Analysis of Challenges in the Implementation of Operations Research Techniques for Value Addition in the Logistics Industry in Kenya: A Survey of selected Nakuru County-Based Logistics Firms

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Abstract

In National and International Supply Chain Management Systems, developing ideas that add value and solve logistics problems successfully when implemented is an important determinant of economic growth and competitiveness of business organizations. The development and the deployment of scientific yet business techniques in the field of Management Science that simplify processes will enhance the expansion of markets through the efficiency and effectiveness realized in the costs involved. This study sought to analyze challenges in the implementation of Operations Research techniques on value addition in the logistics industry in Kenya; A survey of Nakuru County-Based logistics Service providers. The study covered 92 respondents drawn from a population of 100 (staff and customers). Questionnaire was used to collect data after which descriptive and inferential statistics were used to analyze data.. The study concluded that the use of Operations Research techniques have been used but yet to be fully utilized by business firms involved in the logistics service provision in order to bring about value addition in their course of delivery of goods works and services. Inadequate Human Capital in Operations Research, absence of qualified Human Capital in Operations Research, lack of professional input, insufficient platform to develop and train professionals in the field of Operations Research and absence of motivation and recognition were some of the key challenges that deterred the

implementation of operations research techniques as well as the absence of integration between the use of Operations Research techniques and organization's in value addition. The study recommends that organizations engaged in the logistics service provision should invest in the qualified and competent human capital in the area of management science (operations research) in order to attain optimization and meet customer requirements by way of value addition.

Keywords: *Operations Research, Supply Chain Network, Supply Chain Management, Logistics, Value Addition, Human Capital, Organization Policy, Information Technology.*

Background of the Study

The structure of value chains underlines how locations (gateways, regions, localities, etc.) are able to capture, expand and retain value added activities. It is in this context that policies, regulations and investments are articulated for the expected multiplying effects related to value capture. Since many supply chains are globally oriented, added value is performed at a wide array of locations, which is the outcome of decisions made by multinational corporations to maximize their revenue. It is worth underlining that in a supply chain, from suppliers to customers and through all the intermediary stages, it is a matter of where each added value function takes place. For many sectors, added value activities have moved downward the supply chain as a strategy to lower production (input) costs. In other cases, added value activities have moved upward to expand market potential, mainly through better freight distribution strategies. In almost all cases, improving the efficiency of freight distribution is a salient factor of added value.

Operations research is a scientific discipline that managers use to make informed decisions for their operations and draws heavily from math, statistics and science (Winston, 1994). An Operations Research (OR) is a branch of applied mathematics that uses algorithms, simulation, modeling, queuing, and stochastic methods to optimize or improve a real-world situation. Operation Research was developed by a group of British and American mathematicians who were studying strategic logistics problems during World War II. Since that war, this branch of mathematics has been used in a variety of industrial and military applications. The applications are witnessed in areas that include network analysis and finding optimal solutions to problems involving start nodes, arcs, and destination nodes. A basic problem in OR is the “transportation problem,” in which there are known supply bases, known customer demands, and known costs to

each route from supply base to customers. Secondly, programming is used to quantify a problem involving an objective function that is subject to one or more constraints in the system. An objective function attempts to perform actions that affect the output of a system, such as minimizing shipping cost, maximizing throughput, or maximizing material shipped to an area. Constraints are functions that place limits on the range of the objective function. These can include limitations on infrastructure capacity, warehouse space, cost, trucks available, and integer, or non-negativity, limits.

Thirdly, Simulation involves using a combination of deterministic and probabilistic functions to model the problem and then predict actual system improvements after changes. It was first used to calculate the properties of the neutron by Enrico Fermi and Stanislaw Ulam in 1930. As relates to categories of logistics, physical logistics is quite simply the work needed to move or store products and other entities. Companies in this field are often described as working with logistics. Transport logistics relate the concept to pure movements and the transports needed (with truck, train, plane, boat or other means) to fulfill them as well as analyses in this field. Production logistics is of more limited span (the producing activities, of products or services). Internal logistics is often used to describe movements and usually storage within a building (typically a plant). Strategic logistics describes "the big picture". This implies all the processes that are needed to secure the products from an early customer interest/order to delivery. This way of using the word automatically connects to concepts like Supply Chain Management (SCM) and there are direct links to Operative strategy (Hillier, 2005)

Statement of the Problem

Operations Research, also referred to as Management Science, is a scientific approach to solving management problems. It is the application of scientific methods, techniques and tools to problems involving the operations of a system so as to provide those in control of the system with optimum solutions to problems (Churchman et al., 1957). Available today are commercial software systems that incorporate various Operations Research techniques to address specific application areas including transportation and logistics, production planning, inventory control, scheduling, location analysis, forecasting, and supply chain management. It is worth underlining that in a supply chain, from suppliers to customers and through all the intermediary stages, it is a matter of where value addition takes place. For many sectors, value addition activities have formed f the upstream activities in the supply chain by a way of a sound and coordinated logistics system as a strategy to lower production (input) costs (Subramanian et al., 1994)

Timely delivery of the right quantity of goods and services within the expected quality levels by customers at affordable price levels forms the best yard stick within which value addition can be measured. The drawing up of and employment of strategies and techniques that will ensure value addition but with manageable efficiency levels by organizations in a logistics system is the desire of every business organization. Churchman et al., (1957) and Vohra (2010) have appreciated the fact that the use of Operations Research techniques to enhance value addition and to improve decision making has been practiced for decades. The implementation of Operations Research solutions is often more difficult than it may apparently seem. The impact of a decision may cut across various segments of the organization and the factors like resistance to change, desire to be consulted and informed and lack of motivation, may come in the way of implementation (Vohra, 2010). However, the challenges associated with Human Capital, Organizational Policy and Information Technology in the use of Operations Research techniques for value addition in a logistics system and in an entire supply chain management is a concept that has received a considerable attention but has limited empirical literature on its practice, especially in logistics industry. Following thereof, the study sought to analyze challenges in the implementation of Operations Research techniques on value addition in the Kenyan logistics industry with specific

reference to a survey of selected firms involved in logistics service provision based in Nakuru, Kenya.

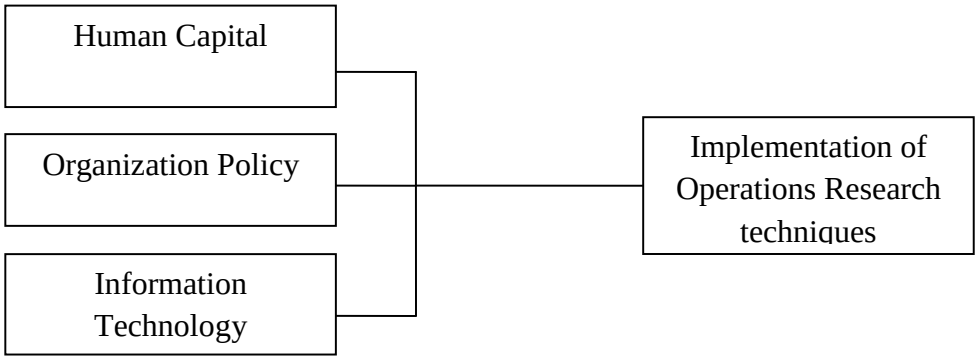
The Purpose of the Study

The purpose of the study was to analyze the challenges in the implementation of Operations Research techniques on value addition in the logistics industry in Kenya, a survey of selected firms engaged in logistics service provision. Specifically the study sought to evaluate the various challenges associated with Human Capital, Organization Policy and Information Technology on value addition in logistics industry in Kenya. The decision to arrive at such criteria was based on the fact that the outlined independent variables and their associated problems were critical to the implementation of Operations Research techniques for value addition and that the available empirical literature have not covered these critical variables.

Methodology

The study used descriptive research design. Based on Sekaran (2003), the study covered a stratified sample of 92 respondents drawn from a population of 100 (staff and employees of selected logistics firms in Nakuru Town, Kenya). A total of 84 questionnaires were returned and this translated to 91.30 % response rate. The independent variables for the study were; Human Capital, Organization Policy and Information Technology whereas the implementation of Operations Research techniques formed the dependent variable for the study. A semi-structured questionnaire was used to collect data upon which analyses were done using both descriptive and inferential statistics. Pearson product Moment Correlation was used to determine the relationship between variables under study. Further, regression analysis was conducted to show the extent to which the dependent variable is influenced by the independent variables covered by the study. The Statistical Package for Social Sciences (SPSS Version 21) was used to aid in the analysis**.**

Conceptual Framework



Independent Variables **Dependent Variable**

From the above conceptual framework, the independent variables that supported the study included the challenges arising from Human Capital, Organization Policy and Information Technology. On the other hand, the implementation of Operations Research techniques formed the dependent variable. Therefore, the study sought to analyze the relationship between the variables as guided by the conceptual framework.

Results and Analysis

The study sought to analyze challenges in the implementation of Operations Research techniques for value addition in the logistics industry in Kenya. The specific independent variables covered included challenges associated with Human Capital, Organization Policy and Information Technology on Implementation of Operations Research for Value Addition in Logistics Industry. These variables were modeled such that: $y= \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + e$, where y = Implementation of Operations Research for Value Addition, α = Constant term, β = Beta coefficients, X_1 = Human Capital, X_2 = Organization Policy, X_3 = Information Technology and e = Error term.

In this question, respondents were asked to indicate the level of extent to which the following outlined Human capital problems affect the implementation of Operations Research techniques on value addition in a logistics system on a scale of 1-5, where 1 represented Very Great Extent while 5 represented 'Not at All'. As shown in Table 1, all the outlined challenges affected the implementation of Operations Research as indicated by mean scores of less than 2.5 with the exception of reluctance by the organization to outsource human capital on Operations Research to advise where necessary which had a mean score of 2.57

Table 1: Effect of Human Capital Challenges on Implementation of Operations Research Techniques for Value Addition in Logistics

Statement	**N**	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Significance of human capital competence and qualifications in the use of Operations Research	84	1	5	2.46	1.471
Inadequate Human Capital in Operations Research	84	1	5	2.48	1.312
Absence of qualified Human Capital in Operations Research	84	1	5	2.43	1.328
Reluctance by organization to outsource Human Capital in Operations Research to advise the organization	84	1	5	2.57	1.615
Lack of a professional body that sensitizes and regulate the practice of Operations Research	84	1	5	2.46	1.312
Lack of sufficient platform to develop and train professionals in the field of Operations Research	84	1	5	2.37	1.306
Absence of motivation and recognition of Operations Research as a functional unit in organizations management	84	1	4	2.11	.971
Valid N (listwise)	84				

The study sought to analyze the challenges associated with the implementation of Operations Research techniques, especially as relates to the Human Capital tasked with advising logistics firms based on the Operations Research techniques for value addition. A combined of 84.8% of the respondents interviewed affirmed that Human Capital is reasonably placed in ensuring the success of the implementation of Operations Research techniques on value addition in a logistics system. Regression was conducted on the Human Capital study variables on the implementation of Operations Research techniques and it showed that the coefficient of determination was 0.719 indicating that the independent variables explain a proportion of 71.9% of the dependent variable. This shows a strong correlation between the independent and the corresponding dependent variable as detailed in Table 2

Table 2: Regression Model on Human Capital study variables in the implementation of Operations Research techniques

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.848[a]	.719	.679	.829

a. Predictors: (Constant), The need for creation of platform to develop and train professionals in the field of Operations Research for value addition in logistics services, Outsourcing of Human Capital in Operations Research where necessary to advise logistics organization, The need for creation and enhancement of professional body that registers and sensitizes on the need for Human Capital specialized in OR, Employment of sufficient Human Capital to implement Operations Research techniques in logistics industry, Sensitization on the use of scientific methods such as OR to bring value addition in logistics industry.

b. Dependent Variable: Significance of Human Capital competence and qualifications in the use of Operations Research.

Organization's Policy on Implementation of Operations Research

The objective of the research question here was to find out the extent to which challenges associated with the organization policy on the use of Operations Research techniques affected its use. The measurement scale used here was 1-5, where 1 represented very great extent while 5 represented no effect at all. The research findings as appear in Table 3 showed that there were challenges such as absence of integration between the use of Operations Research techniques and organization's overall objectives (mean score of 2.22) and also the current organizational structure did not identify and embrace holistic policy on optimization in value addition (mean score of 2.48). On the other hand, the respondents asserted that lack of clear policy on the use of Operations Research techniques for value addition (mean score of 2.87) and absence of organizational policy that is used to allocate resources for training of staff on Operations Research techniques for value addition (mean score of 2.80) were not the main cause and challenge for the implementation of Operations Research techniques for value addition in the logistics industry.

Majority of the respondents strongly agreed or agreed that besides putting in place an organization policy that guides the use of Operations Research techniques, a mechanism of integration within the organization, re-designing of the organizational culture and structure and resources allocation should be the organization's focus in averting the challenges associated with the use of these technique for value addition reasons in a logistics system. Organization policy as an independent variable had a coefficient value of 0.260 when regressed against value addition (dependent variable). The results revealed that 28.9% of the variations in challenges contributed to the implementation of Operations Research techniques for value addition were explained by organization policy with a confidence level of 95%. It was found that the effect of organizational policy had high explanatory power on the implementation of Operations Research techniques for value addition in a logistics system.

Table 3: Descriptive Statistics on Organization's Policy on the use of Operations Research for Value Addition in Logistics Industry

Statement	N	Minimum	Maximum	Mean	Std. Deviation
Lack of clear policy on the use of Operations Research techniques for value addition	84	1	5	2.87	1.439
Absence of integration between the use of Operations Research techniques and organization's overall objectives	84	1	5	2.22	1.381
Current organizational structure does not identify and embrace holistic policy on optimization in value addition	84	1	5	2.48	1.312
Absence of organizational policy that is used to allocate resources for training of staff on Operations Research techniques for value addition	84	1	5	2.80	1.276

Information Technology

Also available today are commercial software systems that incorporate various Operations Research techniques to address specific application areas including transportation and logistics, production planning, inventory control, scheduling, location analysis, forecasting, and supply chain management. Some examples of popular Operations Research software systems include CPLEX, LINDO, OSL, MPL, SAS, and SIMAN. As relates to the challenges and the use of Information Technology in the implementation of Operation Research techniques for value addition, the relevant descriptive statistics on Table 4 indicated that the majority of the respondents argued for the strongly (Notably mean scores of less than 2.5 on a scale of 1-5, where 1=Strongly Agree and 5=Not at All) for investment in IT, the need to train employees on the relevant Operations Research application softwares, Research and Development and

allocation of budgetary resources so as to enhance the use of Information Technology in Operations Research for value addition in a logistics system.

When the findings were regressed between the study variables and its sub variables on IT, the results showed that the successful implementation of Operations Research with the aid of IT were explained strongly at a proportion strength of linearity of 96.4% by its predictors such as allocation of resources and investment in IT for quality and timely provision of goods and services, The need to train employees on relevant application softwares that simplify the use of Operations Research techniques in value addition, Research and Development to fully understand the impacts of IT use in Operations Research and the need to invest in IT to enhance implementation of Operations Research techniques in value addition in logistics activities. This is supported by Leachman (2006).

Table4: Descriptive Statistics on the need to address challenges associated with the use of Information Technology in Operations Research

Statement	N	Minimum	Maximum	Mean	Std. Deviation
The need to invest in IT to enhance implementation of Operations Research techniques in value addition in logistics activities	84	1	5	2.33	1.266
The need to train employees on relevant application softwares that simplify the use of Operations research techniques in value addition	84	1	5	2.24	1.233
Research and Development to fully understand the impacts of IT use in Operations Research	84	1	5	2.35	1.320
Allocation of resources and investment in IT for quality and timely provision of goods and services	84	1	5	2.44	1.410
Valid N (listwise)	84				

As shown in Table 5, the results of the model were $Y= -0.98+0.772X_1 + 0.260X_2 + 0.82X_3$, Predictor Power (0.346) (0.103) (0.088) (0.076), and p-Value (0.780) (0.000) (0.005) (0.290)

Inferring from the coefficients of the variables covered by the study, it can be concluded that the challenges outlined by the research study had a significant influence on implementation of Operations Research techniques for value addition. Human Capital had a p-Value of (0.000), Information Technology (0.290) and Organization Policy had a p-value of 0.005. This meant that the challenges associated with Human Capital challenges and Organization Policy was significant while Information Technology was less significant since its p-value was greater than confidence level of 0.05. According to Rigby (1995), the use of Operations Research in decision making are laced with myriad of challenges ranging from technology infrastructure, organization's willingness to employ such techniques as well as lack of motivation.

Table 5: Regression Coefficients on the variables Studied

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.098	.346		-.282	.780
	Human Capital on implementation of Operations Research techniques in logistics industry	.772	.103	.819	7.515	.000
	Organization's Policy on the use of Operations Research techniques for value addition in logistics services	.260	.088	.274	2.964	.005
	Information Technology on implementation of Operations Research techniques for value addition	.082	.076	.081	1.072	.290

From the regression model in Table 6, the coefficient determination is 0 .886 indicating that the independent variables explain 88.6 % of the change in the independent variable. This reasonably shows a strong correlation between the independent variables (Human Capital, Organization Policy and Information Technology) and the dependent variable (Implementation of Operations Research techniques).

Table 6: Model Summary for Variables Covered by the Study

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.941[a]	.886	.875	.463

a. **Predictors:** (Constant), Human Capital on implementation of Operations Research techniques in logistics industry, Organization's Policy on the use of Operations Research techniques for value addition in logistics services, Information Technology on implementation of Operations Research techniques for value addition.

b. Dependent Variable: Extent to which Operations Research contributes to value addition in logistics services provided by organizations.

Pearson Correlation Analysis (Table 7) for all the variables covered by the study indicated that there were fairly strong correlations between Human capital and value addition with 0.669 and 0.502 respectively. Also positive correlations between Information Technology with human capital (0.669**) as well as (0.914**) with value addition. Finally strong correlations between value addition and Information Technology (0.914) and also with a correlation measure of (0.501**) between value addition and Human Capital. However, negative correlations were revealed by the study between human capital and organization's policy (-0.239). Further, negative correlations were evident between organization policy and IT (-0.54) and between organization policy and value addition at -0.076 of which the same equal measure was the case between organization policy and value addition.

Table 7: Pearson Correlation Analysis of Study Variables

		HC	OP	IT	IOORT
HC	Pearson Correlation	1	-.239	.669**	.501**
	Sig. (2-tailed)		.110	.000	.000
	N	84	84	84	84
OP	Pearson Correlation	-.239	1	-.054	-.076
	Sig. (2-tailed)	.110		.722	.617
	N	84	84	84	84
IT	Pearson Correlation	.669**	-.054	1	.914**
	Sig. (2-tailed)	.000	.722		.000
	N	84	84	84	84
IOOR	Pearson Correlation	.501**	-.076	.914**	1
	Sig. (2-tailed)	.000	.617	.000	
	N	84	84	84	84

**. Correlation is significant at the 0.01 level (2-tailed).
HC- Human Capital

OP- Organization Policy

IT- Information Technology

IOOR – Implementation of Operations Research

Conclusions

Based on the objectives and findings of the research study, we conclude that the use of Operations Research techniques have been used but yet to be fully utilized by business firms involved in the logistics service provision in order to bring about value addition in their course of delivery of goods works and services which is also supported by (Flanders, 1995).

The study concludes that inadequate Human Capital in Operations Research, absence of qualified Human Capital in Operations Research, lack of professional input, insufficient platform to develop and train professionals in the field of Operations Research and absence of motivation and recognition were some of the key challenges that deterred the implementation of operations research techniques. Human Capital study variables on the implementation of Operations Research techniques showed a strong correlation between independent and the corresponding dependent variable.

There was absence of integration between the use of Operations Research techniques and organization's overall objectives and the failure for the current organizational structure to identify and embrace holistic policy on optimization in value addition. 28.9% of the variations in challenges contributed to the implementation of Operations Research techniques for value addition were explained by organization policy with a confidence level of 99% and that the effect of organizational policy had high explanatory power on the implementation of operations research techniques for value addition in a logistics system.

Successful implementation of Operations Research with the aid of IT were explained strongly at a proportion strength of linearity of 96.4% by its predictors such as allocation of resources and investment in IT for quality and timely provision of goods and services, The need to train employees on relevant computer applications that simplify the use of Operations research techniques in value addition, Research and Development to fully understand the impacts of IT use in Operations Research and the need to invest in IT to enhance implementation of Operations Research techniques in value addition in logistics activities.

Recommendations

The study recommends that organizations engaged in the logistics service provision should invest in the qualified and competent Human Capital in the area of management science (operations research) in order to attain optimization and meet customer requirements by way of value addition. Secondly a holistic policy that integrates the use of operations research technique should be put in place so as to bring together the various functional departments in a bid to embrace the use of Operations Research techniques as a common goal. Also there is need to allocate more resources in the area of Information Technology since its use will simplify the application of Operation Research techniques in logistics systems.

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