MATERIALS MANAGEMENT IN A BEVERAGE AND SPICE MANUFACTURING FIRM: A SYSTEM DYNAMIC ANALYSIS

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ABSTRACT

Materials are the chief single element of cost in any manufacturing industries. Recently, anew initiative named as Make in India, proposed by the government of India includes major new schemes designed to facilitate investment, foster innovations, protect intellectual property and build best in class manufacturing infrastructure. Materials form an integral part in all this function and managing them will be a primary step to achieve this milestone. Moreover material is a dynamic asset and as the statistics elicits, materials cover 70 percent of the cash outflows in any organization. Managers need to monitor and control this material that entrench more than half of the cost of any production process. A proper materials management results in improving the profits, reduce lead time, balancing the return on investment, develop a better communication between the supplier and the firm, and thus mitigate the shortages and short supplies. This paper focuses on the need to recognize the materials management function in a beverage and spice manufacturing firm in order to improve its Return on Investment. The work showcases by reducing the current asset through implementing proper managing materials, the Return on Investment improves. Data's was collected through a structured questionnaire from thirty respondents. A System dynamics model is used to collect a feedback system with interdependent variables that have nonlinear relationships and the model fits these characteristics of inventory system.

Keywords: Materials management, inventory management, Return on Investment, Current asset, System dynamics

Introduction:

Make in India initiative puts forward a vision of increase in manufacturing sector growth to 12-14% per annum over the medium term. Manufacturing sector includes Automobile industries, FMCG industries, Chemical Industries, Telecom Industries and so on. Considering the fact that well regulated and stable financial markets open to foreign investors, materials form an integral part of this initiative by the Government of India. A proper execution of materials management improves the continuity of supply with reduced lead time within the country thereby reducing inventories, obsolescence's and materials cost.

A study that reveled five years before elicited that in India materials worth 30,000 crore flow into production channel annually and is considered as material capital. In the present competitive environment, the firm must focus on improving the process productivity by reducing and eliminating waste (looking at non-value added activities) in the supply chain. In order to do so, the firm must strategically focus on managing different parameters such as over production, inventory, defects, processing, transportation, waiting, movement, and people. Managing the materials is considered to be the important task within framework of the supply chain with the goal of maintaining an unbroken chain of components for production to manufacture goods on time to their customer. The major challenge for the manager is to manage with the production process with reduced cycle time in the manufacturing process (Mishra, 2008 pp.66).

Managing the materials looks a simple process, but for the organization it has to cater to the supply of goods and services in order to achieve its overall objectives. The objectives of materials management involves efficient production scheduling, buy/make decisions, quality control of material purchased, prepare specification and standardization of materials. In order to achieve these objectives there should be a proper coordination at all the levels of the management. For the proper coordination and to achieve planned output there should be well planned and controlled inventory management system which has a direct influence on the manufacturing cycle time/throughput time which in turn improves firm performance. The inventory management system comprises of timely delivery of materials from the suppliers, proper locating and binning of materials with parts or component numbering and number of quantities required for assembling that sub assembly and/or the main assembly. The throughput time is defined as the length of time between the release of an order to the factory floor and its receipt into finished goods inventory or its shipment to the customer. Reductions in manufacturing throughput time can generate numerous benefits, including lower work-in-process and finished goods inventory levels, improved quality, lower costs, and less forecasting errors which helps in increasing flexibility and customer orders can be responded quickly.

When firm plans for producing a component, it entails different problems even before the actual production starts. This research focuses on these issues and seeks to identify what are promotional and constraining factor that has the utmostimpact. These problems can be either in

procurement, or planning and/or scheduling of materials. Along with this the firm can also go for problems after the producing the final product. It can be in terms of storage distribution and after sales service providers, therefore integration of materials management function is considered to be very important at all levels within the industry.

Literature Review:

In a research conducted by Asaolu et al., (2012) it was found that, to boost the performance and profitability of manufacturing firms there is a need for interdepartmental coordination among the materials demanding departments. In their research materials management has been recognized as a source of opportunity to reduce production costs and can be treated as a profit centre. It is enough to adopt the cost reducing method in addition a ranking method to the problems related to materials management was considered for true evaluation of respondent percentage in identifying the importance. The results reveal that there is a positive and a significant relationship between material management problems and frequent break down of the plant (Ogbadu, 2013). The finding was clear that for a firm to achieve the profitability the goal of materials management must be on the top priority and the functions need to be carried out effectively.

A study by Lukszo (2006) describes a novel modeling approach aimed at improving complex inventory management of many product grades in a multi-product batch-wise industrial plant. System dynamic model is used to implement a decision support tool that assists the decision maker(s) by providing a systematic structure to arrive at potential improvement options for inventory management. In a similar study by Xiong (2012) state that with the fast development of the market economy in China, the material management of the Power Enterprise Group has changed it operational parameters and could met many challenges. A new procedure modeling method is proposed for the complex management system.

In the research conducted by Atilgan and McCullen (2011) using the Pareto analysisthey have concluded that 80 percent of the production variances were found because of raw material shortages, machinery breakdowns, labor shortages and lack of production equipment such as trolleys and tins. Zhai (2004) considers the importance of supplier partnership in the supply chain of equipment's applying the System Dynamics (SD) model and observed that in order to maintain its market position improving manufacturing efficiency and time-to-market, scalability there should be a better understanding of the key parameters of partnership and manufacturing process of both supplier and parent company. For organization material requirements considerable amount of capital depends upon the availability of materials, so as to efficient planning and control such that minimize the waste and defective components that affects the performance and profitability of the organization(Asaoluet.al., 2012).

Table1: Key Performance Indicators of beverage and spice manufacturing firm (in Rupees)

Return on Investment (ROI) of Manufacturing Firm:

Any momentous savings made on the expenses on materials can directly affect the profitability which in turns can affect Return on Investment (ROI). A proper management of inventory is reflected in a company's Return on Investment (ROI).

Return on investment is usually calculated using the formulae:

$$\text{ROI} = \frac{PROFIT}{CAPITALEMPLOYED} * 100$$

$$= \frac{PROFIT}{(FIXEDASSET + CURRENTASS\,ET)} * 100$$

$$= \frac{PROFIT}{SALES} * \frac{SALES}{(FIXEDASSET + CURRENTASSET)} * 100 \text{(Eq. 1)}$$

It is suggested that in case the sales remains constant and profit also remains constant over a period, the only way to improve ROI is to reduce the assets in the denominator (Shah, 1988). However, since fixed assets in the form of buildings, machines cannot be reduced further in the equation (refer Eq.1); next best alternative is the current assets, large proportions of this in the form of materials- inventory holdings.

ROI can be maximized by either reducing the material cost,indirectly by reducing the current assets in a way that inventory of materials, with the optimized visa-a-vis by increasing the profits and reducing the capital employed (Asaolu and Nassar, 2012).The secondary data for the past four year retrospect(Table 1), it is observed that there is a vociferous decline in ROI of a beverage and spice manufacturing firm from 48.97% in 2011-12 to 37.18 % in 2012-13 after a drastic improvement from 12.8% in the year 2011-12. The decline of ROI is further reduced to rock bottom at 28.61% in the year 2013-14. It is thus lucid that materials management has received very less attention for the past two-three years in the beverage and spice manufacturing firm, after a very significant decline in operational performance during 2012-14.

Thus to know the link between efficient materials management and financial performance, this study focuses to provide suggestions to a beverage and spice manufacturing firm for its decline of ROI by considering the key promoting and constraining factors that influence materials management.

Table1: Key Performance Indicators of beverage and spice manufacturing firm (in Rupees)

Year	Fixed asset (INR)	Current asset (INR)	Current liability(INR)	Capital employed (INR)	Profit (INR)	ROI
2009-10	31,09,44,853	65,99,94,402	12,15,72,718	97,09,39,255	10,97,22,892	11.30 %
2010-11	35,68,05,518	95,93,05,184	22,61,56,299	108,99,54,403	13,97,05,515	12.80 %
2011-12	40,94,68,920	139,65,08,947	77,64,91,921	102,94,85,946	50,41,52,457	48.97 %
2012-13	47,89,23,797	161,02,47,233	72,91,04,634	136,00,66,396	50,56,75,939	37.18 %
2013-14	58,70,23,872	178,23,57,220	58,61,19,276	178,32,61,816	51,02,53,720	28.61 %

(Source: Equity Research, 2014)

Research Questions:

RQ1: What are the factors assisting material management department?

RQ 1.1: What is the key factor (based on ranking) assisting materials management?

RQ2: What are the factors constraining material management department?

RQ2.1: What is the key factor (based on ranking) constraining materials management?

RQ3: Do these factors of material management foster/hinder the ROI?

RQ4: How are these factors related to each other in SD model?

Research Objectives:

RO1: To identify the key promoting factors that influence materials management in the organization.

RO2: To identify the key constraining factors that influence materials management in the organization.

RO3: To provide recommendations and suggestions to the industry based on the findings on handling materials management.

Methodology:

In order to analyze the key functional areas that material management cuts across at beverage and spice manufacturing firm, the key promoting and constraining factors are considered that influence materials management. Method that will be used is mentioned below and is adapted Asaolu et.al (2012). Data collected through total of thirty three questionnaires were administered to the staffs of purchase and stores departments.

Find minimum sample size from the population

Design a questionnaire targeting the departments such as Purchase department and Stores department

Check for the reliability of the questionnaire

Validate the questionnaire

Analyze data, discuss findings and refine conclusions

With respect to the data's obtained from the survey a system Dynamic base model (Fig 1) will be developed as a part of future study to determine how materials management influences Inventory Management.

Results and Discussion:

In order to identify the factors that promote and constrains materials management in the spice and beverage industry, as these respondents directly handles the materials at beverage and spice manufacturing firm, of which thirty were correctly filled and returned with a high response rate of 93% as a part of pilot study. The analysis of this study is based on this questionnaire. The responses to the research questions are formulated (Table 2).

Table 2: Key promoting factors of materials management

Response	Strongly Agree		Agree		Neutral		Disagree		Strongly Disagree	
	n*	%	n	%	n	%	n	%	n	%
Interdepartmental coordination	10	33	18	60	01	03	0	0	0	0

Training	03	10	23	77	03	10	0	0	0	0
Good relationship with vendors	07	23	06	20	0	0	0	0	0	0
R&D in material management	05	17	05	33	09	30	2	7	1	3
Professionalism	07	23	19	63	03	10	0	0	0	0
Proper Auditing	04	13	16	53	05	17	0	0	0	0
Storage Conditions	10	33	17	57	02	07	0	0	0	0
Substandard Raw materials	0	0	05	17	13	44	8	27	2	7
Alternate source of suppliers	06	20	07	23	02	07	0	0	0	0

*n=no. of respondents answered, %=percentage

In most manufacturing companies, a fundamental problem is that purchasing, production planning and control, inventory control, warehouse and distribution, tend to be developed mainly in independent compartments which consequently results in an insular, restricting and uneconomic approach (Barker, 1989). The statistics hold up this by around 93% of the respondents, who admits that inter departmental coordination is an influencing factor for materials management (Table 2).

Training is the most important function of materials management and it forms the nerve centre in any organization (Adeyemi and Salami 2010; Ramakrishna, 2005). This statement is supported by the majority of the respondents (87%) admitting that training has a significant impact as a promoting factor for Materials management. The analysis further showed that storage condition (33%) and professionalism (23%) also contributes to efficient materials management at beverage and spice manufacturing firm. Also 37% of the respondents agree to the fact that developing a good relationship with vendors has a huge impact to the materials management concept. Substandard raw materials and R&D in materials management contributed less to the efficient materials management in the company. More than quarter percentage (27%) of the respondents admitted that company's commitment to substandard raw materials are fallen below. Alarmingly, more than half of the percentage agrees that alternate source of suppliers has a dramatic influence with the concept of materials management.

Table3: Ranking of key promoting factors based on respondent			
Rank	Promoting Factors	Respondents	Percentage
1	Interdepartmental coordination	28	93.0
2	Storage Conditions	27	90.0
3	Training	26	88.0
4	Professionalism	26	88.0
5	Proper Auditing	20	66.0
6	Alternate source of suppliers	13	43.0
7	Good relationship with vendors	13	43.0
8	R&D in material management	10	33.0
9	Substandard Raw materials	05	17.0

On the flipside, considering the factors constraining materials management poor storage facility stands out with 60% respondents agreeing it as the primary factor. That was followed by supplier resource shortage and out of stock with half of the total percentage responding. Vendors influence has made delay of supply and relationship with vendors as the fourth and fifth factor with 47% of respondents in agreement.Inter departmental coordination and storage conditions contribute to more than 90% response along with training, professionalism, proper auditing with more than 50% responses, that makes them primary factors influencing materials management. On the flip side, poor storage facility with 60% agreeing, stands out as the primary factor along with supplier resource shortage (Table 5), and out of stock, with 50 % responses as the constraining factors for materials management. Table also shows 47% of respondents with delay of supply from vendors and poor relationship with them, nearing to half of the total percentage. However, only 13% agreed to the fact that poor spare parts in engineering department and outdated machineries can affect the materials management within the industry.

Table 4: Key constraining Factors of materials management

Response	Strongly Agree		Agree		Neutral		Disagree		Strongly Disagree	
	n*	%	n	%	n	%	n	%	n	%
Frequent power failure	0	0	08	27	01	03	8	27	0	0
Poor storage facility	09	30	09	30	03	10	4	13	2	7
Outdated M/C used for production	01	3.0	03	10	0	0	10	33	0	0
Theft	01	3.0	02	7	09	30	9	30	2	7
Out of stock	03	10	12	40	03	10	2	7	0	0
Delay of supply from vendors	03	10	11	37	05	17	5	17	0	0
Supplier resource shortage	07	23	10	33	02	07	2	7	0	0
Poor spare parts in Engg. Depart.	01	3.0	03	10	13	44	11	37	0	0
Poor relationship with vendors	01	3.0	13	43	02	07	9	30	1	3

*n=no. of respondents answered, %=percentage

Focusing on the major constraining factors and keeping up the promoting factors thus can reduce the current assets.

Table5: Ranking of key constraining factors based on respondent

Rank	Constraining factors	Respondents	Percentage
1	Poor storage facility	18	60
2	Supplier resource shortage	15	50
3	Out of stock	15	50
4	Delay of supply from vendors	14	47
5	Poor relationship with vendors	14	47
6	Frequent power failure	8	27
7	Poor spare parts in Egg. Depart.	4	13
8	Outdated M/C used for	4	13

	production		
9	Theft	3	9

Variables and Relations:

The system dynamic model was developed taking the consideration key factors promoting and constraining materials management. The model provides a base to the future study of how materials management influences inventory management in an organization. The model also involves variables with respect to the inventory management and depicts how they are interrelated to each other. Considering the model drawn, there are basically five aspects of materials management with in the stock and flow diagram. Material order rate, Material in order, materials delivery rate are the three main variables in terms of purchase and raw material inventory and material usage rate are part of stores. Apart from these two divisions, the other variables are that factor that promotes and constrains materials management whose responses are above 50% in the questionnaire that was distributed among the departments. Main variables used as promoting factors are storage conditions, proper auditing, inter departmental coordination, alternate supply of resources and constraining factors such as poor storage facility and out of stock.

Conclusion:

The major intention from this paper is to provide recommendations to the beverage and spice manufacturing firm by considering the factors promoting and constraining materials management. Based on the findings it can be understood that by considering the importance of factors such as interdepartmental coordination and storage conditions which has more than 90% of the respondents followed by training, professionalism and proper auditing with more than 50% responses, Materials management can be fostered within the organization thereby improving the rates of return. On the flip side by concentrating on the constraining factors such as poor storage facility, supplier resource shortage and out of stock can also help in handling materials management in a positive way within the organization. As a future study, with respect to the rankings of factors, a system dynamic model is made to identify the correlation between proper materials management and inventory management at the beverage and spice manufacturing firm by considering one particular product.

The study also supports Make in India program by predicting the factors that has utmost importance in terms of materials and thereby maintaining the presence of India as one of the fastest economies of the world. Focusing these factors can also contribute to Gross Domestic Product (GDP) of the nation through food processing industries. Research is purely conducted with respect to pilot study. However the pilot study that is been conducted was approved by the

heads of the departments in the beverage and spice manufacturing industry, as they were satisfied with the results portrayed.

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