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Advance Technology, New Innovation Utilizes in Warehouse, Logistics and Supply Change Management

Tarun Radadiya

Operation Engineer at Mahindra Logistic Ltd, Ahmedabad, Gujarat India
radadiya.tarun[at]mahindra.com

Abstract: ***Logistics is traditionally driven by operational demands. Therefore innovations are mainly based on direct customer requests. However, logistics service providers (LSPs) have started to realize the importance of proactive innovation and advance technology to improvecompetitiveness. The development of new service concepts enables LSPs to increase customer Satisfaction and strengthen their competitiveness. Due to the fact that services cover specificCharacteristics, their development differs from traditional product development and requires adapted innovation and advance technology management processes. The production of services usually requires the participation of customers.***

Keywords: New innovation, advance technology and customer satisfaction

1. Introduction

The word logistics has its origin from Greek word "logistike" which means the art of calculating. However, the modern interpretation of the term logistics has its origin in the military, where it was used to describe the activities related to the procurement of ammunitions, and essential supplies for troops located at the front. Logistics not only includes activities related to the physical movements of the goods but also manages relationship with suppliers and customers. However Logistic management is a means whereby the needs of customers are satisfied through integration and coordination of the supply chain.

IoT presents a unique technology transition that is impacting allour lives and will have huge implications for the business of logistics.As we move from 15 billion connected devices today to some50 billion by 2020, and embed sensor technology and analytics throughout our organizations, companies will enjoy unprecedented visibility into operations, enabling new sources of value. Thisvisibility, in turn, will transform how logistics providers make decisions, including about how goods are stored, monitored, routed,serviced, and delivered to customers, as well as operationalhealth and safety practices.

The development of logistics in the world is fast. Every day there are more industrial and commercial enterprises, having in the governance structure of logistics services. The economy is constantly expanding the scope of application of modern logistics systems and technologies. The business is rapidly being introduced and a new management concept survives SCM - Supply Chain Management with regard to our country, only a few leading companies are paying enough attention to it, creating the first SCM-units and recruiting appropriate staff.

The importance and role of logistics in business over the past few decades have undergonesignificant changes. Logistics has risen to the level of a certain specific pattern in the conduct ofbusiness. With the increasing competition, individualization of markets, growth and formation of new,ever-expanding network of creation cost, logistics continues to grow and become a strategic resourcethat has already requires a certain level of staff and a variety of in-depth knowledge.For the existence of a market economy, transport companies should focus on getting the singlemost effective economic results in the supply chain. This may contribute to a number of factors,namely formed market of transport services, competition between enterprises and various modes of transport, and others.

Main objective of this paper Advance technology and new innovation utilizes in logistics and supply change management and effect of customers Satisfaction. Logistics industry is most importance research and development in logistics and transportation technology. Logistic and supply change industry use of technology is information technology, communication technology and automatic identification technology.

Latest technologies being used in logistics and supply chain management

1) Automatic Identification and data capture Technology.
2) Communication Technology.
3) Information Technology.

1) Automatic identification and data capture technology

Automatic identification and data capture (AIDC) refers to the methods of automatically identifying objects, collecting data about them, and entering them directly into computer systems, without human involvement. Technologies typically considered as part of AIDC include bar codes, Radio Frequency Identification (RFID), biometrics (like iris and facial recognition system), magnetic stripes, Optical character recognition (OCR), smart cards, and voice recognition. AIDC is also commonly referred to as "Automatic Identification," "Auto-ID," and "Automatic Data Capture."

AIDC is the process or means of obtaining external data, particularly through analysis of images, sounds or videos. To capture data, a transducer is employed which converts the

actual image or a sound into a digital file. The file is then stored and at a later time it can be analyzed by a computer, or compared with other files in a database to verify identity or to provide authorization to enter a secured system. Capturing of data can be done in various ways; the best method depends on application [1-8].

Nearly all of the automatic identification technologies consist of three principal components, which also comprise the sequential steps in AIDC- 1 Data encoder . A code is a set of symbols or signals that usually represent alphanumeric characters. When data are encoded, the characters are translated into a machine readable code. A label or tag containing the encoded data is attached to the item that is to be identified. 2 Machine reader or scanner. This device reads the encoded data, converting them to alternative form, usually an electrical analog signal. 3 Data decoder. This component transforms the electrical signal into digital data and finally back into the original alphanumeric characters.

Barcode

Barcode is an optical, machine-readable, representation of data; the data usually describes something about the object that carries the barcode. Originally barcodes systematically represented data by varying the widths and spacings of parallel lines, and may be referred to as linear or one-dimensional (1D). Later two-dimensional (2D) codes were developed, using rectangles, dots, hexagons and other geometric patterns in two dimensions, usually called barcodes although they do not use bars as such. Barcodes were initially scanned by special optical scanners called barcode readers. Later application software became available for devices that could read images, such as smartphones with cameras.

Barcodes became commercially successful when they were used to automate supermarket checkout systems, a task for which they have become almost universal. Their use has spread to many other tasks that are generically referred to as automatic identification and data capture (AIDC). The very first scanning of the now ubiquitous Universal Product Code (UPC) barcode was on a pack of Wrigley Company chewing gum in June 1974.

Quality control and verification

A barcode verifier works the way a reader does, but instead of simply decoding a barcode, a verifier performs a series of tests. For linear barcodes these tests are:
1) Edge determination, 2) Minimum reflectance, 3) Symbol contrast, 4) Minimum edge contrast, 5) Modulation, 6) Defects, 7) Decode, 8)Decodability

2D matrix symbols look at the parameters:
1) Symbol contrast, 2) Modulation, 3) Decode, 4) Unused error correction, 5) Fixed (finder) pattern damage 6) Grid non-uniformity 7)Axial non-uniformity[17-19].

The bar coding offers the following advantages.

- Ease in identification of inventory items during storage, retrival, pickup, inspection and dispatch.
- Reduce paper work and processing time leading
- Reduce human error
- Increases logistics system productivity through speed, accuracy and reliability.

Impact of Bar code technology on operations of logistics and supply chain management

- Procurement operation – The parts and components brought from suppliers are assigned bar codes, which contain information on item name, batch number, date of manufacture, order no, serial no etc. The information in bar code helps in identifying and tracking the component. In the warehouse, when the goods enter through a conveyor, they are further scanned by the hand held scanner or scanner fixed alongside the conveyor. The information decoded by the scanner is immediately logged in the central computer which helps real time update of inventory records.
- Processing – During the order processing the bar code will help in keeping identification of items based on their date of entry into the warehouse or store. This will ease material storage, retrival and dispatch in FIFO (First in First out) inventory management system.
- Production operation – During the production process the identification of in-process and finished items become easier due to bar coding. The various bathes at different stages of production can be easily tracked.
- Distribution operation – During distribution, barcode helps in identifying and tracking the transit of finished goods to the customers[10-16].

2. Radio-Frequency Identification(RFID)

Radio-frequency identification (RFID) uses electromagnetic fields to automatically identify and track tags attached to objects. The tags contain electronically stored information. Passive tags collect energy from a nearby RFID reader's interrogating radio waves. Active tags have a local power source (such as a battery) and may operate hundreds of meters from the RFID reader. Unlike a barcode, the tag need not be within the line of sight of the reader, so it may be embedded in the tracked object. RFID is one method for Automatic Identification and Data Capture (AIDC). [20].

Yard management, shipping and freight and distribution centers use RFID tracking. In the railroad industry, RFID tags mounted on locomotives and rolling stock identify the owner, identification number and type of equipment and its characteristics. This can be used with a database to identify the lading, origin, destination, etc. of the commodities being carried [21]. Radio frequency identification (RFID) systems have received increased attentions fromacademicians and practitioners. It is a data acquisition and storage method, providing accurate, real-time data without human intervention. With its advent, various business processes are poised for a new and rapid transformation. RFID technology promises numerous benefits in supply chain management: improved speed, accuracy, efficiency and security of information sharing across the supply chain [22], reduced storage, handling and distribution expenses; increased sales through reduced stock outs; and improved cash flow through increased inventory turns [23].

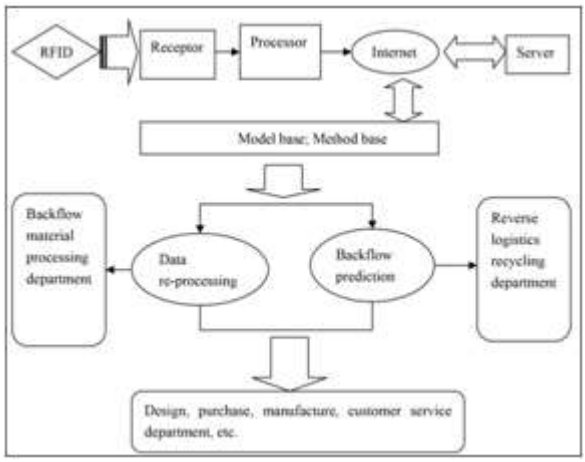

Figure 1: RFID Reverse logistic process flow chart

TAGS
RFTs The reader is connected to the central computer. Radio Frequency Tags (RFTs) are a piece of silicon chip to store data in the microcircuit. The RFTs are programmable with erasable memory. Data is stored in coded form and communicated to the reader through waves. The basic principle of tag is that antenna emits the radio signals.RFTs are very useful to accompany truck shipments. The tag will contain information on consignor, consignee, inventory items, quantity and value, what time the item travelled certain zone; even the temperature etc.The reader receives the tag signal with its antenna, decodes it and transfers the data to the host computer system. RFTs can be attactched to virtually anything-from a semi-tractor, to a pallet, containers etc. RFTs will avoid paperwork and can be helpful in quick clearance at octroi and custom posts. In the warehouse, the barcodes can be applied to the individual inventory items while RFTs can be applied to pallets, containers etc.These will allow the staff to directly communicate to the warehouse computer.

3. RFID benefits in Warehouse Management

Once production has been completed, FMCG producers pack the products into cartons, and deliver the cartons to the warehouse of the freight forwarder or the buying company. After the cargo reaches its destination, it is not uncommon that it ends up in a warehouse first.

Keeping track of the large number of cartons is a very complex as well as time and labor consuming process. However, RFID can be implemented to ease the situation as it can improve information management concerning cargo flow. Usually, read-write equipment is installed at the entry to a warehouse. Every cargo unit is equipped with RFID tags and all the information relating to the tags is stored in the central computer of the warehouse. When the cargo is moved in or out of the warehouse, the read-write equipment registers it and forwards the data to the backend system. This allows the management center to manage the vast amounts of products going into and leaving the storage, recognize cargo and help with placement of the cargo in the warehouse.In cases where read-write equipment is placed within the warehouse, all in-house movements are additionally registered in the system. This allows for strategic planning of product locations within the warehouse.

The information that is gathered with RFID can lead to significant improvements as the tracking and handling of the products can be done in real-time and with great accuracy. In the warehouse, products are easily located as all product movements are tracked and this information is automatically registered in the system. Whilst stock is accurately tracked valuable information concerning losses is also recorded.

RFID in warehouse processes offers: 1) visibility of accurate real-time information, 2) fast locating of products, 3) possibility to record losses 4) ability to plan product locations strategical.

RFID benefits in tracking and managing of shipping containers

Around the world, the most popular way to transport large amounts of cargo is to use shipping containers. Container transports are oftentimes chosen as they ensure safe and secured transportation, low costs, standard packaging and high transport density. Companies that use RFID in tracking and managing of shipping containers are able to track containers in each link of the supply chain. Active RFID Tags can be used to track containers in real-time in yards and docks. Ultra-high frequency RFID technology has long identification distance and speeds up identification.

RFID in container management and tracking:1)offers visibility of real-time cargo movement, 2)improves efficiency, 3)increase accuracy.

4. Benefits in Distribution Processes

Implementation of RFID technology can also add advantages to distribution processes. Usage of RFID will greatly accelerate the speed of delivery management, improve efficiency, and increase accuracy in selection and distribution processes. It will also reduce distribution costs. When products embedded with RFID tags enter a distribution center, the RFID read-write equipment at the entry gate can register the RFID tags, and send the information to the distribution centers' backend system. This information can be used to put the cartons in proper places, sort them quickly and efficiently, and dispatch the cartons to the retailing centers in less time with improved accuracy. Usage of RFID also ensures accurate inventory control.

In 2014, the world RFID market was worth US$8.89 billion, up from US$7.77 billion in 2013 and US$6.96 billion in 2012. This figure includes tags, readers, and software/services for RFID cards, labels, fobs, and all other form factors. The market value is expected to rise to US$18.68 billion by 2026.[24].

5. Procter &Gamble (P&G) Company

Before – P&G used bar codes to track shipments of goods from factory to retail outlets, but couldn't do much to halt the supply shortages on store shelves. After – P&G used RFID is tracking shipments, and eventually individual products, so that they can be stocked on demand in stores. P&G expects to cut its costs by $400 million a year.

Ford Motor Company

Before – Assembly-line workers running low on parts would have to pick up a phone and call the replenishment department to get more parts and then wait for parts. After – Ford puts RFID tags on each parts bin. Warehouse operators now know in seconds, when supplies run low, and automatically deliver parts as needed to workers on the assembly line.

Biometric

Paperless Processes in Warehouse Logistics
Especially in warehouse logistics incure tons of documents that must be printed, signed and scanned to then be electronically archived again.

In order to optimize these operations, delivery notes, security declarations, CMR waybills (eg SAP) can be signed electronically using the e-Sign Single Sign Clients as a PDF and so on from any business application. Using a Sign Pad can replace a handwritten signature on paper by an electronic biometric signature on a document.

The e-Sign Single Sign Client ensures rapid implementation and a simple, paperless handling at the daily business.

Documents in PDF format can be opened straight from the business application, digitally signed and archived without an extra program to open.

In the SAP System the world of e-Sign Single Sign Client is seamlessly integrated via the Secure Store and Forward interface and thus enabling automatic archiving. For all other business application a web service interface is provided. Everywhere in the enterprise documents incur to be printed, signed and to be scanned and to be put into archives afterwards again electronically. All signature processes in the enterprise can be formed with the e-Sign Single Sign Client user-friendly and economically with lasting effect.

e-Sign Single Sign Client

- Neither at the field of store logistics to electronic signing of notes of delivery, security explanations, CMR shipping notes and so on nor
- to the documentation of servicing processes, e. g. from airplanes, machines and so on nor
- for paperless handling of all processes in the health service like REHA applications, medical reports and so onthe e-Sign Single Sign Client is suited for the area-covering application in every enterprise.

With the help of the e-Sign Single Sign Client PDF documents are signed electronically. Using a Sign Pad a handwritten signature on paper can be substituted by an electronic biometric signature in the document.

The e-Sign Single Sign Client guarantees quick implementing and an easy handling at daily business.

Documents in PDF format can be opened out of the business application, digitally signed and filed directly. There is no need to open an extra programme.According to necessary legal security signature [25-30].

Magnetic stripe card

magnetic stripe card is a type of card capable of storing data by modifying the magnetism of tiny iron-based magnetic particles on a band of magnetic material on the card. The magnetic stripe, sometimes called swipe card or magstripe, is read by swiping past a magnetic reading head. Magnetic stripe cards are commonly used in credit cards, identity cards, and transportation tickets. They may also contain an RFID tag, a transponder device and/or a microchip mostly used for business premises access control.
ID Badges for Transportation & Logistics Firm Alpha Card is a veteran expert at supplying shipping companies, logistics firms, and warehouses with robust, high-performance ID card systems. Due to the high amount of dollars in inventory kept in warehouses, and packaging companies, a secure ID system is absolutely essential to safeguarding the facility against unauthorized individuals and non-personnel from illegally entering. ID card systems also work exceptionally well for proper photo identification — make certain that every employee is visibly identified while at work[31-34].

Magnetic Inventory Labeling Improves Accuracy.

One effective way to improve warehousing accuracy and flexibility is using repositionable magnetic inventory labels. Magnetic Inventory Labels, ideal for efficient inventory control organization, are available in four styles: magnetic data card holder kits, magnetic label holders with clear plastic sleeves, magnetic strip with vinyl coating, and standard flexible magnetic strip.

Easily repositionable and available in a range of widths and lengths, magnetic inventory labels hold pre-printed or handwritten inventory labels. Use to hold data cards that contain important product information such as names, SKUs, bar codes, prices, descriptions, and more. When inventory changes or moves, relabeling is as quick and easy as repositioning the magnet. No time consuming scraping off of stickers and no damage to warehouse racking.

Magnetic Hooks Pull Their Strength in the Warehouse

A full line of magnetic hooks provides storage and safety options in the warehouse. Available in a range of sizes and pull strengths up to 65 lbs., magnetic hooks are a great choice for aisle and lane chains; and storage of cables, chains, wires, tools, and other items; and hanging and mounting of repositionable items like work lights and fixtures.

Simple to move and reuse in various locations throughout the warehouse, this line of magnetic hooks features different attachments, including carabineers, key ring hooks, swivel hooks, and reversible hooks.

Optical character recognition

Optical character recognition (also optical character reader, OCR) is the mechanical or electronic conversion of images of typed, handwritten or printed text into machine-encoded text, whether from a scanned document, a photo of a document, a scene-photo (for example the text on signs and billboards in a landscape photo) or from subtitle text superimposed on an image (for example from a television broadcast).[1] It is widely used as a form of information entry from printed paper data records, whether passport documents, invoices, bank statements, computerised receipts, business cards, mail, printouts of static-data, or any suitable documentation. It is a common method of digitising printed texts so that they can be electronically edited, searched, stored more compactly, displayed on-line, and used in machine processes such as cognitive computing, machine translation, (extracted) text-to-speech, key data and text mining. OCR is a field of research in pattern recognition, artificial intelligence and computer vision [35].
This technology can be used to electronically translate images of handwritten, text-written or printed text into machine readable and editable form. For example, they can be used to read and interpret serial numbers which can be used for matching, tracking or sorting packages as they move through various supply chain processes. However, OCR technology is yet to improve in terms of accuracy and speed in its applications.

The optical character recognition (OCR) system detects numbers of transport vehicles and containers, arriving at the terminals, and takes a photograph of the loads and vehicles.

SOLVO receives data from the OCR system and automatically registers the visit as well as the containers. The work station of the tallyman responsible for commercial inspection automatically displays information about the vehicle and container, significantly speeding up the process.

Speech recognition

Voice-directed warehousing (VDW) refers to the use of the voice direction and speech recognitionsoftware in warehouses and distribution centers. VDW has been in use since the late 1990s, and its use is expected to increase rapidly over the next five years due to advances in technology and decreasing costs for the voice directed software and for the mobile computers on which it runs.

In a voice directed warehouse, workers wear a headset connected to a small wearable computer, similar in size to a Sony Walkman, which tells the worker where to go and what to do using verbal prompts. Workers confirm their tasks by speaking pre-defined commands and reading confirmation codes printed on locations or products throughout the warehouse. The speech recognition software running on the wearable computer 'understands' the workers' responses.

Voice-directed warehousing is typically used instead of paper- or mobile computer-based systems that require workers to read instructions and scan barcodes or key-enter information to confirm their tasks. By freeing a worker's hands and eyes, voice directed systems typically improve efficiency, accuracy, and safety. Whilst VDW was originally used in picking orders, now all warehouse functions such as goods receiving, put-away, replenishment, shipping, and returns processing can be coordinated by voice systems

The first incarnations of voice directed warehousing were implemented in distribution centers in the early 1990s. Since then, voice has changed dramatically. Most notably, the technology was originally limited to picking,whereas now all warehouse functions (picking, receiving/put-away, replenishment, shipping) can be coordinated by voice systems. As these processes move from being paper-centric, to RF-centric (barcode scanning) and now voice-centric. For some, voice has become the starting point for re-engineering warehouse processes and systems, rather than an after-thought.
VDW technology has also undergone an evolution as more competitors have entered the market. The first solutions were based on dedicated and rugged voice appliances, mobile computing devices that ran the speech recognition software and that communicated with a server over a wireless network. These special purpose voice appliances use a speech recognition engine that was specially designed for the warehouse and provided by the appliance manufacturer. Since the early 2000s, more voice suppliers have entered the market, providing voice recognition systems for standard mobile computing devices that had been used previously for barcode scanning applications in the warehouse. These standard mobile computers from companies like Motorola, Intermec and LXE also support non-proprietary recognition software. The uncoupling of the hardware and speech recognition software has resulted in lower priced voice-directed warehousing solutions and an increase in the number of software providers. These two factors contributed to a rapid rise in adoption of VDW that continues today.

Implementing voice systems in the warehouse has among its benefits :1) Increased picking accuracy, 2)Increased inventory accuracy, 3) Increased employee productivity, 4)Improved safety, 5)Reduced new worker training time, 6) Increases job satisfaction for warehouse associates, 7)Eliminates cost of printing and distributing picking documents, 8)Growing customer satisfaction[36-42].

Smart cards

A smart card, chip card, or integrated circuit card (ICC), is any pocket-sized card that has embedded integrated circuits[1] Smart cards are made of plastic, generally polyvinyl chloride, but sometimes polyethylene-terephthalate-based polyesters, acrylonitrile butadiene styrene or polycarbonate. Since April 2009, a Japanese company has manufactured reusable financial smart cards made from paper [2].

Smart cards can be contact, contactless, or both. They can provide personal identification, authentication, data storage, and application processing[3]. Smart cards may provide strong security authentication for single sign-on (SSO) within organizations.

6. Benefits of Auto-ID technology

There are numerous benefits of Auto-ID technologies. A few of them are listed below.

1) They help identify the right goods on time
2) Accurate data capturing helps in accurate forecasting resulting in lesser stock outs.
3) Improved count and visibility of stocks, leading to lower stock shrinkage.
4) Accurate data collection leads to accurate binning and picking.
5) Auto-ID also helps in reducing labor costs.
6) Application of automatic identification processes enforces picking rules such as FIFO, LIFO or FEFO so that correct goods are delivered to the customer.
7) Accurate information about the package can be obtained without physically opening the package.
8) Accurate package linking to a delivery order or invoice is possible.

Role of Auto-ID technology in Warehouse Management

Warehouse Management is a key area of the entire supply chain. The primary purpose of a WMS is to control various processes such as identifying the right goods from the point of reception, identification of proper storage locations, sorting, picking, and shipping of the appropriate goods. When it comes to a warehouse, there is a huge flow of products in, out and within the warehouse. WMS uses Auto-ID to effectively monitor this product flow.

In modern times, warehouse management is not limited to a single warehouse anymore. The inbound, outbound and warehouse processes have implications on production management of a particular product. Close monitoring of these products can send accurate information to the original equipment manufacturer (OEM) or even help in accurate forecasting of that product. In its simplest form, a WMS looks at collecting data of a package or a product, interpreting it and storing it on a central database which can be either a standalone server in the warehouse or an ERP suite. Here is an example of how an automatic identification technique can help in effective warehouse management.

Barcodes and barcode scanners can capture the data of an incoming part and assign it to the appropriate storage/ picking location. It can also provide you accurate information about the inventory levels of a particular SKU. RFID systems can help you monitor the flow of products, collect the data and provide real-time transmission and synchronization to a central warehouse. It can also help in optimal utilization of the warehouse space and assets as well as improve the efficiency of warehouse logistics in the areas of receiving, storage, packing and shipping.

Auto-ID helps WMS in achieving the objective of optimizing the cost of order fulfillment in a timely manner by managing the resources economically.

7. Communication Technology

The communication, either oral or written has a very crucial role in business success. The following are the few emerging communications technologies, which are enablers to superior customer service leading to competitiveness through the speed and accuracy in communication.

8. Electronic Data Interchange (EDI)

Electronic Data Interchange (EDI) is a standardized way to exchange information related to inventory using electronic documents; most EDI is generated as soon as an event occurs.

- Warehouse Receiving and Shipping Services – Aid in the creation, scheduling and shipment of orders; the advance ship notice is included in this set.
- Warehouse Movement – Inventory status changes, such as transitions from one type of hold to another.
- Inventory Reporting – Inventory snapshots down to the SKU and date code level; reporting on pallet platforms is also available.
- Transportation – Provide the scheduling information needed for load tendering and appointment status.

Communication is the key for us to guide you to unprecedented levels of success. It's essential to every engagement including the way our systems 'talk' to each other. Automating the exchange of supply chain data between companies can greatly enhance business efficiency and lower costs. Avnet can streamline the data exchange between our companies by connecting with you via Electronic Data Interchange (EDI).

Our team will work with you on data mapping to enable a seamless, constant flow of information between our companies. The data we exchange will automatically populate each other's enterprise requirement planning (ERP) systems without requiring manual intervention. You'll spend more time being proactive and less time on data entry.

Once our systems are connected and the data is mapped, we're ready for action. You'll find an EDI relationship with Avnet saves your purchasing, materials and operations team time a significant amount of time. They'll appreciate being able to use the time saved for higher value activities.

Having an EDI relationship with Avnet also means you're always in the know. You'll have access to your supply-chain data and a number of essential reports, which are constantly updated, providing you with the most current information. We'll plan for your reporting requirements when we first meet to get the EDI process underway [43-48].

Avnet processes millions of EDI transactions each year saving our customers a significant amount of money and time.

EDI transactions

- 810 Invoice
- 820 Remittance Advice
- 824 Application Advice
- 830 Forecast
- 846 Inventory Advice
- 850 Purchase Order
- 855 Purchase Order Acknowledgment
- 856 Advanced Ship Notice
- 860 Purchase Order Change
- 862 Shipping Schedule
- 865 Purchase Order Change Acknowledgment

- 867 Product Transfer Report.

Very Small Aperture Terminal (VSAT)

A very small aperture terminal (VSAT) is a two-way satelliteground station with a dish antenna that is smaller than 3.8 meters. The majority of VSAT antennas range from 75 cm to 1.2 m. Data rates, in most cases, range from 4 kbit/s up to 16 Mbit/s. VSATs access satellites in geosynchronous orbit or geostationary orbit to relay data from small remote Earth stations (terminals) to other terminals (in meshtopology) or master Earth station "hubs" (in star topology).

A star topology, using a central uplink site, such as a network operations center (NOC), to transport data back and forth to each VSAT via satellite,A mesh topology, where each VSAT relays data via satellite to another terminal by acting as a hub, minimizing the need for a centralized uplink site, a combination of both star and mesh topologies. Some VSAT networks are configured by having several centralized uplink sites (and VSAT stemming from it) connected in a multi-star topology with each star (and each terminal in each star) connected to each other in a mesh topology. Others configured in only a single-star topology sometimes will have each terminal connected to each other as well, resulting in each terminal acting as a central hub. These configurations are utilized to minimize the overall cost of the network, and to alleviate the amount of data that has to be relayed through a central uplink site (or sites) of a star or multi-star network [49-51].

The satellite communication channels are playing a crucial role in real time data collection and its exchange, which is vital for customer service. To trace and track the goods carrier, a dish antenna is fixed on the vehicle. This allows the communication between driver, consignor and consignee. The real – time interaction helps in having the up-to-date information on the location of truck and the delivery position.Wal-Mart the retail giant of USA is using this system for controlling the inventory movement.

In the early 80s, LINKABIT (the predecessor to Qualcomm and ViaSat) developed the world's first Ku-band (12–14 GHz) VSAT for Schlumberger to provide network connectivity for oil field drilling and exploration units. LINKABIT which had become part of M/A-COM went on to develop K_u band VSATs for enterprise customers such as Walmart, Holiday Inn, Chrysler, and General Motors. These enterprise terminals made up the vast majority of sites for the next 20 years for two-way data or telephony applications. A large VSAT network, with more than 12,000 sites, was deployed by Spacenet and MCI for the U.S. Postal Service in the 1980s. Today, the largest VSAT Ku-band network containing over 100,000 VSATs was deployed by and is operated by Hughes Communications for lotteryapplications[52-55].

Geographical positioning System (GPS)

The Global Positioning System (GPS), originally Navstar GPS,[56-57] is a space-based radionavigation system owned by the United States government and operated by the United States Air Force. It is a global navigation satellite system that provides geolocation and time information to a GPS receiver anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites[58]. The GPS system does not require the user to transmit any data, and it operates independently of any telephonic or internet reception, though these technologies can enhance the usefulness of the GPS positioning information. The GPS system provides critical positioning capabilities to military, civil, and commercial users around the world.

The ability to track assets in a broad geographic area, typically outdoors, is key to transportation management. Satellite and cellular network-based technologies are often used for real-time asset tracking outdoors. But to track assets indoors in factories, warehouses, or other controlled environments Global Positioning Systems (GPS) and cellular-based systems lack sufficient signal strength. Alternative techniques employing low-cost location labels such as bar-code and RFID tags are often used for indoor asset tracking.

There is a supply chain visibility gap in the yards, however, where over-the-road tracking ends but the assets have yet to enter the confines of the warehouse.

Until recently, manual, resource-intensive processes were typically used to track trailer and tractor location and status in the yard. These methods leave data integrity vulnerable to human error and a lack of real-time updates. Yard process inefficiency may negate visibility gains from investments in asset tracking during transportation or in warehouses.

Real-time location systems (RTLS) technology determines an object's current position based on real-time information gathered through a wireless system.

Increasing demand for real-time visibility in today's globalized supply chains renders RTLS an indispensable part of logistics technology investments. By combining elements of GPS and passive RFID technologies, RTLS solutions take advantage of both technologies' strengths.

Mobile asset tracking in the yards illustrates the unique use of RTLS, in that the environment is outdoors, yet within a contained physical space.

In the yard's outdoor environment, using proven technologies such as GPS to monitor tractors' speed and position eliminates the need to establish location-detecting infrastructure.

On the other hand, you can draw an analogy between trailers in the yard and pallets in the warehouse: They remain immobile until hooked up to the equipment used to move them to the next destination.

Passive RFID tags have longer read ranges than bar codes but don't require direct line-of-sight to acquire data, making them one of the most economical ways to obtain real-time trailer position in the yard.

Combining GPS and RFID leverages existing yard processes. While yard tractors carry out their regular duties, attached GPS-enabled RFID readers recognize trailers by the tags, and report the location data in real time.

RTLS also enables management to monitor yard operations' key performance indicators (KPIs) based on quantifiable productivity metrics measured by the actions of the yard trucks. Managers cannot reliably and accurately collect information such as average time per move and percentage of idle time by manual tracking or other means.

The benefit of having real-time electronic data for asset-location yard activities extends beyond improving supply chain visibility at a particular locale.

Not only do corporations gain actionable data to facilitate process redesign and increase operational efficiency, they now also have information to drive best practices across all organizations and sites.

Finally, being able to share real-time visibility data within the enterprise as well as with supply chain partners is crucial for enabling collaboration and transforming to a more responsive and agile global supply chain.

By minimizing the dependency on infrastructure investment, the new breed of RTLS-enabled yard management solutions combines the cost and availability advantages of passive RFID and GPS technologies.

Geographic information system (**GIS**)
A geographic information system (GIS) is a system designed to capture, store, manipulate, analyze, manage, and present spatial or geographic data. The acronym GIS is sometimes used for geographic information science (GI Science) to refer to the academic discipline that studies geographic information systems and is a large domain within the broader academic discipline of Geoinformatics. What goes beyond a GIS is a spatial data infrastructure, a concept that has no such restrictive boundaries.

In general, the term describes any information system that integrates, stores, edits, analyzes, shares, and displays geographic information. GIS applications are tools that allow users to create interactive queries (user-created searches), analyze spatial information, edit data in maps, and present the results of all these operations. Geographic information science is the science underlying geographic concepts, applications, and systems.

GIS can refer to a number of different technologies, processes, and methods. It is attached to many operations and has many applications related to engineering, planning, management, transport/ logistics, insurance, telecommunications, and business.[4] For that reason, GIS and location intelligence applications can be the foundation for many location-enabled services that rely on analysis and visualization.

GIS can relate unrelated information by using location as the key index variable. Locations or extents in the Earth space–time may be recorded as dates/times of occurrence, and x, y, and z coordinates representing, longitude, latitude, and elevation, respectively. All Earth-based spatial–temporal location and extent references should be relatable to one another and ultimately to a "real" physical location or extent. This key characteristic of GIS has begun to open new avenues of scientific inquiry [59-63].

A supply chain is a network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of finished products to customers. Supply Chain Management (SCM) is the process of planning and management of materials, information and financial flow in a network consisting of manufacturers, distributors, suppliers and customers with the objective of reducing the costs, increasing the business and improving the customer service. GIS can be used as a tool to map manufacturing, clients, processing units, supplier locations, distribution centers, and routing of vehicles. GIS can be used as a decision support for effective supply chain management. In the system, the data of the processing units, the customers, the distribution centers, the suppliers, and the topologies of the roads are stored and managed by the geographic information system (GIS). Badaun district of western U.P. region is considered as the study area. The supply chain management is facilitated for the parag co-operative milk production units.

The routing of vehicles and the management of logistics operations in any company that services a fairly large geographical area can easily become quite a very complex task. The task can be simplified by the applying Geographic Information Systems, which automatically reduce the complexity by bringing out subtle geographic patterns and relationships that can form the basis of good decisions. Systems like ArcLogistics Route can take pain out of applications like Vehicle Tracking and Dispatch, Route Analysis, Warehouse Operations, Facilities and Depot Management, Routing and Scheduling. The ease of work has to be looked at though in the light that all of the data required for maximum accuracy may not be available. The system's potential would suggest that reasonably accurate decisions can still be arrived at with less that complete data sets and in time, India too would grow into a mature GIS market where data would not longer be a constraint.

GISs endeavor to unleash the inherent potential of the geography in most data sets we deal with today. This paper discusses how GIS can help us streamline logistics related business processes like inventory management, fleet/truck management and warehousing applications. ESRI has always had strong networking and analysis tools with products like ArcNetwork and/INFO.ESRI has expanded this feature-loaded toolkit with other focussed products like ArcLogistics Route, RouteXpert and NetEngine for networking and logistics operations. Sears Roebuck and Co., one of the largest retail chains in the United States recently put to use ESRI GIS software to take care of in-warehouse routing and direct delivery systems. The system not only functioned well but also received recognition for its efficiency and success at its work.

GSI Benefit in warehouse operation

- Vehicle Tracking and Dispatch involves being able to keep track of the location and the inventory on board every vehicle in the field and having the latest information on its position and operating status.
- Route Analysis is the operation which aims at minimizing the cost of travel involved in transporting goods from one location to another whether in terms of trips required or time or distance or a combination of these.
- Warehouse Operations become significant in cost reduction when the operation grows big and each warehouse becomes a very large operation in itself.
- Facilities and Depot Management involves minimizing waste by considering the locational aspects, the available capacity, the inventory in question and the range or effective covered area of each facility.
- Routing and Scheduling aims at minimizing all kinds of costs including mileage, overtime and maximizing all attendant benefits including customer satisfaction, adherence to schedules etc.

Web Feature Service (WFS): It is one of the GIS web service interoperable specifications defined by OGC (OGC, 2002). It is the most powerful data service of OGC Web Services. WFS allows a client to retrieve geospatial data from multiple geospatial data servers. It also supports INSERT, UPDATE, DELETE, QUERY and DISCOVERY operations on geographic features using HTTP as the distributed computing platform. WFS define three main operations: GetCapabilities operation describes capabilities of the web feature service using XML (it indicates which feature types it can service and what operations are supported on each feature type); DescribeFeatureType operation describes the structure of any feature type it can serve; GetFeature operation services a request to retrieve feature instances. In addition, the client should be able to specify which feature properties to fetch and should be able to constrain the query spatially and non-spatially. Web Map Service (WMS): It is capable of creating and displaying maps that come simultaneously from multiple sources, in standard image formats such as Scalable Vector Graphics (SVG), Portable Network Graphics (PNG), Graphics Interchange Format (GIF) or Joint Photographic Expert Group (JPEG) (OGC, 2004). It provides three operations: GetCapabilities allows a client to instruct a server to provide its mapping content and processing capabilities and return service-level metadata; GetMap enables a client to instruct multiple servers to independently craft "map layers" that have identical spatial reference system, size, scale, and pixel geometry (the client can then display these overlays in a specified order and transparency such that the information from several sources is rendered for immediate human understanding and use); GetFeatureInfo enables a user to click on a pixel to inquire about the schema and metadata values of the feature(s) represented there.

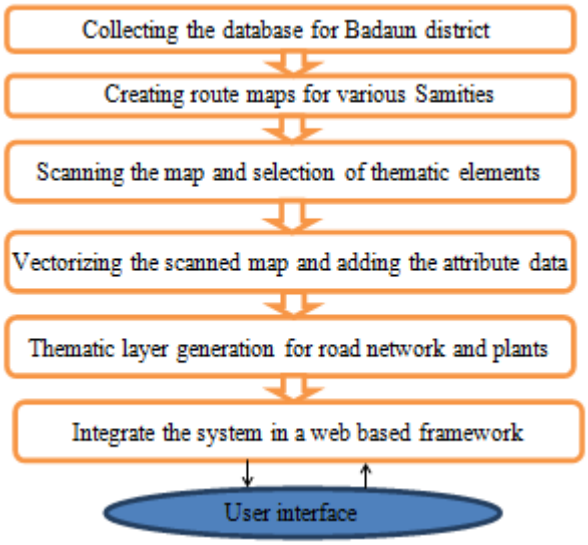

Figure 2: Methodology chart

The present work is done to develop a GIS based supply chain management system. The enterprise for which the work is carried out is PARAG co-operative dairy limited. Badaun district of western UP region is taken as the study area. ArcGIS 9.3 has been used for creating various thematic maps including road network map and the map showing different Samities and the processing plants. The system will answer two types of queries. One is the network related queries and the other is the location related queries. The system can be used as an information system and also as a decision support system for the decision makers. Figure 2 Shows the overall methodology adopted for creating the system architecture for the GIS based DSS for supply chain management.

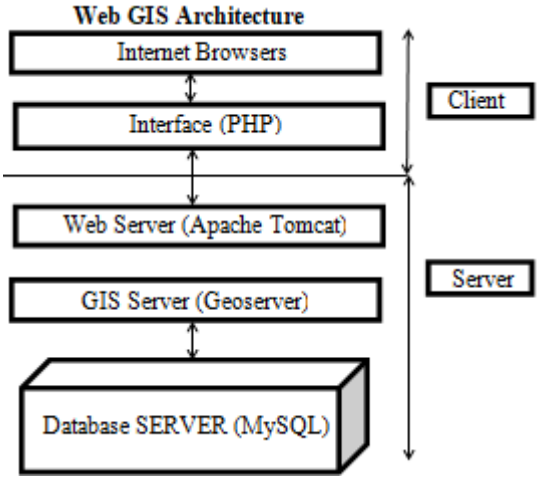

Figure 3: Web GIS Architecture Used

Development of the Web and expansion of the Internet provide two key capabilities that can greatly help geoscientists. First, the Web allows visual interaction with data. By setting up a Web Server, clients can produce maps. Since the maps and charts are published on the Internet, other clients can view these updates, helping to speed up the evaluation process. Second, because of the near ubiquitous nature of the Internet, the geospatial data can be widely accessible. Clients can work on it from almost any location. Both of these features altars the way geoscientists do their work in the very near future. The combination of easy access

to data and visual presentation of it addresses some of the primary difficulties in performing geosciences evaluations. For the creation of integrated geospatial database, the present work uses ArcGIS software. Geoserver and Apache Tomcat have been integrated for imparting the geospatial web capabilities with respect to Web Map Services (WMS), Web Feature Services (WFS) and Web Coverage Services (WCS). Geospatial web capabilities indicate to a web based GIS which can be modelled using the client-server architecture. In the present Web GIS architecture, a thin client model is used, where most of the processing work is done on demand in the server and the client does not perform any task other than to display the data on screen. MySQL is used for storing of security aspects and non-spatial data for decision making. PHP: Hypertext Preprocessor language has been used for dynamic server side scripting in the framework. PostgreSQL and PostGIS are the Geospatial databases where the shape files are stored. Figure 3 Shows the Web GIS Architecture used.

For development of Web GIS Architecture, the main focus has been on the use of a practical approach to explore and extend the concept of Supply chain Management in context with GIS. The framework should provide an effective and efficient means of sharing geospatial data and non- spatial data on the web using GIS in a secure way.

Automated Guided Vehicle System (AGVS)

Automated guided vehicle or automatic guided vehicle (AGV) is a portable robot that follows markers or wires in the floor, or uses vision, magnets, or lasers for navigation. They are most often used in industrial applications to move materials around a manufacturing facility or warehouse.

The AGV *can tow objects* behind them in trailers to which they can autonomously attach. The trailers can be used to move raw materials or finished product. The AGV can also store objects on a bed. The objects can be placed on a set of motorized rollers (conveyor) and then pushed off by reversing them. AGVs are employed in nearly every industry, including pulp, paper, metals, newspaper, and general manufacturing. Transporting materials such as food, linen or medicine in hospitals is also done.

An AGV can also be called a laser guided vehicle (LGV). In Germany the technology is also called Fahrerlose Transportsysteme (FTS) and in Sweden förarlösatruckar. Lower cost versions of AGVs are often called Automated Guided Carts (AGCs) and are usually guided by magnetic tape. AGCs are available in a variety of models and can be used to move products on an assembly line, transport goods throughout a plant or warehouse, and deliver loads.

AGVs automatically transport loading units using unmanned vehicles and connect different warehousing and material handling systems within the warehouse, resulting in time, energy and space savings within the company logistics.

These systems are easy to extend and are characterized by high efficiency and versatility, with the aim of optimizing internal logistics and reducing pallet transport costs.

Efficiency
- Optimisation of transport flows in accordance with vehicle fleet, traffic and missions
- Work flows distributed dynamically between the same AGVs
- Possibility of 24/7 operation without human intervention

Flexibility
- No conventional material-handling infrastructures required
- Increase of AGVs in line with the growth in volume of operations
- Updating possible without shutting down the system
- Easy reconfiguration of routes or addition of new machines
- Reintroduction of vehicles after manual repositioning

Precision
- Just-in-time delivery
- No destination errors
- Improved stock management precision

Savings
- Excellent price/quality ratio
- Low running costs
- Low maintenance costs

Wired
A slot is cut in to the floor and a wire is placed approximately 1 inch below the surface. This slot is cut along the path the AGV is to follow. This wire is used to transmit a radio signal. A sensor is installed on the bottom of the AGV close to the ground. The sensor detects the relative position of the radio signal being transmitted from the wire. This information is used to regulate the steering circuit, making the AGV follow the wire.

Guide tape
AGVs (some known as automated guided carts or AGCs) use tape for the guide path. The tapes can be one of two styles: magnetic or colored. The AGC is fitted with the appropriate guide sensor to follow the path of the tape. One major advantage of tape over wired guidance is that it can be easily removed and relocated if the course needs to change. Colored tape is initially less expensive, but lacks the advantage of being embedded in high traffic areas where the tape may become damaged or dirty. A flexible magnetic bar can also be embedded in the floor like wire but works under the same provision as magnetic tape and so remains unpowered or passive. Another advantage of magnetic guide tape is the dual polarity. small pieces of magnetic tape may be placed to change states of the AGC based on polarity and sequence of the tags.

Laser Target Navigation
The navigation is done by mounting reflective tape on walls, poles or fixed machines. The AGV carries a laser transmitter and receiver on a rotating turret. The laser is transmitted and received by the same sensor. The angle and (sometimes) distance to any reflectors that in line of sight and in range are automatically calculated. This information is compared to the map of the reflector layout stored in the AGV's

memory. This allows the navigation system to triangulate the current position of the AGV. The current position is compared to the path programmed in to the reflector layout map. The steering is adjusted accordingly to keep the AGV on track. It can then navigate to a desired target using the constantly updating position.

- Modulated Lasers The use of modulated laser light gives greater range and accuracy over pulsed laser systems. By emitting a continuous fan of modulated laser light a system can obtain an uninterrupted reflection as soon as the scanner achieves line of sight with a reflector. The reflection ceases at the trailing edge of the reflector which ensures an accurate and consistent measurement from every reflector on every scan. By using a modulated laser a system can achieve an angular resolution of ~ 0.1 mrad (0.006°) at 8 scanner revolutions per second.
- Pulsed Lasers A typical pulsed laser scanner emits pulsed laser light at a rate of 14,400 Hz which gives a maximum possible resolution of ~ 3.5 mrad (0.2°) at 8 scanner revolutions per second. To achieve a workable navigation, the readings must be interpolated based on the intensity of the reflected laser light, to identify the centre of the reflector.

Inertial (Gyroscopic) navigation

Another form of AGV guidance is inertial navigation. With inertial guidance, a computer control system directs and assigns tasks to the vehicles. Transponders are embedded in the floor of the work place. The AGV uses these transponders to verify that the vehicle is on course. A gyroscope is able to detect the slightest change in the direction of the vehicle and corrects it in order to keep the AGV on its path. The margin of error for the inertial method is ±1 inch.

Inertial can operate in nearly any environment including tight aisles or extreme temperatures.Inertial navigation can include use of magnets embedded in the floor of the facility that the vehicle can read and follow.

Natural features (Natural Targeting) navigation

Navigation without retrofitting of the workspace is called Natural Features or Natural Targeting Navigation. One method uses one or more range-finding sensors, such as a laser range-finder, as well as gyroscopes or inertial measurement units with Monte-Carlo/Markov localization techniques to understand where it is as it dynamically plans the shortest permitted path to its goal. The advantage of such systems is that they are highly flexible for on-demand delivery to any location. They can handle failure without bringing down the entire manufacturing operation, since AGVs can plan paths around the failed device. They also are quick to install, with less down-time for the factory.

Vision guidance

Vision-Guided AGVs can be installed with no modifications to the environment or infrastructure. They operate by using cameras to record features along the route, allowing the AGV to replay the route by using the recorded features to navigate. Vision-Guided AGVs use Evidence Grid technology, an application of probabilistic volumetric sensing, and was invented and initially developed by Dr. Hans Moravec at Carnegie Mellon University. The Evidence Grid technology uses probabilities of occupancy for each point in space to compensate for the uncertainty in the performance of sensors and in the environment. The primary navigation sensors are specially designed stereo cameras. The vision-guided AGV uses 360-degree images and build a 3D map, which allows the vision-guided AGVs to follow a trained route without human assistance or the addition of special features, landmarks or positioning systems.

Geoguidance

A geoguided AGV recognizes its environment to establish its location. Without any infrastructure, the forklift equipped with geoguidance technology detects and identifies columns, racks and walls within the warehouse. Using these fixed references, it can position itself, in real time and determine its route. There are no limitations on distances to cover number of pick-up or drop-off locations. Routes are infinitely modifiable.

Steering Control

To help an AGV navigate it can use three different steer control systems.[5] The differential speed control is the most common. In this method there are two independent drive wheels. Each drive is driven at different speeds in order to turn or the same speed to allow the AGV to go forwards or backwards. The AGV turns in a similar fashion to a tank. This method of steering is the simplest as it does not require additional steering motors and mechanism. More often than not, this is seen on an AGV that is used to transport and turn in tight spaces or when the AGV is working near machines. This setup for the wheels is not used in towing applications because the AGV would cause the trailer to jackknife when it turned.

The second type of steering used is steered wheel control AGV. This type of steering can be similar to a car's steering. But this is not very manoeuvrable. It is more common to use a three-wheeled vehicle similar to a conventional three wheeled forklift. The drive wheel is the turning wheel. It is more precise in following the programmed path than the differential speed controlled method. This type of AGV has smoother turning. Steered wheel control AGV can be used in all applications; unlike the differential controlled.[1] Steered wheel control is used for towing and can also at times have an operator control it.

The third type is a combination of differential and steered. Two independent steer/drive motors are placed on diagonal corners of the AGV and swivelling castors are placed on the other corners. It can turn like a car (rotating in an arc) in any direction. It can crab in any direction and it can drive in differential mode in any direction.

Path decision

AGVs have to make decisions on path selection. This is done through different methods: frequency select mode (wired navigation only), and path select mode (wireless navigation only) or via a magnetic tape on the floor not only to guide the AGV but also to issue steering commands and speed commands.

Frequency select mode
Frequency select mode bases its decision on the frequencies being emitted from the floor. When an AGV approaches a point on the wire which splits the AGV detects the two frequencies and through a table stored in its memory decides on the best path. The different frequencies are required only at the decision point for the AGV. The frequencies can change back to one set signal after this point. This method is not easily expandable and requires extra cutting meaning more money.

Path select mode
An AGV using the path select mode chooses a path based on preprogrammed paths. It uses the measurements taken from the sensors and compares them to values given to them by programmers. When an AGV approaches a decision point it only has to decide whether to follow path 1, 2, 3, etc. This decision is rather simple since it already knows its path from its programming. This method can increase the cost of an AGV because it is required to have a team of programmers to program the AGV with the correct paths and change the paths when necessary. This method is easy to change and set up.

Magnetic tape mode
The magnetic tape is laid on the surface of the floor or buried in a 10mm channel; not only does it provide the path for the AGV to follow but also strips of the tape in different combinations of polarity, sequence, and distance laid alongside the track tell the AGV to change lane, speed up, slow down, and stop.

Traffic control
Flexible manufacturing systems containing more than one AGV may require it to have traffic control so the AGV's will not run into one another. Traffic control can be carried out locally or by software running on a fixed computer elsewhere in the facility. Local methods include zone control, forward sensing control, and combination control. Each method has its advantages and disadvantages.

Zone control
Zone control is the favorite of most environments because it is simple to install and easy to expand.[1] Zone control uses a wireless transmitter to transmit a signal in a fixed area. Each AGV contains a sensing device to receive this signal and transmit back to the transmitter. If the area is clear the signal is set at "clear" allowing any AGV to enter and pass through the area. When an AGV is in the area the "stop" signal is sent and all AGV attempting to enter the area stop and wait for their turn. Once the AGV in the zone has moved out beyond the zone the "clear" signal is sent to one of the waiting AGVs. Another way to set up zone control traffic management is to equip each individual robot with its own small transmitter/receiver. The individual AGV then sends its own "do not enter" message to all the AGVs getting to close to its zone in the area. A problem with this method is if one zone goes down all the AGV's are at risk to collide with any other AGV. Zone control is a cost efficient way to control the AGV in an area.

Collision avoidance
Forward sensing control uses collision avoidance sensors to avoid collisions with other AGV in the area. These sensors include: sonic, which work like radar; optical, which uses an infrared sensor; and bumper, physical contact sensor. Most AGVs are equipped with a bumper sensor of some sort as a fail safe. Sonic sensors send a "chirp" or high frequency signal out and then wait for a reply from the outline of the reply the AGV can determine if an object is ahead of it and take the necessary actions to avoid collision.[7] The optical uses an infrared transmitter/receiver and sends an infrared signal which then gets reflected back; working on a similar concept as the sonic sensor. The problems with these are they can only protect the AGV from so many sides. They are relatively hard to install and work with as well.

Combination control
Combination control sensing is using collision avoidance sensors as well as the zone control sensors. The combination of the two helps to prevent collisions in any situation. For normal operation the zone control is used with the collision avoidance as a fail safe. For example, if the zone control system is down, the collision avoidance system would prevent the AGV from colliding [60-82].

9. Information Directed System (IDS)

In this a centralized computer controls the material handling equipment. The communication between the equipment and the computer is through radio frequency. The required movement are fed into computer and it assigns the jobs to the individual equipment's considering its maximum loading capacity and handling speed.IDS can perform variety of complex material handling jobs such as multiple order picking or multiple vehicles loading by the same material handling equipment leading to enhancement in warehouse productivity and flexibility in handling variety of jobs.

All material handling movements are directed and monitored by the command of microprocessors.

- To begin with all required handling movements are fed into the computer for analysis and equipment assignment.
- Analysis of handling requirements and equipment assignment is done in such a way that direct movements are emphasized and deadhead movements are minimized.
- Work assignments are provided to individual forklifts by terminals located on the truck.
- Communication between the computer and the truck uses radio frequency (RF) waves with antennae located on the forklifts and high up in the warehouse.
- Information-directed systems can increase productivity by tracking material handler performance and allowing compensation to be based on activity level.
- A single handling equipment may be involved in loading or unloading several vehicles, selecting many orders, and completing several handling assignments, thus increasing the complexity of work direction.

Information-directed Systems by BMS Team
IDS are a system with centralized control of material handling equipment. This is achieved through coordinated

communication between the central computer system and the equipment through radio frequency. The co-ordinated activity allows the system to achieve maximum handling speed and loading capacity.

10. Information Technology (IT)

Enterprise Resource Planning (ERP)

Enterprise resource planning (ERP) is the integrated management of core business processes, often in real-time and mediated by software and technology. These business activities can include:

product planning, purchase, production planning, manufacturing or service delivery, marketing and sales, materials management, inventory management.

ERP is usually referred to as a category of business-management software — typically a suite of integrated applications—that an organization can use to collect, store, manage and interpret data from these many business activities.

ERP provides an integrated and continuously updated view of core business processes using common databases maintained by a database management system. ERP systems track business resources—cash, raw materials, production capacity—and the status of business commitments: orders, purchase orders, and payroll. The applications that make up the system share data across various departments (manufacturing, purchasing, sales, accounting, etc.) that provide the data[83] ERP facilitates information flow between all business functions and manages connections to outside stakeholders.[84]

Enterprise system software is a multi-billion-dollar industry that produces components supporting a variety of business functions. IT investments have become the largest category of capital expenditure in United States-based businesses over the past[*which?*] decade. Though early ERP systems focused on large enterprises, smaller enterprises increasingly use ERP systems.[85]

The ERP system integrates varied organizational systems and facilitates error-free transactions and production, thereby enhancing the organization's efficiency. However, developing an ERP system differs from traditional system development.[86] ERP systems run on a variety of computer hardware and network configurations, typically using a database as an information repository.[87]

The acronym ERP stands for enterprise resource planning. It refers to the systems and software packages used by organizations to manage day-to-day business activities, such as accounting, procurement, project management and manufacturing. ERP systems tie together and define a plethora of business processes and enable the flow of data between them. By collecting an organization’s shared transactional data from multiple sources, ERP systems eliminate data duplication and provide data integrity with a “single source of truth.”

Today, ERP systems are critical for managing thousands of businesses of all sizes and in all industries. To these companies, ERP is as indispensable as the electricity that keeps the lights on.

ERP systems are designed around a common, defined data structure (schema) that usually has a common database. ERP systems provide access to enterprise data from multiple activities using common constructs and definitions and common user experiences.

A key ERP principle is the central collection of data for wide distribution. Instead of several standalone databases with an endless inventory of disconnected spreadsheets, ERP systems bring order to the chaos so that all users from the CEO to accounts payable clerks create, store, and use the same data derived through common processes. With a secure and centralized data repository, everyone in the organization can be confident that data is correct, up to date, and complete. Data integrity is assured for every task performed throughout the organization, from a quarterly financial statement to a single outstanding receivables report, without deploying error-prone spreadsheets.

It’s impossible to ignore the impact of ERP in today’s business world. As enterprise data and processes are corralled into ERP systems, businesses are able to align separate departments and improve workflow, resulting in significant bottom-line savings. Examples of specific business benefits include:

1) Improved business insight
   - From real-time information generated by reports
2) Lower operational costs
   - Through defined and more streamlined business processes
3) Enhanced collaboration
   - From users sharing data in contracts, requisitions, and purchase orders
4) Improved efficiency
   - Through a common user experience across many business functions and managed business processes
5) Consistent infrastructure
   - From the back office to the front office, all business activities have the same look and feel
6) High user-adoption rates
   - From a common user experience and design
7) Reduced risk
   - Through improved data integrity and financial controls
8) Lower management and operational costs
   - Through uniform and integrated systems

Present: ERP Today
From On Premises to the Cloud
From the 1990s until the beginning of the twenty-first century, ERP adoption grew rapidly, as more organizations relied on ERP to streamline core business processes and improve data visibility. At the same time, the cost of implementing ERP systems began to climb. Not only were on-premises hardware and software expensive capital investments, enterprise ERP systems often required the additional costs of custom coding, consultants, and training.
Meanwhile, ERP technology evolved to embrace the internet, with new features and functionality, such as

embedded analytics. As time went on, many organizations discovered that their on-premises ERP systems couldn't keep up with modern security demands or emerging technologies, such as smartphones.

Enter the cloud—or the software-as-a-service (SaaS) delivery model—for ERP. When ERP software is "in the cloud," it simply means that it is kept on a network of remote servers, instead of at a company's location. The cloud offers a more affordable alternative for ERP that lowers both operational expenses (OpEx) and capital expenses (CapEx) because it eliminates the need for companies to purchase software and hardware or hire additional IT staff. With no costly infrastructure to support, resources can be invested in growth opportunities. Employees can shift their focus from managing IT to more value-added tasks.

11. Next-Generation ERP

Built for Any Size Business while the legacy ERP systems of the past were often too expensive for small to medium businesses (SMBs), the cloud has broken that barrier. With a SaaS solution, smaller companies can leverage the same proven, industrial-strength ERP software that larger enterprises have been using for years. A cloud-based ERP solution can be implemented quickly, with no CapEx investment. For small to medium businesses looking to innovate quickly and seize new business opportunities, cloud ERP offers the flexibility to quickly add new users and support changing business needs.

Delivering an Extended Enterprise to Fuel Opportunities When cloud ERP extends its core financial architecture to include integrated customer relationship management (CRM), supply chain management (SCM), human capital management (HCM), and enterprise performance management (EPM), the system seamlessly ties all the applications together with a single data repository and a common user experience. An extended cloud ERP system enables all departments to be managed with improved visibility and collaboration, as if they were a single organization. It also provides seamless access to advanced reporting features, such as data visualization and advanced analytics. With access to emerging technologies, such as the Internet of Things (IoT), organizations gain a comprehensive, real-time understanding of business activities not only in the front office, but also in warehouses and on factory floors. This knowledge is readily available to employees on their mobile devices through social tools.

ERP helps in optimization of supply chain management and develop competitiveness by ensuring the following advantages

- Quicker response to customer requirement.
- Reduction in inventory costs.
- Improvement in service levels- internal and external.
- Improvement in inventory turnover rate
- Reduction in logistics cost.

Distribution resource planning (DRP)

Distribution resource planning (DRP) is a method used in business administration for planning orders within a supply chain. DRP enables the user to set certain inventory control parameters (like a safety stock) and calculate the time-phased inventory requirements. This process is also commonly referred to as distribution requirements planning.

DRP uses several variables:

- The required quantity of product needed at the beginning of a period
- The constrained quantity of product available at the beginning of a period
- The recommended order quantity at the beginning of a period
- The backordered demand at the end of a period
- The on-hand inventory at the end of a period

DRP needs the following information:

- The demand in a future period
- The scheduled receipts at the beginning of a period
- The on-hand inventory at the beginning of a period
- The safety stock requirement for a period

Distribution requirements planning (DRP) in Service Parts Planning (SPP) organizes replenishment planning within bills of distribution (BODs) (see Bill of Distribution (BOD)).

DRP determines the new demands of all locations in your BOD, rounds them, and aggregates them along the BOD to the entry location. On the basis of this it creates scheduling agreement releases and purchase requisitions. DRP also allows for efficient checking of the planning results and a multilevel release process as required.

Other additional functions (see More Functions in DRP), such as stability rules and anticipated demand coverage, ensure that planning runs optimally, products are available at demand, and that you can thus achieve a high level of service for your customers.

Prerequisites

- You have set up the master data for DRP (see Setting Up Master Data for DRP).
- You have executed all Customizing activities for DRP. For more information, see Customizing for Advanced Planning and Optimization, under Supply Chain Planning Service Parts Planning (SPP) Distribution Requirements Planning (DRP) .
- You have defined packaging specifications for rounding on the SAP Easy Access screen, under Advanced Planning and Optimization Service Parts Planning (SPP) Environment Packaging Specification Maintain Packaging Specification . For more information, see Rounding Settings.
- You have defined a planning profile in Customizing for SCM Basis , under Planning Service Manager Define Planning Profile that contains the planning service SPP: DRP Service (SPP_DRP).
- You have implemented SAP Note 801109 to allow SPP to distinguish receipts from purchase orders within the network as opposed to receipts from purchase orders from suppliers.

Process

1) The system calculates the unrounded net demand for a location product. For more information, see DRP Matrix.
2) The system rounds the net demand calculated in step 1.
3) For more information, see DRP Rounding Rules.
4) The system aggregates the net demands along the BOD from the child locations via the parent locations to the entry location. For more information, see Aggregation of Demands within the BOD.
5) The system performs backwards scheduling over the procurement lead time (see Procurement Lead Times in Service Parts Planning). The procurement lead time is dependent on the deployment indicator (see Deployment Indicators).
6) For more information, see Calculation of Lead Times in DRP.
7) The system checks whether it can perform product group procurement (see Product Group Procurement) for the product to optimize the total ordering and stockholding costs.
8) The system creates DRP stock transport requisitions, scheduling agreement delivery schedule lines, and purchase requisitions.
9) The system performs DRP approval (see DRP Approval). In this independent process step, the system compares the DRP planning results with certain rules in an automatic approval process after the DRP run, before the results are released for the supplier.
10) The system generates releases by informing external suppliers about approved scheduling agreement releases and purchase orders. At regular intervals, the system automatically transfers all approved scheduling agreement releases and purchase requisitions, and triggers the creation of scheduling agreement releases and purchase orders. In addition to automatic transfer, you can also create scheduling agreement releases and purchase orders manually.
11) For more information about the APO scheduling agreement, see Procurement via an APO Scheduling Agreement.

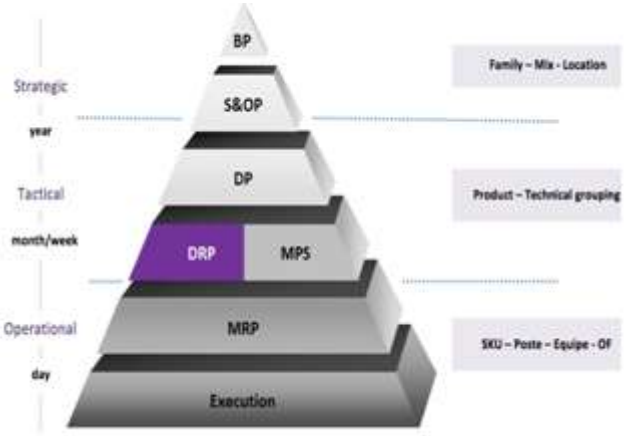

Figure 4: DRP Model

The DRP is a supply chain business process, which enables to anticipate the goods supply to the distribution centers, to the customers 'platforms (collaborative planning) over the whole horizon. It also helps to prioritize the stocks distribution in the short term. Finally, it is one of the entry points to the MPS (refer to our MPS brochure) because it provides production with a plan of accurate needs.

Our preconfigured DRP solution sticks to the APICS concepts. This ensures consistency between solution and process, while maintaining a flexible, simple and ergonomic interface.

Based on the sales forecasts, open orders and dependent requirements, the DRP is calculated with APO-SNP using the calculation called "Heuristic" (MRP Logic).

The planning suggests a DRP of items, mainly finished products, according to the replenishment rules defined by the Supply Chain and / or the distribution.

You can determine:

- Stock coverage profiles per day or quantity, min, target or max,
- Quota arrangements on the distribution centers,
- Lot sizing rules (min, max, rounded value)
- Allocation and deployment rules,
- Periods of high or low stock levels,
- Parameters to be updated as time goes by, to make the management tools more precise.

Throughout your Supply Chain, you set up your procurement rules, which will be used to calculate the replenishment. This calculation will obviously take into account the customer demand: working on one single set of data! This illustration highlights this integration in order to get the right stock at the right place all over the Supply Chain. Thus you play an active role in improving the customer service as you increase the percentage of products delivered on time, (right product references and right quantities), compared to the customer requirement.

On top of the distribution scheduling, the DRP, combined with the MPS in our solution, calculates the best optimized stock assignment. For example, from the DRP planning book, just by clicking on the "Deployment" button, you visualize in real time, your stock situation, your stock coverage and your projected stocks, on the one hand, and your stocks transfers, on the other. You also have the opportunity to build your transport orders using the "Transport Plan" (see illustration here below), which allows you to build optimized loading (volume, weight, pallets, etc.)

Distribution resource planning (DRP) is a method used in business administration for planning orders within a supply chain. DRP enables the user to set certain inventory control parameters (like a safety stock) and calculate the time-phased inventory requirements. This process is also commonly referred to as distribution requirements planning.

DRP uses several variables:

- The required quantity of product needed at the beginning of a period
- The constrained quantity of product available at the beginning of a period

- The recommended order quantity at the beginning of a period
- The backordered demand at the end of a period
- The on-hand inventory at the end of a period.

Distribution resource planning (DRP) is a method used in business administration forplanning orders within a supply chain. DRP enables the user to set certain inventory control parameters (like a safety stock) and calculate the time-phased inventory requirements.

Automated Inventory Tracking System (AITS)

An inventory control system is a set of hardware and software based tools that automate the process of tracking inventory. The kinds of inventory tracked with an inventory control system can include almost any type of quantifiable good, including food, clothing, books, equipment, and any other item that consumers, retailers, or wholesalers may purchase. Modern inventory control systems are almost exclusively based on barcode technology. Though barcodes were initially developed to automate the process of grocery store checkout, their ability to encode a wide variety of alphabetic and numeric symbols makes them ideal for encoding merchandise for inventory applications. Inventory control systems work in real-time using wireless technology to transmit information to a central computer system as transactions occur.

Inventory control systems are employed in a wide variety of applications, but they all revolve around tracking delivery of goods to customers. Inventory control is crucial in retail stores, especially those with a large number or variety of merchandise items for sale. Inventory control is also used in warehouses to track orders and shipments, and for automated order processing. Other important applications of inventory control systems are in manufacturing, shipping, and receiving.

Inventory control is important to ensure quality control in businesses that handle transactions revolving around consumer goods. Without proper inventory control, a large retail store may run out of stock on an important item. A good inventory control system will alert the retailer when it is time to reorder. Inventory control is also an important means of automatically tracking large shipments. For example, if a business orders ten pairs of socks for retail resale, but only receives nine pairs, this will be obvious upon inspecting the contents of the package, and error is not likely. On the other hand, say a wholesaler orders 100,000 pairs of socks and 10,000 are missing. Manually counting each pair of socks is likely to result in error. An automated inventory control system helps to minimize the risk of error. In retail stores, an inventory control system also helps track theft of retail merchandise, providing valuable information about store profits and the need for theft-prevention systems. Automated inventory control systems work by scanning a barcode either on the item. A barcode scanner is used to read the barcode, and the information encoded by the barcode is read by the machine. This information is then tracked by a central computer system. For example, a purchase order may contain a list of items to be pulled for packing and shipping. The inventory control system can serve a variety of functions in this case. It can help a worker locate the items on the order list in the warehouse, it can encode shipping information like tracking numbers and delivery addresses, and it can remove these purchased items from the inventory tally to keep an accurate count of in-stock items. All of this data works in tandem to provide businesses with real-time inventory tracking information. Inventory control systems make it simple to locate and analyze inventory information in real-time with a simple database search.

Collaborative Planning Forecasting and Replenishment (CPFR)

CPFR refers to a business model for cooperative planning, forecasting and management of goods flows and stock between retailers and consumer products manufacturers. The purpose is to jointly forecast the sales of goods to consumers and to plan promotion measures (for example, promotions by vendors, retail promotions and product price reductions). Having more information available reduces the markup risk for everyone involved in the supply chain. The vendor benefits by making optimum use of production capacity, whereas the retailer benefits from increased availability of merchandise and reduced risk of overstocking or under stocking.

- Operational forecast: This provides a sales forecast for stores and/or goods issue forecast for distribution centers, and is intended for internal use only.
- Tactical forecast: A tactical forecast is used for CPFR purposes and is calculated in exactly the same way as an operational forecast (same parameters, same forecast basis). The only differences between them are the forecast horizons and the fact that the tactical forecast is always based on a specified number of weeks (typically 13 weeks, but can be up to 52 weeks). Like the operational forecast, the tactical forecast is a unified forecast. This means that it already contains the effects of the DIF. For stores, a tactical forecast is a sales forecast and for distribution centers it is a goods issue forecast. This forecast is provided in SAP F&R and the related data transfer takes place by calling a standard function module to export the information, such as consumption, tactical forecast, DIF effects, to external applications and allows the vendor to have input into and react to the retailer's stock requirements.
- Tactical order forecast: This provides detailed data for future or projected orders where an outside vendor delivers products directly to the stores.

You can flag the specific products for which information (tactical forecast, DIF effects, consumption, operational forecast) can be exchanged with the vendor. These can be maintained on the vendor/product level and are included in the CPFR product list. The products and the vendors must exist in the SAP F&R master data as well as the transportation lanes.

You cannot import vendor forecasts from an external source to SAP F&R for collaborative forecasting.

To maintain the CPFR parameters:

1) On the SAP Easy Access Screen, choose Forecasting and Replenishment Collaborative Planning Maintain CPFR Parameters .

2) Enter the vendor in the Source Location field, along with the desired selection criteria (for example, products having a particular vendor as a possible source of supply, merchandise categories or subranges for which you want to share a tactical forecast, cumulated DIF effects with this vendor).
3) Choose Perform Selection.
4) When the system updates the screen, it displays a grid with the vendor products corresponding to your selection.
5) For each line in the list, enter the following:
   - Tactical Horizon: Enter the number weeks of tactical forecast to be shared. This setting triggers the creation of the tactical forecast and defines the number of weeks relevant for the length of the tactical forecast.
   - Detail Level: Choose either cumulative (totals for tactical forecast, cumulated tactical DIF effects for all directly supplied locations combined, broken out by product and week), detailed (tactical forecast, tactical DIF effects broken out by individual directly supplied location, product, and week), or both.
   - SN Det. Date: Enter the date for the first/next determination of the directly supplied locations.
   - SN Det. Frequency: Enter the frequency (in days) with which the system is to determine the directly supplied locations; that is, how often the report is run.
   - Operational Forecast: Select this checkbox if you want to share operational forecast data with this vendor.
   - POS Period: If you want to share POS information with this vendor, enter the number of weeks of consumption data you want to provide.
   - Listing Check: Choose whether or not you want the system to take into account the listing status of a location product when providing a tactical forecast, operational forecast, DIF effects and consumption data. The listing status check influences the values of the data provided, depending on the option chosen. See the field help (F1) for more details.
6) Choose Save.

After maintaining the CPFR parameters, you must do the following:

- If you have defined a tactical forecast to be provided, you must determine the directly supplied locations. To do this, you must run program /FRE/CPFR_DETERMINE_LOCPRD or else schedule it in SAP F&R (transaction SE38) before any tactical forecasts can be created. Afterwards, tactical forecasts will be created during the FRP run in SAP F&R.
- To provide the tactical forecast, use the standard SAP F&R RFC function /FRE/CPFR_PROVIDE_DATA,which can be called from an external system.

7) Set up an Online Self-Serve Portal – Harness the power of supplier self-service by deploying internet-based portal with multiple web front possibilities, customized styling and linking to external sources.
8) Streamline Transactions – By taking advantage of an online portal to support many transactions, warehouse inefficiencies are reduced, as are opportunities for errors resulting from manual processes.
9) Lower Your Costs – Rather than having administration at several sites, manage all of your sites out of a single, integrated system and lower your costs.
10) Take Control of Your Inventory – Manage your inventory proactively, even when it is stored in outsourced warehouses. Adjust or audit your inventory and ensure you never miss an order with inbound order receipt and outbound order ship confirmation

12. Conclusion

Today technology is very fast and innovation for totally change the logistic, warehousing, transportation and supply change. Very effective, efficiency and standard quality of service. Very Easy to management to warehouse, transportation and inventory.

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