Knowledge Management for Downstream Supply Chain Management in Indian Public Sector Oil Companies

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Abstract- The Indian Oil Industry is majorly dependent on imports from outside India. Although the major oil producers in India are government public sector organizations like Bharat Petroleum, Hindustan Petroleum and Indian Oil Corporation, it is being argued that the usage of technology, especially software and related hardware for its daily usage is limited to a certain extent. Knowledge Management can help to improve the Supply Chain Management by improving its critical processes through tools, procedures and practices.

Keywords – Knowledge Management, Supply Chain Management, Downstream, Public Sector Oil companies

I. INTRODUCTION

The public sector oil industry was chosen because the processes followed, tools used and practices followed particularly in this industry are complicated. Also there are certain levels of functions followed in this industry like lower level customers, middle level retail and depot managers, as well as higher level general managers.

As far as the Indian economy is concerned, India exports about 70% of its oil from other countries and the Gross Domestic Product of India is also affected by the variations in the oil prices to a large extent. Downstream supply chain management has a greater impact on the overall profitability of the company compared to upstream supply chain management which has certain limitations. Downstream supply chain management has most of its processes and practices carried out outside the company (external to the company) e.g. Transportation, Customer service, etc.

For the western region of survey, Mumbai city was the best choice. Mumbai has a greater impact on the consumer and industrial usage of oil as a resource. Also, Mumbai region has a dense population, having representation from almost all parts of India. Also the major corporate office of the Indian public sector oil companies like BPCL, HPCL and IOCL are located in and around Mumbai.

II. RESEARCH MOTIVATION AND OBJECTIVES

2.1 Motivation of the research:

The oil industry was chosen in the research because it has a complicated Supply Chain Management process where decision making in short term (like operational and transaction processing) and long term (like strategic level planning) is difficult and complex. The focus of research is on looking out for processes in the organization which can be redesigned or improved with the help of Knowledge Management.

2.2 Objective of the research:

The objective of the research is to look at the impact of Knowledge Management on operational and strategic planning for various stakeholders in Indian oil sector companies.

2.2.1 Following are the research objectives identified:

i. To understand the use of Knowledge Management in downstream Supply Chain Management in oil sector around the world.
ii. To identify the critical issues in collaborative decision making at strategic, middle and operations level.
iii. To investigate those issues that are present (or not) and to what extent in the oil companies in India.

iv. To ascertain the level of Knowledge Management implementation in downstream Supply Chain Management in Indian oil companies.
v. To ascertain the parameters of KM implementation in downstream SCM in Indian oil companies.

III. IDENTIFICATION OF ISSUES, PARAMETERS AND PROBLEM DEFINITION

3.1 Identification of Issues and Parameters: [8][9]

Issue No.	Issues	Parameters	Measures
S1	Information sharing and lead time reduction	1.) Order placed, 2.) Consignment delivered	1.) TCWM (Time placed -Time received) 2.) Tcd (Time to dispatch-Time required to deliver) A.) Order placement speed: TOPR = Time Order Received at Depot-Time Order placed B.) Order placement frequency(product wise): No. of orders placed per week per product C.) Order compliance speed: TORP=Time consignment received- Time order placed TORPA=Time consignment received- Time order placed automatically (ERP) D.) Weekly non-compliance / short compliance information: 1.) NCW= Non-compliance warning (No. of days before due date) 2.) SCW= Short-compliance warning (No. of days before due date)
S2	Strategic planning: 1.) Long term, 2.) Medium term and 3.) Short term		**I. Long term: (KM level)** A. Business and Operating plan i.)Two years, ii.) One year B. Demand forecast: (Product, capacity, specific requirements, new categories, advancements) i.)Two years, ii.) One year C. Planning meetings (Frequency) D. Review meetings (Frequency) E. Exception Reporting: (Frequency) **II. Medium term (6 month)** A. Demand forecast: (Product, capacity, specific requirements, new categories, advancements) B. Planning meetings (Frequency) C. Review meetings (Frequency) D. Exception Reporting: (Frequency) **III. Short term: (3 months)** A. Operating status meetings (Frequency) B. Exception Handling (Frequency –product wise)
S3	Career Management	Training schedule	1. Annual training calendar Level wise and skill wise 2. Training support and skills up gradation material (Online, frequency of updates) 3. Feedback frequency and solution support (Planned and need based) 4. Reward and recognition to outstanding performers 5. Warning and punishments to defaulters
S4	Building trust	1. Knowledge shared 2.Support in distress	Knowledge shared is Low, Medium or High
S5	Time to market, Speed , response time, reliability, security	1.) Time to market (TM), 2.) Response time for a service (TR), 3.)Information Availability (IA)	1.) TM= Time taken for the product to reach from depot to retail, 2.)TR= No. of minutes taken to receive the service from the retailer by the customer, 3.)IA= (MTBF+MTTR) / Total time taken
S6	Information overload	Amount of Information shared	Information shared is Low, Medium or High
C1	Lateral co-ordination	1.) Use ERP	Use of ERP to address lateral co-ordination issue is Low, Medium or High
E1	Transfer of best practices	Knowledge shared	Knowledge shared is Low, Medium or High
E2	Capturing	Knowledge captured	Knowledge captured is Low, Medium or High

	expertise		
E3	Train field representatives	Training modules	1. Annual training calendar Level wise and skill wise 2. Training support and skills up gradation material (Online, frequency of updates) 3. Quality of the trainers (H, M,L)
E4	Improve customer service and service quality	1.) Waiting time for service (TQ), 2.)Days taken to resolve a problem (Np)	1.) TQ=No. of minutes waiting in the queue for service 2.)Np= No. of days taken to resolve the problem faced by customer
E5	Minimize paper work and looking through thick manuals	Use of electronic medium for recording and using manuals	Electronic medium is used Not significantly, Significantly, Very Significantly
B1	KM on daily basis	Use of KM	Use of KM is Low, Medium or High
B2	Sharing experiences	Sharing of experience in working	Experience sharing is Low, Medium or High
B3	Knowledge value	Use of KM	Use of KM is Low, Medium or High
BP1	Transportation Cost	1.) Order placed, 2.) Consignment delivered	1.) TCWM (Time placed -Time received) 2.) Tcd (Time to dispatch-Time required to deliver)
BP2	Customer service	1.) Waiting time for service (TQ), 2.)Days taken to resolve a problem (Np)	1.) TQ=No. of minutes waiting in the queue for service 2.)Np= No. of days taken to resolve the problem faced by customer
BP3	Outsourcing	1.) Outsourcing factor (OF), 2.) Efficiency Improvement factor (EIF), 3.) Cost Improvement factor (CIF)	1.) Outsourcing factor (OF) = Total no. of tasks outsourced/ Total no. of tasks, 2.) Efficiency Improvement Factor (EIF) = No. of people used (earlier) / No. of people used (after outsourcing), 3.) Cost Improvement Factor (CIF)= (Total cost of all tasks-Cost of outsourced tasks + Cost of inhouse tasks)/Total cost of tasks
BP4	Many supplier issue	Credit Factor (CF)	Credit factor (CF) = Total amount of credit offered / Total no.of days the credit is offered
BP5	Vendor Selection	No. of years of partnership with a vendor (Ny)	No. of years of partnership with a vendor (Ny)
BP6	Cost of Reverse Logistics	1.) Reverse Logistics Cost (CRL), 2.) Idle Stock Percentage	1.) CRL = Price of each product x No. of goods returned, 2.) Idle stock percentage = (Total Stock acquired - Total stock used)/ Total stock
I1	Time taken-Transportation time	1.) Use GPS tracking devices	Use of GPS is either Low, Medium or High
I2	Demand Forecasting	1.) Monthly Product wise quantity (MPQn), 2.) Weekly Product wise quantity (WPQn)	Use is either Low, Medium or High
I3	Depot to Retail transport	1.) Use GPS tracking devices	Use is either Low, Medium or High
I4	Idle Stock	1.) Idle Stock Percentage,	Idle stock percentage = (Total Stock acquired - Total stock used)/ Total stock
I5	Global Issues	1.) Use ERP	Use of ERP to address Global issues is Low, Medium or High
H1	Inventory	1.) Idle Stock	Idle stock percentage = (Total Stock acquired - Total stock used)/ Total stock

	Holding	Percentage,	
H2	Sharing of products	1.) Reverse Logistics Cost (CRL), 2.) Idle Stock Percentage	1.) CRL = Price of each product x No. of goods returned, 2.) Idle stock percentage = (Total Stock acquired - Total stock used)/ Total stock
H3	Dynamic Pricing	1.) Use Dynamic pricing software	Use is either Low, Medium or High
H4	Trust and collaboration	1.) Use ERP	Use of ERP to address Trust and Collaboration issues is Low, Medium or High

Legends used: S: Shell, E: Exxon, BP: British Petroleum, I: Indian Oil, H: Hindustan Petroleum, C: Chevron, B: Bharat Petroleum

3.2 Problem Definition:

The Literature Survey and initial sample survey has led to the identification of the following problems:

i. The public sector oil companies in India use E-Supply Chain Management but the common issues in E-supply chain management remain unsolved.
ii. The international oil companies use Knowledge Management extensively at all three levels: operations management, middle management and strategic management. As a result of this, some of the common problems faced by E-Supply Chain Management of oil companies in India and outside India are resolved using Knowledge Management.

The research carried out will focus on whether the Indian oil companies use Knowledge Management in the downstream operations of E-supply chain management. If yes, then what impact will Knowledge Management have on the downstream operations of E-supply chain management and at which levels of the management will Knowledge Management be used.

3.3 Literature Survey Outcome:

S No	Issue No.	Issue	S No	Issue No.	Issue
International Experiences					
		Operational			**Strategic / Practice**
FO1	S1	Information sharing	FS1	S2	Strategic Planning
FO2	S4	Building Trust	FS2	S3	Career management
FO3	S5	Time to market, Speed , response time, reliability, security	FS3	S6	Information overload
FO4	C1	Lateral co-ordination	FS4	E1	Transfer of best practices
FO5	BP1	Transportation Cost	FS5	E2	Capturing expertise
FO6	BP2	Customer Service	FS6	E3	Train field representatives
FO7	BP6	Cost of reverse logistics	FS7	BP3	Outsourcing
FO8	E5	Minimize paper work	FS8	BP4	Many supplier issue
			FS9	BP5	Vendor selection
Indian Experiences					
		Operational			**Strategic / Practice**
IO1	I1	Time taken-transportation time	IS1	I2	Demand forecasting
IO2	I3	Depot to retail transport	IS2	I5	Global issues
IO3	I4	Idle stock	IS3	H3	Dynamic pricing
IO4	H1	Inventory holding	IS4	B1	KM on daily basis
IO5	H2	Sharing of products	IS5	B2	Sharing experiences
IO6	H4	Trust and collaboration	IS6	B3	Knowledge value

Summary: Total International = 17, Total Indian = 12, TOTAL= 29

IV. Experiment and Result

4.1 Literature Survey:

The Literature Survey about E-SCM and KM helped us to get the facts, issues and parameters related to E-SCM and KM.

4.1.1 Issues and Parameters:

About 50 Issues and related parameters were identified as a result of the literature survey. The issues and parameters are used as input for the formation of the questionnaire.

4.1.2 Initial Survey:

Pilot Study was carried out over a small sample of customers, retailers, depot managers and general managers. The results were tested with reliability test like Cronbach's alpha test. There were some issues found in the questions while administering the survey. Adjustments like change in the language of the questionnaire, change in the scale of the questionnaire were carried out.

4.1.3 Pilot Survey Outcome:

S No	Issue No.	Issue	Parameters (Measure)	Dep	Ret	Cust
International Experiences from Literature survey relevant as per survey						
FO1	S1	Information sharing	Level of sharing of information (LV=1, HV=5)	Y	Y	Y
FO8	E5	Minimize paper work	Level of usage of ERP (LV=1, HV=5)	Y	Y	
FO8	E5	Minimize paper work	Use of electronic medium to record (LV=1, HV=5)	Y	Y	
FO7	BP6	Cost of reverse logistics	Goods returned(LV=1, HV=5)	Y	Y	
FS6	E3	Train field representatives	Quality of trainers (LV=1, HV=5)	Y	Y	
Indian Experiences from Literature survey relevant to India						
IS1	I2	Demand variability	Effect of demand variability on sales of goods (LV=1, HV=5)	Y	Y	Y
IO1	I1	GPS	Use of GPS (LV=1, HV=5)	Y	Y	Y
IO3	I4	Stocking of goods	Idle stock percentage (LV=1, HV=5)	Y	Y	
Additional Issues as per Pilot Survey relevant to India						
PSO1	PS1	Availability of Goods	Rate the availability of goods in the stock (LV=1, HV=5)	Y	Y	Y
PSO2	PS2	Customer Service	Frequency with which goods are provided to the customer (LV=1, HV=5)		Y	Y
PSO3	PS3	Co-ordination between retailers and customers	Level of co-ordination between retailers and customers (LV=1, HV=5)		Y	Y
PSO4	PS4	Co-ordination between retailers and depot managers	Level of co-ordination between retailers and depot managers (LV=1, HV=5)	Y	Y	
PSO5	PS5	Demand Forecasting	Frequency of Goods ordered per week (LV=1, HV=5)	Y	Y	Y
PSO6	PS6	Smartphone applications	Frequency for the use of smartphone applications (LV=1, HV=5)		Y	Y
PSO7	PS7	Handheld devices	Frequency for the use of handheld devices (LV=1, HV=5)	Y	Y	
PSS1	PS8	Web portals	Frequency for the use of web portals (LV=1, HV=5)		Y	Y
PSO8	PS9	Customer service	Frequency for the customer complaints resolved (LV=1, HV=5)		Y	Y
PSO9	PS10	RFID	Use of RFID (LV=1, HV=5)	Y	Y	
PSO10	PS11	Wireless sensors	Use of electronic wireless sensors (LV=1, HV=5)	Y	Y	
PSS2	PS12	On-time delivery	Speed of order fulfillment (LV=1, HV=5)	Y	Y	Y

Legend: P=Parameter, m =measure, vl = lower value, vh = higher value (m,v where applicable)

4.1.4 Pilot Survey – Summary

Issue category	Total Issues	Total Parameters	Depot Mgrs	Retail Mgrs	Customers
Operational	16	16	12	15	8
Strategic	3	3	3	4	3
TOTAL	19	19	15	19	11

4.1.5 Questionnaire Survey I:

4.1.5.1 Formed out of interview:

Interviews were carried out at various levels like general managers, retailers, depot managers and customers. The findings of the interview are placed in the annexure placed at the end.

4.1.5.2 Formation of questionnaire:

Questionnaire formation was based on the interviews taken of the experts and the literature survey done.

4.2 Validation of Questionnaire:

Validation of Questionnaire was done using Cronbach's factor for checking the consistency of data collected. Following were the results observed:

Title of the questionnaire	Cronbach's factor	Consistency of data
Questionnaire for Customers	0.779	Good
Questionnaire for Retailers	0.812	Good
Questionnaire for Depot Managers	0.71	Acceptable
Questionnaire for General Managers	0.74	Acceptable

4.3 Questionnaire Survey II:

For testing the Hypothesis stated earlier, after performing validation process (qualitative and quantitative) we use Questionnaire 1, 2, 3,4,5 and 6 stated in Annexure B to get the results.

4.4 Hypothesis:

Stating the Hypothesis

- Null Hypothesis (H0): *"The use of Knowledge Management in operationalizing collaborative decision making in the downstream Supply Chain Management of oil companies in western region of Indian operations in respect of critical factors is low"*
- Alternate Hypothesis (H1): *"The use of Knowledge Management in operationalizing collaborative decision making in the downstream Supply Chain Management of oil companies in western region of Indian operations in respect of critical factors is adequate."*

4.5 Survey I Outcome:

Following is the table of issues and facts that will help us to identify the critical issues in SCM from an Indian perspective:

Sno	Issue	GMs		Depot Managers		Retailers		Customers		Correlation
		Criticality	Parameter Value	Criticality	Parameter Value	Criticality	Parameter Value	Criticality	Parameter Value	
FO7	Goods Returned			H	1 good per day	H	1 good per day	H	1 good per day	0.85
FO8	Level of Usage of ERP			H	Level: Low to Very Low	H	Level: Low to Very Low	H		0.87
FO1	Level of sharing of information	H	Level: Low to Very Low	H	Level: Low to Very Low	H	Level: Low to Very Low	H	Level: Low to Very Low	0.90
FO8	Use of electronic medium to record	H	Level: Low to Very Low	H	Level: Low to Very Low	H	Level: Low to Very Low	H	Level: Low to Very Low	0.93
IS1	Effect of Demand variability on sales of goods	H	Level: Low to Very Low	H	Level: Low to Very Low	H	Level: Low to Very Low			0.87

IO3	Stocking of goods			H	Level: High to Very High	H	Level: High to Very High			0.82
PSO1	Availability of Goods			H	Level: High to Very High	H	Level: High to Very High	H	Level: High to Very High	0.87
PSO5	Frequency with which goods are provided to the customer			H	Level: High to Very High	H	Level: High to Very High	H	Level: High to Very High	0.89
PSO3	Level of co-ordination between retailers and customers					H	Level: Low to Very Low	H	Level: Low to Very Low	0.8
PSO4	Level of Co-ordination between retailers and depot managers			H	Level: Low to Very Low	H	Level: Low to Very Low			0.83
PSS1	Frequency for the use of web portals	H	Level: High to Very High	H	Level: High to Very High	H	Level: High to Very High	H	Level: High to Very High	0.91
PSO8	Frequency for the customer complaints resolved	H	Level: High to Very High			L	Level: Low to Very Low	L	Level: Low to Very Low	0.85
PSO9	Use of RFID	H	Level: High to Very High	H	Level: High to Very High	H	Level: High to Very High			0.83
PSO10	Use of Electronic wireless sensors	H	Level: High to Very High	H	Level: High to Very High	H	Level: High to Very High			0.82
PSO2	Speed of order fulfillment	H	Level: High to Very High	H	Level: High to Very High	H	Level: High to Very High			0.85
FS6	Quality of trainers	H	Level: High to Very High	H	Level: Low to Very Low	H	Level: Low to Very Low			0.77
PSO5	Frequency of goods ordered per week			M	Level: Low to Very Low	M	Level: Low to Very Low	M	Level: Low to Very Low	0.75
PSO6	Frequency for the use of smart phone applications	H	Level: High to Very High	M	Level: High to Very High	H	Level: High to Very High	M	Level: High to Very High	0.78
PSO7	Frequency for the use of handheld devices	H	Level: High to Very High	M	Level: High to Very High	M	Level: High to Very High	H	Level: High to Very High	0.67
IO1	Use of GPS			M	Level: Low to Very Low	M	Level: Low to Very Low			0.53

4.6 Survey II Impact of KM on categorized issues and implementation levels:

Sno	Issue / Parameter	Impact of KM on SCM					Implementation Levels			
		VH	H	M	L	VL	Tool	Proc	Practice	Overall *
FO7	Goods returned	26	40	5	24	5	N	Y	N	L
PS01	Availability of Goods	8	84	4	2	2	N	Y	N	L
PS02	Frequency with which the goods are provided to the customer	10	82	4	3	1	N	N	N	VL
PS03	Co-ordination between customers and retailers	14	64	4	12	6	Y	N	N	L
FO1	Sharing information	24	65	7	2	2	Y	Y	N	M
FO8	Use of electronic medium to record	15	62	15	5	3	Y	N	N	L
PS07	Frequency for the use of handheld systems	14	65	18	1	2	Y	Y	N	M
PS08	Frequency of the customer complaints resolved	4	78	14	2	2	Y	N	N	L
FS6	Quality of trainers	17	68	10	4	1	N	Y	Y	H
PS09	Use of RFID	1	76	18	4	1	Y	Y	N	M
IS1	Effect of Demand variability on sales of goods	14	67	16	2	1	Y	N	N	L
IO1	Use of GPS	2	81	11	4	2	Y	Y	N	M
PSO10	Use of electronic wireless sensors	1	93	3	2	1	Y	Y	N	M
IO3	Stocking of goods is costly	22	61	10	5	2	N	Y	N	L
PSS2	Speed of order fulfillment	11	71	11	5	2	N	N	N	VL
FO8	Use of ERP	1	59	7	30	3	Y	Y	Y	VH
PS04	Co-ordination between retailers and depot managers	24	61	7	7	0	N	Y	N	L
PS06	Frequency for the use of smartphones	32	51	3	4	10	Y	N	N	L
PSS1	Frequency for the use of web portals	1	67	25	4	2	N	Y	N	L

4.6.1 Overall Implementation level:

Tool	Procedure	Practice	Overall *
30 %	30 %	40 %	100%
Y	Y	Y	VH
Y	N	Y	H
N	Y	Y	H
Y	Y	N	M
Y	N	N	L
N	Y	N	L
N	N	N	VL

V. CONCLUSION

5.1 Conclusion from KM impact study:

Table 5.1 (a) Summary of Results & outcome

Sno	Issue / Parameter (Category wise) Critical, Essential, Very Important, Important	Impact of KM on SCM(Average)	Implementation Levels (Average)	State of Impact / Implementation (type)
FO7	Goods returned	VH to H	L	Inadequate
PS01	Availability of Goods	VH to H	L	Inadequate
PS02	Frequency with which the goods are provided to the customer	VH to H	VL	Inadequate
PS03	Co-ordination between customers and retailers	VH to H	L	Inadequate
FO1	Sharing information	VH to H	M	Inadequate
FO8	Use of electronic medium to record	VH to H	L	Inadequate
PS07	Frequency for the use of handheld systems	VH to H	M	Inadequate
PS08	Frequency of the customer complaints resolved	VH to H	L	Inadequate
FS6	Quality of trainers	VH to H	H	Inadequate
PS09	Use of RFID	VH to H	M	Inadequate
IS1	Effect of Demand variability on sales of goods	VH to H	L	Inadequate
IO1	Use of GPS	VH to H	M	Inadequate
PSO10	Use of electronic wireless sensors	VH to H	M	Inadequate
IO3	Stocking of goods is costly	VH to H	L	Inadequate
PSS2	Speed of order fulfillment	VH to H	VL	Inadequate
FO8	Use of ERP	VH to H	VH	Adequate
PS04	Co-ordination between retailers and depot managers	VH to H	L	Inadequate
PS06	Frequency for the use of smartphones	VH to H	L	Inadequate
PSS1	Frequency for the use of web portals	VH to H	L	Inadequate

Table 5.1 (b) Impact Implementation State Types:

Impact	Procedure	Type
VH, H	VH, H	Adequate
M	VH, H, M	Adequate
VH	M, L, VL	Inadequate
H	L, VL	Inadequate
M	VL	Inadequate
All other Combinations		Average

Table 5.2: State of implementation KM in SCM in Downstream Side of Oil PSUs in Mumbai Region:

Sno	Issue Category	Total No	Adequate	Inadequate	Average (Satisfactory)
1	Critical	TC=15	CA=0	CI=15	CS=7.5
2	Essential	TE=2	EA=1	EI=1	ES=1
3	Very Important	TV=2	VA=0	VI=2	VS=1
4	Important	TI=0	IA=0	II=0	IS=0
	TOTAL	TT=19			

5.1.1 Overall Impact – Implementation:

Adequate Percentage = {(CA * 4) + (EA * 3) + (VA * 2) + (IA)} / (TT * 10) * 100 = 1.579%

Inadequate Percentage = {(CI * 4) + (EI * 3) + (VI* 2) + (II)} / (TT * 10) * 100 = 63.02%

Satisfactory Percentage = {(CS * 4) + (ES * 3) + (VS * 2) + (IS)} / (TT * 10) * 100 = 18.42%

From the tables above, it is clear that KM usage in the organization for various factors considered as high impact KM factors, the implementation of KM in the organizations is not widely observed. Hence we can say that the KM implementation in Indian oil companies is low in terms of implementation tools, procedures and tools and procedures together.

5.2 Future Scope:

Further study can be carried out based on this research on whether Knowledge Management would help to take critical decisions at various levels in an organization. Irrespective of the domain and type of industry we can identify the critical issues and resolve them using Knowledge Management.

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