) views of business, that BPR borrows, include these characteristics:

- **Business Change** involves a fundamental shift in organizational culture. This includes sociotechnical systems-thinking.
- **Change Management** which is affected by various topics and skills from organizational behaviour e.g., leadership, motivation, personality, decision making, team building, values, attitudes, job satisfaction, communication, conflict resolution, power & politics, and stress.
- **Systems Analyst** which adds many tools used by industrial engineering, information systems development, and by those engaged in software engineering and modeling software.

## 2.4. Principles of BPR

The traditional management concepts for organising and the division of labour are considered to be no longer applicable in a world of global markets, changing customer requirements and rapid communication. The recipes of change, commonly known as reengineering, kaizen (Japanese for continuous improvement), and total quality are based on the same primary assumption: Organisations will have to refocus on their basic task, satisfying customer needs. Even though the means for achieving change differ between the approaches, they share a commonality: A focus on processes instead of

functions. Yet, it is considered that the kaizen and quality approaches are inadequate as they are primarily concerned with existing processes and do not meet the increasing needs of the customer. The primary objective of reengineering is to achieve significant improvements in processes so that the contemporary customer requirements of quality, speed, innovation, and service are met. This can be achieved by adopting a vision and a comprehensive approach to change, focusing on (Love and Gunasekaran, 1997):

- leadership and guidance from top management;
- becoming customer focused, understanding why and how processes can be improved, and implementing process benchmarking;
- identifying appropriate tools and techniques for redesigning work processes to meet strategic performance goals;
- implementing information technology to enable improved performance;
- applying effective change management to adjust the organisations people and culture to the new ways of working; and
- implementing continuous improvement (kaizen) methods to sustain the organisations improved performance.

## **2.5. Advantages and Disadvantages of BPR**

### **2.5.1. Advantages of BPR**

#### **2.5.1.1. Satisfaction**

A big advantage of reengineering is that the work becomes more satisfying because the workers get a greater sense of completion, closure, and accomplishment from their jobs. The employee performs a whole job, a process or a sub process, that by definition produces a result that somebody cares about. The workers not only try to keep the boss happy or to work through the bureaucracy. More important is the fact to satisfy the customer needs.

#### **2.5.1.2. Growth of knowledge**

Furthermore, the personal development within a process team environment does not play such an important role which means climbing up the hierarchy is a minor goal. In

this case it is much more important to get a widespread knowledge of the whole process and there are no such things as “mastering” a job; as a worker's expertise and experience grow, his or her job grows with it.

#### **2.5.1.3. Solidarity to the company**

Moreover, since workers in a reengineered process spend more time on value adding work and less time on work that adds no value, their contributions to the company increase, and, consequently, jobs in a reengineered environment will on the whole be more highly compensated.

#### **2.5.1.4. Demanding jobs**

There is, however, a challenging side to all this good news about work in a reengineered environment. If jobs are more satisfying, they are also more challenging and difficult. Much of the old, routinized work is eliminated or automated. If the old model was simple tasks for simple people, the new one is complex jobs for smart people, which raises the bar for entry into the workforce. Few simple, routine, unskilled jobs are to be found in a reengineered environment.

#### **2.5.1.5. Authority**

In a traditional oriented company the management expects from the employees that they follow some specific rules. In contrast to that the reengineered companies don't want employees who can follow rules; they want people who will make their own rules. As management invests teams with the responsibility of completing an entire process, it must also give them the authority to make the decisions needed to get it done (Kiefer, 2004).

### **2.5.2. Disadvantages of BPR**

#### **2.5.2.1. Resistance to the change**

Resistance has been defined as any conduct that tries to keep the status quo, i.e. resistance is equivalent to inertia, as the persistence to avoid change. It is an

individual's tendency to resist or avoid making changes, to devalue change generally, and to find change aversive across diverse contexts and types of change.

The seven reasons employees resist new technology:

- Change in job content
- Loss of status
- Interpersonal relationship altered
- Loss of power
- Change in decision-making approach
- Uncertainty/unfamiliarity/misinformation
- Job insecurity

Change managers need to delve into the reasons for user resistance and to learn effective strategies for managing different states of changes. A complete model of user resistance would lead to better implementation strategies and desired implementation outcomes (Ray, 2011).

#### **2.5.2.2. Drawbacks to business process reengineering**

Just understanding how to reengineer does not ensure success. When clearly thought out and implemented properly, BPR can be a very good way to improve the success of a company. Unfortunately, many companies implement BPR as a fad, forgetting completely about the people involved. Companies that wish to use Business Process Reengineering must determine the best strategy and follow through with the objectives. BPR will not be successful if the company flagellates. It will also not be successful if the company uses BPR over and over again. The reengineering process must come from the top down – the executives must be committed and ready to promote the changes as an example for the rest of the company (Kiefer, 2004).

#### **2.5.2.3. Higher demands to the workers**

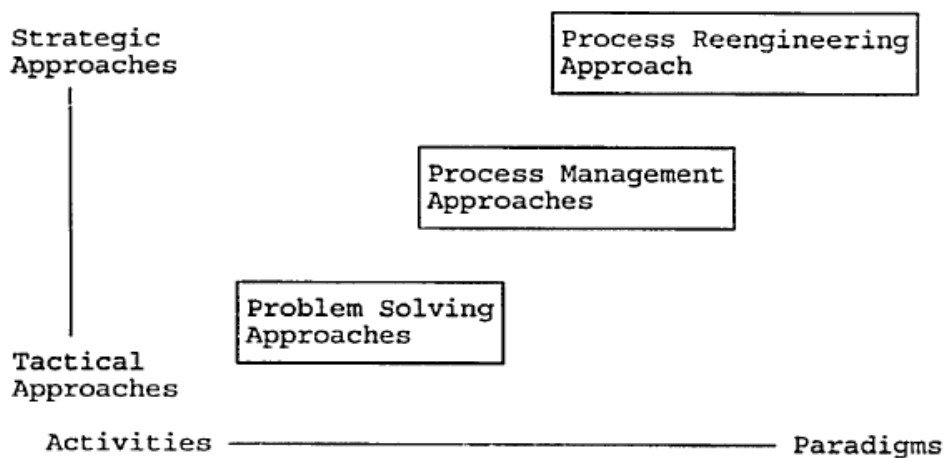
Empowering the workers is an inevitable step in a reengineered process. Therefore the companies which hire new workers have to consider additional criteria in their hiring. It is not longer enough merely to look at prospective employees' education, training, and skills; their character becomes an issue as well. Are they self-starting? Do they have

self-discipline? Are they motivated to do what it takes to please the customer? This might be more complicated to find the right people for one specific job. The worker has to be a kind of “all-rounder” which can perform several jobs. As it was enough to convince a possible employer in a job interview with practical skills, now it is also very important to have the more and more demanded soft skills (Kiefer, 2004).

## 2.6. Comparison with Other Improvement Methodologies

Comparing business reengineering to other business improvement approaches requires mentioning some definitional characteristics of those techniques. This is useful because understanding the differences in these improvement techniques is key to deciding where and when to use each.

Foster (1992) characterizes business reengineering by describing its relationship to other business improvement approaches. Figure 2.2. presents her view of business reengineering in the spectrum of improvement methodologies. Her model is based on two questions: (1) Is a methodology applied at activity level, or is it focused on process/business level? (2) Is a methodology more appropriate for tactical situations, or for strategic situations? Figure 2.2. shows that, for tactical problems at the activity level, approaches like total quality management methods are frequently utilized. However, business reengineering is more effective in the strategic environment and at the core process/ business level, while it still can be applied to tactical problems (Jeong, 1995).



**Figure 2.2.** Alternative Approaches to Business Improvement (Jeong, 1995)

TQM is an approach to improving the competitiveness, effectiveness and flexibility of a whole organisation. It is essentially a way of planning, organising and understanding each activity, and depends on each individual at each level. TQM involves placing the customer as the focal point of operations. Its aim is to continuously improve process performance in order to satisfy customer requirements. BPR also emphasises focus on the process. BPR is much more radical than TQM. However, there is a need to undertake process analysis in order to identify which processes should be reengineered, and which should be managed on the basis of continuous improvement (O'Neill and Sohal, 1999).

More specifically, several studies compare two approaches, business reengineering and quality improvement programs. According to these studies, similarities between these two approaches are as follows: both require extensive organizational change; both are based on the premise that improvement in process performance is critical to competitiveness; and both require rigorous measurement of process performance. However, reengineering and quality improvement are distinct in motivation, objective, technique, and circumstances (Gulden and Reck, 1992).

Reengineering in the classical sense can also be differentiated from other programs such as TQM, rightsizing, restructuring and automation. The hyperbole surrounding reengineering often makes it difficult to differentiate between these change programs. Table 2.1. summarizes key dimensions of these programs. Rightsizing and restructuring are typically used to refer to adjustments in staffing requirements and changes in formal structural relationships, respectively. Neither approach focuses on the business process. Automation refers to typical application of technologies (including IT), where the application focuses mainly on automating existing procedures without questioning their appropriateness or legitimacy. Both TQM and reengineering focus on processes. However, TQM involves bottom-up participation, usually within function, continuous evaluation of current practices resulting in incremental changes in work design. Reengineering, on the other hand, is typically initiated from the top down, focuses on broad cross-functional processes, questions the logic of existing designs and is usually a one-shot attempt at achieving quantum improvements. IT, while only incidental to TQM, is often a key enabler of reengineering. All the same, TQM can often serve as the building block for subsequent BPR efforts (Grover and Malhotra, 1997).

**Table 2.1.** Reengineering and Other Change Programs (Grover and Malhotra, 1997)

	Rightsizing (downsizing)	Restructuring	Automation	TQM	Reengineering
Assumptions questioned	Staffing	Reporting relationships	Technology applications	Customer needs	Fundamental
Focus of change	Staffing, job responsibilities	Organization	Systems	Bottom-up improvements in many places	Radical changes over broad core entities
Orientation	Functional	Functional	Procedures	Processes	Processes
Role of IT	Often blamed	Occasionally emphasized	To speed up existing systems	Incidental	Key
Improvement goals	Usually incremental	Usually incremental	Incremental	Incremental	Dramatic and significant
Frequency	Usually one time	Usually one time	Periodic	Continuous	Usually one time

## 2.7. Supply Chain Management and Business Process Reengineering

A supply chain is a complex and dynamic structure. The Council of Supply Chain Management Professionals (CSCMP) defines supply chain management as follows: “Supply Chain Management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies. Supply Chain Management is an integrating function with primary responsibility for linking major business functions and business processes within and across companies into a cohesive and high-performing business model. It includes all of the logistics management activities noted above, as well as manufacturing operations, and it drives coordination of processes and activities with and across marketing, sales, product design, finance and information technology.”

Today, companies face severe competitive challenges. The agility of a company’s response to customer demand has been recognized as a critical success factor in meeting competition. Supply chain management (SCM) is an effective way to do this. The scope of a supply chain depends on the number of firms involved.

Stronger and more sophisticated customer demands, increasing competitive pressure and the ever-changing market environment are forcing companies to rethink the way they perform operations. One modern management strategy is business process

reengineering. A number of similarities exist between BPR and SCM. Both need fundamental rethinking and consideration of strategies and are process-based; also they generally reduce the duration of the processes. Of course, information technology is used as a catalyst for both. Supply chain reengineering aims to overcome the uncertainty associated with various aspects of the chain, including the changing needs and demands of customers, the quality of the information, and inherent delays that affect purchasing and ordering decisions (Changchien and Shen, 2002).

## CHAPTER 3

### BPR METHODOLOGIES & TOOLS AND TECHNIQUES

#### 3.1. Methodology of Davenport and Short

Davenport and Short put Information Technology (IT) at the heart of BPR. For them, IT possesses the most important role for innovating business processes. Despite their emphasis on innovation and technology, they state, that organizational and human resource issues are more central, than technology issues to the behavior issues that must occur to within a business process. They see culture as a constraint, when there is a poor process innovation to cultural fit. With regard to managing the change, they emphasize traditional management functions, like planning, directing, monitoring, decision making and communicating.

They are convinced, that Business Reengineering should better integrate with the other non-revolutionary (incremental) process approaches, like Total Quality Management (Schumacher, 1995). They recommend a five-step approach to BPR:

##### **a) Develop business vision and process objectives**

Envisioning is the first stage. The enterprise should review its current profile and develop a broad strategic vision. Key activities include evaluating organizational structure and the environment, recognizing needs, and setting reengineering goals (Changchien and Shen, 2002).

During this step the business vision and objectives that the process should reach in order to accomplish the vision are determined. A business vision implies specific objectives for process redesign, such as: cost reduction, time reduction, output quality, the quality of work life and the quality of learning (Ozsoy, 2007).

**Table 3.1.** Key Activities in Developing Process Visions (Davenport, 1993)

- |  |
|--|
| <ul style="list-style-type: none"><li>• Assess existing business strategy for process directions</li><li>• Consult with process customers for performance objectives</li><li>• Benchmark for process performance targets and examples of innovation</li><li>• Formulate process performance objectives</li><li>• Develop specific process attributes</li></ul> |
|--|

**b) Identify processes to be redesigned**

Identify processes to be redesigned can be done in two ways: identify all processes within an organization and prioritize them in order of redesign urgency; the other way is to identify only the most important processes or those most in conflict with the business vision and process objectives (Wu and Huang, 2004).

In this phase, the most critical part is determining core business processes which have a significant impact on the company's overall business performance and bring great value to its customers (Tsalgatidou, 1995).

After a process has been selected for innovation, the company can begin to contemplate on change tools which will enable it to create quantum improvements in the selected process/es (Ozsoy, 2007).

**c) Understand and measure existing processes**

This step studies the exact functioning and performance of the selected Business Processes. This differentiates Davenport and Short from the Hammer/Champy approach. Davenport and Short in particular wants to make sure, that during the process redesign old practices are not being "reinvented" and performance benchmarks for the redesigned processes are being set up (Schumacher, 1995).

Understanding existing processes also facilitates communication among participants in the BPR work. Models and documentation of current processes enable those involved in the BPR initiative to develop and share a common understanding of the existing state (Vakola and Rezgui, 2000).

**Table 3.2.** Key Activities in Understanding and Improving Existing Processes  
(Davenport, 1993)

- Describe the current process flow
- Measure the process in terms of the new process objectives
- Assess the process in terms of the new process attributes
- Identify problems with or shortcomings of the process
- Identify short-term improvements in the process
- Assess current information technology and organization

**d) Identify change levers**

This step serves to study the applicability of IT tools and applications for the newly designed work processes (Schumacher, 1995).

BPR and IT form an integral system in improving the performance of manufacturing companies drastically. Basically, IT can save time and improve accuracy in exchanging information about company goals and strategies. It removes much of the human error inherent complex and repetitive tasks. IT saves money because it reduces errors, and the time it takes to accomplish tasks. IT provides a competitive advantage by helping a company's position and capitalizes on trends so that it should be the first to market a new product (Gunasekaran and Nath, 1997).

**Table 3.3.** Key Activities in which IT (Davenport, 1993)

- Identifying and selecting processes for redesign
- Identifying enablers for new process design
- Defining business strategy and process vision
- Understanding the structure and flow of the current process
- Measuring the performance of the current process
- Designing the new process
- Prototyping the new process
- Implementing and operationalizing the process and associated systems
- Communicating ongoing results of the effort

**e) Design and build a prototype of the new process**

The final step in a redesign effort is the design of the new process .The actual design of the new process should be viewed as a prototype and successive amendments should be expected (Tsalgatidou, 1995).

**Table 3.4.** Key Activities in Designing and Prototyping a New Process

(Davenport, 1993)

- |  |
|--|
| <ul style="list-style-type: none"><li>• Brainstorm design alternatives</li><li>• Assess feasibility, risk and benefit of design alternatives and select the preferred process design</li><li>• Prototype the new process design</li><li>• Develop a migration strategy</li><li>• Implement new organizational structures and systems</li></ul> |
|--|

**3.2. Methodology of Hammer/Champy**

Hammer and Champy popularized business reengineering. They define BPR as a fundamental rethinking and radical redesign of mission critical business processes. They see poor management and unclear objectives as the main problems to business reengineering success. Only just recently they acknowledge people’s resistance as a major obstacle to business reengineering’s successful implementation. Their business reengineering methodology, which was fine-tuned by Champy’s consulting company, breaks into six steps (Schumacher, 1995).

**Table 3.5.** The Hammer/Champy Methodology (Schumacher, 1995)

<b>Project Steps</b>	<b>Objectives</b>
1. Introduction into Business Reengineering	The Chief Executive Officer (CEO) initiates the project. He/she describes briefly and pragmatically the current business situation to start actions. He/she introduces her vision to the employees of the company.
2. Identification of Business Processes	This step looks at the broad picture, of how processes interact within the company and in relation to the outside world. One deliverable is a graphical display of all processes.
3. Selection of Business Processes	The third step serves to select such processes, which - once reengineered - will lead to high value for the company's customers. Also processes that lend themselves to easy reengineering are being selected.
4. Understanding the Selected Business Processes	This step does not dwell on a detailed analysis of the functioning of the selected business processes, rather concentrates on the performance of the current processes as opposed to what is expected from them in the future.
5. Redesign of the Selected Business Processes	The fifth step is according to Hammer/Champy the most creative of all. It is characterized by imagination, lateral thinking and some sort of craziness.
6. Implementation of Redesigned Business Processes	The last step covers the implementation phase of the business reengineering project. Hammer/Champy do not talk about implementation as much as about project planning. They believe in the success of the implementation, once the five preliminary steps have been properly performed.

### **3.3. Methodology of Manganelli/Klein**

Concentration of this methodology goes only to the processes, which are supporting strategic goals of the organization and customer requirements. The processes, which are aimed by this methodology, are the knowledge processes as product development. The main obstacles of the seen by this methodology are: time, cost, risk, and organizational impact. According to (Manganelli et al., 1994) the reengineering should be more successful than the incremental change.

The interesting thing on this methodology is that it includes computer software to support reengineering project. The name of this software is “Rapid-Re Reengineering Software toolset for Microsoft Windows”. This methodology breaks into five steps:

#### **1- Preparation**

During this step, there are all involved persons asked about the goals of the project and the basic project preparation has been done.

#### **2- Identification**

As result of this step is customer oriented organization process model. During this stage are identified those key business processes which should be reengineered.

#### **3- Vision**

This stage gives some kind of benchmarking. There is defined the performance level of the current processes and set up performance level of the processes after the reengineering.

#### **4- Redesign**

This step is broken down to two parallel sub steps. These two sub steps are proceeded simultaneously.

**a. Technology redesign:** Technology is designed during this sub step (mostly information) to deal with the redesigned processes.

**b. Social redesign:** This sub step creates the new working environment for the employees to work with new processes. This includes new organizational and personal plans.

## **5- Transformation**

During this stage is all the work, which has been done at previous stages implemented within the organization that means all the technological and social changes into organization (Prokop, 2008).

### **3.4. The Kodak Methodology**

The international Kodak organization developed a business reengineering methodology that is being applied to Kodak facilities around the world. Similar to other practitioner approaches, has the Kodak methodology been influenced by Hammer/Champy. The Kodak methodology breaks into five steps (Schumacher, 1995):

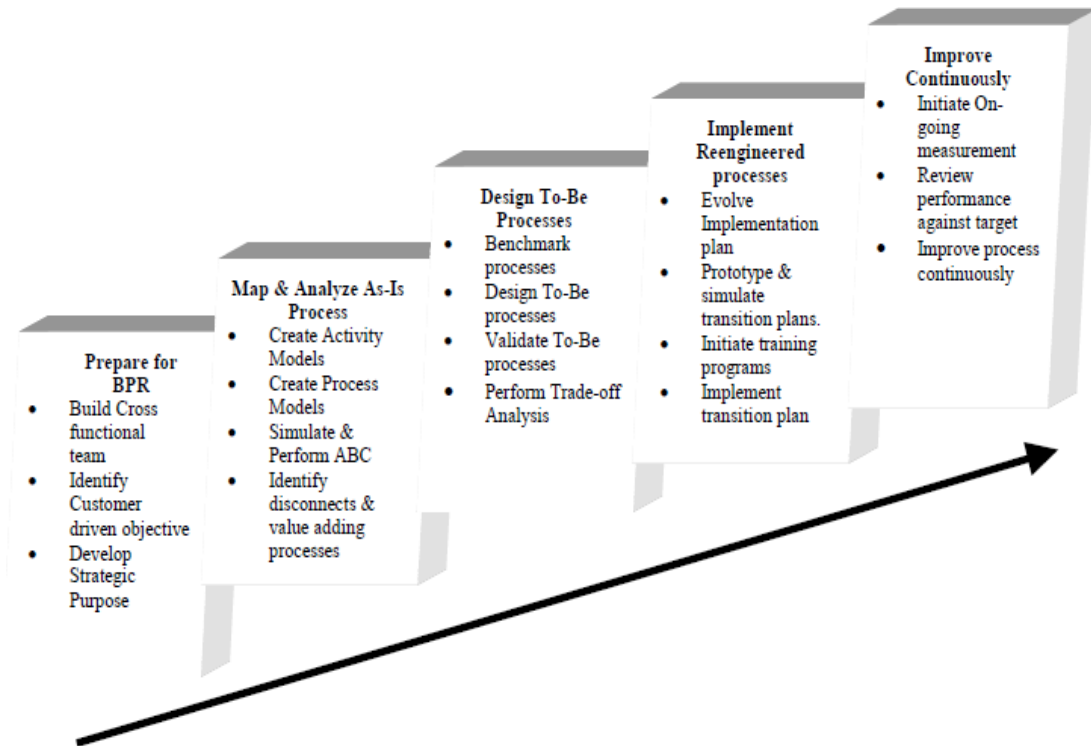
**Table 3.6.** The Kodak Methodology (Schumacher, 1995)

<b>Project Steps</b>	<b>Objectives</b>
1. Project Initiation	The first step is considered key. It covers project planning and definition of all project administration rules and procedures.
2. Process Understanding	This step sets the project team up, designs a comprehensive process model for the organization and assigns process managers, who will be responsible for the redesigned process after implementation.
3. New Process Design	The third step covers the redesign of selected Business Processes, taking into account the potentials of Information Technology. This step ends with the planning of a Pilot Implementation of the redesigned processes.
4. Business Transition	The fourth step is focused towards the implementation of the newly designed processes within the organization. Part of this step is the adaptation of the organization's infrastructure to the requirements of the newly designed processes.
5. Change Management	The last step is being performed parallel to the first four steps. The project team handles barriers, which crop up during the course of the Business Reengineering project.

### 3.5. A Consolidated Methodology for BPR

A consolidated methodology has been developed from the four methodologies previously presented and an Integrated Definition Method (IDEF0) model was developed to provide a structured approach and to facilitate understanding. But for the

sake of brevity, we have shown only the major activities in the IDEF0 model in Figure 3.1. In the ensuing section, we deal with the details of our methodology.



**Figure 3.1.** A Consolidated Methodology for BPR (Muthu et al., 1999)

#### a) Prepare for reengineering

Planning and preparation are paramount factors for any reengineering project to be successful. The first step of “planning and preparation” is identifying whether a need for reengineering is crucial or not.

Here, the question to be asked is “Is BPR necessary?” There should be a significant need for the process to be reengineered. Having vindicated this need, preparation activity can be started.

After top management’s commitment and consensus on the necessity of reengineering is established, a cross functional team which will take on the reengineering effort with an action plan is formed in accordance with the company’s strategy and organizational objectives.

While setting the strategic goals for the reengineering effort it is important to understand the expectations of the customers and analyze whether the current process fulfills these requirements. Having identified the customer driven objectives, the mission or vision statement is formulated.

**b) Map and analyze as-is process**

In order to successfully redesign the process, reengineering team should first understand and delve into the existing process. Although some organizations attempt a new process design while totally ignoring the existing processes most need to map the existing processes first, analyze and improve on it to design new processes.

Delving into current process/es and figuring out problems and bottlenecks related with them ensure that they are not repeated in the new process.

The main objective of this phase is to identify disconnects (anything that impedes the process from achieving desired results and in particular information transfer between organizations or people) and value adding processes. This is initiated by first creation and documentation of “Activity and Process Models” making use of the various modeling methods available. Then, the amount of time each activity takes and the cost that each activity requires in terms resources is calculated through simulation and Activity Based Costing (ABC). After finishing all the groundwork, the process or processes that need reengineering are detected.

**c) Design to-be process**

After identifying the processes to be reengineered design alternatives to the existing process/es which aim at accomplishing company’s strategic goals are generated. One of the ways that facilitate setting alternatives is “Benchmarking”.

Benchmarking is the comparing of both the performance of the organization’s processes and the way those processes is conducted with those relevant peer organizations to obtain ideas for improvement.

Having identified the potential improvements to the existing processes, To-Be models are developed. Then simulation and ABC are performed to analyze factors like time and cost involved. The several To-Be models are validated and best possible scenarios are selected among them for implementation.

#### **d) Implement reengineered process**

When so much time and effort is spent on analyzing the current processes, redesigning them and planning the migration, it would be prudent to run a culture change program simultaneously with all the planning and preparation.

Once this has been done, the next step is to develop a transition plan from As-Is to the redesigned process. This plan must align the organizational structure, information systems, and the business policies and procedures with the redesigned process.

Using prototyping and simulation techniques, the transition plan is validated and its pilot versions are designed and demonstrated. Training programs for the workers are initiated and the plan is executed in full scale.

#### **e) Improve process continuously**

Implementing the reengineered process does not assure the success of the reengineered process alone. A key to success for every reengineering effort is to improve the reengineered process permanently by both monitoring the progress of the process and the results.

The progress of action is gauged by seeing how much more informed the people feel, how much more commitment the management shows and how well the change teams are accepted in the broader perspective of the organization. This can be achieved by conducting attitude surveys and discrete fire side chats with those initially not directly involved with the change.

Monitoring the results involve measures such as employee attitudes, customer perceptions, supplier responsiveness etc. (Muthu et al., 1999).

### **3.6. Comparison of Selected Business Reengineering Methodologies**

Methodology of Davenport and Short has clear definition of the vision on factors like cost reduction, time reduction, and performance improvement. It still does not include “learning phase”, which could take place during the formation of the teams and should improve the long-lasting business results intensively. There is lack of transition to continuous improvement model. This could lead to abandoning of the current methodology and going to another one, another consultant, when another change is

needed within the organization. This methodology has strong technical base, thanks to the fourth step (IT).

Methodology of Hammer/Champy does not include learning process to reorganize business activities and processes. Therefore, using this methodology creates goals without proper knowledge of customers' environment. The other lack within this methodology is that it does not define the key roles. The worst imperfection within this methodology is lack of the involvement workforce into the project. Just management starts projects. The last thing I would like to point out is that this methodology does not include performance measurement step after reengineering. Therefore, there is lack of employees' evaluation, skills and knowledge. Because of this there is lack of BPR failure rate.

Methodology of Manganelli/Klein is more technological oriented. It includes technological and social design. In comparison to the Hammer&Champy methodology, there is no change management as well.

Methodology of Kodak, in comparison to the Hammer&Champy methodology, there is change management introduced into this methodology. This methodology is also adapting organization structure (Prokop, 2008).

**Table 3.7.** Comparison of Selected Business Reengineering Methodologies  
(Schumacher, 1995)

	<b>Step 1: Project Preparation</b>	<b>Step 2: Redesign of Processes</b>	<b>Step 3: Implementation</b>
<b>Hammer/Champy</b>	1. Introduction 2. Identification 3. Selection	4. Understanding 5. Redesign	6. Implementation
<b>Davenport</b>	1. Visioning and Goal Setting 2. Identification	3. Understand and Measure 4. Information Technology	5. Prototyping 6. Implementation
<b>Manganelli/Klein</b>	1. Preparation 2. Identification	3. Process Vision 4.a. Technical Design 4.b. Social Design	5. Transformation
<b>Kodak</b>	1. Project Initiation 5. Change Management	2. Understanding 3. New Process Design 5. Change Management	4. Business Transition 5. Change Management

The comparison of the four selected methodologies shows many similarities. First, the overall approach business reengineering projects take, is of a linear nature. Further, business reengineering projects take a similar route as IT implementation projects. Within the three consecutive steps, the individual approaches differ in the scope of project preparation. Davenport asks for a complete preparation including visioning, whereas the other methodologies contrast by hands-on approaches right from the project start.

Davenport, Manganelli/Klein and Kodak also address the people side of business reengineering, but only as far as implementation issues are concerned. Taking the conclusion further, and applying it to the sources of existing methodologies, then consultants appear to see business reengineering as yet another systematic and marketable approach for fast and cost-efficient implementation of planned change. Technically oriented academics take a broader view, yet shy away from really integrating social psychology into their linear approaches, because this might be considered non-scientific by colleagues. Users prefer an eclectic approach. They take proven elements both from consultants and academics and apply them as needed (Schumacher, 1995).

### **3.7. BPR Tools and Techniques**

Success of BPR projects is crucially dependent on BPR techniques and tools identified 72 techniques which are commonly associated with BPR. These techniques are related to Quality Function Deployment (QFD), process modeling, simulation, rule specification, database techniques, and process measurement. They relate these to five areas of BPR: technology, management, business processes, structure, and people. In BPR projects a battery of tools and techniques is to be deployed based on the conditions and circumstances (Weerakkody et al., 2011).

The various definitions of BPR suggest that the radical improvement of processes is the goal of BPR. They do not, however, refer specifically to the tools and techniques used in reengineering business processes. The result of this void is that authors and consultants alike have pursued the use of many different tools in the search for the best reengineering application. These tools and techniques include the following:

#### **\* Process visualisation**

While many authors refer to the need to develop an ideal “end state” for processes to be re-engineered, Barrett (1994) suggests that the key to successful reengineering lies in the development of a vision of the process.

#### **\* Process mapping / operational method study**

Cypress (1994) suggests that the tools of operational method studies are ideally suited to the reengineering task, but that they are often neglected. Recent evidence suggests that

these concepts have been incorporated into tools such as IDEF0, DFD (Data Flow Diagrams), OOA (Object Oriented Analysis) and Prince2 (Process based Project Management).

**\* Change management**

Several authors concentrate on the need to take account of the human side of reengineering, in particular the management of organisational change. Some authors suggest that the management of change is the largest task in reengineering. Kennedy (1994) on the other hand, incorporates the human element of reengineering due to the perceived threat it has on work methods and jobs.

**\* Benchmarking**

Several authors suggest that benchmarking forms an integral part of reengineering, since it allows the visualisation and development of processes which are known to be in operation in other organisations.

**\* Process and customer focus**

The primary aim of BPR, according to some authors, is to redesign processes with regard to improving performance from the customer's perspective. This provides a strong link with the process improvement methodologies suggested by authors from the quality field.

It should be noted that few authors refer to any single technique when discussing BPR. Most incorporate and integrate a mixture of tools and techniques for change effectively and for the success of BPR projects. While some authors appear to suggest that tools and techniques are the key, most authors suggest that a strategic approach to BPR and the development of a BPR strategy is the key to success (O'Neill and Sohal, 1999).

### **3.8. Simulation As a BPR Tool**

Simulation of a system is the operation of a model of the system. Simulation is a tool to evaluate the performance of a system. This technique is used before an existing system is altered or a new system built, to reduce the chances of failure to meet specifications, to eliminate unforeseen bottlenecks, to prevent under or over-utilization of resources, and to optimize system performance (Maria, 1997).

Simulation is a tool that can be used to support BPR when physical system models or logical mathematics models are too difficult or costly. Simulation refers to methods for studying a wide variety of models of real world systems by numerical evaluation using software designed to imitate the systems' operations. Basically, it is the process of conducting numerical experiments to get a better understanding of the behavior of that system for a given set of conditions.

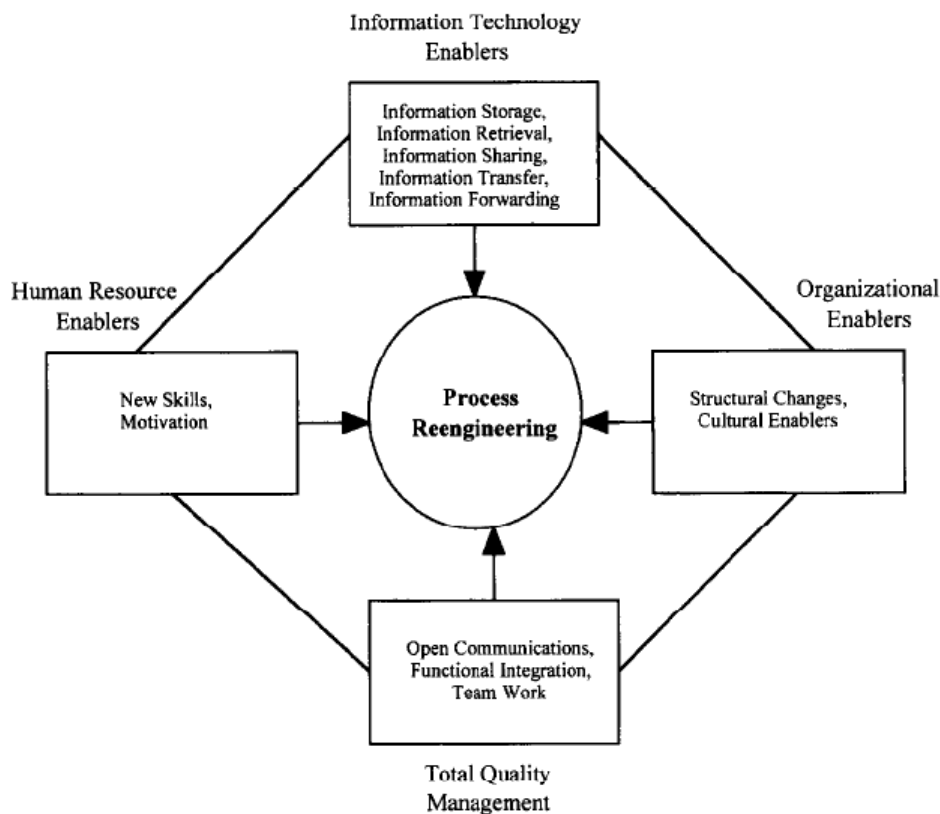
Simulation, a very versatile and powerful tool, is usually the method of choice for complex systems because of its ability to deal with complex models. Over the years, the performance and rising price of hardware have made simulation even more cost effective. Finally, the advances of simulation software power, flexibility, and ease of use have progressed simulation into becoming a quick and valid decision-making tool. As such, simulation is a powerful tool that can be used in business process reengineering.

In the 1950s people began writing computer programs in general-purpose languages to simulate complicated systems. The use of general-purpose languages, like FORTRAN, provided flexibility and the ability to highly customize models; however, the models were highly error-prone and tedious. Eventually, special-purpose simulation languages (GPSS, SIMSCRIPT, SLAM, and SIMAN) were introduced which provided a much better structure for simulation modeling. Several high-level simulator products were soon developed which provided a more user-friendly method of developing simulation models using graphical user interfaces, menus, and dialogs (Kitchen, 2001).

## CHAPTER 4

### ENABLERS OF BPR

The identification and evaluation of enablers is an important step of the reengineering process. Information technology, organisational, human resources and total quality management act as enablers of process reengineering. The enablers required need to identified and evaluated. Identify enabling constraints and additional requirements, i.e. new skills training, etc. A judicious mixture of these enablers is required for process reengineering. A conceptual model is presented in Figure 4.1 to illustrate the enablers of process reengineering (Love and Gunasekaran, 1997).



**Figure 4.1.** A Conceptual Model to Illustrate the Enablers Process Reengineering (Love and Gunasekaran, 1997)

#### **4.1. Information Technology As an Enabler of BPR**

In today's continuously changing and developing world, we witness profound breakthroughs in technology especially in the last couple of decades. One of the areas of technology that we notice a great number of major developments is information technology (Ozsoy, 2007).

In recent years, technological change is one of the most common forms of change experienced in organisations. Major developments in IT have affected most large organisations. Whether it is computer integrated manufacturing (CIM), electronic data interchange (EDI), computer aided design (CAD) or executive information systems (EIS), technological change is becoming a major source of organisational change (Love and Gunasekaran, 1997).

Conceptually, an organization should be able to redesign a business process without the aid of IT. However, many recent successes in reengineering would be difficult to consummate without the enabling IT. Many firms have successfully capitalized on the enabling role of IT in reconfiguring their business processes from a highly serial pattern with many intermediate steps to a parallel pattern permitting several functions to proceed independently.

In the well-publicized case at Ford Motor Corporation, for example, the old accounts payable process involved three functions: purchasing, inventory and account payable, which participated in the process serially with many intermediate steps and sequential flow of paper documents. With direct access to a shared database, the three functions now participate in the reengineered process in a parallel fashion. The reengineered process achieved a 75% reduction in the workforce required, from 500 to only 125 (Grover and Malhotra, 1997).

According to Davenport and Short (1990), IT can actually create new process design options rather than simply support them. Yet, from a different perspective available IT solutions can also have limiting effects on the system to be designed. A further level of strategic decision making is introduced when the source of the IT capability is questioned. Due to the complexity of the problem and the strategic source of the company, mainstream products can be chosen or an application can be developed for the company (Turhan, 2010).

For manufacturing/service organisations IT provides particular capabilities that form the enablers of process reengineering. These include:

- **information storage** - the ability to store information in a form that permits the user or a computer application to retrieve the information when needed, e.g. databases;
- **information retrieval** - the ability to access information and retrieve it from storage, e.g. databases;
- **information sharing** - the ability of a number of users or applications to simultaneously access and view information, e.g. integrated databases and network systems;
- **information transfer** - the ability to connect computers and computer related devices to enable the transfer of information among computers, applications and users, e.g. networking, CAD;
- **information forwarding** - the ability to automatically forward information from one application or user to another user, e.g. electronic data interchange (Love and Gunasekaran, 1997).

Davenport, on the other hand, identifies nine areas where IT can be used for business process innovation:

**Table 4.1.** The Impact of Information Technology on Process Innovation  
(Davenport, 1993)

<b>Impact</b>	<b>Explanation</b>
Automational	Eliminating human labour from a process
Informational	Capturing process information for purposes of understanding
Sequential	Changing process sequence, or enabling parallelism
Tracking	Closely monitoring process status and objects
Analytical	Improving analysis of information and decision making
Geographical	Coordinating processes across distance
Integrative	Coordination between tasks and processes
Intellectual	Capturing and distributing intellectual assets
Disintermediating	Eliminating intermediaries from a process

## **4.2. Organizational Enablers of BPR**

For a BPR effort to succeed, all enablers must be aligned in balance with other key aspects of the organization. For example, if a process is reengineered through the innovative application of IT, this will result in greater worker empowerment and autonomy, and then the organizational culture and organizational structure must be adapted to support these changes. Conversely, if an organization's culture supports control and maximum efficiency systems to enable process innovation must be consistent with these objectives to succeed (Davenport, 1993).

Organisational enablers are divided in two categories: Structural and Cultural.

### **4.2.1. Structural enablers**

Many kinds of structural changes that can facilitate new, process-oriented behaviors, one of the most powerful involves structuring process performance by teams (Karaaslan, 2005).

#### **\* Benefits of teams**

Teams perform better as they integrate cross-functional skills in single work units. Furthermore, a broad set of skills and perspectives increases the likelihood that output will meet multifunctional requirements. For instance, new product development teams increasingly include representatives from all the functions involved in the product development process.

One of the benefits of composing teams to aid process reengineering is that working in teams improves the quality of work life. Teams provide opportunities for small talk, development of friendships, social interaction and empathic reactions from other employees (Ozsoy, 2007).

#### **\* Types of teams**

Different teams' structures can be implemented as structural enablers, for example:

- **Self-managing work teams:** Self-managing teams have control over their jobs, tasks and work environment and they have no formal leader. The positive impact

of peer pressure from within self-managing teams has delivered significant increases in productivity and quality.

- **Cross-functional teams:** In these kinds of teams, multiple functions are combined into one unit. These teams increase the probability that the output team produces meets multi-functional requirements.
- **General purpose problem solving teams:** Generally this structure consists of between five and ten employees from within a department. The team meets on a regular basis to discuss ways of improving productivity, quality and the working environment (Love and Gunasekaran, 1997).

#### \* **Criteria for team success**

Whatever the type of team, one can find research and experience that indicate how it can be successful, both in general and relative to process innovation in particular. Composition, for example, has been shown to be key to team success. Although personality issues may render some productive workers unsuited for teamwork, in general, employees who perform well as individuals tend to perform well as team members. Finding good performers will contribute to productivity, but unless, collectively, they possess the functional background, skills, and experience requisite to the process being innovated, the team is not likely to succeed (Karaaslan, 2005).

#### **4.2.2. Cultural enablers**

Most recent shifts in organizational culture have been in the direction of greater empowerment and participation in decision making and more open, less hierarchical communications. The resulting participative cultures, which have a structural side in flatter organizational hierarchies or broader spans of control, have been widely documented to lead to both higher productivity and greater employee satisfaction. In a process innovation context, these cultural changes are intended to empower process participants to make decisions about process operations. Participative cultures may even lead to self design of smaller, restricted processes by employee teams.

In addition to these, information technology can support either culture control or empowerment. It can supply employees with information that enables them to make their own process decisions or with instructions that dictate precisely how to perform

each process step. This dual nature of IT, which enables individuals or teams to manage themselves with information or information to be used to closely monitor individual or team performance (Davenport, 1993).

### **4.3. Human Resources As an Enabler of BPR**

Traditionally, organisational change that has focused on human resources has used training and development activities such as personal development, and team building, to improve organisational performance. These approaches have focused on improving skills, knowledge and interpersonal relationships at work, but tend to ignore the fact that work performance is often affected by factors such as the design of the job or technological constraints than by motivational or job knowledge (Love and Gunasekaran, 1997).

In this context, we need to focus on skills, job motivation and human resource policies.

#### **4.3.1. New skills**

New processes invariably involve new skills. Because process innovation often involves both greater worker empowerment and a broader set of work tasks, the requisite new skills may involve both greater depth of job knowledge and greater breadth of task expertise. A variety of training programs must be undertaken if the requisite skills are to be available when they are needed. These include specific process training, anticipatory training, and on-the-job training. The most common type of training in a process innovation context is specific process training (Karaaslan, 2005).

When a new process is designed, the process skill requirements must be assessed and workers who will execute the process must be trained in those skills. Though it may seem straightforward, there are several problems with this type of training. One, because skill acquisition often takes longer than process design, the need for workers with new skills may be urgent before their training can be completed. Two, there are likely to be few employees with sufficient experience and knowledge to train others. If the process is truly innovative, no one will be qualified to train anyone else. Three, unless workers are overqualified for their jobs, it may be difficult to find employees

with enough raw intelligence and generic job skills to execute the new process (Davenport, 1993).

#### **4.3.2. Motivation**

Motivation levels of employees unquestionably influence process performance. Employee motivation stems from combination of factors such as the characteristics of the job, the way job is designed, and some other factors determined by individuals' personalities. Companies may aim at hiring employees with high motivation levels but can also find ways to bring motivation into the process/es being designed and make the new tasks for the new process or processes rewarding (Love and Gunasekaran, 1997).

The consensus model in studies of work organization suggests that work motivation originates from five key aspects of the job, or process.

- **Skill variety** - the variety of skills and talents necessary to perform the tasks
- **Task identity** - the degree to which a job involves completion of an entire activity
- **Task significance** - the perceived importance and impact of the job
- **Autonomy** - the extent of the individuals freedom to schedule tasks and determine procedures
- **Feedback** - the extent to which information about the performance of the job is provided to the worker (Ozsoy, 2007).

#### **4.3.3. Human resource policies**

A number of other human resource policies can be considered as process innovation enablers when combined with technological and organizational changes. These policies and their implications for process innovation are referred briefly below:

##### **4.3.3.1. Compensation**

This approach, now usually called "gain sharing", is widely referenced in the quality literature. Obviously, given the strong measurement orientation of a process approach, it would be relatively straightforward to compensate process workers on the basis of process performance. Just as obviously, doing so would probably be an effective

motivational technique for these employees. At the management or process owner level, compensation-oriented enablers might include giving managers a financial stake in the performance of the process, perhaps even ownership in the literal sense (Karaaslan, 2005).

#### **4.3.3.2. Career paths**

A process view of the organization usually implies career paths different from those found in the typical functional, hierarchical organization. Career movement is likely to be more lateral than upward; titles may no longer reflect the importance of the role. We are aware of several firms in which new processes already seem to involve fewer options for upward advancement. Companies that can figure out how to motivate employees under these new career conditions will have a long-term advantage in process innovation over those that cannot (Davenport, 1993).

#### **4.3.3.3. Work role rotation**

Since processes are typically collections of functions, a process worker should have enough knowledge about other functions and activities so as to effectively integrate across them. One way to ensure broad process knowledge is to rotate workers through various jobs in the process or in related processes. This, like process oriented career paths, is a long term enabler of process reengineering that should be established throughout a company rather than for a specific process (Ozsoy, 2007).

#### **4.3.3.4. Lifetime employment**

A lifetime employment policy greatly facilitates process innovation. Employees who feel that they have a job for life are much less worried about designing or performing their jobs out of existence. IBM is one of the few large companies headquartered in the United States that still maintains a lifetime employment policy (and its policy is weakening rapidly under economic pressures), but many firms around the world do so, particularly in Japan. Large Japanese firms' employment of this policy is often credited for the process flexibility and grass-roots innovativeness of their employees (Davenport, 1993).

#### **4.4. Total Quality Management As an Enabler of BPR**

Total Quality Management is an enabling ingredient that can contribute to the successful implementation of process reengineering. Essentially, TQM forms the foundations of process reengineering as it embrace's open communications, and breaks down the barriers which exist between management and non-management personnel (Love and Gunasekaran, 1997).

Both TQM and reengineering focus on processes. However, TQM involves bottom-up participation, usually within function, continuous evaluation of current practices resulting in incremental changes in work design. Reengineering, on the other hand, is typically initiated from the top down, focuses on broad cross-functional processes, questions the logic of existing designs and is usually a one-shot attempt at achieving quantum improvements. IT, while only incidental to TQM, is often a key enabler of reengineering. All the same, TQM can often serve as the building block for subsequent BPR efforts (Grover and Malhotra, 1997).

In essence, TQM has similar underlying principles as process reengineering focusing on: customers, cultural change, best practice and an integrated approach to doing work. Nevertheless, the major differences between TQM and process reengineering are identified as follows (Love and Gunasekaran, 1997):

- TQM encourages incremental change whereas process reengineering encourages radical change,
- TQM concentrates on existing processes, whereas process reengineering abolishes the existing process and starts all over again with a new one.

At this point, it is important to underline that although these two approaches are different in some ways they are both based on change but generally TQM falls behind the needs of increasing productivity and quality requirements. To meet these increasing needs, a more pragmatic approach implementing the tools and techniques of TQM to an increased level of sophistication are required. This can be achieved through process reengineering. With this in mind, it can be concluded that organizations with a built-in philosophy of TQM will have a good understanding and be more adaptable to process reengineering than those without.

Consequently, when it is questioned whether TQM is an enabler or not, it can be inevitably said that TQM is an enabling ingredient and stepping stone towards process reengineering (Ozsoy, 2007).

## **CHAPTER 5**

### **A BPR CASE STUDY**

In this chapter, supply chain process of an industrial company will be analyzed; a simulation model will be set and developed for BPR. This BPR case study will be applied for a particular product. Firstly, general information about the company will be given and then the studies will be detailed. The information given here has been obtained from the interviews conducted with the company personnel and from the company's website. The name of the company will not be denounced and it will be called "the Company" from here onwards.

#### **5.1. The Company**

Founded in 1942, the Company is a prominent Turkish industrial group with 39 companies, 10,950 employees and a combined net turnover of TL 5.35 billion in 2011.

The Company's core sectors are building products, healthcare and consumer products. Additionally, the Company is active in finance, information technology, welding technology, mining, and property development. In Turkey, the company is the leader in most of its businesses with some of the most effective distribution networks in the country for building products, pharmaceuticals, and fast-moving consumer goods. Globally, the Company has established itself among the world's top providers of bathroom and tiling solutions for homes and commercial venues with its special brands. It is also a major exporter of tissue paper, welding electrodes, electronic smart cards and industrial raw materials such as clay and feldspar.

International partnership is a central component of the Company's growth strategy. It has six international joint ventures and numerous cooperation agreements with leading international companies. All of these are grounded on the principles of long-term mutual benefit and sustainable business practices.

The Company's mission is to be a pioneer of modern lifestyles that are healthy, high quality and sustainable. Accordingly, the Company encourages each of its companies to surpass established standards and raise consumer benchmarks of product and service

quality. Through sponsorship and responsible corporate practices, it also promotes social and economic development that nurtures cultural and scientific activity, protects the environment and preserves scarce natural resources.

This study has been performed in the Company's Building Products Division. The Building Products Division operates globally and owns a total of 15 manufacturing facilities: 9 spread out over Germany, England and France and 6 in Turkey. Combined, these factories produce an average of 5 million ceramics sanitary ware, 36 million square meters of ceramic and wall tiles, 370 thousand modules of bathroom furniture, 3 million faucets, 350 thousand bathtubs, 2,5 million bathroom accessories, 150 thousand concealed cisterns and 550 thousand WC pan seats and covers every year.

With a wide range of products and an extensive distribution network, the Building Products Division currently exports its products to more than 75 countries. It has become a globally recognised supplier of bathroom products and tiles. Long the market leader in Turkey of bathroom products and ceramic tiles, it contends for top three ranking in Europe.

## **5.2. Examination of the System**

The system in hand involves supply chain process of the company. The main problem of the system is the large amounts of demands arriving at unforeseen times. These demands can not be meet within the desired speed and quality of service. So, the percent of responding demands is low. With performed this BPR study, to increase the percent of responding demands and to shorten lead time is aimed. This study was applied for a particular product. The product in hand is the bathroom furniture. It will be called product "A" from here onwards. Product "A" is one of the most demanded products. Demands regarding product "A" are made from two different channels as retail and project sales.

Monthly demand amounts provided by the company for both types of the demands between the years of 2010 and 2012 are shown in Table 5.1.

**Table 5.1.** Monthly Demand Amounts

Month	Retail Sales Demand (unit)			Project Sales Demand (unit)		
	2010	2011	2012	2010	2011	2012
01	255	589	921	142	309	322
02	203	527	1466	180	547	144
03	246	911	1439	268	131	557
04	207	986	1421	130	1178	1365
05	655	938	1359	393	729	270
06	270	1245	828	221	338	678
07	297	867	1230	368	391	775
08	265	1149	724	129	452	429
09	137	794	1135	56	175	246
10	391	698	737	251	694	199
11	379	597	1195	183	241	733
12	290	980	1005	110	2371	616

The data given above has been evaluated using the Best Fit program and it has been found that both types of the demands conform to Normal Distribution. The fiction in the simulation study to be made is to create a time-based demand. Therefore, what counts as the basis for us is the interarrival times of the demands. Thus; while the mean ( $\mu$ ) and standard deviation ( $\sigma$ ) of the interarrival times of the demands made through retail sales channel are 0,95 and 0,33 hour (hr) respectively, the mean and standard deviation of the interarrival times of the demands made through project sales channel are 1,59 and 0,78 (hr) respectively.

The production policy of the company is “make-to-order (MTO)”. The make-to-order strategy that typically allows consumers to purchase products that are customized to their specifications. This is the most important reason of using that strategy at the company. The MTO production strategy only manufactures the end product once the customer places the order. This creates additional wait time for the consumer to receive the product, but allows for more flexible customization compared to purchasing from retailers' shelves.

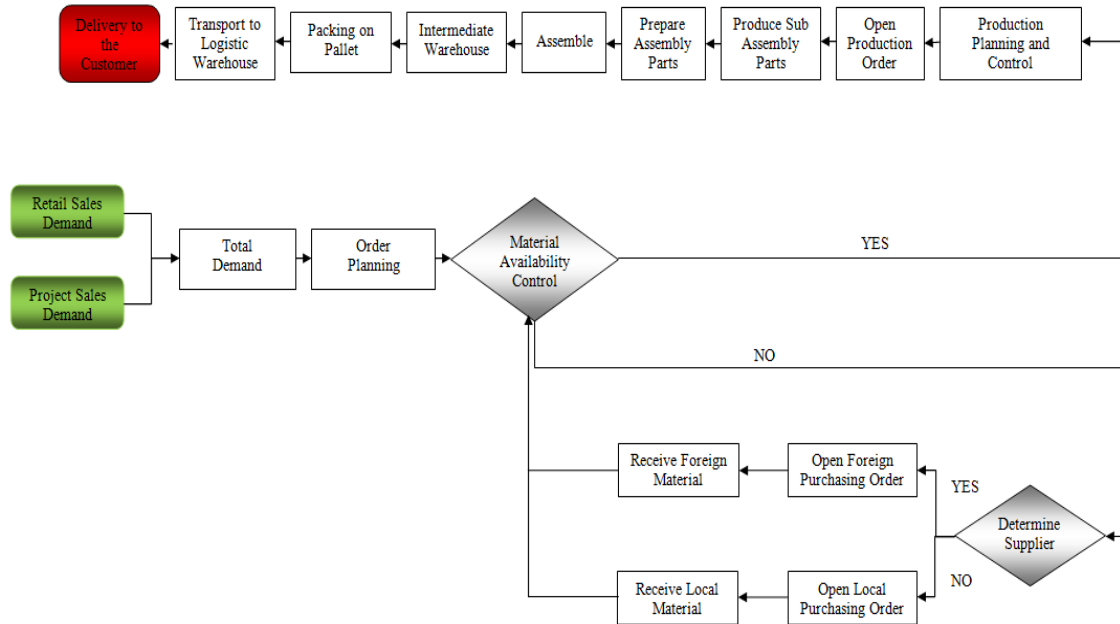
The stock policy applied by the company can be summarized in the following way. Monthly demand amounts concerning the previous years, are kept under record in the system. Using these data and taking into account the growth ratios, the company determines the amounts of the material that must be available in stock at the beginning of each month. The order process is started two months prior to the related month so that the specified amounts are obtained in time. The company does not hold finished goods inventory in order to be able to make production according to the requests of the customers. According to the data of the company, the amounts of the material in stock at the beginning of each month between the years of 2010 and 2012 are as shown in Table 5.2.

**Table 5.2.** Beginning Inventory

<b>Month</b>	<b>Beginning Inventory (unit)</b>
01	846
02	1022
03	1184
04	1762
05	1448
06	1193
07	1309
08	1049
09	848
10	990
11	1109
12	1791

### 5.3. Workflow of the System

The current process flow can be summarized as follows:



**Figure 5.1.** The Current Process Flow Chart

**Retail sales demand:** These types of demands are end user demands. So, these demands have a great importance. They must be responded primarily and their service level must be the highest.

**Project sales demand:** Project sales demand which are project basis, received in large quantities. These demands are not end user demands. So, their priority is lower than retail sales demand. Delivery time depends on the project's completion time.

**Total demand:** These demands are the total of retail sales demand and project sales demand. Demands are instantaneous and can be taken at any time.

**Order planning:** At this stage, time of delivery to the customer is determined considering criteria such as forecasts, reorder point (ROP), capacities. This operation is done three times a week on Monday, Wednesday and Thursday. This is a very crucial

stage. Because if this stage is not completed, procurement and production processes can not start. In other words, the step of order planning triggers all other processes.

**Material availability control:** Material requirements planning (MRP) over the Systems, Applications and Products in Data Processing (SAP) system runs to control material availability. Due to this control, the material requirements are determined. So, it is decided to material availability based on quantity on hand. If material is available, it is proceeded to the stage of production planning and control. If material is not available, order is placed.

*In case of material requirement;*

Firstly, supplier is determined. Then according to this information, purchasing orders are opened.

**Open foreign purchasing order:** This operation is done once a week on Friday. Friday is waited to do this operation collectively because of the variety of the products.

**Open local purchasing order:** This operation is done twice a week on Tuesday and Friday. Tuesday and Friday are waited to do this operation collectively because of the variety of the products.

**Receive foreign material:** The lead time of the import materials are between fifty and seventy days. Most probable value is fifty-five. In the meantime, ordered import materials are received. After receiving operation had been done, received quantity is checked.

**Receive local material:** The lead time of the local materials are between seven and eighteen days. Most probable value is fifteen. In the meantime, ordered import materials are received. After receiving operation had been done, received quantity is checked.

*In case of material availability;*

**Production planning and control:** If material is available, it is proceeded to production phase. So then first planned orders are transformed into production orders. The production plan required is prepared.

**Open production order:** At this stage, production order is opened according to the production plan prepared. Thus, materials are reserved for relevant order.

**Produce sub assembly parts:** After production order had been opened, sub assembly parts are produced. This production stage is for the production of the semi-finished goods.

**Prepare assembly parts:** Produced sub assembly parts and raw materials are prepared quantities and dimensions used in assembly. Following these materials are transmitted on the assembly line.

**Assemble:** The assembly process is the final stage of production. At this stage, prepared assembly parts are combined with each other and finished. Thus, production process is completed.

**Intermediate warehouse:** Finished products are stored in the intermediate warehouse order-based temporarily.

**Packing on pallet:** The products of the same order are packed based on optimum pallet structure.

**Transport to logistic warehouse:** After the products had been packed, they are transported to logistic warehouse.

**Delivery to the customer:** This is the final stage of the process. At this stage, it is made delivery to the customer by logistic warehouse. Delivery time is about two days.

## **5.4. Simulation Model of the System**

### **5.4.1. The software used in the simulation**

The system in question was modelled via Micro Saint Sharp simulation software. Micro Saint Sharp is a discrete-event network simulation software package for building models that simulate real-life processes. With Micro Saint Sharp models, useful information can be gained about processes that might be too expensive or time-consuming to test in the real world (Micro Saint Sharp, 2003).

Micro Saint Sharp does not use the terminology or graphic representations of a specific industry. If the system can be drawn as a flow chart, then a model of the process can be built in Micro Saint Sharp. The degree of model complexity is flexible. A simple, functional model can be built just by drawing a network diagram and filling in the task timing information. Also a more complex model that includes dynamically changing variables, probabilistic and tactical branching logic, sorted queues, conditional task execution, and extensive data collection can be built in Micro Saint Sharp. Micro Saint Sharp includes a fully functional programming language. This sophisticated programming language will make it more efficient to write code especially for large, complex models (Bloechle and Schunk, 2003).

#### **5.4.2. The assumptions of the model**

The assumptions related to the model are explained below:

- A month contains 30 days.
- A month contains 24 work days.
- Inter task switching time is ignored.
- Unit of time used in simulation is second.
- Each model run takes one year.
- Demand characteristics are assumed to be normal distribution.
- One unit raw material is used to obtain one unit finished product.
- First-in first-out (FIFO) method is taken as a basis.
- The main outputs of the model are responding demand percentage and lead time.
- Based on the information obtained by the company, the data that does not significantly affect the real system are ignored.

#### **5.4.3. The definition of the variables for simulation model**

The variables defined so that the system can work as anticipated and the outputs are evaluated as well as the information concerning these variables are shown in Table 5.3.

**Table 5.3.** List of the Variables

<b>Variable</b>	<b>Variable Type &amp; Initial Value</b>	<b>Function of the Variable</b>
B_1	Boolean / True	These are variables that provide the transfer of amounts of the raw material inventory determined for each month to the variable of “Beginning Inventory” once a month.
B_2	Boolean / True	
B_3	Boolean / True	
B_4	Boolean / True	
B_5	Boolean / True	
B_6	Boolean / True	
B_7	Boolean / True	
B_8	Boolean / True	
B_9	Boolean / True	
B_10	Boolean / True	
B_11	Boolean / True	
B_12	Boolean / True	
Beginning Inventory	Integer / 0	It is a variable that keeps the amount of raw material inventory on hand at the beginning of each month.
Day_in_Year	Double / 1	It is a variable that keeps what day of the year it is.
Day_of_Week	Integer / 0	It is a variable that keeps what day of the week it is.
Day_of_Year	Integer / 1	It is a variable that keeps what day of the year it is.
Finished Number	Integer / 0	It is a variable that keeps the number of the amount of the products delivered to the customer.
Finished Project	Integer / 0	It is a variable that keeps how much of the demands

		made through project sales channel have taken product form and delivered to the customer.
Finished Retail	Integer / 0	It is a variable that keeps how much of the demands made through retail sales channel have taken product form and delivered to the customer.
Lead Time	Double / 0	It is a variable that keeps the time between the placement and receiving of the order.
Material Availability	Boolean / True	It is a variable that keeps whether the raw material that is necessary for production is available in stock at any time.
Ordered Piece	Integer / 0	It is a variable that keeps the number of the raw material orders made since the raw material necessary for production is not available.
Produced Number	Integer / 0	It is a variable that keeps the number of the products produced.
Project Number	Integer / 0	It is a variable that keeps the number of the demands made through project sales channel.
Raw Material Inventory	Integer / 0	It is a variable that keeps the number of raw material in

		stock at any instant of the simulation.
Received Piece	Integer / 0	It is a variable that keeps the number of the orders for which the raw material order has been made and the receiving process completed.
Responding Demand Percentage	Double / 0	It is a variable that keeps as a percentage of how much of the demands arrived to the system during the simulation have taken product form and delivered to the customer.
Retail Number	Integer / 0	It is a variable that keeps the number of the demands made through retail sales channel.
Simulation Time	Double / 0	It is a variable that keeps the simulation time in terms of seconds.
Total Number	Integer / 0	It is a variable that keeps the number of all of the demands arrived to the system during the simulation.

#### 5.4.4. System service time for simulation model

In the simulation study conducted, the service time allocated for the progress of the demands created in the system is shown in terms of time (hr)/unit in Table 5.4. These times and the data regarding the distribution of these tasks have been determined based on the data provided by the company and the experiences.

**Table 5.4.** Service Time for Tasks

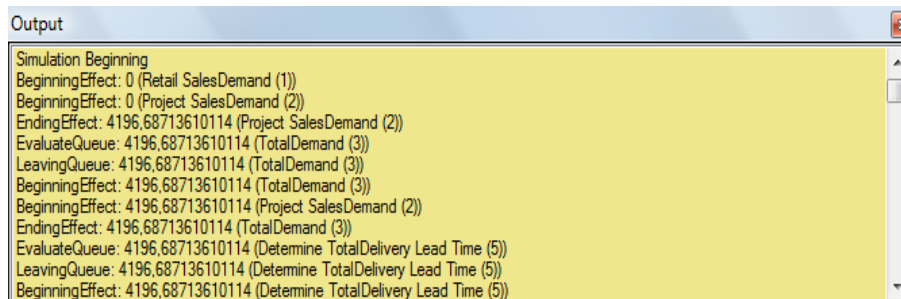
<b>Task Name</b>	<b>Distribution</b>	<b>Parameter Values (hr)</b>
Receive Foreign Material	Triangular	(1; 1,09; 1,39)
Receive Local Material	Triangular	(0,14; 0,3; 0,36)
Produce Sub Assembly Parts	Normal	(0,1; 0,05)
Prepare Assembly Parts	Normal	(0,01; 0,002)
Assemble	Normal	(0,1; 0,07)
Intermediate Warehouse	Triangular	(0,01; 0,02; 0,04)
Packing on Pallet	Normal	(0,002; 0,0004)
Transport to Logistic Warehouse	Normal	(0,0004; 0,0002)
Delivery to the Customer	Normal	(0,04; 0,02)

#### 5.4.5. Verification and validation of the model

One of the most effective methods used to verify the model is to get “Trace” report of the program. Micro Saint Sharp provides this opportunity to users. By this way flow of the system during simulation was followed and running of the model properly is observed.

Trace data can be viewed during simulation in the Output window. To display trace data in the Output window; from the Utilities menu, Display Trace must be selected so that a check mark displays adjacent to Display Trace.

The Output window displays the trace of the execution, which consists of the actions that occur when the model is run. The clock times for beginning effects, ending effects, and scenario events are listed. Application errors, whether plugins were loaded successfully, and the start and end of a simulation are also included. Any syntax errors are indicated and you can use them for debugging purposes. The information can be saved in the Output window to a file or to the Windows clipboard and clear the information in the window before running a new simulation (Micro Saint Sharp, 2003).



**Figure 5.2.** Output Window

Fallon and Browne (1987) propose that in the case that an investigated system is not a real system, it is not possible to conduct a complete validity test due to non-existence of real data. On the other side, Chaturvedi and Golhar (1992), state that a comparison to be made with the output of a similar system can provide some information regarding the validity of the system under examination.

For the system examined by us, since the data are limited and similar models do not exist, conducting a complete validity test has not been possible. However, based on the

data at our hands and the outputs obtained after the simulation study, it is said that the system reflects the reality in general.

#### **5.4.6. As-Is simulation model**

In the light of the above given information for the current supply chain process of the company, a simulation model in Micro Saint Sharp simulation program has been created. The visual form of the created model in Figure 5.3 and the details regarding the model has been given below.

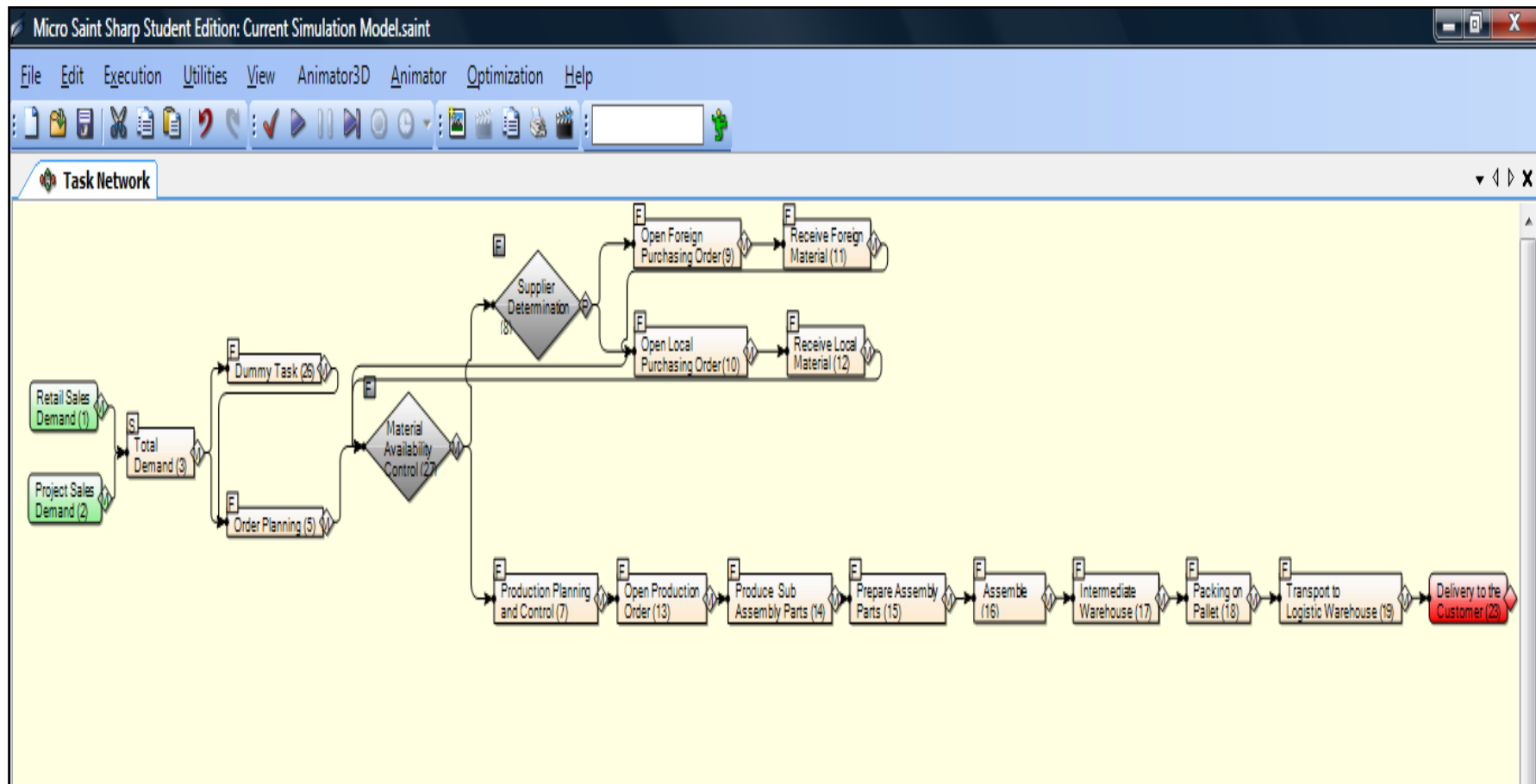


Figure 5.3. As-Is Simulation Model

The unit of the time used in the simulation study conducted is second. Each run of the simulation to be conducted is designed to continue for 1 year. Within this scope, the following code has been implemented and during the simulation time, the information concerning which every second corresponds to what day of the year and week has been reached. The need to create this arises as some of the steps in the process can be conducted on certain days of the week and the system is not active on Sundays.

```
SimulationTime = Clock;

Day_in_Year = Math.Floor(SimulationTime/86400);

Day_of_Year = Convert.ToInt32(Day_in_Year);

Day_of_Week = Day_of_Year % 7;
```

At the end of this arrangement, each day of the week has been associated with a code defining itself. This relationship is shown in Table 5.5.

**Table 5.5.** Codes Associated with the Days

<b>Day</b>	<b>Code</b>
Monday	0
Tuesday	1
Wednesday	2
Thursday	3
Friday	4
Saturday	5
Sunday	6

Based on the stock policy of the company, the following code has been implemented. The stock information regarding the raw material necessary for production of product “A”, is generically kept by the variable defined by the name “Raw Material Inventory”.

```

if (Day_of_Year == 1)
{
    if (B_1 == true)
    {
        BeginningInventory = 846;
        RawMaterialInventory = BeginningInventory;
        B_1 = false;
    }
}
if (Day_of_Year == 31)
{
    if (B_2 == true)
    {
        BeginningInventory = 1022;
        RawMaterialInventory = BeginningInventory;
        B_2 = false;
    }
}
.
.
.
if (Day_of_Year == 301)
{
    if (B11 == true)
    {
        BeginningInventory = 1109;
        RawMaterialInventory = BeginningInventory;
        B11 = false;
    }
}
if (Day_of_Year == 331)
{
    if (B12 == true)
    {
        BeginningInventory = 1791;
        RawMaterialInventory = BeginningInventory;
        B12 = false;
    }
}
}

```

### **[Task 3 – Total Demand]**

Following the creating of the demands, what the ordered based on the priority degrees are the section where they created a tail. A demand is made from retail sales channel and project sales channel every 0,95 and 1,59 hr on the average respectively (see: Examination of the System). Within this scope, the following code is implemented and during the simulation, the priority degrees of the demands made through retail sales channel and project sales channel have been defined as 2 and 1 respectively.

```

//FOR RETAIL SALES DEMAND

    Entity.Priority = 2;

//FOR PROJECT SALES DEMAND

    Entity.Priority = 1;

```

The codes given above as well as the demands created throughout the simulation have been assigned priority degrees. Afterwards, by the help of the following code, all of the demands have formed a tail in the Total Demand by taking their priority degrees into account. With this code, the general policy of the company is tried to be transferred into the simulation medium. The purpose in the aforementioned policy is that the demands made through retail sales channels are met before the demands made through project sales channel.

```

return Entity.Priority;

```

### **[Task 5 – Order Planning] & [Task 26 – Dummy Task]**

Order planning is made manually and weekly on Monday, Wednesday and Thursday. The demands arriving to the system on other days are kept in the Dummy Task until the first day on which the next order planning operation will be made. The demands arriving in the days during which the order planning is being made and keeping until that moment in the Dummy Task, can proceed to the next stage after this operation is completed.

By the help of the following code, the demands included in the Total Demand can proceed to the order planning operation only on Mondays, Wednesdays and Thursdays.

```

if ((Day_of_Week == 0) || (Day_of_Week == 2) || (Day_of_Week == 3))

{
    return true;
}
else
{
    return false;
}

```

By the help of the following code, the demands included in the Total Demand can be directed to the Dummy Task on the days except on Mondays, Wednesdays and Thursdays.

```
if ((Day_of_Week == 1) || (Day_of_Week == 4) || (Day_of_Week == 5) ||
(Day_of_Week == 6))
{
    return true;
}
else
{
    return false;
}
```

### **[Task 27 – Material Availability Control] & [Task 7 – Production Planning and Control] & [Task 8 – Supplier Determination]**

At this stage, first of all, whether or not the raw material used in the production of product “A” exists in stock is controlled. After the control made, the production stage is started or procurement of the raw material that is necessary for the production is made. In order to be able make this decision, the following code is implemented. With the variable of “Material Availability”, whether or not material is needed is being generically kept.

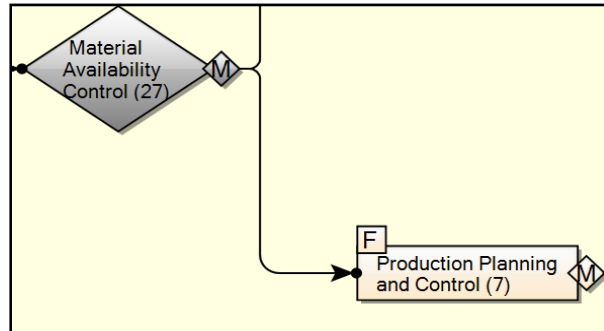
```
if (RawMaterialInventory > 0)
{
    MaterialAvailability = true;
}
else
{
    MaterialAvailability = false;
}
```

In the case that there is raw material in stock, the production stage is started. In this case by the help of the following code, the demands are directed to the task named Production Planning and Control.

```

if (MaterialAvailability == true)
{
    return true;
}
else
{
    return false;
}

```



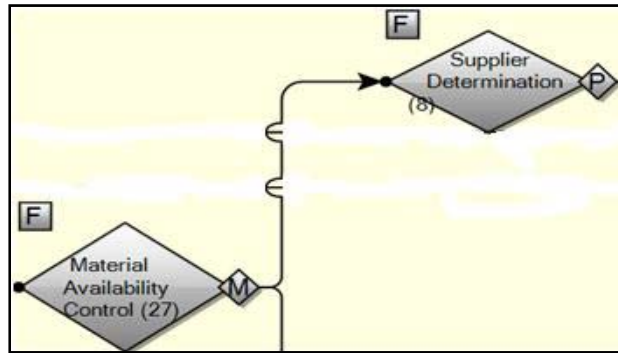
**Figure 5.4.** Material Availability Control & Production Planning and Control

In the case that there is no raw material in stock, raw material order is made in order to meet the demands. In this case by the help of the following code, it is the point in question to be directed to the task named Supplier Determination in order to decide from which type of supplier (local–foreign) the orders will be met.

```

if (MaterialAvailability == false)
{
    return true;
}
else
{
    return false;
}

```



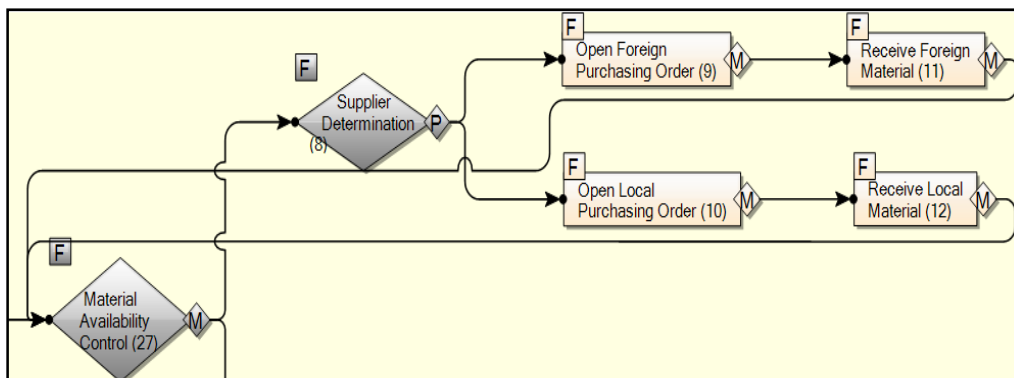
**Figure 5.5.** Material Availability Control & Supplier Determination

**[Task 9 – Open Foreign Purchasing Order] & [Task 11 – Receive Foreign Material]**

**[Task 10 – Open Local Purchasing Order] & [Task 12 – Receive Local Material]**

In the case that the raw material that is necessary for the production of product “A” is not available in stock, raw material procurement is made that is likely to be 70% local or 30% foreign procurement.

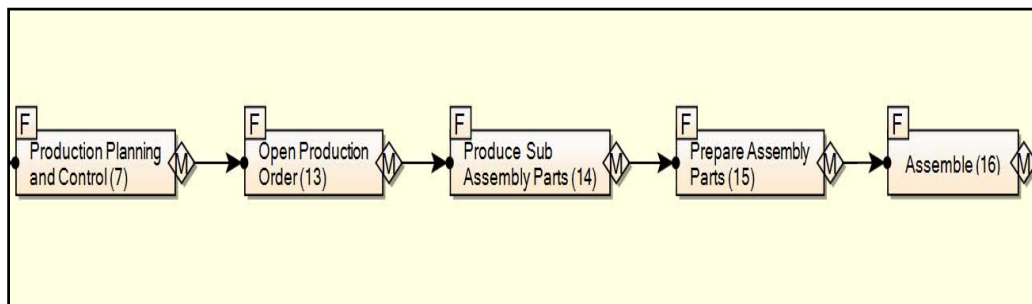
As foreign purchasing orders only open on Fridays, local purchasing orders open on Tuesdays and Fridays. Based on the orders, meeting the material need is waited after the receiving operations are completed and before the production process is started, and the amounts received are controlled. Therefore, it is the point in question to return back to Material Availability Control in the system.



**Figure 5.6.** Local and Foreign Supply Routes

**[Task 13 – Open Production Order] & [Task 14 – Produce Sub Assembly Parts] & [Task 15 – Prepare Assembly Parts] & [Task 16 – Assemble]**

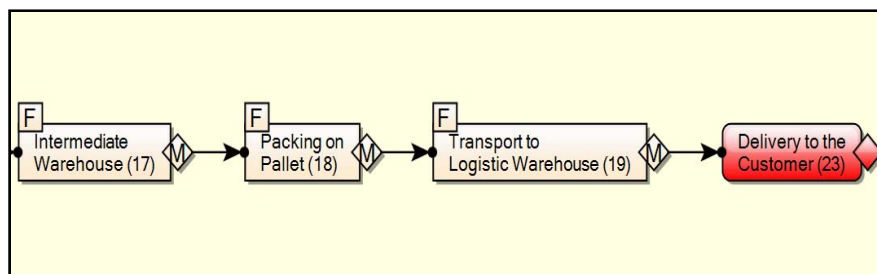
In the case that the raw material necessary for production is available, these are the sections in which the production is realized step by step. After completion of the production planning and control phase, production order is opened to initiate production actually. Then, the production of product “A” is realized step by step.



**Figure 5.7. Production Phase**

**[Task 17 – Intermediate Warehouse] & [Task 18 – Packing on Pallet] & [Task 19 – Transport to Logistic Warehouse] & [Task 23 – Delivery to the Customer]**

These are the sections that include the intermediate warehouse unit where the products, production of which are completed are kept all together, packing of these products on pallets in the intermediate warehouse unit, transportation of the packed products to logistics warehouse center so that their logistics operations can be completed and the delivery of the products to the customer.



**Figure 5.8. Logistic Phase**

#### 5.4.7. Analysis of current process outputs

The data obtained as a result of running of the simulation model created for a period of a year under the assumption that each month is thirty days long are shown in Table 5.6.

**Table 5.6.** Current Process Outputs

<b>Output</b>	<b>Value</b>
Total Number	14409
Retail Number	9106
Project Number	5303
Finished Number	6302
Finished Retail	3993
Finished Project	2309
Produced Number	6302
Ordered Piece	0
Responding Demand Percentage	0,44
Lead Time (hr)	1,07

The following results have been obtained as a result of the simulation study conducted:

- It is seen that 9106 and 5303 demands from retail sales channel and project sales channel respectively and a total of 14409 demands have arrived to the system. 44% of these demands have taken finished product form and have been delivered to the customer. That is to say, the responding demand percentage, which is one of the major outputs of the simulation model created is 0.44. That this ratio is low means that there are significant bottlenecks in the current system and these must be resolved in order to increase the system performance.
- While 63% of 6302 number of finished products corresponding to the percent of responding demands constitutes the demands made through the retail sales channel that have taken the product form and delivered to the customer, 37% constitutes the part that made through the project sales channel and have taken product form that is delivered to the customer.

- When the variable of Produced Number is examined, it is seen that the value which this variable has taken after the end of a year is the same as the variable of Finished Number. This shows the result that all of the products produced in the system have been delivered to the customer.
- When the variable of Ordered Piece is examined, it is seen that no state in which the raw material necessary for the production of product “A” is not available in stock has been experienced. All of the demands have been met the available of raw material inventory.
- When the lead time which is one of the major outputs of the simulation model created is examined, it is seen that the time between the placement and receiving of the order is 1,07 hr/unit. It is among our major goals to shorten the lead time. After the bottlenecks existing in the system are determined and resolved, it is expected that this period will become shorter.

#### **5.4.8. The effect of the demand change on the current system**

As stated also in the beginning (see: Examination of the System), it is thought that the main problem experienced by the company in the current system, is the large amounts of the demands arriving at unforeseen times. In other words, the state that the demand is very change is not managed by the company. For this reason, the effect of the demand change on the current system has been asked to be investigated. Based on this, in order to be able to measure the behavior of the current system against the demand change, time-based standard deviation values of the demands made through retail and project sales channels are shown in Table 5.7. Under the assumption of the 20% of the standard deviation values under normal state, low and high change values have been calculated.

**Table 5.7.** Standard Deviation Values against the Demand Change

	<b>Standard Deviation for Retail Sales Demand in hours (<math>R_i</math>)</b>	<b>Standard Deviation for Project Sales Demand in hours (<math>P_i</math>)</b>
<b>Low Change</b>	0,26	0,63
<b>Normal State</b>	0,33	0,78
<b>High Change</b>	0,40	0,94

The combinations that will occur between the change states for the demands made through retail and project sales channels are as given below:

**Table 5.8.** Combinations Between Change States

$(R_1, P_1)$	$(R_1, P_2)$	$(R_1, P_3)$
$(R_2, P_1)$	$(R_2, P_2)$	$(R_2, P_3)$
$(R_3, P_1)$	$(R_3, P_2)$	$(R_3, P_3)$

For each of the combination occurred above, the variables of Responding Demand Percentage and Lead Time values have been reached as shown in Table 5.9 as a result of running of the simulation model for a period of one year. Accordingly, it is seen that the values of these performance criteria taken as a result of different combinations, are very close to each other. In other words, the demand change, contrary to what is assumed has not affected the percent of responding demands and lead time significantly. In this case, it is observed that the major problem in the system is in fact not the demand change, but there exists a critical problem in the operational process/processes of system working.

**Table 5.9.** Performance Measurements

<b>Demand Change</b>	<b>Responding Demand Percentage</b>	<b>Lead Time (hr)</b>
<b>(R<sub>1</sub>, P<sub>1</sub>)</b>	<b>0,436</b>	<b>1,083</b>
(R <sub>1</sub> , P <sub>2</sub> )	0,436	1,074
(R <sub>1</sub> , P <sub>3</sub> )	0,439	1,074
(R <sub>2</sub> , P <sub>1</sub> )	0,438	1,065
<b>(R<sub>2</sub>, P<sub>2</sub>)</b>	<b>0,437</b>	<b>1,068</b>
(R <sub>2</sub> , P <sub>3</sub> )	0,437	1,082
(R <sub>3</sub> , P <sub>1</sub> )	0,437	1,067
(R <sub>3</sub> , P <sub>2</sub> )	0,438	1,069
<b>(R<sub>3</sub>, P<sub>3</sub>)</b>	<b>0,440</b>	<b>1,077</b>

In the case that the demand change is at extreme points ((R<sub>1</sub>, P<sub>1</sub>), (R<sub>2</sub>, P<sub>2</sub>), (R<sub>3</sub>, P<sub>3</sub>)), as a result of running the simulation model for a period of one year on a monthly basis, the amounts of raw material inventory at the end of each month, and holding costs are shown in Table 5.10. Based on this, for both of the demand types; in the case that low change is experienced, the total annual holding cost is at the minimum level; in the case that high change is experienced, the total annual holding cost is at the maximum level.

**Table 5.10.** Monthly Raw Material Inventory Amounts and Cost Values

Month	Raw Material Inventory (unit)			Unit Holding Cost (m.u.)	Total Holding Cost (m.u.)		
	(R <sub>1</sub> ,P <sub>1</sub> )	(R <sub>2</sub> ,P <sub>2</sub> )	(R <sub>3</sub> ,P <sub>3</sub> )	(R <sub>i</sub> ,P <sub>i</sub> )	(R <sub>1</sub> ,P <sub>1</sub> )	(R <sub>2</sub> ,P <sub>2</sub> )	(R <sub>3</sub> ,P <sub>3</sub> )
January	326	318	330	1	326	318	330
February	490	483	508	1	490	483	508
March	693	701	699	1	693	701	699
April	1217	1230	1236	1	1217	1230	1236
May	908	923	916	1	908	923	916
June	722	709	703	1	722	709	703
July	815	844	822	1	815	844	822
August	556	547	569	1	556	547	569
September	322	306	326	1	322	306	326
October	496	512	520	1	496	512	520
November	561	578	595	1	561	578	595
December	1258	1256	1265	1	1258	1256	1265
				<b>Total</b>	<b>8364</b>	<b>8407</b>	<b>8489</b>

In the case that the demand change is at extreme points, as a result of running the simulation model for a period of one year on a monthly basis, cumulative production amounts at the end of each month and the production costs are shown in Table 5.11. Based on this, for both of the demand types; in the case that low change is experienced, the total annual production amount and production cost are at the maximum level; in the case that high change is experienced, the total annual production amount and production cost are at the minimum level.

**Table 5.11.** Monthly Production Amounts and Cost Values

Month	Production Amounts (unit)			Unit Production Cost (m.u.)	Total Production Cost (m.u.)		
	(R <sub>1</sub> ,P <sub>1</sub> )	(R <sub>2</sub> ,P <sub>2</sub> )	(R <sub>3</sub> ,P <sub>3</sub> )	(R <sub>i</sub> ,P <sub>i</sub> )	(R <sub>1</sub> ,P <sub>1</sub> )	(R <sub>2</sub> ,P <sub>2</sub> )	(R <sub>3</sub> ,P <sub>3</sub> )
January	520	528	516	3	1560	1584	1548
February	1094	1101	1075	3	1722	1719	1677
March	1585	1585	1561	3	1473	1452	1458
April	2129	2117	2087	3	1632	1596	1578
May	2671	2643	2619	3	1626	1578	1596
June	3185	3168	3154	3	1542	1575	1605
July	3679	3633	3641	3	1482	1395	1461
August	4212	4176	4157	3	1599	1629	1548
September	4776	4759	4719	3	1692	1749	1686
October	5272	5237	5190	3	1488	1434	1413
November	5819	5767	5704	3	1641	1590	1542
December	6353	6302	6230	3	1602	1605	1578
				<b>Total</b>	<b>19059</b>	<b>18906</b>	<b>18690</b>

Using the production and holding costs obtained in Table 5.10. and 5.11., in the case that the demand change is at extreme points, the total annual costs for product “A” are calculated in Table 5.12. Based on this, for both of the demand types; in the case that low change is experienced, the total annual cost is at the maximum level, in the case that high change is experienced, the total annual cost is at the minimum level. The reason for this, according to the information obtained from the company is that the production cost of the product “A” is three times the holding cost of the raw material constituting it and in the case that low change is experienced, since the production amounts are at the

maximum level, the production cost based on this and the total cost have reached the maximum level.

**Table 5.12.** Total Cost Values

<b>Demand Change</b>	<b>Total Holding Cost (m.u.)</b>	<b>Total Production Cost (m.u.)</b>	<b>Total Cost (m.u.)</b>
(R <sub>1</sub> , P <sub>1</sub> )	8364	19059	27423
(R <sub>2</sub> , P <sub>2</sub> )	8407	18906	27313
(R <sub>3</sub> , P <sub>3</sub> )	8489	18690	27179

#### **5.4.9. Proposed simulation model**

Within the scope of the reengineering work conducted after the examination of the current supply chain process of the company, the proposed simulation model has been created in the Micro Saint Sharp simulation program. The visual form of this created model in Figure 5.9 and the details regarding the model are given below.

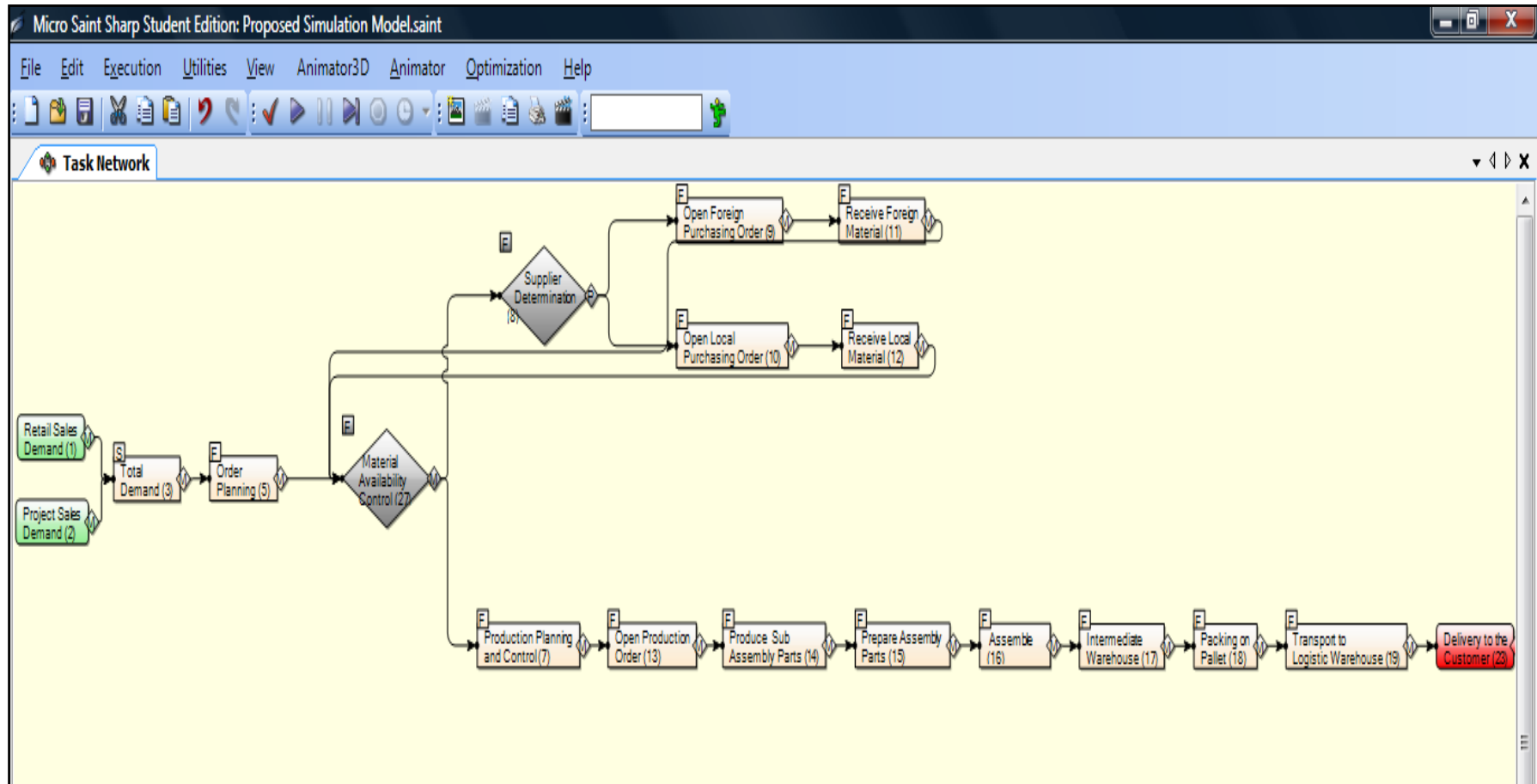


Figure 5.9. Proposed Simulation Model

Order planning process which has a critical role on the current system, have been manually made only three times a week on Mondays, Wednesdays and Thursdays. While this causes time loss for labour and also holding of the orders received on other days, it has lowered the system performance. With the redesign of the process, it is proposed that this process be automated on SAP via concurrent programmes that can be done by the software team of the company or outsources. In other words, before reengineering this process that is manually made only three days a week, will be able to be done automatically by the system on every day of the week after reengineering. Thus with saving of time, the system performance will be significantly increased.

Based on the solution proposal explained above, designed on the new model as shown in Figure 5.9, Dummy Task has been removed. Herein after by the help of the following code, the demands included in Total Demand can be transferred to order planning process on every day of the week.

```
if ((Day_of_Week == 0) || (Day_of_Week == 1) || (Day_of_Week == 2) ||  
(Day_of_Week == 3) || (Day_of_Week == 4) || (Day_of_Week == 5) ||  
(Day_of_Week == 6))  
{  
    return true;  
}  
else  
{  
    return false;  
}
```

#### **5.4.10. Analysis of proposed process outputs**

The data obtained as a result of running of the proposed simulation model for a period of a year under the assumption that each month is thirty days long are shown in Table 5.13.

**Table 5.13.** Proposed Process Outputs

<b>Output</b>	<b>Value</b>
Finished Number	12101
Finished Retail	7680
Finished Project	4421
Produced Number	12101
Ordered Piece	191
Received Piece	191
Responding Demand Percentage	0,84
Lead Time (hr)	0,47

The following results have been obtained in the simulation study conducted after reengineering:

- It is seen that 84% of demands have taken finished product form and have been delivered to the customer. That is to say, the responding demand percentage, which is one of the major outputs of the simulation model created is 0.84.
- While 63% of 12101 numbers of finished products corresponding to the percent of responding demands constitutes the demands made through the retail sales channel that have taken the product form and delivered to the customer, 37% constitutes the part that made through the project sales channel and have taken product form that is delivered to the customer.
- When the variable of Produced Number is examined, it is seen that the value which this variable has taken after the end of a year is the same as the variable of Finished Number. This shows the result that all of the products produced in the system have been delivered to the customer.
- When the variable of Ordered Piece is examined, it is seen that raw material order for 191 numbers of demands has been made, since the raw material that is necessary for the production of product “A” is not available in stock. On the

other side, when the variable of Received Piece is examined, it is observed that the receiving of all of these orders has been made.

- When the lead time which is one of the major outputs of the simulation model created is examined, it is seen that the time between the placement and receiving of the order is 0,47 hr/unit.

#### 5.4.11. The effect of the demand change on the proposed system

In this section, the effect of the demand change on the proposed system has been investigated. Based on this, in the case that the demand change is at extreme points in order to measure the proposed system behavior, necessary examinations have been made based on the time-based standard deviation values of the demands made through the retail and project sales channels as in the current system.

In the case that the demand change is at extreme points, as a result of running of the proposed simulation model for a period of one year, the variable of Responding Demand Percentage and Lead Time values have been obtained as shown in Table 5.14. Based on this, similar to the current system, it is seen that the values that these performance criteria taken as a result of different combinations are very close to each other. Thus, the demand change has not significantly affected the responding demand percentage and the lead time in the proposed system. It has been once more observed that the fundamental problem in the system is not related with the demand change, it arises from the operational process/es.

**Table 5.14.** Performance Measurements

<b>Demand Change</b>	<b>Responding Demand Percentage</b>	<b>Lead Time (hr)</b>
(R <sub>1</sub> , P <sub>1</sub> )	0,839	0,460
(R <sub>2</sub> , P <sub>2</sub> )	0,839	0,473
(R <sub>3</sub> , P <sub>3</sub> )	0,849	0,440

In the case that the demand change is at extreme points, as a result of running the proposed simulation model for a period of one year on a monthly basis, the amounts of raw material inventory at the end of each month, and holding costs are shown in Table 5.15. Based on this, for both of the demand types; in the case that low change is experienced, the total annual holding cost is at the minimum level; in the case that high change is experienced, the total annual holding cost is at the maximum level.

**Table 5.15.** After Reengineering Monthly Raw Material Inventory Amounts and Cost Values

Month	Raw Material Inventory (unit)			Unit Holding Cost (m.u.)	Total Holding Cost (m.u.)		
	(R <sub>1</sub> ,P <sub>1</sub> )	(R <sub>2</sub> ,P <sub>2</sub> )	(R <sub>3</sub> ,P <sub>3</sub> )	(R <sub>i</sub> ,P <sub>i</sub> )	(R <sub>1</sub> ,P <sub>1</sub> )	(R <sub>2</sub> ,P <sub>2</sub> )	(R <sub>3</sub> ,P <sub>3</sub> )
January	0	0	0	1	0	0	0
February	10	0	28	1	10	0	28
March	198	182	194	1	198	182	194
April	763	759	785	1	763	759	785
May	444	445	449	1	444	445	449
June	184	184	206	1	184	184	206
July	343	344	378	1	343	344	378
August	42	40	47	1	42	40	47
September	0	0	0	1	0	0	0
October	0	0	8	1	0	0	8
November	105	121	131	1	105	121	131
December	782	807	806	1	782	807	806
				<b>Total</b>	<b>2871</b>	<b>2882</b>	<b>3032</b>

In the case that the demand change is at extreme points, as a result of running the proposed simulation model for a period of one year on a monthly basis, cumulative production amounts at the end of each month and the production costs are shown in Table 5.16. Based on this, for both of the demand types; in the case that normal state is experienced, the total annual production amount and production cost are at the maximum level; in the case that high change is experienced, the total annual production amount and production cost are at the minimum level.

**Table 5.16.** After Reengineering Monthly Production Amounts and Cost Values

Month	Production Amounts (unit)			Unit Production Cost (m.u.)	Total Production Cost (m.u.)		
	(R <sub>1</sub> ,P <sub>1</sub> )	(R <sub>2</sub> ,P <sub>2</sub> )	(R <sub>3</sub> ,P <sub>3</sub> )	(R <sub>i</sub> ,P <sub>i</sub> )	(R <sub>1</sub> ,P <sub>1</sub> )	(R <sub>2</sub> ,P <sub>2</sub> )	(R <sub>3</sub> ,P <sub>3</sub> )
January	896	919	910	3	2688	2757	2730
February	1910	1944	1907	3	3042	3075	2991
March	2937	2989	2936	3	3081	3135	3087
April	3936	3993	3913	3	2997	3012	2931
May	4981	5038	4950	3	3135	3135	3111
June	6032	6082	5977	3	3153	3132	3081
July	7037	7090	6944	3	3015	3024	2901
August	8084	8138	7986	3	3141	3144	3126
September	9001	9053	8903	3	2751	2745	2751
October	10032	10085	9927	3	3093	3096	3072
November	11038	11075	10904	3	3018	2970	2931
December	12087	12101	11931	3	3147	3078	3081
				<b>Total</b>	<b>36261</b>	<b>36303</b>	<b>35793</b>

Using the production and holding costs obtained in Table 5.15. and 5.16., in the case that the demand change is at extreme points, the total annual costs for product “A” are calculated in Table 5.17. Based on this, for both of the demand types; in the case that normal state is experienced, the total annual cost is at the maximum level; in the case that high change is experienced, the total annual cost is at the minimum level. The reason for this, according to the information obtained from the company is that the production cost of the product “A” is three times the holding cost of the raw material constituting it and in the case that normal state is experienced, since the production amounts are at the maximum level, the production cost based on this and the total cost have reached the maximum level.

**Table 5.17.** After Reengineering Total Cost Values

<b>Demand Change</b>	<b>Total Holding Cost (m.u.)</b>	<b>Total Production Cost (m.u.)</b>	<b>Total Cost (m.u.)</b>
(R <sub>1</sub> , P <sub>1</sub> )	2871	36261	39132
(R <sub>2</sub> , P <sub>2</sub> )	2882	36303	39185
(R <sub>3</sub> , P <sub>3</sub> )	3032	35793	38825

## CHAPTER 6

### RESULTS AND DISCUSSION

After the reengineering work conducted via simulation, several results have been obtained. In order to be able to evaluate these results, the findings before and after reengineering have been summarized in Table 5.18.

**Table 5.18.** Comparison of Before and After Reengineering

<b>Output</b>	<b>Before Reengineering</b>	<b>After Reengineering</b>
Responding Demand Percentage	0,44	0,84
Lead Time (hr)	1,07	0,47
Total Holding Cost (m.u.)	8407	2882
Total Production Cost (m.u.)	18906	36303
Total Cost (m.u.)	27313	39185

The following results have been obtained in consequence of comparison of before and after reengineering:

The main outputs of the study conducted are “responding demand percentage” and “lead time”. When the values that these outputs taken are examined, while 44% of the demands were being responded before reengineering, it is seen that 84% of them have been responded after reengineering. Thus after the reengineering work, it has been observed that an improvement at a ratio of 91% has been achieved in responding demands.

On the other side, when the lead time is examined, as this period was 1,07 hr before reengineering, it has decreased to 0,47 hr after reengineering. Here, an improvement at a ratio of 56% has been achieved.

All of these values clearly show us that with its being conducted every day and automation of the order planning process that was earlier done manually three days a week, the process innovation have been experienced in the current system.

Finally, when the cost values before and after reengineering are examined, a decrease of approximately 66% in the total holding cost after reengineering and an increase of 92% in the total production cost have been observed. The reason why the total production cost has increased this much is the increase of the production amount depending on the improvements in the system performance after reengineering. When the total cost after reengineering is examined, it is seen that an increase at a ratio of 43% is experienced due to the significant increase of the total production cost. Despite the high ratio improvements achieved in BPR projects, increases in the costs are inevitable.

## **CHAPTER 7**

### **CONCLUSIONS**

In this thesis, supply chain process of a company operating in the private sector has been examined and the simulation model of the related process has been created in the Micro Saint Sharp simulation program. After running the created model for a period of one year, several performance outputs have been obtained. Major ones of those are “responding demand percentage” and “lead time”.

With the assessment of the outputs obtained, the bottlenecks on the system have been tried to be determined and besides, the effect of the demand change on the current system have been investigated. As a result of the evaluations made, it has been observed that the demand change does not significantly affect the system performance and the main problem is related with the operational processes in the current system. Based on this, the order planning process that has a triggering role for other processes on the system has been focused.

The order planning process conducted manually only three days a week in the current process, is proposed to be automatized and be conducted on every day of the week as a solution with process reengineering. In parallel with this, a new model has been designed in the Micro Saint Sharp simulation program. After running this model for a period of a year, several outputs have been obtained.

Besides, the effect of the demand change on the proposed system have been investigated and as a result of the evaluations made, it has been concluded that the demand change does not have any significant effect on the system performance. Thus, it has been once more observed that the fundamental problem in the system is not the demand change, it arises from the operational processes.

When the results obtained before and after reengineering are commented, while 44% of demands are being responded before reengineering, it has been seen that 84% of them are being responded after reengineering. Thus after reengineering, it has been observed that an improvement at a ratio of 91% has been achieved in responding demands. When

the lead time is examined, while this period was 1,07 hr before reengineering, it has decreased to 0,47 hr after reengineering. Here, an improvement at a ratio of 56% has been achieved.

All of these values clearly show us that with being conducted every day and automation of the order planning process that was earlier done manually three days a week, the process innovation has been experienced in the current system.

On the other side, with the increase of the system performance after reengineering, it has been observed that the costs increase as well. This state is inevitable in BPR projects. Here, the production amounts have increased and based on this, there has been increase in the production costs and total costs. Besides, based on the solution proposal presented in the IT area; in the case that the company gets outsources to make the necessary software, this will also cause an additional cost.

However, in order to succeed in the BPR projects, IT infrastructure must be very strong. Paper and Chang (2005) and Ahadi (2004) emphasized that one of the critical success factors in BPR projects is the IT infrastructure. Therefore, the companies should introduce innovations into the IT area during their business processes as far as possible by considering the changing and developing technology.

The solution proposed in this study is basic and easy to apply practically. Therefore, it can be easily applied in the company where it is handled during the study and in the case that it is applied, it will provide significant benefits. Also, the solution proposal propounded is expected to help similar companies trying to redesign their business processes in order to achieve dramatic improvements in the performance.

It is possible to develop the in question study from several aspects. For example, the created model can be run for a different product type on the basis of more performance measures. Thus, different bottlenecks on the system can be determined and based on this, different solution proposals can be presented.

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