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Development of an Optimal Strategy for Raw Material Supply in Paper Industry with an Approach to ERP: A Case Study of Maragheh Paper Company

[1]Yaghoub Alavi Matin, [2]Arash Farhoudi, [3]Mohammad Amin Alavi, [4]Kamal Esapour

[1,2,3,4]Khalkhal Branch, Islamic Azad University, Khalkhal,Iran

Abstract: In the contemporary, fast evolving world, managers are constantly looking for ways to enhance their organizations. By having a specific outlook and strategy as well as effective ERP systems, organizations can cover all their activities and functions and can improve their capacities, performance, and decision-making and enable competitive advantage (Alizadeh 2007:45). Considering the lack of raw materials for the paper industry and the need of managers of these companies for applying decision-making techniques and providing solutions for this problem (Azizi et al. 2006:1), studies were first carried out for identifying the factors affecting the supply of raw materials for paper industries based on the Comprehensive Strategic Management Model (Fred R. David 2000:43). Then, the general outlook and strategies were formulated based on 19 indices that affect the supply of raw materials in the form of four primary variables based on SWOT matrix including the variables of internal weaknesses (costs), internal strengths (social benefits), environmental opportunities (situations), and environmental threats (risks) and their hierarchy was determined (Farahmand 2005:157). Then, a questionnaire was devised for asking the views of experts in paper industry. To measure the above indices, the current condition and the optimal condition of raw material supply was compared using SPSS software and applying correlated t-test revealed a significant difference between the current and the optimal condition. The sum of the means of current condition indices was 53.33 and that of the optimal condition was 63.97 showing a difference of 10.64. The variables and indices were ranked based on their weight and importance. In the optimal condition, the internal weaknesses and strengths must be given priority and environmental threats and environmental opportunities take the other ranks of the hierarchy. Based on the obtained results, the effective strategies for improving the current condition and the optimal supply of raw materials will be provided with an approach to ERP.

Key words: internal strengths, internal weaknesses, environmental opportunities, environmental threats, enterprise resource planning

INTRODUCTION

Iran has very limited resources of raw materials necessary for paper companies and the present research tries to provide a model for decision-making of senior managers of paper companies so that they can make decisions regarding how to solve the problem of lack of raw materials by taking into consideration the effective indices and strategic planning and consequently, to contribute to the survival of these companies. Presently, the paper industry is one of the strategic industries in our country which is faced with the essential difficulty of shortage of raw materials necessary for paper manufacturing and the managers of these companies are in urgent need of a decision-making model and they must be provided with a proper solution for this problem (Feghhi Farahmand, N 2005). On the other hand, change, evolution, and dynamism are the fundamentals of the contemporary age and managers should constantly seek for ways to enhance their enterprises(Khojasteh, P.M., 2006). Companies are growing rapidly in various fields and the paper industry is a high-tech industry which is quickly evolving throughout the world. Thus, in a comprehensive, general view, besides paying attention to strategies and identifying the effective indices from social benefits, environmental opportunities, environmental risks, and internal risks, the efficacy and proper utilization of resources must correspond to these environmental and internal factors. It is thus imperative and inevitable for enterprises to replace or enhance their outdated systems. Using information systems that can provide its users with all the activities and duties in an organization is one of the vital tools in today's organizations (Javanmard, M.A 2004). Among these systems, enterprise resource planning systems are of the newest management tools that can uniformly and coherently collect the available information in an enterprise using information technology from all the areas of activity of the enterprise and these systems can make the obtained results available to users at different organizational levels. Using ERP, enterprises can achieve such advanced organizational applications as customer relationship management (CRM), supply chain management (SCM), electronic logistics, etc. Finally, the present research attempts to conclude whether one can formulate a proper strategy for raw material supply and identification of its components using information technology in all the areas of activity of an enterprise to collect information from such areas and make it available to different levels of organization management, (Shafayee, R 2008).

Corresponding Author: Yaghoub Alavi Matin, Khalkhal Branch, Islamic Azad University, Khalkhal,Iran

Various environmental factors such as economic, social, cultural, political, and technological factors have brought about fluctuating, unusual effects in the paper industry of Iran which is an industry producing strategic goods; thus, this industry is particularly complicated and the managers of these companies must provide proper solutions for these problems using models and optimal decision-making strategies. In case the importance of the said issue is disregarded, these industries, in particular Maragheh Paper Company will face serious problems in near future, (Khodadad Hosseini, S.H., 2008)

Meticulous, systematic planning must be done in line with the general strategies and outlooks of an enterprise for developing the supply chain strategy for a product and this planning requires the consideration of uncertainty in demand, costs, and changes in market conditions over time (Ghazanfari et al. 2006:1). Development of effective and optimal strategies and effective information systems can cover all the activities and duties of an enterprise and improve its capacities, performance, and decision-making, and help them in achieving competitive advantage as well as the following goals:

1. Development of an outlook and the duty of Maragheh Paper Company to create a clear, desirable image for long-term achievable planning as well as incorporating in strategies each of the principal components of the society as an adaptive, purposive, and synergetic system.
2. Development of general strategies and identification of weaknesses, strengths, opportunities, and threats facing Maragheh Paper Company in order to achieve the specified outlook.
3. Development of optimal strategies for supply of raw materials and identification of the indices that affect this supply in order to facilitate decision-making among senior managers of Maragheh Paper Factory
4. Development of a hybrid model for coordinating and connecting the activities of different organizational units into an integrated whole including customer relationship management and increasing customer loyalty as well as providing better services and working with suppliers who take into account the internal and external environment of an organization,(Seyyed Hossein, S.M 2004).

Thus, the question is: what are the proper strategies for the optimal supply of raw materials for Maraghe paper industries? What are the indices that affect the development of a proper strategy of optimal supply of raw materials for Maragheh paper industries with an approach to ERP?

Methodology:

Considering the novelty and originality of the issue, the methods and model development have been done as an applied research under the following conditions:

1. Development of the general outlook of Maragheh paper industries
2. Development of strategies for Maragheh Paper Company by means of matrices and by rating different factors using the views of experts and experienced managers
3. Development of a strategy for optimal supply of raw materials and identification of variables and indices that affect that strategy in Maragheh Paper Company
4. Statistical analysis for choosing and prioritizing the variables and indices that affect the optimal supply of raw materials
5. EXCEL and SPSS have been used in analyzing and processing data

The model of interest in this research is adopted from the comprehensive strategic management model of Fred R. David for development of strategies. The methodology is survey research in that it asks for feedback from experts and experienced managers and it is as well descriptive in that it examines the properties of a company (Maragheh Paper Company) and that it compares the current condition with the desired condition. Thus, the present research is descriptive-survey carried out as an applied research.

Purposive sampling has been used considering the scarcity of experts in this field and the sample is $n = 40$; the present research is of high validity and the reliability of the research is 0.897 according to Cronbach's alpha. The material for data collection is a questionnaire.

Results:

Hypothesis 1:

Correlated t-test was applied to determine the differences between the current condition and the optimal condition in the mean of the four variables of raw material supply.

Table 1: Correlated t-test for determining the differences between the current condition and the optimal condition in the mean of the four variables of raw material supply

Rank	Variables	Condition	Mean		Std. Deviation	Std. Error Mean
1	Social Advantages	Optimal	20.38	0	1.675	.265
		Current	12.52	0	2.013	.318
2	Internal Weaknesses	Optimal	12.75	0	3.894	.616
		Current	19.62	0	3.027	.479
3	Environmental Opportunities	Optimal	19.60	0	2.405	.380
		Current	10.78	0	2.412	.381
4	Environmental Threats	Optimal	11.25	0	2.499	.395
		Current	12.42	0	2.011	.318

Rank	Variables	Paired Differences					t	DF	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
1	Internal Strengths (Optimal and Current)	7.850	2.497	.395	7.052	8.648	19.886	39	.000
2	Internal Weaknesses (Optimal and Current)	-6.875	4.789	.757	-8.407	-5.343	-9.080	39	.000
3	Environmental Opportunities (Optimal and Current)	8.825	3.335	.527	7.758	9.892	16.736	39	.000
4	Environmental Threats (Optimal and Current)	-1.175	3.226	.510	-2.207	-.143	-2.304	39	.027

In comparing the optimal condition with the current condition in the four variables of raw material supply for Maragheh Paper Company with an approach to ERP, the significance level of t is 0.000 to 0.027 and this is lower than 0.05 which is the minimum significance level. Thus, we can conclude that there a significant difference between the current and optimal condition of raw material supply in the four variables.

1. In table 1, the descriptive statistics of the correlated t-test, the mean for current condition of the first variable is 12.520 and the mean for the optimal condition is 20.38. Therefore in the current condition, internal strengths (social benefits) of the company have been assessed to be lower than that of the optimal condition and using proper strategies in the optimal condition of raw material supply, internal strengths (social benefits) can be increased considerably.
2. In table 1, the mean for the current condition of the second variable is 19.62 and the mean for the optimal condition is 12.75. Thus, in the current condition, internal weaknesses (costs) of the company have been assessed to be higher than that of the optimal condition and by applying proper strategies in the optimal condition of raw material supply, internal weaknesses (costs) can be to a large extent reduced.
3. In table 1, the mean for the current condition of the third variable is 10.78 and the mean for its optimal condition is 19.60. Thus, in the current condition, environmental opportunities of the company have been assessed to be lower than that of the optimal condition and by applying proper strategies in the optimal condition of raw material supply, environmental opportunities can be considerably increased.
4. In the table of the descriptive statistics of the correlated t-test, the mean for the current condition of the fourth variable is 12.42 and the mean for its optimal condition is 11.25. Thus, in the current condition, environmental threats facing the company have been assessed to be higher than that of the optimal condition and by applying proper strategies in the optimal condition of raw material supply, environmental threats can be reduced.

Table 2: A comparison of the means of the indices of each of the four variables of raw material supply in the current and optimal condition

Indices of Internal Strengths (Social Benefits)	Mean of the Current Condition	Mean of the Optimal Condition	Difference	Significance Level
1. Environmental Friendliness	2.5	3.75	1.25	0.00
2. Cultivation of woody and Non-Woody Crops	1.75	4.18	2.425	0.00
3. Decrease in Storage Costs and Increase in Sales	2.18	4.02	1.85	0.00
4. Employment	2.85	4.1	1.250	0.00
5. Increase in Employment of Local Workforce	3.25	4.32	1.075	0.00
Total	12.53	20.37	7.84	0.00
Indices of Internal Weaknesses (Costs)				
1. Costs of Raw Materials	2.2	2.65	-1.550	0.00
2. Costs of Raw Material Transport	3.75	2.55	-1.225	0.00
3. Customs Fees and Duties	3.48	2.85	-0.625	0.006
4. Costs of Deforestation	3.72	2.38	-1.350	0.00
5. Costs of Pause of Production	4.45	2.32	-2.125	0.00
Total	17.6	12.75	-4.85	
Indices of Environmental Opportunities				
1. Economic Growth in the Region	2.85	4.2	1.35	0.00
2. Export Capacity	1.32	3.18	1.850	0.00
3. Expansion and Development of Industry	2.42	3.98	1.55	0.00
4. Investment	2.2	4.22	2.025	0.00
5. Meeting ISO Standards	1.98	4.22	2.05	0.00
Total	1.77	19.6	8.83	
Indices of Environmental Threats (Risks)				
1. The Possibility of Flood	2.7	2.25	-0.450	0.006
2. Decrease in Sales	3.75	2.52	-1.225	0.00
3. Limitation in Identifying Foreign Suppliers of Raw Materials	3	2.88	-0.125	0.05
4. Prohibition of Harvest by the State and Governmental Regulations	2.98	3.6	0.625	0.005
Total	12.43	11.25	-1.18	
Grand Total	53.33	63.97	10.64	

1. According to table 2, using correlated t-test, the difference between the mean rating of the indices related to each of the variables that affect the supply of raw materials has been compared in both the current and optimal condition and on the whole, internal strengths (social benefits) have been assessed as 20.37 in the optimal condition and 12.53 in the current condition which shows an increase and improvement of 8.84 with respect to the current condition.
2. Internal weaknesses (costs) have been assessed as 12.75 in the optimal condition and 17.6 in the current condition which shows an improvement and decrease of 4.85 with respect to the current condition.
3. Environmental opportunities have been assessed as 19.6 in the optimal condition and 10.77 in the current condition which shows an improvement and increase of 8.83 with respect to the current condition.
4. Environmental threats have been assessed as 11.25 in the optimal condition and 12.43 in the current condition which shows an improvement and decrease of 1.18 with respect to the current condition.

Testing Hypothesis 5:

Correlated t-test and Friedman test were applied to determine the difference between the means of the indices of each variable and measuring their importance in raw material supply in the current and optimal condition and the results are as follows:

A) Considering the fact that in comparing the indices of raw material supply for Maragheh Paper Company with an approach to ERP (table 2) the significance level of correlated t in all the indices except for "*limitation in identifying foreign suppliers*" is less than or equal to 0.05 which is the minimum significance level, it can be concluded that there is a significant difference between the current and optimal condition in the indices that affect the supply of raw materials except for the mentioned case.

B) Ranking of the four variables

Using Friedman test and the results obtained from the survey regarding the variables that affect the supply of raw materials, the results and variable ranking are presented in tables 3 and 4.

Table 3: The results of measuring the importance of the variables that affect the optimal supply of raw materials using Friedman test

Ranking (Degree of Importance)	Variable	Importance Weight
1	Internal Strengths (Social Benefits)	3.55
2	Environmental Opportunities (Situations)	3.26
3	Internal Weaknesses (Costs)	1.84
4	Environmental Threats (Risks)	1.35

Table 4: The results of measuring the importance of the variables that affect the supply of raw materials in the current condition using Friedman's test

Ranking (Degree of Importance)	Variable	Importance Weight
1	Weaknesses (Costs)	3.98
2	Internal Strengths (Social Benefits)	2.31
3	Environmental Threats (Risks)	2015
4	Environmental Opportunities (Situations)	1.35

C) Ranking the indices that affect the supply of raw materials

Using Friedman test and the results from the surveys regarding the indices that affect the optimal supply of raw materials and the current condition, the results and variable ranking are presented in the following table:

	Optimal Condition		Current Condition	
Indices	Weight (Importance)	Rank	Weight (Importance)	Rank
Export Capacity	1.61	19	2.96	9
Possibility of Floods	1.85	18	1.85	18
Decrease in Sales	2.14	17	2.5	13
Costs of Pause of Production Due to the Lack of Raw Materials	2.46	16	3.59	4
Limitation in Identifying the Foreign Suppliers of Raw Materials	2.62	15	4.1	2
Costs of Deforestation	2.74	14	3.44	5
Environmental-Friendliness	2.74	13	2.64	12
Decrease in Storage Costs and Increase in Sales	2.76	12	2.26	15
Employment	2.9	11	2.68	11
Costs of Raw Material Transport	3	10	3.99	3
Expansion and Development of the Industry	3.06	9	4.11	1
Cultivation of Woody and Non-Woody Crops	3.12	8	1.69	19
Costs of Raw Materials	3.14	7	3.42	6
Meeting ISO Standards	3.19	6	3.1	8
Prohibition of Harvest by the State and Governmental Regulations	3.39	5	2.68	10
Increase in Employment of Local Workforce	3.48	4	2.14	17
Economic Growth in the Region	3.54	3	3.29	7
Attraction of Investment	3.6	2	2.21	16
Customs Fees and Duties	3.66	1	2.36	14

Discussion:

Minimizing the Weaknesses (Costs):

A) Costs of Raw Materials

The Costs of raw materials is one of the driving indices related to the internal weaknesses in the supply of raw materials which has taken the value of 3.14 in importance. Using optimal methods and strategies, the net price of materials can be reduced because correct, optimal choice of suppliers will lead to competition among them and as a result, materials can be bought with minimum price.

- ***Costs of Loading and Unloading***

Using mechanization and mechanical equipment such as forklifts can speed up the loading and unloading process and special dumper trucks can as well be used if possible.

- ***Ordering Costs:***

By meticulous planning of the required raw materials and making the necessary and timely arrangements, the optimal ordering can be determined for each of the items and as a result, the ordering costs will be minimized.

- ***Costs of Material Maintenance and Safety:***

Since wood is harvested on a seasonal basis and the harvested wood is sent to the factory from relatively far locations, more storage is required for use during the seasons; however, if strategic and optimal planning is conducted for cultivation and supply through imports at the right time and as much as required, there will be no need for more storage and consequently the costs of maintenance and safety will decrease.

- ***Costs of Decline in the Quality of Materials and as a Result, the Product:***

Greater storage of materials (due to seasonality) more than the standard period which is 45 days at most for wood material will lead to the decline in the quality of materials and a as a result the quality of the product will decline which will lead to decrease in sales.

- ***Costs of Decrease in Weight:***

Considering the fact that fresh wood consists of 50-55% moisture (water), moisture will be lost over time and the decrease in weight will change the fibers and inner tissue of the wood and will negatively affect the quality and quantity of the product.

- ***Costs of Depreciation of Equipment and Machinery:***

With the decline of the quality of raw materials (wood) or buying wood chips that are not within the defined standards (very high diameters greater than 50 cm or very low diameters less than 10 cm, woods with too many nodes, awry woods, etc.), the equipment in the production line will be damaged and these costs can be minimized by close observation of these issue at the time of purchasing as well as quality control of materials.

B) Transfer Costs, Customs Fees, and Duties:

These costs can be paid in short-term and they can be minimized in long-term through strategic planning and wood cultivation.

C) Deforestation Costs:

With correct planning for farming and optimal supply from foreign sources, deforestation costs and damage to the environment will be minimized.

D) Costs of Pause of Production Due to the Lack of Raw Materials:

Considering the fact that 50% of the production pauses in this company is due to the lack of raw materials and additives which leads to an increased final price, meticulous planning in timely and optimal supply of raw materials can prevent these costs.

Reinforcing the Internal Strengths (Social Benefits):

Considering the fact that natural environment is one of the important issues and parameters in the development of industries in both developed and developing countries, it must be given special attention and this company must on one hand supply its raw materials using meticulous planning for planting and farming and on the other hand, prevent damages to the environment which is considered a threat by the government through installing industrial wastewater treatment.

Farming Woody and Non-Woody Crops:

Using non-woody crops in this company entails much expenditures and a change in the pulp production process and is thus disregarded here. But farming woody crops and spruce wood is considered as a long-term strategy which will involve the following issues if administered by the company: (Tehrani, M.S 2005),

Plans for Developing Wood Cultivation (Spruce Cultivation):

1. Activation of the private sector and provincial farmers in wood production
2. Development of spruce farming using national projects (the Tuba Project and the Green Movement National Project)
3. Administering participatory projects with public, cooperative, and private firms and centers in order to develop spruce cultivation
4. Creating cooperative and manufacturing associations in order to develop wood farming through organizing the graduates of the fields of study related to agriculture in cooperation with Iran's Ministry of Cooperatives.
5. Administering a plan for pre-ordering woods and creating modern nurseries with the trilateral cooperation of paper industries, farmers, and the Agriculture Bank.
6. Providing necessary supports for the administration of spruce planting projects at the outskirt of farms, roads, and parks as well as biological fixation of river banks and so on.

7. Production and breeding of high-quality spruce saplings from foreign and domestic high-yielding varieties which are compatible with the ecological and edaphic conditions of the region.
8. Determining the warranted rate and insurance of wood products as well as creating motivation among farmers and supporting cultivators against incidents such as famine, flood, fire, and outbreak of pests and diseases.
9. Carrying out studies on the geographical distribution of the existing spruce cultivation and extracting the actual level of area under cultivation, standing timber, production period, the planted species and varieties, pests and diseases, and socioeconomic issues that affect spruce farming are of the extremely essential issues for planning and administration of any spruce planting development project.
10. Scientific advice for planting, nurturing, and harvesting as well as agricultural methods and optimal planting intervals, fertilization, water supply, and disinfestation.
11. Identification of water and soil potentials of Northwestern Iran and identification of the centers apt for development and formulation of agricultural systems for each of the spruce cultivation centers.

Implementation and Administration of Enterprise Resource Planning (ERP) in the Complex:

In the ever-changing dynamic world of today, optimal and efficient use of business information systems is of utmost importance as a competitive advantage in line with the progress of the strategic goals of the organizations. Proper use of the infrastructures of information and communication technology will contribute to the integration and transparency of the organization for having a strong supply chain.

Enterprise resource planning (ERP) systems facilitate and optimize information flow and material flow among different sections of the enterprise and is regarded throughout the world as a strong management and planning tool for integrating manufacturing resource planning (MRP) including the limitation of warehouse planning system and the lack of integration of other organizational operations such as production, distribution, accounting, and financial and personnel issues. ERP is a set of systems adopted from "best practice" which is utilized for improving organizational processes including financial, manufacturing, commercial, and support activities and by incorporating E-CRM, E-SCM, and ERP, one can achieve extended resource planning (ERP or XRP) so that an integrated management will be created between the three systems for increasing profit and accelerating the proper reaction to environmental and internal factors. Thus, the following cycle and its implementation are recommended as an optimal strategy (Alizadeh 2007:79):

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