Chapter 1

Enterprise Resource Planning and Enterprise Productivity

1.1 Introduction

In the last couple of decades, there has been a renewed interest on the term enterprise, more specifically on looking at the enterprise as a whole instead of looking at it as fragmented pieces called *silos*. Productivity may also be given a similar direction wherein the emphasis is on Enterprise Productivity. Enterprise Resource Planning systems by the very nature of their integrating philosophy and their deployment across organizations, large and small are a critical aspect of Enterprise Productivity.

1.2 Enterprise Resource Planning

Enterprise or Enterprise-wide Resource Planning Systems (ERP) has been defined as “an enterprise wide system which encompasses corporate mission, objectives, attitudes, beliefs, values, operating style and people who make the organization. It is a software solution that addresses the enterprise needs, taking a

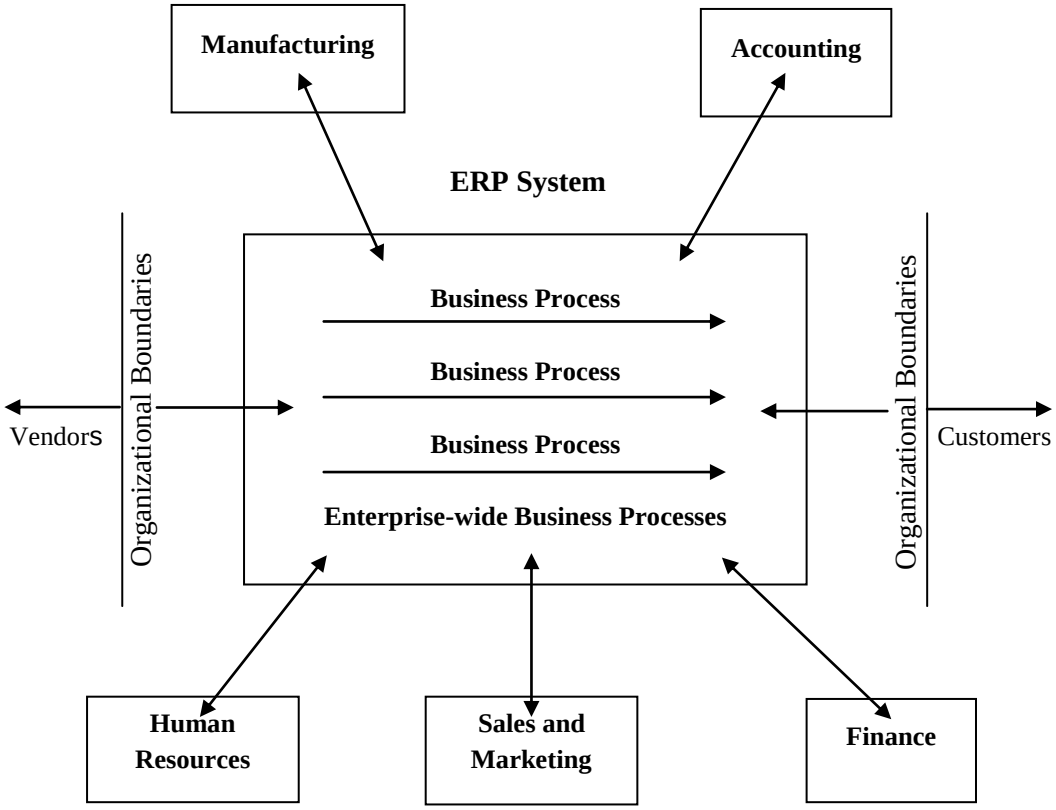
process view of the overall organization to meet the goals, by tightly integrating all functions and under a common software platform."(Subramoniam, Tounsi, Ghani and Krishnankutty, 2009)

ERPs integrate (or attempt to integrate) all data and processes of an organization into a unified system. A typical ERP system will use multiple components of computer software and hardware to achieve the integration. A key ingredient of most ERP systems is the use of a unified database to store data for the various system modules.

The term ERP originally implied systems designed to plan the utilization of enterprise-wide resources. Although the acronym ERP originated in the manufacturing environment, today's use of the term ERP systems has much broader scope. ERP systems typically attempt to cover all basic functions of an organization, regardless of the organization's business or charter. Business, non-profit organizations, non-governmental organizations, governments, and other large entities utilize ERP systems (Wikipedia, 2011).

ERPs are characterized by Integrated, modular and open architecture, Real time processing, Flexibility, Best business practices and processes, Global functionality and Ability to cross organizational boundaries. These characteristics constitute the most important advantages of an ERP system.

Illustration 1.1: Enterprise Resource Planning System [Adapted from Laudon and Laudon (2006), Management Information Systems – Managing the Digital Firm, Eighth Edition, Pearson Education]



A major drawback of an ERP system is its inability to plan and analyze business situations as they merely record what has already happened. It also lacks the ability to expand its scope to multiple enterprises. There are also problems in continually reshaping and restructuring workflows which are vital in today's rapidly changing business environments.

Jacobs and Weston Jr. (2007) give a comprehensive review of the history of ERP systems starting from the 1960s. But the history of ERP may be traced to the

1940s with the early attempts at calculating machines. The journey of ERP started in the early 1960s from a joint effort between J.I. Case, the manufacturer of tractors and other construction machinery, and partner IBM through the introduction of Material Requirements Planning or MRP. It is an application software serving as the method for planning and scheduling materials for complex manufactured products. The early MRP systems were understandably big, clumsy and expensive. The early 1970s saw a big shift in the evolution of ERP systems with the setting up of software companies who in due time were to be the main ERP vendors. In 1972, five engineers in Mannheim, Germany established the company, SAP (Systeme, Anwendungen und Produkte in der Datenverarbeitung now referred to as Systems, Applications and Products in Data Processing) with the aim of producing and marketing standard software for integrated business solutions. In 1975, Richard Lawson, Bill Lawson, and business partner, John Cerullo began Lawson Software. Jack Thompson, Dan Gregory, and Ed McVaney formed JD Edwards in 1977. Larry Ellison began Oracle Corporation the same year. In 1978, Jan Baan began the Baan Corporation to provide financial and administrative consulting services. In the early 1980s, MRP (Manufacturing Resources Planning) evolved into MRP-II as a more accessible extension to shop floor and distribution management activities. PeopleSoft was founded by Dave Duffield and Ken Morris in 1987. The term ERP (Enterprise Resource Planning) was coined in the early 1990′s by the Gartner Group when MRP-II was extended to cover areas like Engineering, Finance, Human Resources, and Project Management. By the early 2000s, most ERP systems were enhancing their products to become “Internet Enabled” so that

customers worldwide can have direct access to the supplier's ERP system. Services Oriented Architecture (SOA) has also become a standard that ERP vendors have adopted aggressively. This software architecture allows different systems to communicate between one another. This has helped ERP to evolve into extended ERP or ERP II which uses the Internet to reach out to suppliers, customers and a wider range of employees bringing in much wider integration of all stakeholders. Applications such as Customer Relationship Management (CRM), Supply Chain Management (SCM), Supplier Relationship Management (SRM), Product Lifecycle Management (PLM), Employee Lifecycle Management (ELM), Corporate Performance Management (CPM), E Business, Business Intelligence (BI), etc. provide the additional functionalities in ERP II (Møller, 2005).

The implementation approaches for ERP are Single ERP Package, Single ERP package with other systems, Multiple ERP packages with other systems, Best-of-breed from several ERP packages, Totally in-house developed and In-house plus specialized packages. The first two are the most dominating approaches. Typically, before ERP implementation, each department maintains its own information system optimized for requirements that the department needs. Each department thus maintains separate databases and design applications as per their functionalities. This results in local optima and creation of what are known as silos. ERP changes this scenario by doing away with all the separate information systems with their separate databases and replacing it with a single enterprise-wide information system and a single database. The various departments are as

such in a position to easily share information with each other and communicate more effectively. For example, someone in the Finance department can use the ERP to see if any sales order has been shipped from the warehouse so that he can now confidently plan for working capital management for the next period. ERP systems also overcome the problem of data redundancy, ensures data integrity and up-to-date data availability (Altekar, 2004).

It is expected that ERP will be implemented in well reengineered and process based organizations. Business Process Reengineering (BPR) is considered to be a powerful tool for reengineering and successful ERP implementation. One of the most accepted definitions of BPR is that it is the fundamental rethinking and radical redesign of business processes to bring about dramatic improvements in critical contemporary measures of performance, cost, quality, service and speed (Hammer and Champy, 2003). One major thrust behind the BPR philosophy is to fix the processes before automating them. This simply means that an organization should redesign its business processes before going for ERP implementation. If done correctly, this would produce an increase in performance, not only through the streamlining of the processes, but also an additional increase through the use of properly applied information technology.

The basic objectives of ERP systems are (Rao, 2000):

- To provide support for all variations of best business practices.
- Enable implementation of these practices with a view towards enhancing productivity.

- Empower the customer to modify the implemented business process to suit their needs.

It is clear from the objectives that the central theme of ERP implementation is improving productivity in the enterprise. The principal purpose of implementing an ERP or ERP II system is to help in managing the operations of a firm to facilitate a better competitive position in today's global market by increasing the productivity and saving on costs (Beheshti and Beheshti, 2010). Given the scale of ERP implementation projects as well as the possibility for both large successes and failures, it is reasonable to expect that ERP deployment have a significant and measurable effect on firm performance. While both costs and potential benefits are high, it is not clear whether the net effect results in higher productivity for the firm. In addition to that, because implementation is a difficult and uncertain process, firms that are successful in implementing ERP may gain competitive advantage over other firms that are unwilling or unable to make similar changes (Hitt, Wu and Zhou, 2002).

Enterprise systems are complex and integrated enterprise-wide suites of software for businesses aimed at particular process integration across the value chain. They include a plethora of software products supporting efficient handling of day-to-day business operations and quick decision-making. The three main enterprise systems are Enterprise Resource Planning (ERP), Supply Chain Management (SCM) and Customer Relationship Management (CRM). These enterprise systems serve many industries in numerous areas. They are designed to

automate operations in the context of supply management, inventory control, manufacturing scheduling, sales force automation and almost any other data-oriented management process or function.

ERP is a software solution integrating the various functional spheres in an organization - a link through the entire supply chain, aimed at adapting best industry and management practices for providing the right product at the right place at the right time at least cost (Rao, 2000).

ERP systems are designed to enhance organization's competitiveness by upgrading an organization's ability to generate timely and accurate information throughout the enterprise and its supply chain. A successful ERP system implementation can shorten production cycles, increases accuracy of demand for materials management, controlled sourcing and leads to inventory reduction because of material management, etc. Moreover it can be used as a primary tool for re-engineering (Singla, 2008).

ERPs started to be implemented in enterprises in a big way in the early 1990s. Studies on their impact on Enterprise Productivity also started during the same period. In an important longitudinal study (Huntona, Lippincottb and Reckb, 2003), 63 firms that had adopted ERP systems were compared with 63 non-adopters peer firms. Results indicated that Return on Assets (ROA), Return on Investment (ROI), and Asset Turnover (ATO) were significantly better over a 3-year period for adopters, as compared to non-adopters.

Increase in productivity is a result of performance. Overall performance is typically composed of two performance dimensions: operational performance and strategic performance. Operational performance is concerned with production efficiency, primarily how much input quantity is used to make the output. Strategic performance is concerned with deriving revenues from a competitive market by extracting value from customers (Anderson, Banker, Menon and Romero, 2011).

ERP is packaged software that organizes codes and standardizes an enterprise's business processes and data. This packaged software converts transactional data into useful information and collates the data so that they can be analyzed and used for decision making by the top management. Many company ERP products developed in the 1990s have enabled companies to redesign their business processes and eliminate duplications. Hence the employees were able to focus on process design value adding activities that have dramatically increased productive capacity. Enterprise resource planning system has the herculean task of seamlessly supporting and integrating a full range of business processes, uniting functional islands and making their data visible across the organization in real time. ERP is a structured approach to optimize a company's internal value chain. When the software is fully installed across an entire company, it connects the components of the business process through a logical transmission and sharing of common data within an integrated framework. Hence, the performance of ERP matters in the performance of the company (Parthasarathy, Anbazhagan and Ramachandran, 2007).

Although ERP vendors claimed for the impact of their ERP systems in enterprises' performance, few studies have demonstrated this impact in enterprises' performance or in their productivity. The press is plenty of examples of not so successfully ERP implementations and, in some cases, there is the evidence of high expectations before ERP implementations. The question as to whether ERP affects Enterprise Productivity has been treated by approaches that identified non-financial performance measures since investment decision making remains a complex management process due to the scope and magnitude of interacting variables, which cannot always be quantified in financial terms (Bohórquez and Esteves, 2008).

The use of ERP software has become increasingly more common in a lot of today's businesses. It is adopted in many firms with the prime objective of attempting to improve business performance. The concept of business performance can be operationalized as financial gains by the organization, operational improvements for the organization or intangible gains for the organization (Elragal and Al-Serafi, 2011).

Despite the fact that enterprise systems are now widely spread among industries around the world their influence on firm performance is still not absolutely clear. The literature is mostly based on case studies which offer concrete and meaningful lessons for implementation strategies but in general fail to provide clues for economy-wide effects. Studies providing evidence on the basis of firm-

level data are still quite rare. Most of the studies report positive effects on firm performance through enterprise system adoption (Engelstätter, 2009).

1.3 A Primer on SAP

SAP is the most well know of the current ERPs and it has an overwhelming market share. Five former IBM employees founded SAP in 1972 in Germany. It is pronounced as S-A-P and not as Sap. The first releases, called R1 and R2, were mainframe-only applications. SAP started with a set of financial applications and then added logistics, manufacturing, and HR. In the 1980s, they moved to a true 3-tiered client-server solution and by the early 1990s, R/3 was released to the market. In 2000, SAP renamed their solution mySAP and released the latest version of SAP, ECC or ERP Central Component, and the most recent release is ECC 6.0, Enhancement Pack 7 (EHP 7). SAP's current release strategy is to provide Enhancement Packs with additional functionality instead of releasing new versions of the software. SAP's Enhancement Pack strategy eliminates major upgrades and allows customers to choose which enhancements to apply to their systems.

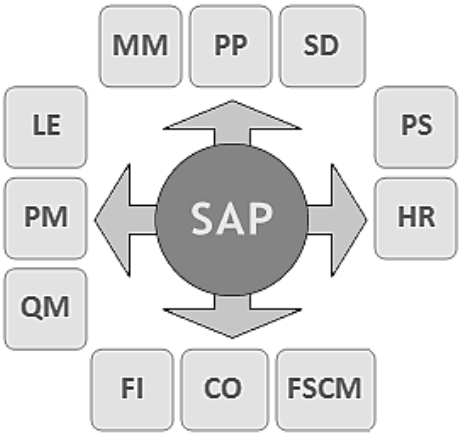
1.3.1 SAP Modules and Tools

SAP's solution includes a number of functional modules, which support transactions to execute key business processes, such as:

- Financial Accounting (FI)
- Financial Supply Chain Management (FSCM)
- Controlling (CO)

- Materials Management (MM)
- Sales and Distribution (SD)
- Logistics Execution (LE)
- Production Planning (PP)
- Quality Management (QM)
- Plant Maintenance (PM)
- Project System (PS)
- Human Resources (HR)

Illustration 1.2: SAP Modules [Adapted from http://www.erptips.com/Learn-SAP/What-Is-SAP/Introduction-To-SAP.html[1]]



[1] This site has of now closed down. It was retrieved on 17.11.2011

SAP Basis is a set of middleware programs and tools that provide the underlying base that enable applications to be interoperable across operating systems. SAP Basis includes a RDBMS (Relational Database Management System), GUI (Graphical User Interface), and client server architecture. Beyond the interface aspect of Basis, it also includes such components as a data dictionary as well as user and system administration. Basis is the administration of the SAP system. It's a piece of middleware which links the application with the database and the operating system. Basis is most commonly associated with the GUI interface to the SAP.

SAP Basis consists of the following applications/sub modules/screens:

- Security (BC – SEC)
- Application Link Enabling (ALE)
- Remote Function Calls (RFC)
- Object Linking and Embedding (OLE)
- Common Program Interface Communications (CPI – C)
- Electronic Data Interchange (EDI)
- Customizing (BC – CUS)
- ABAP Programming and Runtime Environment (BC – ABA)
- Client Server Technology (BC – CST)
- Network Integration (BC – NET)
- Basis Services/ Communication Interfaces (BC – SRV)
- Computing Center Management System (BC – CCM)

- Upgrade General (BC – UPG)
- Change and Transport System (BC – CTS)
- Operating System Platform(BC – OP)
- Database Interface, database platforms (BC – DB)
- Front End Services (BC – FES)
- ABAP Workbench (BC – DWB)
- Documentation and Translation Tools (BC – DOC)
- Controls and Control Framework (BC – CI)
- Business Management (BC – BMT)
- Middleware (BC – MID)
- Computer Aided Test Tool (BC – CAT)
- Ready to Run R/3 (BC – BRR)
- Authorizations System Monitoring with CCMS Workload Alert Monitor

ABAP 4 is the programming language used to code SAP R/3. The full form of ABAP is Advanced Business Application Programming. The latest version is ABAP Objects, which is object-oriented programming. There are three main components of the ABAP 4 language. These are:

- ABAP 4 Development Workbench
- ABAP 4 Data Dictionary
- ABAP 4 Repository Information

The development workbench gives access to SAP's development tools. Any program developed in ABAP is stored in the R/3 repository. Definitions of variables and parameters on the other hand are stored in the data dictionary. ABAP programmers use the development workbench to write programs in SAP. ABAP is similar to many other programming languages. It consists of Source Code, Text elements and Attributes. As part of the ABAP 4 syntax, certain rules apply to writing the ABAP code.

ABAP consists of the following applications/sub modules/screens:

- ABAP Workbench
- Menu Painter
- Screen Painter
- Data Dictionary
- SAP Script
- Business Workflow (BC – WF)
- ALE
- EDI
- Business Connector
- Business Server Pages
- Internet Application Server
- Mercator Report Painter
- ALV reporting
- Report writer

- Dialog Programming
- Repository Information System
- ABAP 00
- IDOCS
- LSMW
- Smartforms
- EBP
- ASAP methodology
- ABAP Query

1.3.2 SAP Named Users

SAP is used through what are named users. The following are some of the more common named users as obtained from *SAP List of Prices and Conditions, SAP Software and Support, 2012/1 Switzerland, Version January, 2012*.

1.3.2.1 SAP Application Developer User

It is a Named User authorized to access the development tools provided with the licensed Software for the purpose of making Modifications and/or Add-ons to the licensed Software and also includes the rights granted under the SAP NetWeaver Developer User and SAP Application Employee User.

1.3.2.2 SAP Application Business Expert User

It is a Named User authorized to perform all roles supported by SBOP[2] (excluding the right to make Modifications and/or Add-ons to SBOP) and also includes the rights granted under the SAP Application Professional User.

1.3.2.3 SAP Application Professional User

It is a Named User authorized to perform operational related and system administration / management roles supported by the licensed Software (excluding SBOP) and also includes the rights granted under the SAP Application Limited Professional User.

1.3.2.4 Application Limited Professional User

It is a Named User authorized to perform limited operational roles supported by the licensed Software (excluding SBOP) and also includes the rights granted under the SAP Application BI (Business Information) User. The Software Agreement has to define in detail the limited use rights being performed by such Limited Professional User.

1.3.2.5 SAP Application BI User

BI stands for Business Information. It is a Named User authorized to use (excluding the right to modify and/or customize) standard and interactive reports delivered with licensed Legacy SBOP, and reports created through use of

[2] SAP Business Objects Portfolio

licensed Legacy SBOP by appropriately licensed Named Users, solely for such individual's own purposes and not for or on behalf of other individuals. Each SAP Application BI User also includes the rights granted under the SAP Application Employee User.

1.3.2.6 SAP Application Employee User

It is a Named User authorized to perform the following roles supported by the licensed Software (excluding SBOP), all solely for such individual's own purpose and not for or on behalf of other individuals: (i) use (excluding the right to modify and/or customize) standard and interactive reports delivered with the licensed Software, (ii) travel planning / expense reporting self services, (iii) perform procurement self services, and (iv) room reservation self-services. Each SAP Application Employee User also includes the rights granted under the SAP Application ESS User.

1.3.2.7 SAP Application ESS User

ESS stands for Employee Self-Service. It is a Named User authorized to perform the HR self-services role of employee time and attendance entry supported by the licensed Software (excluding SBOP), all solely for such individual's own purpose and not for or on behalf of other individuals: (i) employee records maintenance, (ii) employee time and attendance entry, (iii) employee directory, and (iv) benefits enrollment. Further, an ESS User is also authorized to access "Non-SAP Content" that resides on Licensee's "SAP Portal", so long as accessing such Non-SAP Content doesn't require or result in any Use of the licensed Software

(beyond access to such Non-SAP Content as it resides on Licensee's SAP Portal). As used in this ESS User definition, (i) "Non-SAP Content" means information created through no Use of the licensed Software and (ii) "SAP Portal" means any portal created by Licensee Using SAP Enterprise Portal Software (as provided with the licensed SAP NetWeaver Software) which provides appropriately licensed Named Users a common access point by which to Use licensed SAP Software.

1.3.2.8 SAP Application ESS Core User

It is a Named User authorized to perform the following HR self-services roles supported by the licensed Software (excluding SBOP), all solely for such individual's own purpose and not for or on behalf of other individuals: (i) employee records maintenance, (ii) employee directory, and (iii) benefits and payment services. Further, an ESS Core User is also authorized to access "Non-SAP Content" that resides on Licensee's "SAP Portal", so long as accessing such Non-SAP Content does not require or result in any use of the licensed Software (beyond access to such Non-SAP Content as it resides on Licensee's SAP Portal). As used in this ESS Core User definition, (i) "Non-SAP Content" means information created through no use of the licensed Software and (ii) "SAP Portal" means any portal created by Licensee Using SAP Enterprise Portal Software (as provided with the licensed SAP NetWeaver Software) which provides appropriately licensed Named Users a common access point by which to use licensed SAP Software.

1.4 ERP in the Refineries of Assam

In Assam, ERP has been implemented in the oil sector units, and some other industries, specifically the cement companies like Star Cement ("Century Plyboards selects IBM to consolidate disaster recovery operations", 2010) and Calcom ("Calcom Goes Live With mySAP", 2005). It is expected that in the near future, more and more industries will implement ERP in Assam. The oil industry in Assam is the most visible of the industries of Assam where ERP has been implemented on a wide scale. So to study the effect of ERP implementation, the oil industry is the best option as far as Assam is concerned. Apart from the presence of Oil India Limited (OIL) and Oil and Natural Gas Corporation Limited (ONGC) as upstream oil companies, Assam is fortunate to have four oil refineries within its boundaries. The refineries are located at Bongaigaon, Digboi, Guwahati and Numaligarh. Unlike in the downstream sector, business processes in the upstream sector are not well integrated. And only in recent times have ERP vendors come up with products for the upstream sector. So, a study on the downstream sector, i.e., the refineries is more suited with respect to ERP implementation.

Oil companies, whether upstream or downstream have traditionally been technology driven companies. Oil refineries are process-oriented companies where the flow of information and management activities are "horizontal" across functions, in line with the flow of materials and products. Major business processes of an oil refinery include procurement of crude oil and other feed stock, inventory management for hydrocarbons, stores and spares, product sales,

production planning and scheduling, assets management, financial and operational budgeting and financial and managerial reporting. They have also been IT (Information Technology) savvy. The refineries located in Assam have also followed this trend by adopting latest developments in IT. Huge investments have been made in the IT infrastructure by all the refineries. They have made big investments and spent considerable time and effort in implementing ERP systems and making them operational to carry out their business processes. The refineries in Digboi, Guwahati and Bongaigaon started their IT forays by developing and implementing stand-alone applications in the areas of Finance, Materials, Sales, etc. While these applications could take care of the short term IT requirements, they could not cater to the information requirements in the changed competitive environment. With the dismantling of APM (Administrative Pricing Mechanism), the efficiency of the refineries became very important for their survival. Coupled with the re-alignment of market players in the Oil Sector, the need came for an integrated approach towards IT and hence ERP ("Use of Information Technology by Oil Refining Companies in North-East", n.d.).

The refineries at Bongaigaon, Digboi and Guwahati are operated by India's largest refiner, Indian Oil Corporation (IOC) while the fourth one is run by the public sector company, Numaligarh Refinery Limited. All the three refineries under IOC have an integrated IT system through the use of ERP. Numaligarh Refinery Limited (NRL), the newest of the four refineries located in Assam has also adopted the latest technologies in the areas of IT. As per the information available on the NRL official website (http://nrl.co.in), NRL was the first Public

Sector Oil Company in India to implement full suite of ERP applications from Ramco Systems in the year 1998. All the refineries are currently using SAP. The refineries under consideration are presently using ECC 6.0. The SAP Modules/Components being used are: ABAP, BASIS, FICO (Financials and Controlling), HR (Human Resource), MM (Materials Management), PJ (Payroll Journal), PM (Plant Maintenance), PP (Production Planning), PS (Project System), QM (Quality Management) and SD (Sales and Distribution).[3]

IOC (which controls the refineries at Digboi, Guwahati and Bongaigaon), while underlying the need for ERP implementation in the company had projected substantial financial benefits due to implementation of ERP and due to implementation of add-ons. This benefit was supposed to flow after implementation of the project from inventory optimization, reduction in transportation expenses, saving in banking cash, reduction in demurrage costs, discounts through accounts payable management, reduction in cheque holding time, reduction in accounts receivable, reduction in time overrun in project implementation and reduction in communication expenses. The benefits from 'add-ons' were expected to flow from crude mix optimization and yield improvement in refineries. The project called "Manthan" was conceptualized in 1996 and started in April 1997 by IOC (Comptroller and Auditor General of India, 2005).

[3] SAP Version and Module information have been obtained from the Refineries as part of data collection

As per information obtained from the refineries, there are 268 SAP user licences in use at Digboi Refinery, 271 at Guwahati Refinery, 328 at Numaligarh Refinery and 343 at Bongaigaon Refinery. The total number of users in the four refineries of Assam is thus 1210[4]. The exact numbers do vary from time to time. The licenced users as mentioned do not include the ESS (Employee Self Service) users.

1.5 Enterprise Productivity

The economic progress of nations and the standard of living of its citizens are today determined by their Gross Domestic Product (GDP) and the GDP growth rate. A key factor of higher GDP growth rate is productivity. At a macro level, it is the productivity of the enterprises which drives the fortunes of the nation and its citizens. Hence, studying the driving forces behind Enterprise Productivity carries substantial weight and ought to be rigorously pursued.

A review of literature on productivity, performance and growth dynamics in organizations does refer to the term 'Enterprise Productivity' regularly. Similar terms like 'organizational productivity', 'enterprise performance', 'firm performance', etc. are also found. But, a proper and precise definition of the term Enterprise Productivity is not found. The Telstra Productivity Indicator published in February 2009 which is a report on business attitudes towards improving productivity in Australia states that 54% of organizations agreed on a definition

[4] Information for Digboi Refinery, Guwahati Refinery and Numaligarh Refinery was obtained in January 2014. Information for Bongaigaon Refinery was made available in July 2014.

of Enterprise Productivity that revolved around "efficiency and working smarter". The world renowned consulting firm Deloitte LLP has conceptualized Enterprise Productivity as "lasting value which is only created when increased earnings are balanced with efficient use of assets".

The least controversial definition of productivity is that it is a quantitative relationship between output and input. This definition suggests what productivity may be thought of in the context of an enterprise, an industry or an economy as a whole. Thus, we may say that Enterprise Productivity = Enterprise Output / Enterprise Input, i.e., Enterprise Productivity may be defined as the ratio of the sum total of all outputs and sum total of all inputs for the enterprise. Unfortunately again, definition of either output or input or both may sometimes pose more difficulty to the understanding of what productivity is. The problem becomes more acute if sufficient data is not available to quantify input, output or both.

The European Productivity Agency came up with an interesting definition more than five decades back. It said that, "Productivity is an attitude of mind. It is mentality of progress, of the constant improvement of that which exists. It is the certainty of being able to do better today than yesterday, and less well than tomorrow. It is the will to improve on the present situation, no matter how good it may seem, no matter how good it may really be. It is the constant adaptation of

economic and social life to changing conditions, it is the continual effort to apply new techniques and new methods; it is the faith in human progress[5]. ”

A focus on Enterprise Productivity is desirable so as to make enterprises competitive and sustainable. With an increasingly competitive global economy, the ability of companies to enhance the productivity of their resources is critical for remaining competitive in this environment.

1.6 Factors Effecting Enterprise Productivity

The factors affecting Enterprise Productivity have been categorized into two types (Prokopenko, 1987): External Factors and Internal Factors. The external factors (not controllable) are Structural Adjustments (Economic, Demographic and Social), Natural Resources (Manpower, Land, Energy, Raw Materials), and Government & Infrastructure (Institutional Mechanism, Policies and Strategy, Infrastructure, Public Enterprise). The internal factors (controllable) are Hard Factors (Product, Plant and Equipment, Technology, Materials and Energy) and Soft Factors (People, Organization and Systems, Work Methods, Management Styles). A focus on increasing Enterprise Productivity will naturally gravitate towards the internal factors.

Various ways can be traceable in order to increase productivity in an enterprise (Yildirim and Şahin, 2007):

[5]The European Productivity Agency’s Rome Conference, “The Concept of Productivity and Aims of the National Centres” in 1958

- Getting use of scientific and technologic developments. According to this, the enterprises that are able to reconstruct their organization structures and always keep them firm, will gain productivity increase and by increasing their income, they will strengthen their competition capacity.
- Applying some changes within the scope of production process. For instance, if an establishment buys semi-finished products and starts processing it, since the units that are having high costs and risks will be switched off, the productivity will increase.
- Together with the developments in the organization and the administration, productivity can be increased. The enterprises that can be successful in putting forward targets and defining the means that are to be used in order to attain them, transporting the materials, planning the production, managing the active and passive assets, and finally managing people.
- Using the capital capacity of the machineries and counters that cannot be changed much in a short time period and are being used in production in full capacity as well as man power and preventing the long term inactivity of these in particular, are one of the ways of increasing productivity.
- Enhancing the quality of the inputs and most important of all enhancing the quality of man power will enable the enterprises increase their productivity for sure.

1.7 Determinants of Enterprise Productivity

Enterprise Productivity rests on a range of critical determinants, some integral to the enterprise itself and others within the broader economic environment in which the enterprises are operating. The Framework for Economic Development in Scotland has identified the following determinants of Enterprise Productivity:

- The generation through R&D of knowledge that can drive productivity.
- The rate of innovation and technical advances in productive processes.
- Capital investment, especially where it provides a vehicle for technical progress.
- Investment that enhances the equality of human capital – the education and skills.
- The quantity and quality of the physical and electronic capital infrastructure.
- The effectiveness and efficiency of resource use in production and distribution.
- The environment in which enterprises are seeking to flourish.

1.8 Strategies for Improving Enterprise Productivity

Enterprise Productivity is a long term goal and is therefore a strategic activity. Deloitte Consulting has mentioned five basic strategies for improving Enterprise Productivity. According to them, companies that follow these strategies can put themselves in a better position to respond to future economic and consumer shifts. They have concentrated on the following:

- **Strengthen business fundamentals**: The business has to be understood very well in the context of both competitors and the general business environment. A simple SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis will help identify where the company stands and build up from there. Every business process must be given a thorough look and any scope for improvement should be quickly latched onto. Cash flow has to be improved.
- **Reduce asset intensity**: Ways must be devised to reduce fixed asset costs without sacrificing product quality and service quality. It has been observed that outsourcing and contract manufacturing wherever appropriate helps to cut down on these costs. Improving inventory management can have a significant bearing on working capital requirements.
- **Bolster planning and analysis capabilities**: Enterprise Productivity is maximized when investment is made in areas that deliver the highest overall return. However, many companies lack the analytical prowess to know where to focus. Upgrading analytical capabilities to turn data into useful insight should be given due attention. Developing and communicating productivity metrics that motivate the workforce and improve decision-making needs to be prioritized. Aligning operating plans and management rewards with long-term strategies is a key requirement.

- **Adopt value-based management principles**: Measuring is critical to getting things done. Individual productive goals and incentives with shareholder values have to be aligned and should directly contribute to achievement of organizational goals. Productivity metrics to improve operating margins and asset efficiency must be developed which will reflect incentives and rewards due to the employees. Training and skill development of employees which enable them to think about new ways to improve shareholder value should be a regular feature.
- **Improve cost efficiency and customer responsiveness across the value chain**: This is the most complex strategy to implement, but also offers the greatest potential returns when done right. Listening to customers and creating products and services that add value across the enterprise will not only retain customers but add new ones. Improving supply chain responsiveness will increase sales and improve margins. Using demand synchronization to help understand and optimize product profitability while driving consumer behavior will create a strong value chain.

1.9 Information Technology and Enterprise Productivity

Information Technology (IT) has led to radical changes in how enterprises operate and have enabled the creation of innumerable opportunities. Many economists have credited the adoption of IT as a key driver the productivity growth in the enterprises. It is beyond doubt that technology especially information technology is playing and will continue to play a leading role in

increasing Enterprise Productivity. IT has a central role in raising productivity because it is a source of leverage for information, communications, collaboration and management. In other words, IT resources are available and for the most part are not consumed or used up in the execution of business activities. What is being said is that we can readily flow more activity over the same resource base and therefore drive more productivity.

In 2001, the McKinsey Global Institute's (MGI's) US Productivity Growth Report found that the productivity acceleration of the mid to late 1990s, the so called "new economy", was concentrated in only six sectors and that the role of IT was only one of several factors at work in the productivity jump. These results were sometimes interpreted by outside observers as "McKinsey says IT doesn't matter." On the contrary, MGI's Productivity Growth Report highlighted IT's enabling role as a key component of the managerial innovation that allows firms to compete in the modern economy.

The Telstra Productivity Indicator as mentioned earlier has reported that 44 percent of organizations which were early adopters of technology had increased productivity a lot or to a great deal. Significantly again, 61 percent of organizations had reported that use of Information and Communication Technology (ICT) had resulted in their productivity increasing a lot or to a great deal. IT increases the productivity of the enterprises in three ways (Yildirim and Şahin, 2007):

- As a result of the increase in information technologies, the capital per employee increases and this increases the productivity of the employees of the enterprise.
- As a result of technological developments for the production of information technologies and services, there is also an increase of productivity in the information industry and this reflects to other enterprises as external benefit.
- As the usage of information technologies in a country spreads to all sectors, in general the country economy and specifically the enterprises in the country have a total increase in productivity.

IT-enabled platforms can play an important role in mediating knowledge flows that can increase productivity. Knowledge inflows, called *spillovers*, from other participants of an online community of practice on enterprise software are associated with a significant increase in firm productivity (Huang, Ceccagnoli, Chris and Wu, 2013). Here are some of the ways in which enterprises can use IT resources and capabilities to improve Enterprise Productivity (McDonald, 2010):

- IT can automate business processes and activities; shifting those activities from resource constrained employees to high capacity automated systems. This will not only improve efficiency of the business processes but also streamline them.
- IT can shift a good deal of work from employees to customers, suppliers and other interested parties. Such a move raises productivity particularly

when they have the information and motivation to perform those works better than employees.

- IT can accelerate cycle time for internal processes by improving coordination and workflow among teams. Shorter cycle time means that more work units can flow across the teams.
- IT can raise the quality and availability of external products and services as well as internal operations. Here information combined with preventative maintenance and continuous improvement locks in gains.
- IT can expand trading/operational hours and access without requiring additional resources.
- IT can raise the value of products and services with minimal increase in the cost of providing those products and services.
- IT can play a big role in providing personalized or differentiated products and services.
- IT reduces external coordination costs, internal coordination costs and operational costs increasing productivity.

In order to create the most value, companies need to view enterprise IT in a fundamentally different way from how they did in the past. Hitherto, its main effect has been to standardize business processes, and wherever possible, automate activities to remove people from those processes. The primary focus of IT innovation is now about connecting people, and helping them improve performance more rapidly through working together. And more and more, it's

about connecting people across institutional boundaries (Taylor, 2008). IT is understood to offer substantial information efficiencies and synergies to an organization. It does not just allow access to prior knowledge, as might result from a knowledge codification, but in fact enables the employees to search for and absorb new knowledge that is relevant to a problem at hand (Gupta, Kanungo, Kumar and Sahu, 2007).

The exponential growth and advancement in IT is a significant factor that influences today's business environment and thus business organizations. Organizations are typically composed of different dispersed units that require integration. Therefore, managers can focus on IT to integrate information and communication across units of an organization (Qutaishat, Khattab, Zaid and Al-Manasra, 2012). On average IT does appear to be statistically significantly associated with higher firm level productivity. The magnitude of the association between IT and company productivity is also substantial (Reenen and Sadun, 2005). Productivity per information technology dollar varies widely, and may differ with clusters of technology, strategy and organizational practice (Bulkley and Alstyne, 2004).

1.10 ERP and Enterprise Productivity

Measuring the benefits from an enterprise system is a difficult task, particularly when the benefits of these systems are strategic in nature. Understanding the value of an ERP system entails examining the amount of duplicated effort that the

ERP system eliminates and the increased efficiency that results from having an ERP solution in place. Savings can be derived from a reduction in staff numbers and productivity improvement. ERP helps companies control their purchasing, inventory, manufacturing, finance, and human resource activities by centralizing information collected from dispersed geographical sites (Ragowsky and Somers, 2002).

The values that ERP systems may generate are multifaceted: operational benefits, financial benefits, benefits for investors, user satisfaction, etc. Sometimes, the value may be measured by observing market reactions to the mere announcement of the ERP project. The value assessment methods can be numerous and complex. For example, the benefits may be measured by cost savings, return on investment, asset turnover, return on assets, perceptions by the market, etc. (Moon, 2007). Data on 29 firms in the Oil and Gas industry of the US where ERP was implemented between 1990 and 2005 showed that measures such as return on sales improved after implementation. However, measures such as inventory turnover, which reflect operational benefits, improve during implementation (Anderson et al., 2011).

Users can evaluate the benefits of the ERP systems and users can judge whether or not ERPs provide reasonable payoff and outcomes for organizations. This premise is based on the view that the user creates the benefits through the accomplishment of tasks leading to the achievement of goals (Abugabah and Sanzogni, 2009). ERP system success can be measured by four dimensions —

user satisfaction, individual impact, organizational impact and intended business performance improvement (Chang, Chou, Yin and Lin, 2011).

1.11 Chapterization Scheme

The research study will be presented in the form of a thesis which will be composed of eight chapters. The schemes of chapters are as follows which also outlines the objectives of the study. Out of these, the first chapter has already been presented.

Chapter 1: Overview of ERP, Enterprise Productivity issues with emphasis on ERP, survey of literature to introduce the research topic and the schemes of chapters.

Chapter 2: Details of the methodology used for the study including objectives, approach, scope and limitations.

Chapter 3: Study details of Objective 1 – To understand the concept of Enterprise Productivity from the point of view of the Enterprise Resource Planning (ERP) users in the refineries of Assam.

Chapter 4: Study details of Objective 2 – To understand the use of productivity indicators for Enterprise Productivity analysis due to Enterprise Resource Planning (ERP) implementation from ERP user's perspective in the refineries of Assam.

Chapter 5: Study details of Objective 3 – To develop a Measurement Framework for Enterprise Productivity analysis due to Enterprise Resource Planning (ERP) implementation from ERP user's perspective in the refineries of Assam.

Chapter 6: Study details of Objective 4 – To make a comparative analysis of the impact of Enterprise Resource Planning (ERP) implementation on Enterprise Productivity from ERP user's perspective in the refineries of Assam.

Chapter 7: Study details of Objective 5 – To understand the impact of Enterprise Resource Planning (ERP) implementation on Enterprise Productivity from user's perspective from ERP user's perspective in the refineries of Assam.

Chapter 8: Conclusion of the study and directions for future research.

1.12 Conclusion

The preceding sections provide an overview about ERP and Enterprise Productivity. It is clearly seen that the term Enterprise Productivity is not well defined though the term is in usage. What employees think about Enterprise Productivity is a good beginning to understand and define the term as they are the ones who are supposed to drive productivity in the enterprises. Gaps in ERP research also continue to be huge. Taxonomy of ERP research suggests that important areas of research which can help fill the gaps in ERP research are Business Process Management, ERP & Competitiveness, Standardization &

Flexibility, Change Management, Performance Management, Knowledge Management, etc. (Al-Mashari, 2003). The current study will incorporate these areas as Enterprise Productivity due to ERP is related to all of these. No systematic study has yet been done to know the impact of ERP implementation on the Enterprise Productivity of the refineries of Assam, which are the most visible in the industrial landscape of Assam. A research is thus warranted and due on the topic: "Effectiveness of Enterprise Resource Planning on Enterprise Productivity – A Study on the Refineries of Assam". Various audit reports of the Comptroller and Auditor General of India (2005, 2010, 2011) clearly suggest that considerable investment has been made in implementing ERP in the refineries. This also adds justification for a study.

The thesis records a descriptive and empirical piece of work relying on primary data. The study tries to focus on Enterprise Productivity from the point of view of the users of ERP and what role ERP is playing in driving Enterprise Productivity in the refineries of Assam. Any discussion on Enterprise Productivity is incomplete without measurement and thus a measurement framework for Enterprise Productivity because of ERP is outlined. Overall, the study is expected to open the doors for the systematic study of ERP in the organizations where it has been implemented from the point of view of the users of the system.