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Supply Chain Modeling and Improving Manufacturing Industry in Developing Countries: A Research Agenda

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***Abstract*—**This paper presents a research agenda on the SCOR model adaptation. SCOR model is designated to measure supply chain performance and logistics impact across the boundaries of individual organizations. It is at its growing stage of its life cycle and is enjoying the leverage of becoming the industry standard. The SCOR model has been developed and used widely in developed countries context. This research focuses on the SCOR model adaptation for the manufacturing industry in developing countries. With a necessary understanding of the characteristics, difficulties and problems of the manufacturing industry in developing countries' supply chain; consequently, we will try to designs an adapted model with its building blocks: business process model, performance measures and best practices.

***Keywords*—**developing countries, manufacturing industry, SCOR model adaptation

I. Introduction

AS a result of developments in information and communication technology (ICT) and transportation, globalization is now accepted as the normal way of doing business. In many industries, companies are adopting/considering a global view in their operations. The developing countries have also got opportunities to participate in the global supply chain. Developing countries are participating actively and more integrated into the world manufacturing market for the global nature of the retailing and manufacturing. So, the MIDC has been a part of the global supply chains for long time as a supplier of raw material and manufacturer of finished products (see figure 1). Currently, The manufacturing industry in developing countries (MIDC) are trying to access the different markets segment of the world starting from their local market to the complex and dynamic international market of USA and EU.

Even though the MIDC plays an important role as supplier and producer, the MIDC didn't get enough attention and are not studied well and seems to be isolated from global literature. At the same time, they have faced challenged in highly competitive markets because all manufacturers are trying to improve their product quality, cost and reduce their product delivery lead time to compete in the world market.

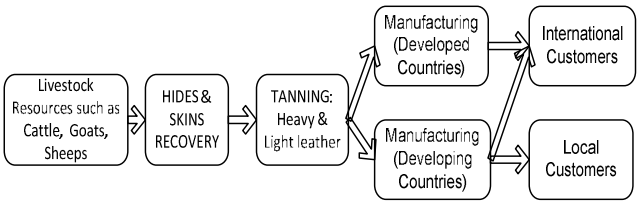

Fig. 1 Typical leather and leather products SC

In the current dynamic competitive market, it is supply chains (SC) rather than companies that compete [5, 12]. We cannot retain our higher competitive position by improving the efficiency of the products and process alone; the MIDC need to improve the efficiency of product, process, and SC [10, 29].

The key issue for improvement is measuring the performance of the activities, the processes, and the supply chain. [16] states that ``If you cannot measure it, you cannot control it. If you cannot control it, you cannot manage it [16]. If you cannot manage it, you cannot improve it.´´ However, the MIDC still has been practicing a backward and an independent performance evaluation on intra-organizations assessments. Traditionally, the focus of performance measurement has been on process operations within the departments' boundaries emphasizing on financial measures.

Lee and Bilington (1992) suggested performance measurement systems (PMSs) are necessary for firms to successful implement supply chain management (SCM) [22]. According to Neely et al. [26], "A Performance Measurement System is the set of metrics used to quantify the efficiency and effectiveness of past actions" and "it enables informed decisions to be made and actions to be taken because it quantifies the efficiency and effectiveness of past actions through the acquisition, gathering, sorting, analysis and interpretation of appropriate data". PMSs are considered as a tool to gain competitive advantages and continuously react and adapt to external changes [6].Recently, many consultants, academics, and professional have suggested new performance measurement approaches that support day-to-day operations and provides managers, supervisors, and operators with information that is both timely relevant. There are seven reasons why so many people become so interested in performance measurement in this day. These reasons are as follows: the changing nature of work; increasing competition; specific improving initiatives; national and international

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award; changing organizational roles; changing external demands and information technology [25].

There are a lot of researches and practices in the performance measurement in developed countries. Therefore, there is high need for systematic supply chain modeling of each player in the chain. For that we need to measure, benchmark and devise mechanism for improvement the whole supply chain. The necessitate for such type research also starts from the fact that the majority of existing studies have been conducted in developed countries, such as the US, Europe and Japan. A few attentions have been given to developing countries, such as African Countries. It is safe to conclude that little is known about the supply chain modeling and improvement to manufacturing firms in developing countries.

The paper is divided into five sections. In the first section, we introduce the research agenda. In the second section, we review the literature relating to SCOR model implementation. In the third section, we describe the problem definition. Methodology is presented next. In the fifth section, we conclude the research agenda.

II. Literature Review

In this article, we use performance measurement system (PMS) as a common term to describe any process that evaluates benchmark and improve the performance of an organization. The Supply Chain Operations Reference (SCOR) model is one of several performance measurement systems. Because we discuss only the SCOR model, we may use the terms interchangeably except when discussing particular aspects of the SCOR model.

Performance measurement system is critical to the success of the supply chain [8]. What particularly challenging are the successful design, selection and implementation of such a PMS with its business processes, performance measures and best practices for performance improvement. From a range of PMS, the SCOR model is viewed as a powerful tool to evaluate the performance of the supply chain.

SCOR model is the first one available designated to measure supply chain performance and logistics impact across the boundaries of individual organizations [2]. It is at its growing stage of its life cycle and is enjoying the leverage of becoming the industry standard [17]. This process reference model was also integrated with the well-known concepts of the business process reengineering, benchmarking and best practice (see figure 3). It is a model that links business processes, performance metrics and best practice. It was developed to be configurable and aggregates a series of hierarchical process components that can be used as a common language for enterprises to describe the supply chains and communicate with each other [17, 35].

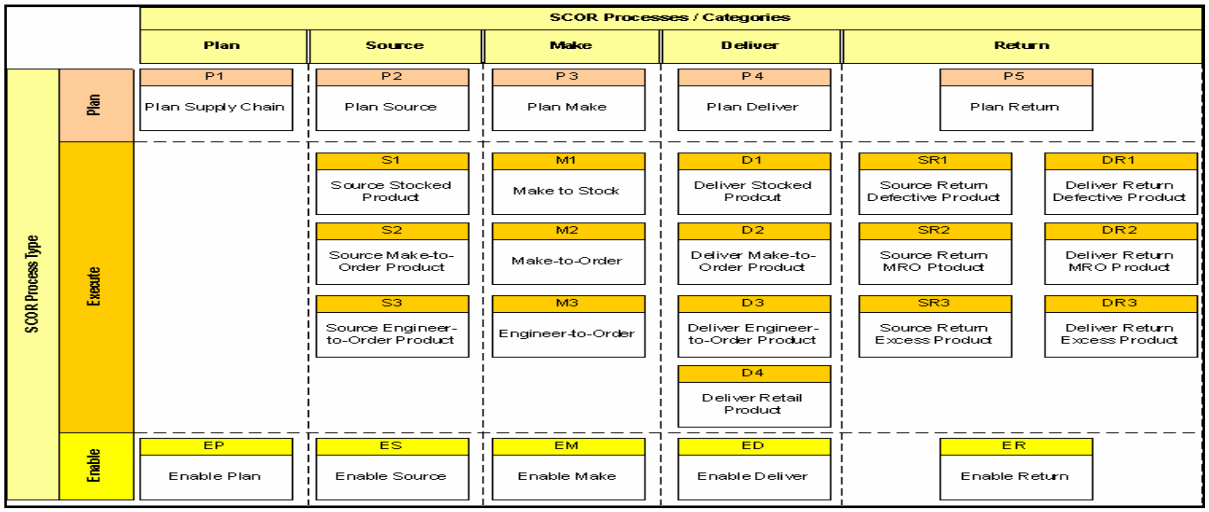

Fig. 3 Original SCOR V9.0 Model [15]

Companies in different industries which operating with different environmental conditions and factors have used the SCOR model in assist in designing and improving their supply chains. Han et al. [15] in their paper extend the SCOR model by integrating collaborative product commerce and project management to propose a comprehensive collaborative supply chain operations reference model (CSCOR). Schmitz, P., [32] used supply chain concepts using SCOR model to improve the production and delivery cycle times of new data by geographical information systems (GIS) units. Pundoor, G., and Herrmann, J.W., [30] in their research describe a novel supply chain simulation framework that based on the (SCOR) model. This framework is build simulation models that integrate discrete event simulation and spreadsheets.

Irfan, D., et al. [18] presents supply chain management efforts, key challenges and opportunities in Pakistan's industrial most successful sector and span of business 'from seed to smoke' by deploying the eminent supply chain operations reference-model. Fronia, et al. [11] in their research project have tried establishing an easy to use the framework

for aiding decision makers faced with this problem and at providing a solution for this classical optimization problem in supply chain management. For this purpose, the widely applied and accepted SCOR model was enhanced.

Samuel A., et al., summarizes the SCOR model, its benefits along with illustrative case stories and describes a computer-assisted tool to configure the supply chain threaded diagram per SCOR specification [31].

James H.B. has presented his research findings on SCOR model adaptation to service sector. The conversion of the SCOR "MAKE" process to service semantics creates a situation that is lost in translation. In fact, "MAKE" in the service industries does not have a direct translation. Another process that is not in any services setting is the "RETURN" process. One reason is that the physical return of a service is highly improbable. This is because once a service is rendered the service is consumed, thus invalidating the semantic and process descriptions in relation to services [19].

Laura [21] gives an overview of SCOR model, and analyses SCOR limitations for application in Telecom industry. Enhancement to the SCOR model and a SCOR based practical roadmap for SCM modeling and implementation are proposed and applied in a case study for Telecom industry. Bora et al. [3] investigates a way to derive KPI's for performance controlling of the supply chain's non-financial operations for a company following the SCOR model. Based on Stephens 2000 developed the SCOR model, Lai et al. [20] used the model to evaluate supply-chain performance. Lai et al. identified three dimensions of supply chain performance in transport logistics, which are service effectiveness for shippers, operational efficiency, and service effectiveness for consignees. Wang [36] related product characteristics to supply-chain strategy in order to analyze a product-driven supply chain selection, and adopted SCOR model level-1 performance metrics as the decision criteria for supplier selection.

In conclusion, a lot of efforts and research work has previously been done in the area of supply chain management improvement of manufacturing industries using SCOR model in developed countries and emerging countries but very limited or not in developing countries. The review of literature has shown that research works have previously been done utilizing SCOR model for improving performance different industry sector and enterprises in the European Countries, UK, the US, China, Brazil, Malaysia, Thailand, and Turkey. Very limited researches focused on developing countries and less-developed manufacturing industry to improve efficiency and effectiveness using the SCOR research model. Some were found but used the model for the performance assessment methods for initial data collection. In the literature reviewed, no records of prior research work on adaptation of SCOR model for manufacturing industry in developing counties – were found.

III. Problem Definition

Managing the supply chain within a single country is complicated due to various types of uncertainties in demand, supply and process. In the most developed economies, there are limited uncertainties in availability of the basic necessities for any kind of business such as power, ICT, roads, water, etc. However, in developing countries infrastructure is weaker and that poses several newer types of challenges that developed countries have not faced. It may even cause successful well tested strategies and models that worked in developed economies to fail.

A classical example is that of Wal-Mart which has an efficient network of cross docking facilities in the US that store minimal inventory in them while simultaneously enabling more frequent suppliers to the retailer stores [14]. When Wal-Mart went into operation into South America (Brazil) and Korea, it was very difficult to run a logistics system based on such-docking facilities and had to adapt its approach. The biggest challenge that Wal-Mart faced in Brazil was shipping products on time and getting them on the shelf. Delivering products for retailer customer on time is very difficult practice to implement in the bumper-to-bumper traffic in Sao Paulo like Seoul in Korea. Because Wal-Mart deliver their products by contract truckers its goods to retailer stores. Consequently, Wal-Mart lost approximately between $20 and $30 million in 1997 in addition to $48 million loss since its operation in South America in 1995 [34].

A lack of trust among and between manufacturers and retailers further hampers the creation of collaborative supply chain partners in Korea. Therefore, operating supply chains in developing nations often require firms to enable to tailor their existing supply chain strategies and models or develop newer ones for that environment [13, 14].

SCOR model is not a magic tool; it is somewhat difficult, resources and time-consuming to implement the SCOR model in manufacturing industries. Manufacturing industries in economically developed countries such as USA and EU are well-designed and supported by an outstanding infrastructure, which, in turn, enables smooth information flow and physical goods among supplier, manufacturer and customers. Lack of a well-developed infrastructure, which is a pre-condition for successful supply chain improvement, imposes additional pressure on implementation of SCOR model. If supply chain integration fails to create a net value for customers and shareholders, it is certainly doomed to fail its original purpose.

Craighead and Shaw [7] argue that supply chain performance is dependent on multiple capabilities: supply chain relationship capabilities, manufacturing firm capabilities, information and communication technology capabilities and operational capabilities. These four capabilities, along with final customer's desire, create and accumulate the value of the supply chain. Developed countries manufacturing industry has been in well-established and status in the four capabilities for SCOR model successful implementation. Almost all manufacturing industries in the developing country are in stage of very low and limited level of the four capabilities.

McCormack [24] have demonstrated the supply chain relationship types from the Discovery, Reuse and Knowledge Transfer (DRK) research that combine Manugistic´s supply chain compass level for the horizontal axis and supply chain maturity levels as the vertical axis. They have presented in

five stages of the relationships as shown in the figure 4. Most developed countries have achieved stage III and have become competent in today's market. The developed counties are also trying to achieve the requirement of tomorrow's market by employing SCOR model that requires innovation and differentiation of products.

The DCMI has very low and limited in the four mentioned capabilities. When we observe the supply chains relationship in developing countries, it is safe to say that they are between stage I and stage II [14]. Since, this stage of supply chain relationship is far from today's and tomorrow's market which SCOR model is created to address for. The DCMI should work hard to adapt for smooth implementation of the SCOR model in their scenarios that shows success in developed.

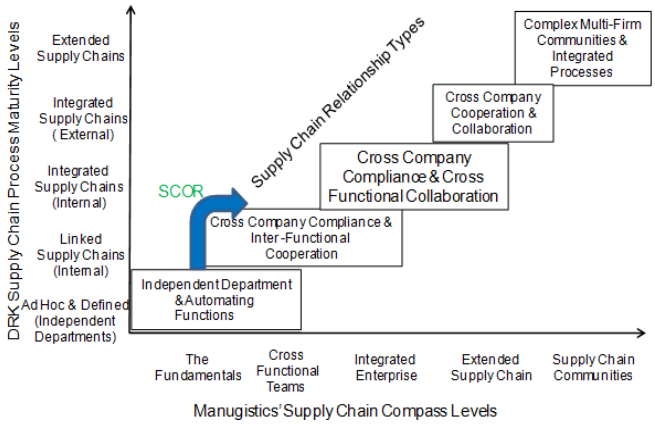

Fig. 4 Supply Chain Relationship (adapted from McCormack, K, 2001)

In recent years, the lack of process models, performance measures and best practices have been recognized as one of the major problems in process evaluation and improvements of a supply chain in the MIDC [1, 9, 18, 23]. Direct application of the SCOR model to developing countries is not advisable and may not wholly be satisfactory due to variations in environmental factors and conditions. Shewchuk (1998) says that "one size does not fit all," which means that there is a strong recommendation to find the best fitting supply chain management approach and model based on respective business activities and processes and its operating environmental condition and factors [4].

The MIDC is small and medium enterprises, which produce Food, Beverages, Textile and Leather products. From a technical perspective, supply chain operations have been manipulated on a manual or semi-automated basis with the support of basic or legacy applications. Lack of connectivity, limited resources, and skilled labor are still a challenge for direct application of the model. There is often the system of shortage of qualified and experienced professional employees, weak and lack of ICT as well as inexperience in the use of such technologies. Several cultural and organizational challenges face ICT base advanced manufacturing technologies' implementation (see figure 5).

Other considerable obstacles are related to poor supporting infrastructure of the developing countries. Poor infrastructure leads to unresolved issues that are demonstrated in late delivery and material shortage. Magder has shown this issue by investigating the Egyptian apparel industry in 2005 emphasized the need to improve the supporting infrastructure of the country to extend its export rate of industries such as: apparel, fresh food and flowers. This can be considered as the major barrier facing developing countries manufacturing industries to proceed in their upgrade [23].

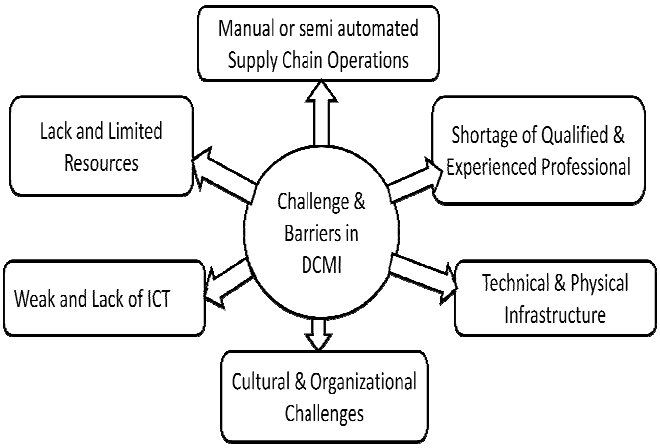

Fig. 5 Supply Chain Challenges and Barriers in the MIDC

The SCOR model has developed for a developed countries environment may not be suitable for DCMI. We need to find away largely on finding solution for adaptation to developing countries' environmental and local factors. For the intended task, we need to adapt the SCOR model to the developing countries manufacturing industry environmental factors and conditions. These factors have the different impact on the model that did not expect in developed countries environment and local factors as explained above with supply chain relationship level, culture, infrastructure, human and ICT capabilities' issues in the consideration for our adaptation.

Despite the evidence of the benefits that can be achieved, the adaptation of supply chain process model, performance measures/indicators, best practices and its associated technology in the DCMI supply chains has been slow over the past thirty years. This slow adaptation process is preventing DCMI from reaching the process efficiency which other's country manufacturing industries have realized and most importantly. It is affecting the sector competitiveness. The MIDC should adapt the SCOR model with its building blocks: business processes, performance measures and best practices to their local scenarios and conditions for their supply chain performance improvement. Therefore, the SCOR model adaptation is an important to the local environments and conditions for the successful application of the model.

Like many innovations in management, the SCOR model emanated from a developed country. It has been adopted by managers in other developed countries and is beginning to be adopted by managers in less-developed countries such as China; Malaysia; Turkey. However, it is not clear that innovations such as the SCOR model can be applied in the cultural context of a less-developed country. The attempt to do

so may encounter a variety of problems that occur when any performance measurement system (PMS) is applied in a different cultural context. The PMS may not be designed to include all aspects of culture that influence individual and organizational behavior in the less-developed country. Even if the PMS is designed appropriately, managers may not understand its importance or how to implement it. Even when managers understand its importance, they may be unwilling to act according to the incentives and constraints of the PMS because of individual or cultural bias. Industrial practitioners and managers in developing countries may face a lot of challenges to implement a PMS in an organization consisting of workers who have never experienced such a system before. Because of such barriers and challenges, the implementation of performance measurement systems such as the SCOR model in varied cultural scenarios is beginning to receive attention from researchers. This research will add to the few studies relating to implementing a PMS in a less-developed country.

We derive several conclusions based on analysis of the literature:

- The SCOR model faces challenges wherever it is attempted for implementation.
- Implementing the SCOR model in a developing country may encounter problems that are not encountered in developed countries.
- The problems faced when implementing the SCOR model in a developing country have not been widely studied.
- It is possible that the assumptions underlying the SCOR model system may be antithetical to the managerial culture and environmental context of the developing country.

IV. Methodology

A study will be carried out by review the available literature on SCM concepts, PMS, SCOR model, which helps in encapsulating various research outcomes in a structured manner. An industrial analysis will be carried out to assess how SCM is managed, measured, evaluated and improved in the manufacturing industry and detail investigation studies will be carried out in different organizations.

The industrial analysis and mapping the DCMI will be used to evaluate the manufacturing industry supply chain. The industrial analysis results will then be compared against the SCOR model process elements. Corresponding process elements will be chosen to regenerate manufacturing industry supply chain process elements, which will be based on the SCOR model concept. Then, there will be also a corresponding selection of suitable performance metrics and best practices for each process element to adapt the existing metrics or add new ones and similarly best practices to suit with the product characteristics (see figure 6).

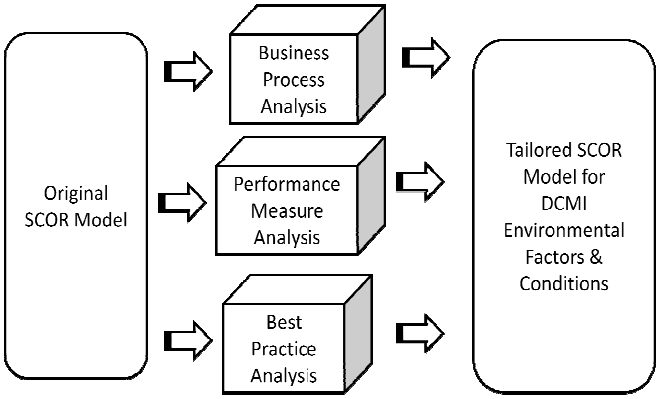

Fig. 6 Approach for Adaptation

V. Conclusion

The objective of this paper was to introduce a research agenda on the SCOR model adaptation and applying it for evaluating and improving manufacturing industry supply chain operations in developing countries. In fulfilling this objective, the following questions should be addressed:

- What are the differences between supply chain's characteristics in developing countries and developed countries with an effect on performance measurement?
- What are current practices and characteristics of the manufacturing industry supply chain in developing countries?
- What type of key performance indicators and best practices are available currently in developing countries manufacturing industry supply chain?
- What type performance indicators or metrics and best practices are applicable in the MIDC supply chains in future according to different market maturity conditions and scenarios (Figure 7)?

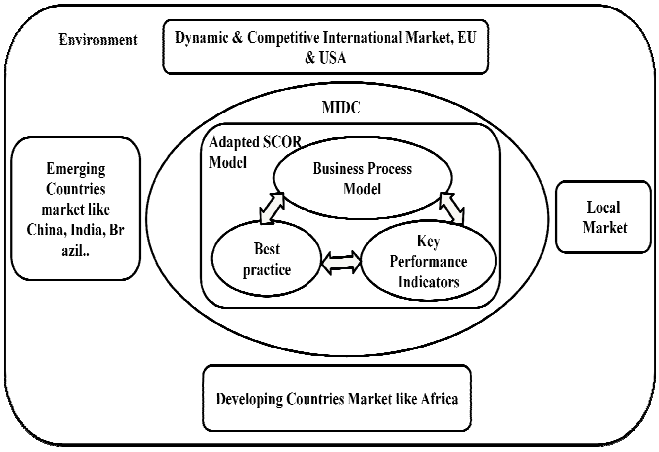

Fig. 7 Adapted SCOR model and Market

Finally, the result of adaptation will be established of business process model and best practices for DCMI. At the same time, each process element included suitable performance metrics to evaluate supply chain performance.

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