Developing Approaches of Supply Chain Management Systems of Enterprises in Pakistan

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Abstract: *This paper identifies the problems of pakistani enterprises concerning supply chain networks and orders solutions to improving its overall performance and competitiveness. Seldom, a non-trivial amount of research efforts has been made in emergent nations to improve and enhance supply chain management paradigm. Our survey comprised nine enterprises; among them four are successfully modelled and presented. The detailed supply chain structure and study is also made. The paper concludes by suggesting and adopting modelled approach to the corporations in their move towards implementing supply chain management strategies.*

Keywords: *Supply chain, supply chain management, supply chain networks.*

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1. Introduction

Supply Chain Management (SCM) has gained significance as one of the 21st century's manufacturing technology and innovative paradigms for improving organizational competitiveness. SCM has been considered a competitive strategy for integrating suppliers and customers with the objective improving response time and flexibility [6].

Competitiveness in today's marketplace depends closely on the ability of a firm to grip the challenges of reducing lead-time, cost estimation, increasing customer service levels and improving product quality. Conventionally, sourcing, production, distribution and marketing have been working independently. Unfortunately, although they seem to be working towards a common goal, the organizational units have different objectives. Nowadays, the focus is shifting toward digitally integrated demand and Supply Chain (SC) configurations that are built around establishing networks of relationships between the firm, its suppliers, customers and partner entities.

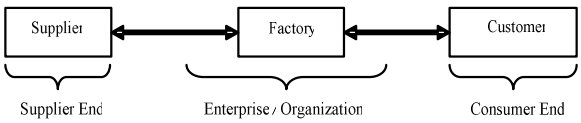
In our paper, we explain the work of different enterprises of pakistan considering their abilities and the SCM key challenges faced in developing their SCM approach. The data utilized for different SCM systems in this paper are derived from large, nationwide and cosmopolitan pakistani corporations, among them four of which we refer to as enterprises A, B, C and D.

Section 1 gives a brief introduction of the four enterprises from SCM perspective. Section 2 describes the related work in SCM. In section 3, we study existing systems and propose the SCM models for each enterprise. Section 4 concludes the study and presents future directions and strategies.

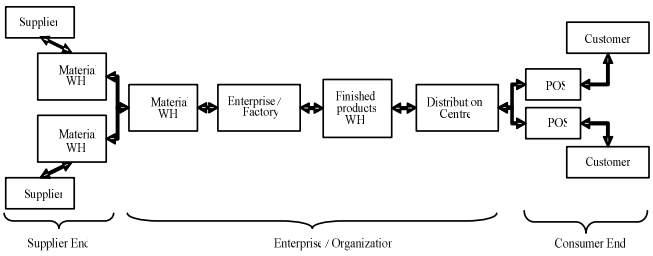
2. Related Work

Unfortunately, there is no explicit narration of SCM or its activities in the literature [2]. The ultimate success of firms will depend on management's ability to integrate the company's intricate network of business relationships, allowing improved decision making and consequently, reducing cost and customer response time. SCM is not only this but much more and beyond. SCM concerns neither to minimize nor to maximize but rather to optimize (integration, coordination, variability, uncertainty management and control) processes for the enterprise.

An efficient and responsive SCM aims to move from a simple SC Figure 1 (a) to a well structured and extended SC Figure 1 (b).



(a) Simple supply chain.



(b) Extended supply chain.

Figure 1. Supply chain type.

Literary summary shows the SCM concepts as follows: centralized vs. decentralized control, business process re-engineering strategies, information distortion, detrimental effect of bullwhip factor, SCM for suppliers and firms performance, incorporating model between supplier and retailer; benefits, impact, influence, activities, challenges to integrated SCM, need for performance measures for support of global supply chain improvement; value of information in a two level SCM; modelling the complexity and dynamics; design and management for SC systems; information sharing; and applications of lean thinking to manufacturing operations [3].

Supply chain strategy assessment including sourcing, development of inventory planning and management processes, benchmarking and SC Key Performance Indicators (KPI) collectively approach improvement of SC performance. It combines a strategic approach with practical tactical solutions that save time and money for the consumers.

Nowadays, few enterprises are in commencement to adopt SCM to improve their performance and to address their unfavourable inter-organizational purchaser-supplier relationships and disjointed processes. Although SCM in erection is still in its infancy, there is a need for SCM adoption to date and to scrutinize whether its maturity matches the key features of such a class of improvement. SCM featuring market saturation driven, operationally agile, consumers customized, logistics optimized and trade focused prioritization are accenture's successful supply chain strategies which are widely varied but are equally successful [1, 5]. In [4] the SCOR reference model captures the "as-is" state of the business process with the objective of achieving the desired "to-be" future state of PTC, pakistan. In the next section we proceed with the modelled SCN schema of the following enterprises.

3. Typical Enterprises Concerning SCM in Pakistan

In this section, we describe the enterprise structure one by one. Firstly, enterprise 'A' describes the SCM phase inspection of certain Vehicle (V). Secondly, enterprise 'B' gives proposal of Business to Consumer (B2C) model for development of electrical appliances. Then, enterprise 'C' discusses SCM for design and manufacture segments of communication equipment and lastly, enterprise 'D' shows the SC mechanism at a research oriented enterprise. We refer to appendix A for acronyms used in this paper.

3.1. Enterprise 'A': SCM Phase Inspection" of Certain Vehicle (V)

In this enterprise study, we only focused on the SCM phase inspection of certain Vehicle (V). Its key segments are forecasting, planning, scheduling, demand of components and procurements. The purpose of this phase inspection is to access and evaluate:

- Usage of vehicle 'V'.
- Calendar based inspection schedule staggered so as to assure the SC procurement.
- Induction of vehicle for inspection in the presently available time.

The hierarchy of phase inspection in the enterprise 'A' concerning SCM is shown in Figure 2.

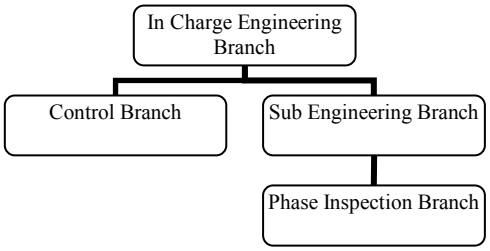


Figure 2. Hierarchy of phase inspection in enterprise 'A'.

If vehicle usage is more than the specified time then inspection time held is decreased, i.e., from 10 months to one year. The types of phase inspection as described by OEM along with its codes are shown in Table 1.

Table 1. Types of phase inspection as described by OEM.

Inspection Code	Time (Days)
M1	20
M2	21
M3	22
M4	25

The 'premeditated maintenance' branch views the item's checklist. It receives the current stock levels for a variety of stock types required for inspection and monitors the flow of materials in and out of inventory. All the items are prerequisite before phase inspection's induction starts. The control branch takes responsibility and forecasts to keep living items recorded and tracks them for timely replacement. It forecasts the processes on three-monthly, six-monthly, yearly and bi-yearly basis. The demand process is initiated by the user and a query is sent to the logistics department. Jet warehouse takes action on demand via Automatic Logistics Management System (ALMS). The demand is processed to the depot for accomplishment; otherwise the item is put on demand from source abroad in consultation with the head office of the department.

The SC in phase inspection of the vehicle is shown in Figure 3. It includes procurement agencies, depot Ware Houses (WH), logistics, jet stores, material control and the users. Table 2 shows demand priorities over the lead times of the phase inspection. The 'designator priority system' of current enterprise is based on historical assumptions, experience, system log-in, log-out time, intercontinental and local logistics

in-between lead times and depot area. Here the consumption is based on usage value.

Table 2. Demand priorities over the lead times.

Demand Priority Code	Lead Times (Days)
03	12 - 13
06	16 - 17
13	69 - 84

Altering the item criteria for phase inspection is defined as:

- Mandatory change items as specified by OEM are forecasted, procured and kept as a kit.
- Conditional change items are demanded if the bench checks fail. Firstly, items are sent for Local Repair (LR) and issues Dead-Line-Date (DLD). If it succeeds, items are sent back to procurement department; otherwise a query is placed to the Local Manufacture (LM) department.

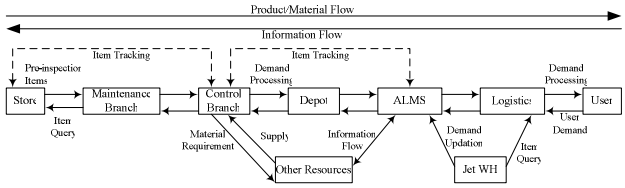


Figure 3. SCM phase inspection of a certain vehicle (V).

In the proceeding section we discuss ALMS, an automated system adopted by enterprise 'A'.

3.1.1. Automatic Logistics Management System

Automatic Logistics Management System (ALMS) is an interactive, fully automated, incorporating data processing, knowledge base and effective support to all operational units in the organization. It is a family of software implemented on an IBM 3090 machine. Its main functions are inventory and maintenance management. Mainly, it contains a maintenance and supply module as shown in Figure 4.

The ALMS characterises the SCM phase which make the whole system. SC modules of ALMS are comprised of Automatic Inventory Management System (AIMS), Deport Automated Inventory Management System (DAIMS), Purchase Order Management System (POMS), Local Purchase Management System (LPMS), Clothing Exchange Management System (CEX), Catalogue Management System (CMS) and Transportation Management System (TMS). These components results in:

- Featuring the whole SC of phase inspection of the enterprise.
- Online requisitioning and feed back status.
- Auto requisitioning based on demand level.
- Assets visibility to all authorized users.
- Repairable asset control through Stowage Tracking System (STS).

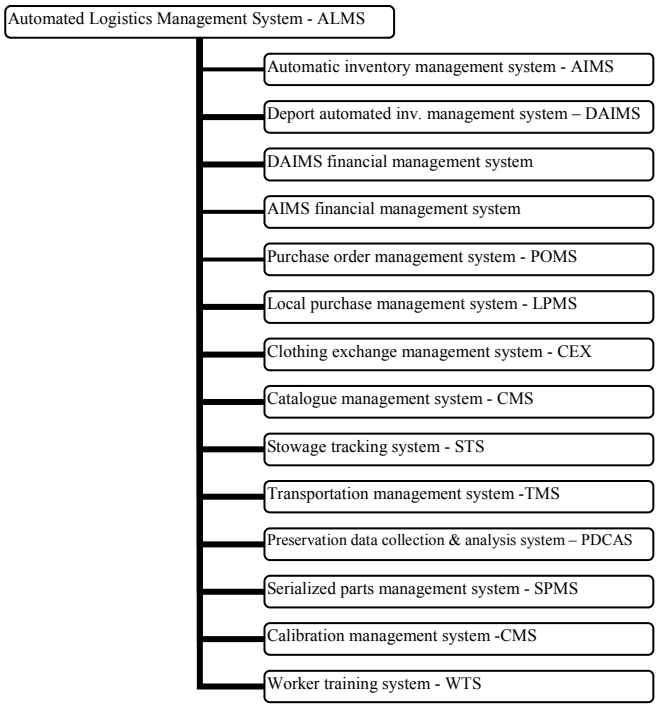


Figure 4. Automatic logistics management system.

Essential supply reports are made daily on a document register and submitted to higher authorities for completion indication of this phase. Here it concludes the SCM of phase inspection of Vehicle (V).

3.2. Enterprise 'B': Proposal of Business to Consumer Model for Development of Electrical Appliances

Enterprise 'B' gives a SCM model for proposal of B2C development of electrical appliances. The main objectives include:

- Multiple vendor development for large scale production.
- Efficient demand and supply management system.
- Self driving automated network.
- After sales support network for production support services like spare parts and repair.
- Awareness of SC actors.

The first objective explains the contingency plan, i.e., not depending on a single vendor and must have reliable supplier/s. The Main SCM activities of the B2C model for electrical appliance growth are shown in Figure 5. Depending upon product status and type, the customer interaction with the SC can be categorized into three parts. First, in case of complex products e.g., ship. Customers have to directly contact the manufacturers or the OEM. Second, e.g., in case of a car, the customer can contact a repair factory and the repair factory or agent can contact the manufacturer. Last, in the example of a desktop computer, the customer contacts with the sales distributors, who further link with the regional suppliers and so on.

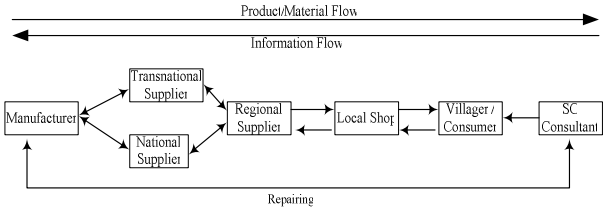


Figure 5. SCM activities flow and coordination in B2C model for development of electrical appliances.

Figure 6 describes the use case diagram of the characters of the "as is" schema of current enterprise. Our main characters include national and regional suppliers, manufacturer, local shop and the customer.

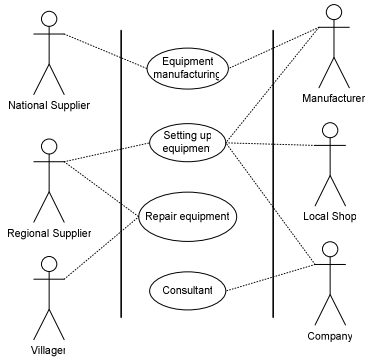


Figure 6. Case diagram of "as is" process.

The time frame of implementing SCM activities flow is shown in Table 3. The current enterprise schema lacks in customer relationship phase. Regional suppliers must be expanded to give a broader scope for its customers and local retailers.

Table 3. Time frame of implementation for different phases.

Phases	Duration (weeks)	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7
1	5																											
2	4																											
3	7																											
4	8																											
5	3																											

The goal to eliminate the vast majority (costs of receiving, shipping, expediting, data entry, data processing, accounting, and error follow-up) of regional suppliers need Just-In-Time (JIT) interaction with the manufacturer for enhancement of effective SC.

3.3. Enterprise 'C': Design and Manufacture Segments of Long Message Equipment

Enterprise 'C' discusses design and manufacture segments of long message equipment with the objective to acquire and develop a sophisticated technological base for long message systems and to enlarge and expand production of components. Durable AS400 system support is available for its Enterprise Resource Planning (ERP) and Supply Chain Network (SCN).

In the current system, SCM comprises three main departments: sales and marketing, production and planning control, and procurement and inventory management which serve as the backbone of the SC. The planning phase goes through MRP which checks what, for whom and how much to order. Capacity planning overviews the additional investment (if any) to meet the targets. Then production planning looks for facilities, technical and transportation phases. Sourcing makes the order scarification. In Bill Of Materials (BOM) it shows the item source code from local and foreign production within the enterprise and then assembles. It lacks in maintaining a standard of vendor evaluation. The enterprise 'C' schema is shown in Figure 7.

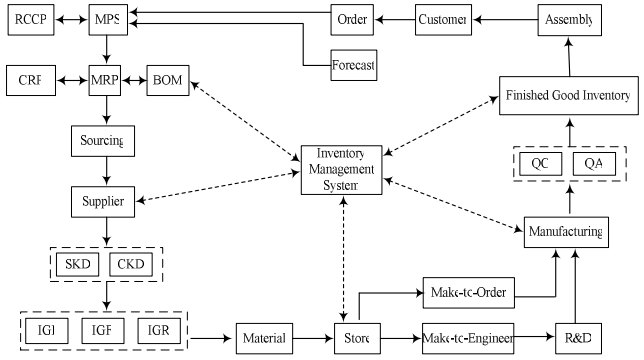


Figure 7. Design and manufacturing framework for enterprise 'C'.

For ordering, quotations are called and regarding the minimum amount quotation the order is placed. The steps include:

- Quotations call/ float.
- Cost comparison statements.
- Selection of potential customers.
- Order placement.

The Receiving/ storing section receives the items in form of Semi Knock Down (SKD) and Completely Knock Down (SKD). Right from the main entry of the goods in the enterprise, a receipt is generated against the goods received. The phases include Incoming Good Inspection (IGI), Incoming Goods Forwarding (IGF), Incoming Goods Receiving (IGR), allotting code No's to items and updating inventory in the system. The Quality Control (QC) of the engineering department ensures the quality of the received products. The receipts along with the inspected goods are frontward to the store department. Here an inventory code is generated for each item. The make/ deliver ensure value addition and quality inspection.

The question arises why to have an inventory? Our requirements fulfil the answer for the question. First, we want to meet anticipated demand and smooth production requirement. Second, we want to have a buffer of items and avoid stock out. It also takes advantage of the order cycle and hedges against price increase. The business nature of the under discussed

enterprise can be categorized as "make-to-order" and "engineer-to-order". The customer tells specification and the RandD of the enterprise works on the required demand of its customer.

The main work in current enterprise 'C' is made on "inventory turn over" or "turnaround time calculation". For this, let inventory turnover be Q, inventory I, sales S, cost C and time taken t for the system. Then Q is defined as number of times a company is able to convert its inventory I into sales during the course of a year. It is calculated by dividing cost of sales by average inventory.

$$Q = \frac{C(t)}{I(t)} \quad (1)$$

Turnaround time=

$$\frac{\text{Cost of goods sold from stock sales during one year}}{\text{Average inventory investment during one year past}} \quad (2)$$

Table 4. Annual inventory turnover.

Year	Annual Cost of Goods Sold ($)	Inventory ($) Investment	Annual Inventory Turnover
2000 - 01	85692	12312	6.96
2001 - 02	77600	14923	5.20
2002 – 03	99356	21981	4.52
2003 – 04	50000	9766	5.12
2004 - 05	65000	15330	4.24
Average			5.21

Table 4 shows the annual inventory turnover which converts inventory into saleable goods for this product. Most of the inventory is pilled up which also checks sales vs. inventory. The disadvantage of annual inventory turnover shows the block up inventory of the enterprise which could be used for some other purposes in the enterprise. Some of the reasons for the pilling up of inventory show that:

- This analysis of inventory has revealed the cases for increase in inventory over the years.
- Some stock is held to cater for after sales support during the warranty period as well as for providing repair services against invoices.
- For items where backup support from the main supplier has been stopped, the enterprise has to keep some inventory to provide backup support to its customers.
- In order to meet the spare requirement for customers under the contractual obligations, a certain stock of modules is kept.
- Pre-ordered materials that are not converted into sales also add up to stock up inventory.
- Some items are pilled up due to Minimum Order Quantity (MOQ) requirement.

The imperfections found in the system are tribulations to manufacturing. First, there is demand of items but no traceability. Demand section is unable to predict the items to fulfill the demand. Second, there is no entry of lead times showing the absence of items from inventory physically.

3.3.1. Recommendations for Improvement in Turnover Time of Inventory

- All items (sales stores as well as main stores) required after-sales-support during the warranty period may be shifted for the repair (*R* code) warehouse. The items lying in repair may be excluded from inventory evaluation.
- After the completion of delivery against a project or near the closing of the financial year, if the bulk of the project is delivered, which ever is earlier, the sales and marketing department will transfer an appropriate quantity of modules for backup support during the warranty period to the repair warehouse.
- The cost of such items, as worked out by the finance department should be charged to the after sales support account.
- When the product is phased out and its backup support is stopped by the main supplier to other collaborators, the balance of materials for that product may be zero valued.
- The responsibility of the issuance of material from the repair warehouse should rest with the customer services department. In order to realize some of the struck up funds in the preordered existing inventory of the enterprise, the same may be offered as discounted prices to prospective customers.
- Greater emphasis may be given on accurate forecasting to avoid losses resulting from failure to sell pre-ordered material.
- The purchase committee should also take care in placing orders against anticipated customer orders. If possible, an agreement should be made with the supplier where it will be bound to take back the materials if the expected customer order is not received.

The exercise for obsolescence should be carried out regularly especially after every six months and the materials identified as obsolete should be disposed of to rationalize inventory value as well as to free storage space. The above SCM study gives opportunity to gain knowledge about:

- Envisioning the whole SC and understand its impact on inventory
- Cost reduction for a better inventory control
- Differentiation between visualizing different ordering types in an enterprise like make to order, make to engineer and assemble to order *etc*., and the same, can be compared with current systems.
- Understand how a surplus inventory plays a vital role in lashing up the capital investment of an enterprise (turnover value).

- Understand and calculate turnaround value and its benefits by considering the saved investment to be utilized in an additional business opportunity for the same enterprise.
- Understand the impact of ABC analysis on Economics Order Quantity (EOC).
- Understand the importance and various aspects of software utilization for a good inventory management through visibility and traceability of information.
- To use jargons of SC and inventory management effectively and confidently while discussing relevant issues in the current enterprise.

3.4. Enterprise 'D': SC Mechanism at a Research Enterprise

Enterprise 'D' embraces the Planning and Production Control (PPC) department, logistics, supplier, log warehouse, QC and demand department for completion of its SCM. It adopts a Supplier Quality Management (SQM) system in the enterprise. Its significance concludes:

- The enterprise demands very high standards of its products and in-time delivery of the components.
- Failure of hardware or software in the business can be calamitous.
- Implementation of quality system model AS9100 Quality Management System (QMS) for quality assurance in design, development, production and installation.

AS9100 QMS is being used for supplier support. For this, the enterprise provides modern equipment and training for its suppliers. AS9100 was formed to bring all of its vendors to one platform for production of a high standard product. SQM system starts with the implementation of the Master Production Schedule (MPS) of the enterprise. It maintains a database of all suppliers for supplier performance analysis. By communication, it makes a confirmation that synchronization exists between the production and supplier components, happening at component level by using cards. The components which are falling short or at production line are mentioned by the card. The components at assembly are measured by the operator who accordingly upgrades and passes it to the logistics department, manually or through the ERP system. The logistics department has visibility about components falling short or in excess. It sends orders to its suppliers whether they bring items internationally or locally.

How does quality play an important role in SCM? The system not only ensures JIT delivery but also ensures the right quality of product has been delivered. The QMS works for Quality Control (QC), Quality Assurance (QA) and supplier evaluation system. The link to SC is built through the QC department which receives items from the supplier, called the incoming inspection department. Then items go through various phases from a vendor. The targets for incoming inspection are based on acceptance or rejection of the receiving goods. Specifications of the items like standard, grade, dimension, drawing *etc*., are given by that particular department's program management which require particular components. A conformance report of the product with specifications acts as a base for rejection or acceptance of incoming items. If a regular obsession is bought then it only needs an OEM certificate.

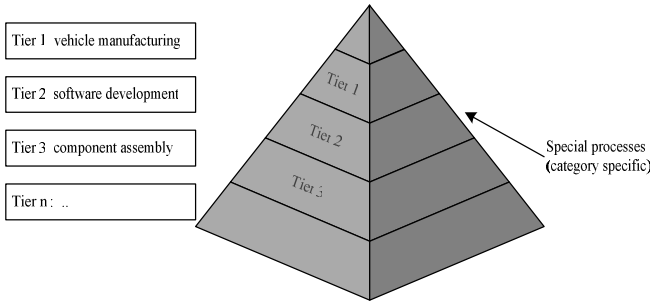


Figure 8. SCM pyramid for research enterprise.

The focus on supplier control in AS9100 QMS machine gives globalization, diversity of regional requirements, challenges of assuring quality of products and suppliers throughout the world and in-time delivery.

Various vendors/ suppliers or tiers are distributed all over the world, so it is very difficult to align them at one quality level. Figure 8 shows SCM pyramid tiers for this research enterprise. In the current enterprise, tier 1 produces the vehicle, tier 2 concerns in the software development and tier 3 deals with component assembly and so on. Now, how do we assure that all of these tiers are manufacturing products at a quality and attuned with the standards, or according to the pattern given by the organization?

For assurance and conformation of the above scenario, we apply the demand-pull logic of JIT theory. For its deployment, multitasking is ensured, various components are being manufactured at various vendors and they are required for final assembly. MPS is made commune to all vendors. Since the enterprise status is online, all the components are brought in time to final assembly and fabricated and then delivered to customers.

The current enterprise's MPS is analyzed on the basis of orders, forecasting, and capacity. It depends upon the size of this period and ABC classification of the supplier.

The demand planning shows the supplier visibility/ negotiation and the cumulative lead time of the system. The system SC cycle contains the works orders which are issued on the basis of MPS and orders. The job cards play an important role in this scenario.

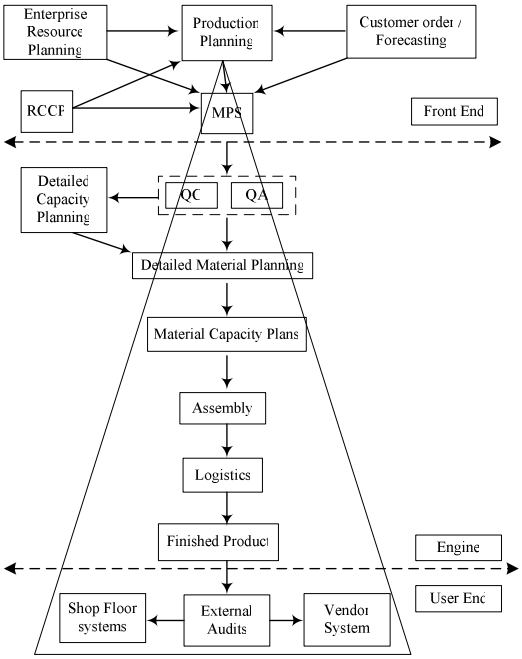


Figure 9. JIT pull logic for customer demand.

4. Conclusions

Our current exertion demonstrates that SCM can make a huge impact on the enterprise's bottom line and customer's satisfaction level. In the enterprise 'A' study, the schema needs design enhancement. Alteration of "lead time" and "cycle time" is desired to be minimized and optimized further.

Enterprise 'B' needs to improve the customer relationships. Regional suppliers must be expanded to give a broader scope for its customers and local retailers. Regional suppliers also need JIT interaction with the manufacturer for enhancement of effective SC.

In Enterprise 'C', we conclude that the SCM structure can be made easy by categorization of the items, focused lead times for delivery, cost and quality to acquire and develop a sophisticated technological base for enlarging and expansive production of components. Delivery target of the product to customer is scheduled keeping the view main items in our designed SCM. Thus, it also enables managers to reduce their cost through more effective contract negotiations. Concerned managers now can direct that class A items may be reviewed frequently to reduce the average-lot size and to keep their inventory records accurate.

In Enterprise 'D', SC targets its goals by making demand visibility through an online ERP system. It has compressed time and breaks down barriers for the top management/ leadership of the enterprise. It has also learnt the organization as working together and teamwork brings up an active SC domino effect. The effective SC has also lead the enterprise to break down barriers by efficient communication, initial planning meetings, communication during contract, partnership for quality, supplier training, seminar/ exhibition, supplier quality audit and supplier improvement strategies.

Hence, we conclude adaptation of the most promising innovations enabled by the modern IT-enhanced SCM systems. The modelled approach of the SCM system provides a foundation for future experimentation with prospect scenarios and strategies.

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