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Knowledge Management for Supply Chain Management in BPCL

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ABSTRACT
Supply chain management is a complex process involving many processes in oil industry. Managing these processes is a challenging task in itself. Our focus is on BPCL, its processes and stakeholders throughout India especially the customers and retailers. Our study will find whether Knowledge Management is helpful for BPCL for improving its processes, better decision making and formulating a short and long-term strategy for business.

General Terms
Software Engineering

Keywords
Knowledge Management (KM), Supply Chain Management (SCM).

1. INTRODUCTION
The layout of this paper is to study the various techniques related to Knowledge Management and use them to improve processes followed in the industry. For this we studied the use and relation of Knowledge Management in E-governance, Artificial Intelligence, SCM and Disaster Recovery. So our main focus is on the use of KM in SCM specifically in the Oil industry. Oil industry was chosen because it is complicated and involves various processes which can be improved by inculcating different techniques used in our research.

2. SUPPLY CHAIN MANAGEMENT (SCM)
Supply chain management (SCM) is defined by the Global Supply Chain Forum (GSCF) as "*the integration of key business processes from end users through original suppliers that provide products, services and information which add value to customers and other stakeholders*" [1]. As a result, SCM embraces various business processes and firms/companies which are of relevance to service customers: order fulfilment, customer service management and product development [2].

SC collaboration (in practice) usually starts with an uncomplicated scenario due to the low mutual trust between trading partners. Then this mutual trust may gradually increase and lead to a boost in confidence in a complicated and profound collaboration mechanism)[3]. It is also important to consider that collaboration in a SC may be present in many varying forms, but it generally has a common goal: to create a transparent and visible demand pattern that paces the entire supply chain [4]. Another fact established by Holweg et al. [4] is to achieve more transparent information in order to reduce uncertainty in the environment, which is another of the goals of the collaborative processes in the Supply Chain.

Two main aspects are commonly considered in the study of the collaboration relationship in the Supply Chain: the first deals with the intensity of the relationships between partners whose considerations vary from simple information sharing to risk and profits information sharing; the second studies the extent of the collaboration across the Supply Chain[5].

Drawbacks of the Supply chain are as follows:

- **Trust and collaboration:** Trust involves a process where a company estimates the costs and rewards of either cheating or keeping the trust.
- **Global issues:** Global issues such as political concerns, currency risk, governmental concerns, production quality and infrastructure issues.
- **Outsourcing:** It concerns basically with make- or- buy decisions.
- **Many-supplier strategy:** This tends to decrease risk and increase costs.
- **Vendor Selection:** From whom to buy goods and services. Includes vendor evaluation, vendor development and vendor negotiation.
- **Difficulty in Demand Forecasting:** Demand and supply mismatches can lead to short and long term loss in sales and market share, excess inventories or unavailability of products.
- **Cost of reverse logistics:** Reverse logistics is the process of taking back products or package materials to avoid wastage. It can be costly and can create difficulties when managing supply chain life cycle.

The solution for this problem would be to create an application that handles the Supply Chain. At one end we have Supply Chain and at the other end, we have Knowledge Database and Artificial Intelligence tools to handle the problems.

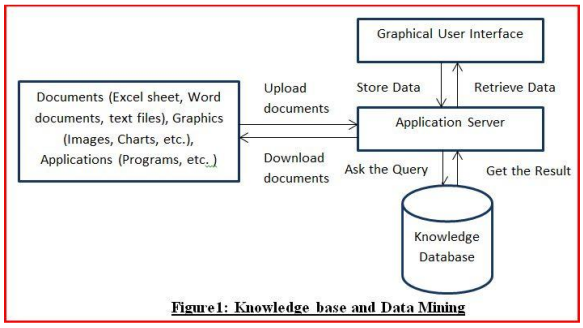

Figure1: Knowledge base and Data Mining

In the above diagram, the documents coming from various sources like "Excel sheets", "application programs", "word" or "pdf" documents, etc. are collected and stored into the Knowledge Database only after converting them into useful information.

This conversion is done by an expert who knows about the information collected. The application server consists of application programs which help the expert for converting these documents into some meaningful information. Another way of collecting information is to use a graphical user interface through which data can be put directly into the Knowledge Database, here, the expert will decide before storing the data in the Knowledge Database, which is the useful information and which is not useful information.

If an employee retires or leaves the organization, still his knowledge and experience (transcendental knowledge) is present in the Knowledge Database in the form of information. So if another employee replaces him, he will be able to continue from where the latter had left his work. Also the new employee will be able to grasp what the earlier employee had done in the organization just by referring to the Knowledge Base.

Similarly for a Supply Chain Management, we too can have a Knowledge Database which will store data related to the same domain together. For this to be implemented properly, we need to keep a demand-driven business model instead of a supply-driven business model which totally focusses on the requirements of the customers.[6]

3. KNOWLEDGE MANAGEMENT (KM)

Nonaka (1991) [7] establishes that *knowledge can be understood as the information flow among the resources within the company. Information flow can come about from the worker's experience or be a result of the physical document generation process (which, in our case, can also be understood as knowledge), where tacit knowledge may be most important because it is one of that is most unpredictably and uneasily expressed.* A validation technique to analyze the role of the intangible resources in individual firms. [8]

More often than not, these partners do not like to share their private information completely. Therefore when knowledge/information must be shared, it must be managed in such a way that it develops over a period of time [9]. So, it is necessary that managers should not only be skilled in technical and operational areas, but should also develop relationships that favor the trust required to encourage information exchange.

Collaborative architecture based on a multi-agent coordination mechanism. Then, the knowledge management process is assigned to agents who are able to retrieve information for specific applications from databases, made possible by considering mechanisms that use intelligent queries. Furthermore, these agents are also able to process the information by storing, transforming and transporting it.

Linking enterprise models, mainly those related to the enterprise environment in which the enterprise goals and strategies are considered to be the first step in the software development process, and which involve establishing a requirements elicitation, are presently becoming a very common research trend [10]

4. KM and SCM

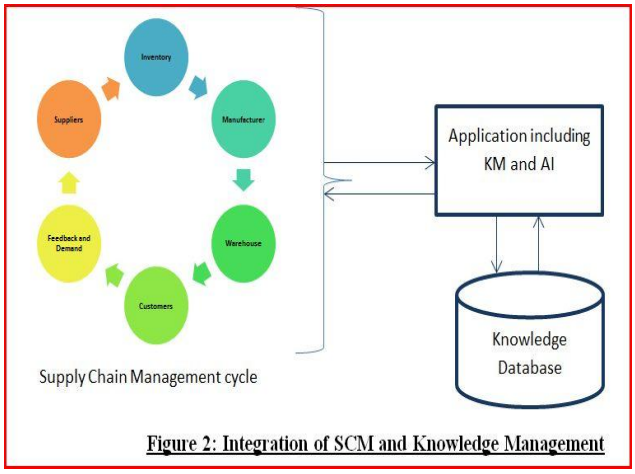

Figure 2: Integration of SCM and Knowledge Management

The Supply chain cycle will have information which is generated dynamically during various stages of the Supply chain. This information if tapped at the proper stage and time will help to remove drawbacks of the Supply chain cycle.

As far as the problem of forecasting the demand is concerned, we can predict the demand based on statistical analysis of data using Artificial Intelligence. We need to mine the data from the Knowledge Database and use it.

If we know the actual figures of demand and sales in the last one year, it becomes easy to predict the trend of the

market i.e. there is demand or no demand of the commodity in the market. The catch here is though, we have to consider all the internal and external factors while doing such a prediction as they directly or indirectly influence the market. The most important factors are Social, Legal, Economical, Political and Technological factors. If these factors are taken carefully into consideration, we can handle the global issues easily in the Supply chain cycle.

If the prediction of demand is done accurately, there will be no excess production or over production of commodities which in-turn will address the reverse logistics problem as well. Vendor selection problem can be solved by keeping a track of the vendors, their efficiency in providing the goods and services and also whether these goods and services are provided with good quality and in time. We can assess the vendors by accessing and statistically analyzing information from the Knowledge Database.

Similarly, when many suppliers are present in the market to buy the raw materials, we can once again assess them using the information of their performance present in the Knowledge Database and not only that, we can actually compare the suppliers at one go using this information so that we can make a decision on who should be given the highest priority and who should be given the lowest priority.

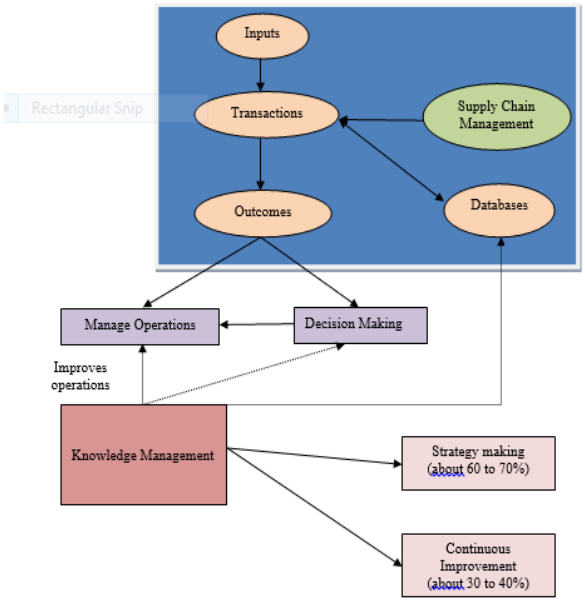

Figure 3: Integration of SCM with TPS

The above diagram shows the Supply Chain Management system integrated with a normal Transaction Processing system. (marked as blue rectangle). As per the normal TPS, there are certain inputs into the system which are processed by different transactions to produce a number of outcomes. In doing so, some data is stored in the databases or is retrieved from the databases to use in the transactions. (All marked orange oval shape).These outcomes are used for two distinct processes: 1.) To manage the operations and 2) To make decisions (marked violet rectangles).

Knowledge management helps to improve the operations as well as helps in decision making process. KM itself is divided into two major categories as far as managing operations and decision making is concerned. These are: a) Strategy making: which is about 60 to 70% of the processing and which directly affects the policies and processes of the organization. b) Continuous improvement: it is about 30 to 40% of the organizations work. It involves improving the processes, improving the quality of work, minimizing the wastage, optimizing the resources used and so on.

After understanding this, we focus on actually looking out for processes in the organization which can be redesigned or improved with the help of Knowledge Management. And if we use these processes into practice, what impact it will make on the decision making process and on strategy making and continuous improvement processes. Our research is to find out the impact factors that when changed or redesigned will help the organization in the overall SCM processes. SCM and databases are related to our study but our study does not focus on these only. It focuses on how KM when used will have an impact on the organization. We also studied the use of SCM in Oil sector (Bharat Petroleum) for which we did a personal interview for collecting answers for our questions.

So we would be comparing organizations especially from the Indian Oil sector specifically BPCL, which are using KM in their SCM decision making process. The output would result into a matrix comprising of what are the impact factors in the organization which are affected after using KM and how are they improving and helping the organization in decision making process.

5. RESULTS AND DISCUSSIONS

5.1 MATRIX:

Parameters ->	Application			Advantages		
Category	Tools	Inferences	Type of data	1	2	3
D- Board of Directors	Executive Information System, Expert System and Decision Support	Policy making and strategy making based on the reports generated	Knowledge	Policy making is based on real data and not on hunch	Long term planning can be done based on historic data. Knowledge is achieved here.	Future prediction can also be achieved using this system
C-General Managers	ERP, MIS and DSS	Managing the resources efficiently and generating reports	Information	Resources are utilized efficiently and planning for availability of resources is done accurately	Decisions are based on solid data. Information can be achieved	Report generation helps in identifying errors and helps for future reference if required
B-Supervisors	ERP, Management Information System & OLAP	Monitoring over resources, acquiring resources	Semi-information	Acquiring resources becomes easier and are delivered as and when required	Data is not in the crudest form it is filtered into something which makes sense but it cannot be called complete information	Real time data can be used for short-term planning and trend analysis
A-Operators	ERP, Transaction processing system like OLAP and Finance ERP	Data entry and using the resources	Data	Less complications in using the resources and are available always	Data is present in the crudest form hence it doesn't provide any information here	Used for day to day analysis and record keeping
Customers	Web portal and e-CRM	Feedback and payments	Data	Convenient to use, available 24x	Faster and efficient system	Feedback can be recorded which can be used for CRM
Suppliers	SCM ERP	Sales of raw materials	Semi-information	Keeps a track of resources required	Can be used for estimating the requirement of raw materials based on demand and supply in	Payments are made online and a track of payments is made using ERP
Retailers	Inventory Management ERP	Estimating requirements depending on demand and supply cycles	Information	Keeps the most demanded products in the inventory stock and removes/replaces out those products which are less in demand	Can be used for estimating the requirement of finishes products based on demand and supply in the market	Customers are provided the products without having an empty inventory at any point of time

Software management	Ethics	Quality of service/product	Customer feedback	Customization of products	Time factor	KM
EIS and Expert System are used for long term decision making	Code of conduct, ethical values and guidelines are set by BOD	ISO and other applicable standards are followed by the company to provide quality of service	All the decisions taken by general managers are reported to the BOD. Long term decisions although are taken exclusively by BOD	If customization of products is going to affect the long term poilices of the company then the decision on it is taken by BOD	About a year to about 5 years	KM can be helpful to make long term decisions
DSS is used for short term decision making	General code of conduct and ethics are followed as per the guidelines given by the individual company	ISO and other applicable standards are followed by the company to provide quality of service	General managers decideand take action depending on whether the feedback is positive or negative	If customization of products is giving large profits over a short period of time then the decision to customize it is taken by the General managers	About a month to a quarter of a year	KM can help to make short term decisions
MIS is used for generating reports, inventory management software is used to manage the inventory levels	General code of conduct and ethics are followed as per the guidelines given by the individual company	Checking and testing the product before it is sent into the market, ensures quality of products	Supervisors report the feedback to the general managers	Understandin the requirements and expectations of the customer and finding out that whether it is possible to practically produce the product is done by the	One week to two weeks	KM can help to manage the inventory levels at retailers and will be able to provide raw materials in time
TPS is used for day to day record keeping	General code of conduct and ethics are followed as per the guidelines given by the individual company	Providing the products and services on time to the customer, as and when required, ensures customer satisfaction and quality of service and products.	Customer feedback is actually faced by the operators whether it is positive or negative	Gathering requirements of customers and their expectations is done by operators	One day to one week of data	KM will help to manage the day to day transactions helping to provide customer service and building strong partnership
Customers are satisfied with the software/web portal provided, but they want improvement in the software.	There are hardly any cases observed regarding unethical practices followed by the companies.	QOS is satisfactory and most of the products/services required by the customer are provided in time with best quality	Customer problems are noticed and solutions are provided to their problems in time.	A range of products are provided to the customers depending on their requirements.	Customers time is considered of great importance. QOS and problem solving is done in time.	KM is useful to provide feedback about products and services to the higher authorities. New product requirements can also be taken into consideration from customers.
ERP looks after the demand and supply gap and often provides information for decision making.	Suppliers need to be loyal to their manufacturers, this can only be achieved through trust and collaboration over a long period of time.	Providing raw materials of highest quality is a major concern	Customer feedback is helpful in designing and developing new products, hence useful for providing the raw materials for maufacturing	Customization of products can be done after considering the requirements of the customers.	Bringing the newly developed product in the market on time is a major concern. Acquring and providing raw materials on time is a major issue.	KM can provide the help required for planning ahead on acquiring the raw materials and providing them on time due to its demand forecasting feature. Also KM can be helpful for choosing the correct suppliers out of many present.
Present software can perform all the basic operations required to be performed daily. Sufficient analysis and reporting tools are provided. There is a	The oil companies follow the ethical practices in their day to day working culture.	Products and services are easily provided to the customers using present software system	Responses and feedback are collected from the customers	Retailers role in customization is just to provide the requirements of the customer to the manufacturers	Products and services should be made available to the customer as and when required	KM is not used for collecting information or training new employees when they join

Table 1: Matrix showing different levels of interaction and use of data, information, knowledge, etc.

4.2 Hypothesis Testing

Step 1: Stating the Hypothesis

Null Hypothesis (H0): Customers and retailers strongly agree or agree that present software needs modification to improve decision making process and other processes. (Knowledge Management is helpful for decision making at Bharat Petroleum Corporation Limited.)

Alternate Hypothesis (H1): Customers and retailers strongly disagree or disagree that present software needs modification to improve decision making process and other processes. (Knowledge Management is not helpful for decision making at Bharat Petroleum Corporation Limited.)

Step 2: Assumptions

We hereby assume that the samples gathered for customer data were uncorrelated and random.

Step 3: Assume Significance level (α) = 5%

Step 4: For testing customers' data, we will use z-test (Sample of 105).

Calculate $Z_{cal.}$ Compare the values with the table values.

Step 5: Accept the null hypothesis or reject it.

Mean (X)	4.225806452	4.161290323	4.290322581	4.096774194	3.677419355	3.516129032	4.290322581	4.225806452	4.129032258
Std. Deviation (sigma)	0.762000762	0.96942506	0.642575463	0.87005129	1.275071156	1.060533443	0.937853876	0.844972482	0.884757424
z-test	1.6505	0.9259	2.5177	0.619	-1.408	-2.541	1.7238	1.4884	0.8123
p=5%	Reject	Accept	Reject	Accept	Reject	Reject	Reject	Reject	Accept
ation std. deviatior	0.74960968	0.953661	0.632126385	0.855903172	1.254336909	1.043287847	0.922603203	0.831232176	0.870370165
Correlation	0.400294937 (Q1&Q2)	0.296897895 (Q2&Q3)	-0.051929223 (Q3&Q4)	0.239405833 (Q4&Q5)	0.447678932 (Q5&Q6)	-0.189188858 (Q6&Q7)	-0.001356873 (Q7&Q8)	0.138077051 (Q8&Q9)	0.1531118 (Q1&Q9)
	0.338188028 (Q1&Q3)	0.167052898 (Q1&Q4)	0.043161033 (Q1&Q5)	0.428443097 (Q1&Q6)	-0.141434162 (Q1&Q7)	0.384102308 (Q1&Q8)	0.573681002 (Q2&Q4)	0.070461747 (Q2&Q5)	0.143284433 (Q2&Q6)
	0.386736698 (Q2&Q7)	0.401681352 (Q2&Q8)	0.480150481 (Q2&Q9)	-0.00393713 (Q3&Q5)		0.017356463 (Q3&Q6)	0.40859516 (Q3&Q7)	0.059411648 (Q3&Q8)	0.049174737 (Q3&Q9)
		0.341440826 (Q4&Q6)	0.372926679 (Q4&Q7)	0.105308185 (Q4&Q8)	0.676072611 (Q4&Q9)		0.192424881 (Q5&Q7)	0.131738889 (Q5&Q8)	0.392695234 (Q5&Q9)
		0.088793636 (Q6&Q8)	0.388479554 (Q6&Q9)	0.23455043 (Q7&Q9)					

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
The present system is sufficient to perform all the tasks that are required to perform on a day to day basis (i.e. we get all the data necessary to perform the tasks easily)	The present system provides sufficient analysis and reporting tools	The products and services are easily provided to the customers using the present system	Gathering responses and feedback from the customer is easily done using the present	The present system is complicated to use	When an employee leaves the organization, does the system provide data about the	There is a scope for improvement in the present system	All the features of the present system are used efficiently	Training a new employee is easy in the present system

Table 2: Statistics obtained after processing the retailers questionnaire

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Mean (X)								
Std. Deviation (Sigma)	BPCL is a well-managed company (all the systems are well managed, people are well trained and problems are handled	BPCL follows ethics as a business standard (people are not cheated or asked for bribe)	BPCL Oil products and services are of high quality	BPCL products and services are available everywhere in the country	Customer concerns are held in high regard in BPCL	It takes lesser time to get a products/services when I go to BPCL store	BPCL provides products/ services according to our requirements	BPCL solves our problems in quick time
Population std. deviation (Mu)								
z-test								
Correlation								

Table 3: Statistics obtained after processing the customers questionnaire

6. CONCLUSION

6.1 HYPOTHESIS TESTING

From Table 2 we can say that BPCL provides sufficient analysis and reporting tools to its retailers, hence the hypothesis is proven to be accepted. Gathering responses and feedback from customers is easily done by the retailers, hence the hypothesis is proven to be accepted. Training a new employee in the system is easily done by the retailers, hence the hypothesis proven to be accepted.

From Table 3 BPCL solves customers problems in short span of time is the hypothesis which is proven to be accepted.

6.2 CORRELATION

From Table 2 we conclude that analysis and reporting tools are strongly positively correlated to gathering responses and feedback from the customers. Also gathering responses and feedback from the customers is strongly positively correlated to training a new employee in the system. There is negative correlation between all that is required to be provided by the system and using all the features present in the system.

From Table 3 we can conclude that there is a strongly positive correlation between training, managing BPCL and ethical practices followed in BPCL. Also there is a strongly positive correlation between the products required by the customer and providing solution to the problems of the customers.

7. ACKNOWLEDGMENTS

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