4.1 Introduction

In the 21st century, Petroleum Industry is reaching deeper and further to gain access to the world’s energy supply. To support this, rapid changes in Information Technologies are revolutionizing the way the industry acquires data and processes it into information. This new ability has raised the need for petroleum industry to work with real-time information available around the clock. There is increased emphasis on managing the end-to-end value chain more effectively and to achieve this, Information Technology Integration operation programs are underway in most companies.

Prior to 1990s the information flow between functional areas within and outside an organization was paper based. The paper based transaction and communication was slow and ineffective in providing the right information at the right time. During this period, information was often over looked as a critical competitive resource because its value to profitability of a company was not clearly understood. Besides, the cost of IT implementation was very high, which also affected the management’s reluctance for IT. The Managements were of the opinion that the key to success depends upon providing the product/service at the lowest cost, leading to an “Economic of scale” approach.

In the recent year, with the increase in the variety and volume of products and services, increasing competition, reduced product life cycle and ever growing customer demands has forced the organization to re-think the IT-Strategies of their firms. Now, the key to success has moved beyond the “Economic of Scale” approach to providing quality product / service to the right customer, at the right time and price, across the globe. This business goal can only be achieved through effective utilization of Information Technology. The Recent time has also seen a sharp decrease in the cost of IT Infrastructure i.e. software, hardware, networking
and the required manpower, enabling organization of all levels to opt for total automation of their business process through the use of Information Technology.

Supply chain management (SCM) is concerned with the flow of products and information between supply chain members’ organizations. Recent development in technologies enables the organization to avail information easily in their premises. These technologies are helpful in coordinating the activities to effectively manage the supply chain. Information Technology enables Supply Chain Management to lowers its cost and time while increase its productivity by Efficient Demand Forecasting, E-Procurement, Lowering Inventories, Decreased Product Life Cycle, Transparent Communication and ease of Information Sharing vital for the responsiveness of Supply Chain Management. With the increase in Competition, Customer Satisfaction has become an important element for Success which can be achieved through IT enabled Customer Relationship Management (CRM).

4.2 I.T Solutions for SCM:

The Advancements in Information Technology has made possible various solutions for managing the Supply Chain efficiently. Some of the major developments in IT which are beneficial for Supply Chain Management are as follows:

1. Electronic Data Interchange (EDI)
2. Bar Coding, Smart Cards & RFID
3. Enterprise Resource Planning (ERP)
4. E-Commerce
5. Data Warehousing & Decision Support Systems (DW & DSS)
6. Supply Chain Management Systems (SCMS)

4.2.1 Electronic Data Interchange (EDI):

The American National Standard Institute (ANSI) defines EDI as “Electronic Data interchange as the transmission in a standard syntax of unambiguous information of business or strategic significance between computers of independent organizations”.

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EDI is the interchange of standard formatted data between computer applications of trading organization with minimal manual intervention. EDI is perceived as the inter-company computer to computer communication of standard business transaction in a standard that permits the receiver to perform the intended transaction without human intervention. In the EDI environment, a computer can directly use the data send by other computer for the benefit of the receiver computer’s organization. Other communication such as email, fax, etc are not considered EDI since these do not support automation facility and information send using such communications has to be re-arranged or re-entered into a computer for further use.

The EDI Process

1. Directing Data and Gathering Data From Different Application Programs
2. Converting Data from propriety formats as used by the source to standard format for transmission and again reversing this process at other end.
3. Actual transfer of data between trading partners over a communication network.

**Figure 4.1 – Working of EDI**
Through the use of EDI, supply chain partners can overcome the distortions and exaggeration in supply and demand information by real time sharing of actual demand and supply information. Other benefits of EDI are as follows:

- Software Application to Application Information sharing
- Reduction in time, cost and man power
- Greater effectiveness and efficiency
- Lead to cooperation at industry level
- Optimized inventory
- Improved decision making

4.2.2 Bar Coding, Smart Cards & RFID:

Bar Codes

Bar Codes are produced from a set of Bars and spaces between bars of varying width. These set of bars are read by a Bar Code Reader which scans it and interprets it into a character string which forms the unique identity of that product. Bar code encodes an identification number for something that will be unique. It does not provide all the information of the product. Using this unique identification number read through a bar code reader, all the possible information of that product is fetched from the database using an application.

The benefits of bar codes are as follows:

Improved Operation Efficiency:

Since barcodes permits faster and more accurate recording of information, work in process can move more quickly and be tracked precisely. Quite a bit of time can be spend in tracking down the location or status of projects, folders, instruments, materials or anything else that moves within an organization. Bar codes can help keep track so that one can save time and respond more quickly to inquiries and changes.

Saves Time:

Depending upon the application, time saving can be significant e.g.: determining inventory status. Consider a shipment of 10 cartons; it will take
approximately 2 minutes or more to write down product codes and serial numbers compared to 10-20 seconds to scan the bar codes. In a busy operation this can be significant saving.

**Reduce Errors & Cost:**

Dlerical and data entry errors can be significant source of cost and time. The extra time spend in locating and resolving the errors also adversely affects the organization and may lead to customer dissatisfaction. Bar Codes eliminate the possibility of human errors enabling smooth functioning of the organization.

**Customer Satisfaction:**

Bar codes enables a customer keep track of his/her shipment. For instance, almost all major courier company, upon receiving a courier order, provides a tracking ID to the customer. The customer can then logon to the website of the courier company to check the status and location of his/her order. The courier company’s website is integrated with the bar code scanners at various supply depots and provides the company and customer the present location of the given product and estimates the time required for delivery of product.

**Smart Cards**

A smart card is a plastic card the look like a credit card but contain an embedded computer chip. The smart cards can be used for various purposes, one for instance, is a scheme launched by Bharat Petroleum Corporation Limited (BPCL) named ‘Smart Fleet’. It allows a fleet owner to obtain a BPCL smart card and provide it to the truck driver, who can use it to purchase diesel and other products at a BPCL retail outlet. This allows the fleet owner for cashless transaction, eliminating any misuse of money. The fleet owners may also call up the BPCL call center to check where a particular smart card was last used to check the last location of the truck.
Radio Frequency Identification Device (RFID) :

RFID is a form of labeling where electronic labels or tags are programmed with unique information and attached to objects that need to be identified or tracked. The key component of RFID tag contains a small chip and a coiled antenna to broadcast signal. This tag is attached with the product. A ‘Reader’ to track the product captures the signal the tag emits. The ‘Reader’ is generally a remote mechanism such as a hand held device or a satellite. Conceptually, RFID and Bar Coding serve the same purpose, tracking and locating products. The difference is the way they operate. A Bar Code has to be read by a Reader, i.e. the product must pass through the bar code reader so that the bar code may be scanned and interpreted. Whereas RFID uses radio frequencies to locate a product thus enabling remote tracking and locationing as well. RFID do not require a physical contact with the product as it can remotely ‘read’ the radio frequency emitted by the tag on the product.

Consider a large warehouse, where a shipment has arrived. In case of bar coding, each product in the shipment needs to be unloaded and scanned using bar code reader. But RFID further simplifies this by remotely catching the radio frequency of each product in the shipment and updating the required inventory without having to even open the shipment and scan each product in it. This saves considerable time and manpower. Even with the availability of smarter technology – RFID, bar codes are still in use since the cost of bar coding is significantly lower than that of RFID.

4.2.3 Enterprise Resource Planning

Medium and Large Scale Organization on realising the benefits of IT has opted for Automation of their business process, but this IT automation posed new challenges. Most organizations developed or purchased software application for their organization’s individual departments, one at a time. For Instance, an organisation’s Accounts department went ahead with software of their choice, Sales department went ahead with software that suited their requirements, and so on. This Non-standard approach, were different department were using software packages
supplied by various vendors let to the absence of Integration and Information sharing among department of the same company. This had an adverse affect on the business cycle, increasing its time and cost. A strong need was felt for total integration of all the departments within and outside an organization, where information would be available across departments and globe. This lead to the dawn of “Enterprise Resource Planning” systems.

Kumar and Van Hillegersberg (2000) define ERP systems as ‘configurable information systems packages that integrate information and information-based processes within and across functional areas in an organization’. In this sense, ERP systems are designed to integrate business functions and allow data to be shared across many boundaries and divisions within the company. For example, a customer service department of a company would have access to information being used by its finance and accounting divisions. This ability to share information gives businesses increased flexibility and allows them to operate more efficiently than before. ERP systems consist of series of integrated modules from accounting, distribution, marketing and sales, manufacturing, to human resources. Instead of concentrating on specific functional areas, these modules focus on business processes. Typically, ERP systems include a single repository of data, and all business processes occur seamlessly within a single information system. Today’s ERP systems are an outgrowth of materials requirement planning (MRP) systems. MRP systems were developed largely for manufacturing concerns and were initially designed for inventory controls from 1970s to 1980s. The inventory levels could be reduced by an integrated control of supply and demand, measured against on-hand inventory and replenishment lead times. As these systems evolved (e.g. MRP II in the early 1990s), they began to incorporate financial control and measure, master production scheduling and capacity planning. EPR has extended the reach of the planning system to include the entire enterprise, from marketing to product development, and to achieve total organizational excellence through integration. The major goal of ERP is to unite the various departments across an enterprise through one system application package. The information managed by an ERP system can be utilized in many different ways. For example, executives and
employees in production, customer service, accounting and finance are able to rely on the information within the system to make more effective decisions. This system with its ability to share information in today’s business world becomes an invaluable tool, which provides various departments with the capacity to work in concert and communicate across a common interface. From another aspect, ERP enables the integrated flow of information to be the core system that provides the data needed for all corporate components. In this way, how to take advantage of that information for the use of gaining competitive edge is the key to success. Since the above mentioned concept is clear but not yet perfect, the core system requires all components working together to attain excellent performance. Information managed by ERP systems can be used in business in many ways. For instance, an order made by a salesperson in the ERP system, goes through the entire company. The system then updates the inventory of parts and supplies automatically and worldwide if needed. Production schedules and balance sheets change as well. Most efficient of all, the employees of different departments have the information needed just in time to complete their jobs. The feedback would be fast. As for the salesperson, he or she then can inform the delivery dates, and the managers can receive the effects of financial, inventory, or SCM decisions immediately.

Different ERP vendors provide ERP systems with some degree of specialty but the core modules are almost the same for all of them. Some of the core ERP modules found in the successful ERP systems is as follows:

- Financial management
- Manufacturing management
- Production management
- Transportation management
- Sales & distribution management
- Human resources management
- Supply chain management
- Customer relationship management
- E-Business
The modules of an ERP system can either work as stand-alone units or several modules can be combined together to form an integrated system. The systems are usually designed to operate under several operating platforms such as UNIX, MS Windows Series, IBM AIX, and HP-UX systems, etc.

**Advantages of an ERP system**

The core advantage of ERP is that it integrates the several complex processes by which businesses operate saving time and expense. Decisions can be made more quickly and with fewer errors. Data becomes visible across the organization. Tasks that benefit from this integration include:

- Sales forecasting, which allows inventory optimization
- Chronological history of every transaction through relevant data compilation in every area of operation
- Order tracking, from acceptance through fulfilment
- Revenue tracking, from invoice through cash receipt
- Matching purchase orders (what was ordered), inventory receipts (what arrived), and costing (what the vendor invoiced)

**Other Benefits of an ERP systems Include:**

- They eliminate the need to synchronize changes between multiple systems
- They bring legitimacy and transparency in each bit of statistical data
- They enable standard product naming/coding
- They provide a comprehensive enterprise view.
- They make real–time information available to management anywhere, any time to make proper decisions.
- They protect sensitive data by consolidating multiple security systems into a single structure.
Disadvantages of an ERP system

High Licensing Cost:

ERP systems are one of the costliest software available in the IT industry. This high cost may not be bearable by all organization, especially considering that this IT investment is to support their core business and IT itself is not their core business. For Instance, A manufacturing company may not hesitate to invest large amount on a machine needed for manufacturing product, since, it is their core business, but investing a large amount in ERP will need a lot of considerations by the management. Besides the ERP licensing cost, large amount needs to be invested in IT infrastructure such as Hardware – Servers, PC, and Networking Equipments & Software – Operating Systems for Servers and End-Users.

Implementation Challenges:

Cost -

ERP software License is not the only cost a company has to pay. ERP implementation is achieved by highly skilled ERP consultants, whose charges may be equal to or in some cases more than the license cost itself. The Task of ERP Implementation is generally awarded to an IT company specialized in the said domain.

Duration –

ERP system are very large complex software and its successful implementation is a highly skilled and time consuming task. ERP implementations, may take months or even several years, depending upon the modules chosen and the size of the organization.

Distraction From Core Business -

During this ERP implementation, Data needs to be migrated from different legacy applications into the ERP systems. While the data migration is in progress, the routine business has to be halted. Besides this, the ERP consultants involved in the implementation process may often need functional inputs from various
departments. All this lead to the shift of focus from the core business process and may hamper the daily routine of an organization.

**Re-Engineering The Business Process –**

ERP system are ready to use software that can be further customized based on the organization’s requirement. ERP’s systems are based on standard business practices and sometimes may force an organization to adopt the standard processes as offered by the ERP system.

**Staff Training:**

All the staffs from managers to data entry operators has to undergo extensive training on using the ERP systems.

**Recurring Cost:**

Even after the ERP is successfully implemented and is “Go Live” i.e. in use, continues modifications and customization is required. This generally requires an ‘Annual Maintenance Contract’ to be signed with the ERP Implementing Firm and is renewed annually.

**ERP Vendors**

There are about 50 established and a few more newly emerging smaller and midsize ERP vendors including third-party developers competing for the ERP market. Each vendor, due to historic reasons, has a specialty in one particular module area. The result is stiff competition and feature-overlapping products difficult to differentiate. Due to keen competition for control of the lucrative ERP market share, the vendors are continuously updating their products and adding new technology-based features. Long-term vision, commitment to service and support, module features, specialty, experience and financial strength for R&D are considered the major vendor qualities for product selection and turnkey implementation.
Profiles of leaders of ERP Segment:

SAP AG

SAP AG ("Systeme, Anwendungen, und Produkte in Datenverarbeitung"), or Systems, Applications and Products in Data Processing, is a German software corporation that makes enterprise software to manage business operations and customer relations. SAP AG is headquartered in Walldorf, Germany, with regional offices around the world. It was started by five former IBM engineers in Germany in 1972 for producing integrated business application software for the manufacturing enterprise. In 2011, with a revenue of $16,654 mn (2011) and employee strength of 54,589 (2011)\(^1\), SAP is the world’s Fourth Largest Software Company after Microsoft, IBM and Oracle Corp\(^2\). In terms of ERP market share and revenue, SAP is at number one spot. The company's best known products are its enterprise resource planning application SAP ERP, its enterprise data warehouse solution - SAP Business Warehouse, SAP Business Objects software, and most recently, Sybase mobile products and in-memory computing appliance SAP HANA. SAP's products focus on Enterprise Resource Planning (ERP). The company's main product is SAP ERP. The current version is SAP ERP 6.0 and is part of the SAP Business Suite. Its previous name was R/3. The "R" of SAP R/3 stood for real-time. The number 3 related to the 3-tier architecture: database, application server and client. SAP's Business Suite is a package of five enterprise applications, they are:

- Enterprise Resource Planning
- Customer Relationship Management
- Product Lifecycle Management
- Supply Chain Management
- Supplier Relationship Management

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1. www.wikipedia.com/SAP
Amongst the above mentioned Enterprise Applications provided by SAP, SAP’s ERP Provides the following solutions:

**SAP ERP Financials:**
- Accounts Payable
- Accounts Receivable
- Accounting and Financial reporting
- Risk management, regulatory compliance, and cash flow monitoring
- Travel management

**SAP ERP Human Capital Management:**
- HR and Payroll
- Recruitment and Training
- HR Reporting

**SAP ERP Operations:**
- Procurement and Logistics
- Product development and manufacturing
- Sales and service
- Operations analytics

**Oracle Corporation**

Oracle Corporation, Founded in 1977, is an American Multinational IT Company which specialises in Developing Database Servers, Application Development Tools & ERP Products. Oracle Corporation is Headquartered is at Redwood City, California, United States and employs approximately 111,298 people worldwide (2011)\(^1\). Oracle Corporation has the third-largest software revenue, after Microsoft and IBM\(^2\). Oracle Corporation is best known for its

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flagship Relational Database Management System, ‘Oracle Database Server 9i/10g/11g’. When considered the database server market, Oracle Corp. is ranked number one.

Oracle Corp. after leading the Database Server market since its inception in 1970s entered the ERP segment with the launch of Oracle Financials in 1987. Today Oracle Corp. is the second largest company in ERP segment with its flagship product ‘Oracle E-Business Suite R/12’. Oracle Corporation's E-Business Suite (also known as Applications/Apps or EB-Suite/EBS) consists of a collection of enterprise resource planning (ERP), customer relationship management (CRM), and supply-chain management (SCM) computer applications either developed by or acquired by Oracle. The software utilizes Oracle's core Oracle relational database management system technology.

4.2.3 E-Commerce

According to the International Journal of Electronic Commerce, ‘Electronic commerce is sharing business information, maintaining business relationships and conducting business transactions by means of telecommunications networks’.

In the 1960s a cooperative effort between industry groups produced a first attempt at common electronic data formats. The formats, however, were only for purchasing, transportation and finance data, and were used primarily for intra-industry transactions. It was not until the late 1970s that work began for national Electronic Data Interchange (EDI) standards, which developed well into the early 1990s. Electronic commerce was re-defined by the dynamics of the Internet and traditional e-commerce rapidly moved to the Internet. Modern electronic commerce typically uses the ‘World Wide Web’ at least at one point in the transaction's life-cycle, although it may encompass a wider range of technologies such as e-mail and mobile devices as well. Electronic commerce is generally considered to be the sales aspect of e-business. It also consists of the exchange of data to facilitate the financing and payment aspects of business transactions.
Impact of E-Commerce:

E-commerce is not solely the Internet, websites or dot com companies. It is about a new business concept that incorporates all previous business management and economic concepts. As such, e-commerce impact on many areas of business and disciplines of business management studies.

Marketing:

E-Commerce benefitted the marketing of products through on-line advertising, marketing strategies and consumer behaviour and cultures. One of the areas in which it impacts particularly is direct marketing. In the past this was mainly door-to-door, home parties and mail order using catalogues or leaflets. This moved to telemarketing. E-Commerce facilitates Direct Consumer Marketing through internet.

Computer Sciences:

E-Commerce paved the way to a new application of Computer Science leading to the development of different network and computing technologies and languages to support e-commerce and e-business. For instance, migration of the old legacy system to web based applications accessible across the globe round the clock.

Finance and Accounting:

E-Commerce made possible On-Line Banking, ATM Machines, Credit Card, Debit Card and many other facilities offered by modern banks. Without Internet and E-Commerce, this would have been a distant dream.

Production and Operations Management:

The impact of on-line processing has led to reduced cycle times. It takes seconds to deliver digitized products and services electronically. Similarly the time for processing orders can be reduced by from days to minutes. E-Commerce shifted the production strategy from Mass Production to Demand-Driven, Mass Customisation. Web-based Enterprise Resource Planning systems (ERP) can also be used to forward orders directly to designers and/or production floor within
seconds, thus cutting production cycle times, especially when manufacturing plants, engineers and designers are located in different countries. In sub-assembler companies, where a product is assembled from a number of different components sourced from a number of manufacturers, communication, collaboration and coordination are critical – so electronic bidding can yield cheaper components and having flexible and adaptable procurement systems allows fast changes at a minimum cost so inventories can be minimised and money saved.

**Human Resource Management**

E-Commerce has made possible Online Recruitment which reaches the eligible employees across the globe. With E-Commerce, Employee Efficiency Monitoring & Employee Appraisal Systems has been made easy.

**Benefits of E-Commerce**

**International Marketplace**

What used to be a single physical marketplace located in a geographical area has now become a borderless marketplace including national and international markets. By becoming e-commerce enabled, businesses now have access to people all around the world. In effect all e-commerce businesses have become virtual multinational corporations.

**Lower Communications Cost**

Today, Internet is one of the cheapest and amongst the most widely used mode of communication, especially between organisations. Email with the facility to attached documents has almost replaced the traditional fax machines. Besides this, through internet, Video conferencing / Video meeting have been made possible allowing for remote yet face-to-face communication.

**Digitization of Products and Processes**

Particularly in the case of software and music/video products, this can be downloaded or e-mailed directly to customers via the Internet in digital or electronic format.
Availability:

Businesses can be contacted by or contact customers or suppliers at any time. 24/7 access Enables customers to shop or conduct other transactions 24 hours a day, all year round from almost any location. For example, checking balances, making payments, obtaining travel and other information.

Increased Choices:

Customers not only have a whole range of products that they can choose from and customise, but also an international selection of suppliers. Customers can ‘shop’ around the world and conduct comparisons either directly by visiting different sites, or by visiting a single site where prices are aggregated from a number of providers and compared.

Limitations of e-commerce to organizations:

Security:

This biggest threat faced by E-Commerce industry is security of Data. There are numerous reports of websites and databases being hacked into, and security holes in software. This is most dangerous where financial transactions are done through Credit Cards / Debit Cards. Unless proper security software such as a ‘Firewall’ is not installed, one is vulnerable to be ‘Hacked’.

Rapid Development of Technology:

The rate at which the IT industry has grown is unmatched. This has lead to vast research and development of technology and new innovations. In most cases, New Technology is welcomed but in some, it may pose a problem by forcing the consumer / organisation to adapt to change and upgrade their infrastructure / hardware for better compatibility.
4.2.5 Data Warehouse & Decision Support Systems (DSS):

Data Warehousing:

Data warehouse can be described as a relational database that is designed for Query (Reporting) and Analysis (Decision Support) than for Transaction Processing. It usually contains historical data derived from transaction data, but it can include data from other sources. It separates Analysis workload from Transaction workload and enables an organization to consolidate data from several sources. To simplify it further, A Data Warehouse is a Computer System; Capable of Storing Very Large Volume of Data Obtained From Various Sources i.e. several Departments of a Company. A Data Warehouse Storages ‘Historic’ as well as ‘Current’ data of an organization which will most often be used for Decision Making Through Reporting.

Characteristics of a Data Warehouse:

According To W. H. Inmon [2005], “A data warehouse is a subject-oriented, integrated, time-variant and non-volatile collection of data in support of management's decision making process”.

Subject-Oriented:

A data warehouse can be used to analyze a particular subject area. For example, "sales" can be a particular subject.

Integrated:

A data warehouse integrates data from multiple data sources. For example, source A and source B may have different ways of identifying a product, but in a data warehouse, there will be only a single way of identifying a product.

Time-Variant:

Historical data is kept in a data warehouse. For example, one can retrieve data from 3 months, 6 months, 12 months, or even older data from a data warehouse. This contrasts with a transactions system, where often only the most recent data is kept. For example, a transaction system may hold the most recent address of a customer, where a data warehouse can hold all addresses associated with a customer.
Non-volatile:

Once data is in the data warehouse, it will not change. So, historical data in a data warehouse should never be altered.

Figure 4.2: Architecture of a Data Warehouse

Decision Support System (DSS)

A decision support system (DSS) is a computer application software that supports business or organizational decision-making activities. DSS serve the management, operations, and planning levels of an organization and helps to make decisions based on the facts and figures, generally derived through reports from a Data Warehouse. A properly designed DSS is an interactive software-based system intended to help decision makers compile useful information from a combination of raw data, documents, and personal knowledge, or business models to identify and solve problems and make decisions.
**Major components of DSS**

**Input Data** - This is a database which has the basic information required for decision making. It can come in the form of a data warehouse where all the company’s past transaction are stored; distributed databases that are accessed through a network or a PC-based database extract used for a specific problem.

Information technology such as point-of-sale, ERP, bar coding and electronic commerce provides companies with large amounts of data. The supply chain network requires both static and random data from all various parts of the organization. Static data will include such information as plant locations, warehouses, plant production rates and transportation costs. Dynamic data will encompass such things as forecasts, orders, and current deliveries. The quality of all data needs to be evaluated to ensure that the data required is appropriate and not redundant. Below is an illustration of the type of data a company would need to collect for their logistics network design:

**Table 4.1: Major Components of a DWH**

<table>
<thead>
<tr>
<th>Component</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer</td>
<td>Location, production capacity, production costs, transportation costs to warehouse</td>
</tr>
<tr>
<td>Warehouse</td>
<td>Location, fixed costs, variable costs, inventory turnover, transportation costs to retailers</td>
</tr>
<tr>
<td>Retailer</td>
<td>Location, demand for product annually</td>
</tr>
<tr>
<td>Product</td>
<td>Volume, weight, holding costs</td>
</tr>
</tbody>
</table>

Source: Compiled From Secondary Sources

**Analytical Tools** -

Once data has been collected it needs to be analyzed and tools that may be used to do this are as follows:

**Statistical Analysis** -

This is used to determine trends and patterns
**Data Mining** -
These look for hidden patterns, trends, and relationships in data.

**Online Analytical Processing (OLAP) Tools** -
It allows the user to navigate through the hierarchies and dimensions by drilling down. This also has presentation tools that will present data after it has been analyzed.

**Simulation** -
This creates a model of the process. The random elements are specified using a probability distribution and each time a random event occurs. The computer will use this to determine what would happen in that specific situation. As the model is running, statistical data is collected and analyzed and then statistical techniques help determine the average outcome and variability of this outcome.

**Artificial Intelligence** -
These can be databases of rules that are collected from experts which can be used for specific problems or online intelligent agents. These intelligent agents can be characterized by the number of activities allocated to them, the level of interaction with other intelligent agents and the level of knowledge embedded in it.

**Presentation Tools:**
These are Tools used to Represent Data in a Graphical Format. Data visualization techniques are used to help the user understand the output data. There are various formats used to present data to the user such as: reports, charts, spreadsheet tables, animation, specialized graphic formats and Geographic Information Systems (GIS).

GIS is the main presentation format used in supply chain DSS. It is an integrated spatial database management and integrated mapping system that allows for management, analysis, retrieval, storage, and display of geographically referenced data. It has the following capabilities:
• Mapping and thematic mapping
• Geo-coding
• Spatial data analysis
• Geographic data manipulation
• Interactive data query
• Database management

The fact that GIS can combine the entire top attributes makes it the best choice for use in DSS in supply chain management. GIS is used to in the following in SCM:

• Routing
• Site selection
• Network analysis
• Traffic Analysis

Applications of Data Warehouse & DSS in Supply Chain Management:

Supply chain management problems are not rigid and require not just computer but human knowledge to effectively manage the systems. DSS systems are meant to help ensure that analysis is easily understood with the help of computers. DSS in supply chain management is often called **Advanced Planning and Scheduling (APS)** systems. Data Warehousing & Decision Support Systems help create solutions in the following areas:

**Demand planning**-

Determine accurate forecasts based on historical data, help understand buying patterns of customers, helps facilitate collaboration between suppliers and customers.

**Supply planning**-

These are sometimes known as Distribution Resource Planning (DRP) and help in inventory planning, transportation planning, procurement planning, strategic supply chain planning.
Manufacturing planning and scheduling:

These incorporate the traditional Material Requirement Planning (MRP) system. It helps to efficiently allocate manufacturing resources to meet demand. It can also quote lead times to customers

4.2.6 Supply Chain Management Software:

Supply Chain Management software provides a comprehensive suite of software applications and functionality that have been designed to aid, automate and efficiently manage an organization Supply Chain.

Supply Chain Management Software enables companies achieve and maintain a competitive edge by empowering them to streamline and enhance their supply chain operations from start to finish. With supply chain management software in place, organizations can maximize cost-efficiency & increase productivity. Supply Chain Management Software offers broad range of robust features, delivered through a comprehensive suite of tightly integrated modules and applications. This functionality is designed to fully automate and support supply chain processes from end-to-end.

The Key Features of a Supply Chain Management Software are as follows:

Inventory Management:

With supply chain management software, companies can significantly improve the way they track and manage their supplies of raw materials and components needed for production, finished goods to satisfy open sales orders, and spare parts required for field service and support. This eliminates excess and waste, frees up valuable real estate for other important purposes, and minimizes related storage costs.

Order Management:

Supply chain management software can dramatically accelerate the execution of the entire order-to-delivery cycle by helping companies to more productively generate and track sales orders. Supply chain management software also enables the dynamic scheduling of supplier deliveries to more effectively meet demand, as well as more rapid creation of pricing and product configurations.
**Procurement:**

All activities and tasks associated with sourcing, purchasing, and payables can be fully automated and streamlined across a company’s entire supplier network with supply chain management software. As a result, businesses can build stronger relationships with vendors, better access and manage their performance, and improve negotiations to leverage volume or bulk discounts and other cost-cutting measures.

**Logistics:**

As companies expand globally, their supply chains become more and more complex. This makes the coordination of the numerous warehouses and transportation channels involved quite a challenging endeavor without supply chain software in place. With supply chain management, businesses can improve on-time delivery performance and boost customer satisfaction by achieving complete visibility into how finished goods are stored and distributed, regardless of the number of facilities or partners that participate.

**Forecasting and Planning:**

With supply chain management, organizations can more accurately anticipate customer demand and plan their procurement and production processes accordingly. As a result, they can avoid unnecessary purchases of raw-materials, eliminate manufacturing over-runs, and prevent the need to store excess finished goods, or slash prices to move products off of warehouse shelves.

**Return Management:**

Supply chain software can simplify and accelerate the inspection and handling of defective or broken goods – on both the buy and sell side of the business – and automate the processing of claims with suppliers and distributors, as well as insurance companies.

Many supply chain management software also include add-on options or modules designed to enhance related activities. Through these features, support is provided for a variety of important processes such as contract management, product lifecycle management, capital asset management, and more.
Supply Chain Management software can offer tremendous value to any company that relies on the smooth planning and execution of related operations to achieve long-term profitability and maintain a solid competitive edge. That’s why more and more organizations are purchasing and implementing supply chain applications.

**The key benefits of SCM software:**

**Improved Supply Chain Network:**

Supply chain management software provides complete, 360-degree visibility across the entire supply chain network. It allows users to monitor the status of all activities across all suppliers, production plants, storage facilities, and distribution centers. This enables more effective tracking and management of all related processes, from the ordering and acquisition of raw materials, to manufacturing and shipping of finished goods to customers or retail outlets. The status of mission-critical activities can be tracked at all times, and potential inefficiencies or problems can be identified and corrected immediately, before they become unmanageable.

**Minimized Delays:**

Many supply chains – particularly those that haven’t been enhanced with a supply chain application – are plagued by delays that can result in poor relationships and lost business. Late shipments from vendors, hold-ups on production lines, and logistical errors in distribution channels are all common issues that can negatively impact a company’s ability to satisfy customer demand for its products. With SCM software, all activities can be seamlessly coordinated and executed from start to finish, ensuring much higher levels of on-time delivery across the board.

**Enhanced Collaboration:**

SCM Software provides the ability to know exactly what your suppliers and distributors are doing at all times – and vice versa. SCM software makes that possible by bridging the gap between disparate business software systems at remote
locations to dramatically improve collaboration among supply chain partners. With SCM software, all participants can dynamically share vital information – such as demand trend reports, forecasts, inventory levels, order statuses, and transportation plans – in real-time. This type of instantaneous, unhindered communication and data-sharing will help keep all key stakeholders informed, so that supply chain processes can run as smoothly as possible.

**Reduced Costs:**

Supply Chain Management software can help reduce overhead expenses in a variety of ways. It can, for example:

- Improve inventory management, facilitating the successful implementation of just-in-time stock models and eliminating the strain on real estate and financial resources incurred by the storage of excess components and finished goods.
- Enable more effective demand planning, so production output levels can be set to most effectively address customer requirements – without the shortages that result in lost sales or wastes that drain budgets.
- Improve relationships with vendors and distributors, so that purchasing and logistics professionals can identify cost-cutting opportunities such as volume discounts.

The Petroleum Industry has a complex Supply Chain spread across the globe where the crude oil is extracted in one country/region refined in another country/region and then sold worldwide. These diverse locations of the entities involved in the petroleum industry make the efficient supply chain management the key to success. This business goal can only be achieved with effective SCM software.