Supply Chain Management: After Business Process Re-Engineering

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Abstract— This paper is prepared to provide a review of how an automotive manufacturer, ISUZU HICOM Malaysia Co. Ltd. sustained the supply chain management after business process re-engineering in 2007. One of the authors is currently undergoing industrial attachment and has spent almost 6 months researching in the production and operation management system of the company. This study was carried out as part of the tasks in the attachment program. The result shows that delivery lateness and outsourcing are the main barriers that affected productivity. From the gap analysis, the authors found that new business process operation had improved suppliers delivery performance.

***Keywords*—** Supply Chain Management, Business Process Re-Engineering, Delivery, Outsourcing, Automotive Manufacturer.

I. INTRODUCTION

THERE are many definitions of supply chain management (SCM). In general, SCM is the oversight of materials, information, and finances as they move in a process from supplier to manufacturer to wholesaler to retailer to consumer. SCM seeks to synchronize an organization's functions and those of its suppliers to match the flow of materials, services, and information with customer demand [1]. Schroeder [2] stated that SCM involves in planning, designing, and controlling the flow of information and materials along the supply chain in order to meet customer requirements in an efficient manner, now and in the future. In other words, supply chain is the sequences of business processes and information that provides a product and service from suppliers through manufacturing and distribution to the ultimate customer [2,3].

SCM involves coordinating and integrating these flows both within and among organization. It is said that the ultimate goal of any effective SCM system is to reduce inventory (with the assumption that products are available when needed). While short, this definition is fairly complete. It indicates that it is not only the flow of goods that is important, but the flow of information and money as well [4]. Most manufacturing enterprises are organized as networks of manufacturing and distribution sites that procure raw materials, transform them into intermediate and finished products, and distribute the finished products to customers [5].

SCM involves coordinating activities across the supply chain. Central to this is taking customer demand and translating it into corresponding activities of each level of the supply chain. The key elements of SCM are listed in the Table 1.

TABLE 1
ELEMENTS OF SCM

Element	Typical Issue
Customers	Determining what products and service customers wants
Forecasting	Predicting the quantity and timing of customer demand
Design	Incorporating customers, wants, manufacturability, and time to market
Capacity planning	Matching supply and demand.
Processing	Controlling quality, scheduling work
Inventory	Meeting demand requirements while managing the costs of holding inventory
Purchasing	Evaluating potential suppliers, supporting the needs of operations on purchased goods and services
Suppliers	Monitoring suppliers quality, on-time delivery, flexibility: maintaining suppliers relations
Location	Determining the location of facilities
Logistics	Deciding how to best move information and materials

Source: Stevenson [3].

II. SUPPLIER

Reliable and trustworthy suppliers are the vital link in an effective supply chain. Timely deliveries of goods or services and high quality are just two ways that suppliers can contribute to effective operations. A purchasing manager may function as an 'external operation manager', working with supplier to coordinate supplier operation and buyer needs [3]. In order to satisfy customer needs, suppliers must have their responsiveness to delivery their product and service just in time (JIT) regarding to the customer demand. Suppliers have their own strategy to fulfill their delivery operations. According to Schroeder [2] with JIT system, several deliveries might be made each day, provided the supplier is located in the same vicinity. Suppliers located at a distance may have local warehouses where they receive bulk shipments and then break them down for frequent deliveries to the customer. However, since too much inventory builds up in the pipeline and reaction time is too long, local suppliers with short lead times are preferred. The JIT was developed to support and improve the

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manufacturing efficiency and cycle time as well as minimize and manage the inventory. In this period, the buyer and supplier relationship was accountability [6].

Svensson [7] believe that supplier segmentation is one fundamental business activity to improve the outcome of a company's efforts to maintain and enhance its position in the marketplace, as well as customer segmentation, market targeting, and positioning (i.e. strategic marketing). Manufacturers are able to help their suppliers by providing them knowledge, skills and experienced in order to improve supplier's improved delivery performance. Besides, assist from organizations can decrease production disruptions that are caused by poor quality materials. In addition, the suppliers also become more competitive than other suppliers as their performance improves and reduce the cost. Thus, supplier development is a vehicle that can be used to increase the competitiveness of the entire supply chains [5].

According to Summers [8], to ensure quality products, the suppliers of these raw material and parts are subjected to several requirements. The organization established these requirements and judges their performance by visiting the supplier's plant site and reviewing the supplier's quality systems. The Quality Management Systems such as ISO 9000, TL 9000, QS 9000, ISO/TS 1649, and AS 9100 is to document and recorded the organizational policies, procedures, work instruction and general form.

The statement above is argue by Xu and Lim [9] stated that in order to achieve supply chain goals and fulfilling customer orders faster and more efficiency than competitors, a supply chain needs competitors, a supply chain needs continuous improvement. The items of improvement in performance measurement are total cost, distribution cost, manufacturing cost, inventory cost and return on investment. Then, for output measure include sales, profit on time delivery customer response time, manufacturing lead time and customer complaints.

III. CASE STUDY

A. *IHM milestones*

Table 2 shows the Isuzu Hicom Malaysia Co Ltd. (IHM) milestones.

TABLE 2:
IHM MILESTONE

Year	Event
1994	Established As Name Of HICOM Commercial Vehicles Sdn Bhd. Incorporate In 4th January 1994. The Main Business Planning Is To Build The National Commercial Vehicle (NCV). Share holder: DRB Group (40%), Hicom Bhd (40%), Isuzu Motor Limited (IML) (20%).
1996	Confirmation to build NCV with the product name is Hicom Perkasa Truck; The company name is change from Hicom Commercial Sdn Bhd to Malaysia Truck & Bus Sdn Bhd (MTB), Incorporate of DRB Group with Hicom ot form DRB-Hicom. DRB-Hicom being involved in the manufacturing, assembly, distribution and sales of motorcycles, passenger cars, utility vehicles and commercial vehicles. Share holder: DRB-Hicom Bhd (80%), IML (20%).
1997	Introduce the Malaysian Truck & Bus Sdn Bhd; Launch the Hicom Perkasa Model in 1st July 1997; Model line-up Hicom Perkasa which is MTB 140, MTB 150T, MTB 150dx and MTB 170.
2000	Eliminate MTB 140 and MTB 150T model; Introduce new Model of MTB 145 (4.5 tons); MS ISO 9001:2000 (approved for manufacturing and contract assembly of commercial vehicle). National Productivity Award 2001.
2002	Eliminate MTB 170 (7 tons) and replace with new model which is MTB 170UV (7.7 tons); 5S implementations
2005	Introduce new model MTB 150 DxL (long wheel base).
2007	Discuss with Isuzu Japan to increase the share capital due to financial crisis of MTB in 19th June 2007; The principal's commitment to introduce new models led to a business process re-engineering (BPR) during the year; In 17th October 2007, DRB-Hicom Berhad through its effectively 100% subsidiary, HICOM Holding Berhad (HICOM) entered into Joint Venture Agreement with Isuzu Motor Limited (ISUZU), Japan in respect to the parties equity participation in Malaysian Truck & Bus Sdn Bhd. Share holder: Hicom Holding Sdn Bhd (49%), Isuzu Motor Limited (IML) (20%), Isuzu Motor Asia Limited (31%). Product line up is MTB 145, MTB 145 dxL, MTB 145dx, MTB 170UV, Isuzu 4x4 pick up (D-Max).
2008	Change of operation method based on Isuzu Japan and Isuzu Motor in Thailand; Manpower Decrease; System upgrades – Isuzu Manufacturing Management (IMM) from Japan that focus on continuous improvement; Improvement in Documentation Level in ISO 9001:2000 based on Quality Management, Department Procedure, and SOP (Standard Operation Procedure).

Before BPR, MTB produce Hicom Perkasa only 30 units per day. But after restructuring, the output is double to IMM system. There is less manpower to produce 56 units per day. With production increment, IHM decides to push the dealer which is Automotive Corporation (Malaysia) Sdn Bhd (ACM) to sell the product. For continuous improvement, there are incentives for production worker based on target achievement structure which has been made according to their job description.

Why re-engineering? Isuzu Motor Japan sees the potential of Malaysia to become commercial vehicle base and can distribute the commercial vehicle at Southeast Asia. The capacity of Isuzu Factory in Thailand is limited and decided that Thailand only produce pick up truck for global need.

B. *An Overview of SCM at IHM (After BPR)*

SCM activities include purchasing and outsourcing activities by IHM to manage the part for assembling the National Commercial Vehicle (NCV) product plus many other function and action that are important to the relationship with suppliers and distributors. IHM strives to increase their competitiveness via product customization, high quality, costs reduction, and speed to market in order to satisfy the market needs and competitive advantages with other automotive companies. Strategic SCM makes the suppliers in the IHM's strategy to satisfy an ever-changing marketplace. A competitive advantage depends on close-long term strategic relationship with few suppliers.

To ensure the supplier support the strategy, IHM considers the SCM issue as in Table 3 that indicates suppliers to be selected based primarily on cost. Such supplier should have the ability to design low-cost products that meet the functional requirements, minimize inventory, and drive down lead times. With this, IHM can achieve the integration of selected strategies and find the best supplier to supply the product

without any difficulty in the long term period due to the need of marketplace for IHM's product.

TABLE 3:
SUPPLIER REQUIREMENT FOR IHM PRODUCT PURCHASE

Characteristic	Low-Cost strategy	Response Strategy	Differentiation Strategy
1. Supplier's goal	Supply demand at lower cost	Respond quickly to changing requirement and demand to minimize stock outs	Jointly develop products and option
2. Primary selection criteria	Select primary for cost	Select primary for capacity, speed, and flexibility	Select primary for product development skills
Process characteristic	Maintain high average utilization	Invest in excess capacity and flexible process	Use modular process for preparation to mass customization
3. Lead-time characteristic	Shorten lead time	Invest aggressively to reduce production lead time	Invest aggressively to reduce development lead time
4. Product design characteristic	Minimize performance	Use designs that leads to low setup time	Use modular design to postpone product differentiation for as long as possible

C. Vendor Performance Issues (Early stage of BPR)

After vendor selection, IHM monitors vendor performance evaluation through vendor rating system and countermeasure on the problem. The focus of monitoring is based on quality, delivery and service by vendor. The procedure of vendor monitoring is to maintain the vendor performance continuously and avoid any problem that can affect the production. Vendor ranking can be identified by comparing the vendor performance every month. If vendors get ranking of C (see Table 4 for vendor ranking list) after three month in a row, the vendor should be terminated and IHM should start preparing the outsourcing to find new vendor to be replaced.

TABLE 4
VENDOR RANKING LIST

Categories	Point	Action	Remark
A	$75 \leq x \leq 100$	Self Audit	Yearly
B	$55 \leq x \leq 74$	Reminder Letter	3 month in a row
C	$x \leq 54$	Actual Audit	Immediately

Note: 1st Reminder : 3 month in a row
2nd Reminder : 2 month after 1st Reminder
3rd Reminder : 1 month after 2nd Reminder

i. Quality

Quality specification is important to run the production. The material from vendor must meet all IHM's specifications. For vendor performance, to achieve the best rating, a vendor must have NO warranty claims from the customer. Any rework history, line problems or warranty claims on the vendor product will decrease the rating accordingly. If the material have defect, IHM will return back to vendor and confirm for replacement.

ii. Service

Service by vendor should consist of communication, responsiveness to problems, and availability for field assistance. For example, rating should be a collaboration of all employees in a department who have contacts with vendors. This include such as activities as calls regarding incoming shipments and/or vendor services, availability for training, direct involvement in problem solving, etc. For example, if there are any quality or delivery problems, vendor must come over to communicate with IHM's to solve the problems. The conversation with buyer is also need to be as frequent as possible. This is to prevent any misunderstanding about the delivery and also prices towards vendor.

iii. Delivery

Based on vendor evaluation, delivery is the major issue in vendor performance. From 67 vendors for local part sections at IHM, there are a few vendors that have critical delivery problem which means late supply of parts to IHM for running the production. Problem vendor is based on the midyear and end of year period of supply.

D. Delivery Issue

For discussion, let vendor ABC as an example. In this case, vendor ABC is defined as category C supplier and listed in termination list due to delivery problems. The product of vendor ABC is chassis frame and other part related on it. Delivery issues are the most concerned by IHM because those problems will cause additional cost and product delay. IHM uses 5M methodology to analyse the problem which consists of manpower, method, material, machine and money. Then, IHM will provide some countermeasure when the analysis is completed.

The countermeasure is a reference. It is used as a guide for both vendor ABC and IHM to look for an alternative in solving problems as well as reducing problems that occurred among IHM's vendors. It will be prepared in proper document for next references. Vendors' performances are used for benchmarking while improving the vendors to align with IHM standards.

For vendor termination process, reminder letter is used to obtain the vendor's feedback on current problems on delivery based on delivery instruction (D.I). IHM acknowledges their supplier because for IHM, supplier is IHM's business partner and in other words, supplier is a part of IHM team. On the other hands, IHM will try to sustain and create good relationship between suppliers and the termination is the last action if the supplier is not able to supply good product and service on time that stated in D.I. If the vendor fails to improve their performance, IHM will proceed with the process of auditing for their feedback which helps to identify whether the supplier can stay or be eliminated from the vendor list.

There are many factors that contribute to problem for 'C' category. As can be seen in Fig.1, the pie chart shows that 86% of the problem is contributed by Vendor meanwhile only 14% of the problem is caused by IHM.

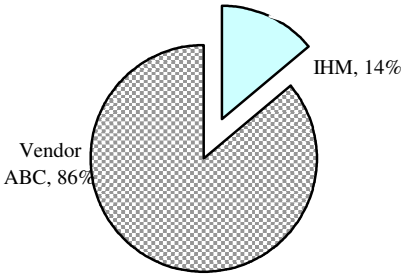

Fig. 1: Overall Contribution of Problem for 'C' category

Fig. 2 shows the fraction of popular problem causes by vendor. As can be seen in Fig. 2, half of total problem that contributed delivery issues in IHM is due to early delivery from vendor which required IHM to locate more inventories in warehouse. Besides, the vendor who does not have a proper plan had contributed at least 17% of delivery problem. On the other hands, late receive raw material, commissioning machine, not deliver in complete set, delay and transport problem become other minor problems for delivery issues for vendor.

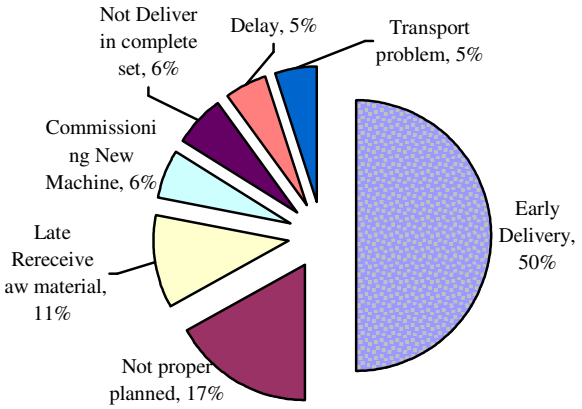

Fig.2 Contribution of Problem for 'C' Category From Vendor ABC

Fig. 3 shows the reasons for delivery issues that occurred in IHM. Mainly, there are three types of causes which influenced the bad result of delivery issues in IHM. Just below a third quarter of problem is due to late release purchase order followed by delivery instruction amendment and forecast and actual order. It is too different with 20% and 15% respectively.

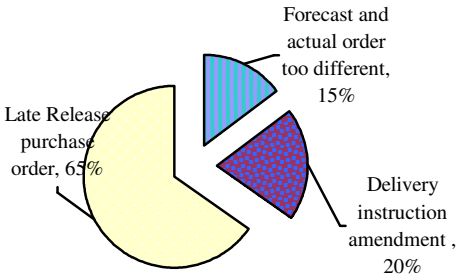

Fig.3 Contribution of Problem for 'C' Category from IHM

The following are the causes of problems that experienced by vendor and countermeasure action made by IHM for improvement.

i. Material

Material availability in market is one of the causes because a unique specification is required for assembly and price will increase based on market trend and demand. The material problem can cause delay of production. Imported material from overseas; lead time because late receives; MOQ (material order quantity) which is limited in one time of purchase. Unable to purchase raw material, internal problem by vendor such as relationship of vendor with supplier to buy raw material, and lastly repeat order from IHM.

Countermeasure action: The raw material is direct purchase by IHM in order to help vendor ABC sourcing problem. To schedule for longer lead time, material must available earlier and vendor must confirm the ordering status from IHM as soon as possible. For example, for 8 December delivery, vendor must order the material before 15th November which is about half of month earlier in the following month. Vendor must take an action to follow up the supplier for deliver before 15th November to production. Furthermore, if vendor ABC has problem with their machines, IHM will send the raw material to other related vendor for production while the vendor ABC solve their machinery problems.

ii. Method

Logistic, unable to manage flow of goods, service, cash and information, material handling, warehousing, inventory control and order fulfillment and distribution. Production planning, production scheduling, capacity planning, MRP, forecasting. Transport, limited transport to sent item to subcontractor company such as for stamping the part and limited transport to deliver to IHM.

Countermeasure action: Vendor ABC is required to do the forecast based on D.I request by IHM in order to prevent any late delivery. Other than that, they purchase new truck of Hicom Perkasa to easy supply their part. In case the vendor unable to supply parts due to logistic problem, IHM will provide trucks to go and take the part itself to prevent delay of production. IHM take an action by giving top management

training about the important of logistic and production planning management.

iii. Manpower

Shortage, shortage of manpower in welding operation and shortage of manpower in assembly. expertise, lack of expertise and experience to running and maintenance the machine for production and lack of expertise to implement new tools and techniques for production such as production planning and scheduling. Overtime, no worker desire to work overtime if any shortage of part complaint by IHM, no worker desire to overtime if there have additional order request by IHM and worker cannot work long hour (overtime) during fasting month.

Countermeasure action: IHM introduce contract manpower to vendor at premium cost. Therefore, two shift of working period can be done with no problem. The hiring of contract worker is considered as premium manufacturing cost by IHM. Vendor ABC might reward and gives incentive to worker who did overtime at least 3 hours per day. They also can provide training on new machine and introduce tools and techniques to run production process such as production planning and control, for example.

iv. Machine

Capacity, not enough capacity to do stamping process, only few 250 T machine available (stamping machine), 250 T machine available can't support the requirement and demand of IHM parts. Schedule, the production process not follow the schedule done by top management, inappropriate schedule orientation in line process, and machine loading schedule due to effected part to run on a single machine. die & jig inspection, less maintenance and inspection done to machine, frequently faced of machine shut down and oldest and need to be replace to new one.

Countermeasure action: IHM and vendor ABC decide 3 options for improvement which is transferring die to other vendor and discuss the drawing and process flow confirmation with other vendor. Second option is outsourcing to other three vendors that do same operation as vendor ABC or buy the 250 T machine. But if there is no manpower to run the machine, IHM will introduce contract manpower to vendor ABC. They need to replace the oldest machine to 200 T capacity machine (need additional man/hours) and do second shift operation for the new machine. These three options need to be decided for long term delivery improvement. IHM will send their manpower or technician to repair if the broken machine.

v. Money (financial)

Unable to buy material, can cause late receive of raw material purchase for production and cash tight to pay supplier purchase part & old outstanding for raw material. Unable to pay subcontractor, payment problem by vendor ABC to subcontractor for stamping the material until finished part.

Countermeasure action: IHM buy the raw material and supply to vendor ABC and at the same time IHM pays vendor ABC in advance. For example, the actual payment to vendor is 90 day per order but in order to help them, IHM will make an early payment that is about 80 days. Vendor ABC will have the opportunity to improve financial management. Vendor ABC can also request IHM to continue early payment until further notice to cover the outstanding raw material from supplier.

E. Outsourcing

Outsourcing means if there any vendor going to be eliminated, IHM will have an action to find new vendor to replace the existing problems vendor. For example, vendor ABC needs to be eliminated because there are a lot of problem such as delivery problem in supplying automotive part. All countermeasures done by IHM doesn't work anymore. Hence, localization program is one of procedure used in selecting a new proper vendor as a replacement for the existing vendor. IHM will determine the new vendor in two months time before eliminating vendor ABC.

PVD will decide the new vendor to supply those part based on vendor performance evaluation sheet. PVD program is one of the processes to help IHM to identify what kind of improvement can be developed in SCM. PVD consist three consideration items which is Localization program, Product Development and Vendor Monitoring. PVD team consists of qualified executive with technical knowledge from different department at IHM which is production planning and control, Procurement, and Production Engineering department.

If there are any suitable vendor for replacement, PVD will study the company background whether they have any delivery, quality and services problems with their customers. As a result, vendor ABC will be eliminated, and PVD team will appoint new vendor such as Vendor XYZ, for example. The process is complex and sometimes required a long time. PVD will try to identify multiple suppliers rather than single or sole supplier to avoid supplier constraints.

F. SCM Enhancement

After BPR, IHM become more confident to survive with new challenge with the purpose of spearheading the commercial vehicle manufacturing and assembling industry in Malaysia. There is a little change on management done in order to increase the productivity. To successfully implement a supply chain management, IHM is committed to redesign the existing business and production process. Streamlining and improving business and production process should be a crucial part of management's strategy for improving business performance.

i. E-Procurement

One must adopt new technologies and tools such as information technology to control the inventory and outsourcing. E-procurement is used to improve the SCM at IHM. E-procurement uses the internet to facilitate purchasing. E-procurement speeds purchasing, reduces costs, integrates the supply chain, and enhances an organization's competitive advantage. The traditional supply chain at IHM is full of paper transactions such as purchase order, request for bids, bid evaluations, purchase order, order release, receiving documents, invoices and the issuance of checks. E-

procurement reduces this barrage of paperwork. In truth, few vendors even come close to understanding the breadth of requirements that any procurement system must satisfy. Nevertheless, they were all scrambling to identify what parts of today's procurement processes are tractable and amenable to their specific internet capabilities.

ii. RFQs

When purchasing requirement are nonstandard, the time spent in preparing request for quotes (RFQs) and the related bid package can be substantial. Consequently, e-procurement has now moved these often expensive parts of the purchasing process online. For example, e-procurement provides purchasing personnel with an extensive database of vendor, delivery, and quality data. With this extensive history, vendor selection has improved. Electronic files containing engineering drawing are also available. These resources allow purchasing agents to attach electronics copies of necessary drawing to RFQs and inexpensively send the information required to vendor in matter of hour. Therefore, it can save time and lower the cost.

IV. CONCLUSION

In the nutshell, the authors conclude that business process re-engineering (BPR) has improved supply chain management at IHM. By introducing e-procurement, it is indirectly enhanced the supply chain information system as well as productivity and reducing supply errors. Problem on delivery and outsourcing which are the major problem in IHM were managed properly in short period with better production system. The authors also found that new business operation is encouraging the employee to do better job while adopting Japanese work culture in effort. Besides, by having the top management involvement in every single activity in IHM is one of the main reasons for the SCM success.

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