

Supply Chain Information Systems Technologies and Management Strategies in Northern Minnesota

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ABSTRACT

Improving supply chain (SC) operations is one of the goals that all organisations strive to achieve. Enhancing Supply Chain Management (SCM) will help organisations improve efficiency, generate more profit, and reduce business expenses. High value customers and suppliers can be added or retained by maintaining a reliable SC information system. Using SC information systems is considered as best practices in the management field. The more reliable and efficient SC, the more profits a company can generate and the easier to compete globally. This research aims to explore Northern Minnesota enterprises' strategies, practices, and information systems technologies that are used for managing their supply chains. An online survey is used to collect information on three questions: What are the major challenges with the use of information systems for SCM in Northern Minnesota? What is the level of satisfaction of current strategies and practices that are used in SCM? What are the actual needs for the effective use of SCM information systems? The reliability of the survey has been insured by conducting a polite study of the survey by three companies. SPSS program is used to analyse the collected data. Descriptive analysis is used to present and explain the results. This research may help managers to determine the needs to improve their supply chains. This research can be used as a benchmark and can be implemented in other areas.

Keywords: Supply Chain Management, Strategies, Information Systems Integrations, Bemidji, Northern Minnesota

INTRODUCTION

Tremendous research studies have been conducted in the last decade to investigate the best practices in Supply Chain Management (SCM). Researchers and organisations focus their efforts to identify strategies and techniques to improve SC efficiency and customers' satisfaction, and reduce cost (Singh & Pandey, 2015). Involving different partners (e.g. customers, suppliers etc.) and activities (e.g. reverse logistics) in SCM makes it a complex environment to be managed and this complexity increase managers' uncertainty in making decisions.

Implementing an efficient SCM requires considering different factors. First, companies need to implement integrated information systems to better collect SC data and monitor the internal and external activities such as raw material, inventory, purchasing, distribution, delivery, production process, and vendor (Arnold, Chapman, & Clive, 2011).

Globalisation is another factor that should be considered. Organisations are not competing locally anymore; their customers and suppliers are from all over the world and

therefore establishing efficient information systems to compete globally is required.

Third, sharing information through electronic systems will enable companies to achieve real-time information flow along their supply chains partners. Digital technologies (e.g. IoT, cloud-base applications) are used to assist firms build stronger relationships with local and global customers and suppliers. By using these information technologies, companies are increasing the level of sharing important information with other parties inside and outside an organisation.

Other traditional factors are included in the following section to cover all important aspects of the SCM.

LITERATURE REVIEW

Supply Chain Management Pillars

Forrester (1958) identifies the pillars of SCM field as "Management is on the verge of a major breakthrough in understanding how industrial company's success depends on the interactions between the flows of information, materials, money, manpower, and capital equipment".

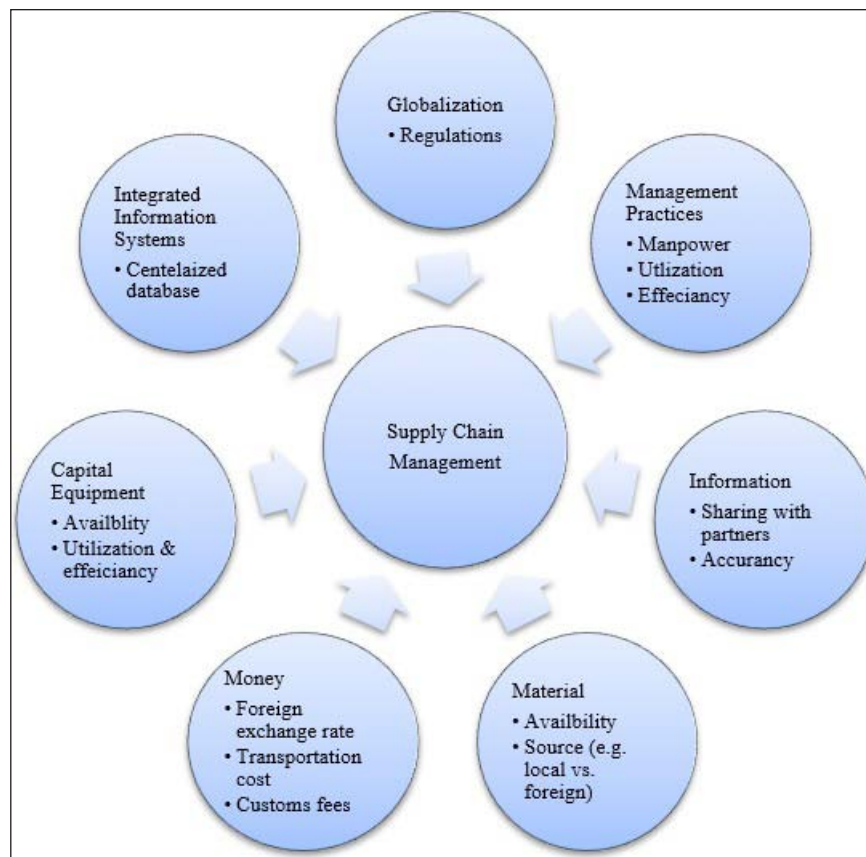


Fig. 1. Factors Impact Supply Chain Management

Forrester provided some of the factors that affect the performance and efficiency of managing SC (e.g. exchange rate as explained in Magara, Oloko, & Nyangau, 2013). The globalisation and integrated information systems are added to these factors to make it more comprehensive model as summarised in Fig. 1.

Supply Chain Management Definition

The Council of Supply Chain Management Professionals (2015) considers SCM as “The planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners which can be suppliers, intermediaries, third party service providers, and customers.”

There are a lot of opinions about SCM, but it can be summarised by three opinions. The first opinion is from Monczka, Trent, and Handfield (1984) who believe SCM should be defined based on the integration between different parties. They defined SCM as a concept “whose

primary objective is to integrate and manage the sourcing, flow, and control of materials using a total systems perspective across multiple functions and multiple tiers of suppliers”. Other researchers, La Londe and Masters (1994) classify SCM according to building relationships between two or more parties “the development of trust and commitment to the relationship” between two or more firms. Finally, Stevens (1989) considers that SCM system should be managed to address customers’ needs. He believes that “the objective of managing the supply chain is to synchronize the requirements of the customer with the flow of materials from suppliers in order to affect a balance between what are often seen as conflicting goals of high customer service, low inventory management, and low unit cost.” Stevens emphasizes on the importance of customers’ relationships with a firm, and how it is important for a firm to improve this relationship to be stronger.

From these definitions, in order for a company to implement an efficient SCM, four characteristics should be addressed:

1. Managing, monitoring, and controlling the flow of material efficiently



Fig. 2. Supply Chain based on the flow of material and information

2. Strengthen external relationships with customers and suppliers
3. Empowering internal parties.
4. Forming cross-functional teams to make a balance between material processing, customers' satisfaction.

Supply Chain Types

SC can be classified based on the flow of material and information. For example, Christopher (1992) classifies SC partners into three categories: upstream, downstream, and the activities that connect the first and second categories. He defines SC as “network of organisations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services delivered to the ultimate consumer”. Fig. 2 explains these categories. The two-side arrow refers to the flow of material and information that could be going into both sides: from upstream to downstream or vice-versa (Abdulkader, Bhatt, & El-Mekkawy, 2015).

Other research studies divided SC into two types. The first type is the external SC which involves companies' relationships with customers and with suppliers. Also, it may include external firms as a third party. The internal SC is the second type, which involves the relationship between different units within an organisation. Fig. 3

shows the internal and external types (Hicks, 1999; Dobler & Burt, 1996).

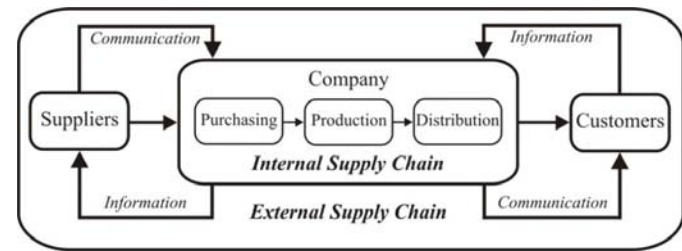


Fig.3. The Internal and External Supply Chains (Hicks, 1999)

Another researcher was concerned with defining SC in more depth by dividing SC into three degrees of complexity (Mentzer, 2001). These three degrees are a direct supply chain, an extended supply chain, and an ultimate supply chain. A direct SC is when the flow processes of products, services, and information is divided between three parties, the firm itself, a supplier, and a customer. Fig. 4 shows the first level of SC.

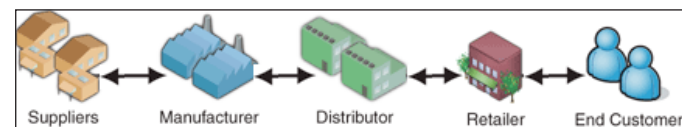


Fig.4. Direct Supply Chain

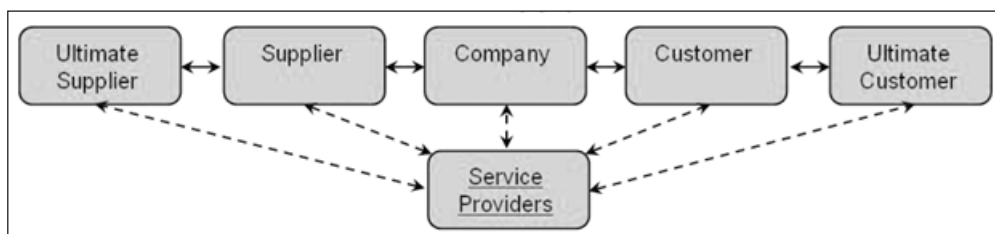


Fig. 5. Extended Supply Chain (SCM Globe Corp, 2014)

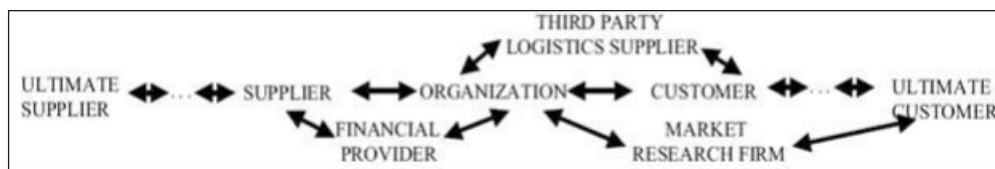


Fig. 6. Ultimate Supply Chain (Mentzer, 2001)

The extended SC is when the flow process of products, services and information is divided between “suppliers of the immediate supplier and customers of the immediate customer (Mentzer, 2001).” Fig. 5 Shows the Extended Level

The ultimate SC level is when all organisations shared in managing the flow processes of products, services, and information “from the ultimate supplier to the ultimate customer (Mentzer, 2001).” Fig. 6 summarises this type of SC.

Integrated Information Systems in Supply Chain Management

Implementing efficient and reliable SCM information systems can lead to goals that help organisations success and compete in the global marketplace (Varma & Khan, 2014). The efficiency of a SC depends on the ability of managing the flow of materials, information, and money. Managing this flow is supported by information system (Turban, Rainer, & E. Potter, 2004). The most encouraging factors for implementing information system in SCM are: reduce costs and increase customers’ satisfaction (Kumar, Saxena, & Agrawal, 2012).

The A.T. Kearney Management Consulting Company conducted a study about challenges in SCM. The main SC challenge that has been found in the study is the cost. It has mentioned that “supply chain costs can represent more than eighty percent of the cost structure in a typical manufacturing company” (Kearny, 2008). Most of the costs came because there were losses in sales regarding insufficient customer service or sold out products. Also, the study concludes that “for every dollar of inventory in a system, there are one to two dollars of hidden supply chain costs: working capital costs, asset costs, delivery costs, write downs and so on” (Kearny, 2008). The study emphasizes on the importance of implementing SCM information systems to improve SC efficiency. If a company invested in implementing information systems, it can improve the efficiency of their SC and it

can “achieve savings equal to three to seven percent of revenues compared with their median performing peers” (Kearny, 2008). A similar study conducted by IBM (2010) found the cost containment is number one issue in SCM along with other factors such as visibility, risk, customer intimacy, and globalisation.

Another study estimated that “42 days could be removed from the typical grocery supply chain, freeing up \$30 billion in current costs, and reducing inventories by 41 percent” (Mentzer, Fundamentals, 2004).

Implementing integrated electronic information systems between SC partners is necessary to meet the future SC challenges and will help companies achieve the high performance efficiency. The SC information systems help organisations compete in the global market by reducing cost, improving services, maintaining sufficient inventory level, and reducing backlog (Bhatt, 2000). All these factors will lead to build stronger relationships with customers and suppliers.

Another factor encourages companies to implement integrated information systems is improving communication with partners (e.g. customers, suppliers etc.). Efficient communication will help managers improve customers’ satisfactions (Stevenson, 2014). For example, customers can use companies’ website to order customised products. The information entered by the customer on the website can be shared with different suppliers and departments in the company. The information can be shared with the suppliers who will better plan for the future demands. Allowing customers to manage their orders help companies to move from the customers’ satisfaction level to customers’ loyalty level because of better understanding for the customers’ needs. Fig. 7 demonstrates the different levels of customers’ satisfaction. This chart assists the reader understand that building partnership with customers is the ultimate goal to build an efficient SC (Singh H, 2015). This partnership can be achieved by implementing SCM information systems that integrate customers’ information with the different departments in a company.

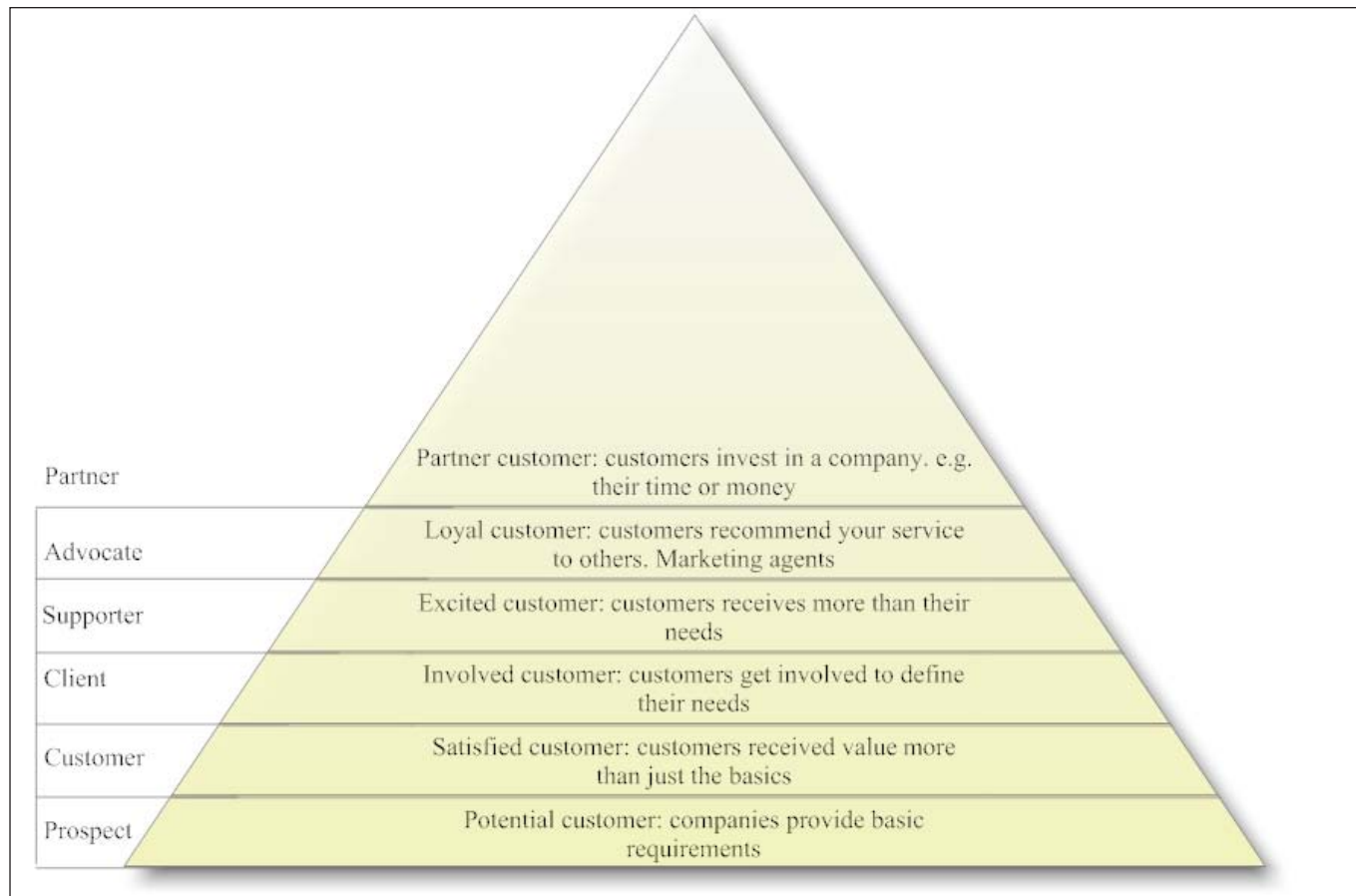


Fig. 7. Customers Satisfaction Levels

Improving customers' satisfaction can be achieved by reducing backlog and maintaining sufficient inventory levels. One way to achieve this goal by using inventory buffers alert feature that exists in every SC information system. The integrated SC information system means connecting companies' SC information system with suppliers' systems. The alert feature is activated when inventory levels fall under pre-defined certain level, warning messages will be sent to SC manager and suppliers who both will have more time to prepare for future orders and avoid backlog or any risk associated. Using such feature requires integration in information systems between the SC partners and this will result better planning, shorten the delivery time, and improve customers' satisfactions.

Last but not the least, waste can be reduced using efficient SCM information system. Most SCM information systems these days have monitoring functions that will help managers determine areas of improvements in the operations. Using these functions will enable companies reduce waste by maintaining sufficient levels of inventory (Singh, Sohani, & Marmat, 2013). Managers will order

products when needed and they will not have any extra or unneeded material.

There are a lot of information systems that are used to manage, monitor and improve the SCM operations. Examples of the systems can be Material Requirements Planning (MRP), Manufacturing Resource Planning (MRPII), Enterprise Resource Planning (ERP), Supplier Relationships Management (SRM), and Customer Relationships Management (CRM). These days, the most powerful technique in management is technology (Mentzer & Kahn, 1996; Mavengere, 2014).

Companies are using information systems technologies to coordinate activities and share information with their SC partners including upstream, internal processes, and downstream. For example, one of the most recent SCM information technologies is adopted by Walmart is the wireless technology Radio Frequency Identification (RFID). The RFID technology is supposed to be able to eliminate many of the problems with SC efficiency. It helps in tracking assets by using electromagnetic waves. RFID helps companies to improve tracking processes,

processing information and customer relationships (Parvatiyar & Sheth, 2001). Example on real-time information sharing and systems integration between the supply chains partners is implementing Cisco's e-hub solutions that allow multiple organisations interact and exchange information in a SC (Kaplan & Sawhney, 2000). Using these solutions, suppliers can have benefits such as sharing safety inventories (Lee & Whang, 2001).

STATEMENT OF THE PURPOSE

The study aims to investigate the SCM practices and information technology systems in rural area in Northern Minnesota. Strategies and practices for managing SC are explored. The use of information systems for SCM in Northern Minnesota is investigated. This study analyses the major challenges and developments, level of satisfaction of current practices, and determines the needs of enterprises for the effective use of SCM information systems. The result of this study may help managers and policy makers in the State of Minnesota to determine the needs to improve SCM performance in the area. It has been assumed that the target populations of this study are representative of the industry located Northern Minnesota.

METHOD OF INVESTIGATION

There are different techniques are used in this study, a literature review, a questionnaire survey, and phone interviews. Previous studies are used to generate list of different information systems that are utilised for SCM. Reviewing the literature review helped in creating an online questionnaire to gather data from enterprises on issues related to challenges, benefits, and development on the use of SCM information systems. The survey has been sent to 120 companies that are located at Bemidji, MN. There are 27 of them who responded to the survey. Bemidji is a city in Northern Minnesota in the US with population of about 14500 (U.S. Department of Commerce, 2015). The survey is sent to the operations and technology managers of those companies to partake in the research. Also, the subject names have been collected from the local yellow book. An Institutional Review Board (IRB) considered the study as an exempt study. The participants voluntarily participated in the study.

After collecting data, the analysis process started using descriptive techniques. Figures are used to give a better understanding of the results.

The Structure of The Online Questionnaire

An online survey consists of 17 closed questions designed based on best practices from the previous studies and feedback from industry. A trial study for the questionnaire was conducted to collect the participants' feedback regarding the questionnaire. Three companies were randomly chosen for this refinement process. The questions were modified based on the feedback that is received during the pilot study. About 10-15 minutes are needed to finish the survey that consists of five parts that aim to identify:

1. The demographics of the companies that are participated in the study.
2. The plans for managing supply chains.
3. Current information systems benefits and challenges.
4. The future SCM strategies and information systems.
5. The factors and measures that will help improve SCM.

Table 1 summarises the questions in the survey.

FINDINGS

Companies Profiles

The majority of the participated companies (54%) are manufacturing companies. Fig. 8 shows the sectors of participated companies in the study. This result gives an indication that more manufacturing business in the area than service companies.

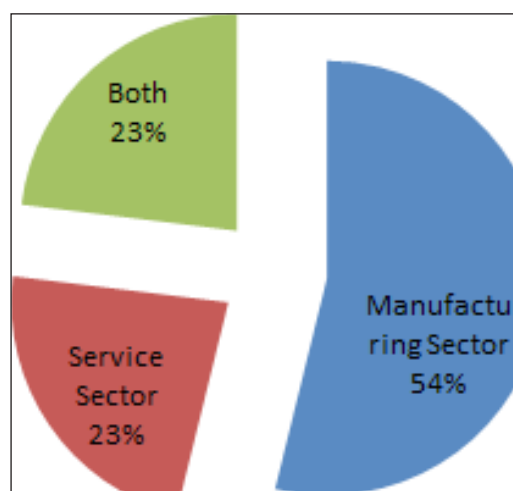


Fig. 8. The Participated Companies' Profile

Table 1. Questions Used in the Survey

Demographic Information	
• Business Type	• Is your company part of a group?
• Company Size	• Are there other branches for your company outside the state or the country?
Strategic Planning for Managing Supply Chains	
• How do you evaluate logistical customer service?	• How do you manage your supply chain?
• How successful do you think is your company in managing its SC in general?	• Which of the following do you think that your company needs to do in order to manage its SC better?
• Does your company have a separate logistics department?	• Does your company have a clear logistics strategic plan?
• Does your company provide SCM courses or training programs to the employees?	
Current information Systems, Benefits, or Problems	
• What types of information systems are currently in use in your company to support SCM?	• How much did you actually benefit from using these systems?
• In what level is your company facing the problems below when using information technology systems?	
Future Plans	
• What types of information systems do you plan to implement in the near future (within the next 2 years)?	
SCM Policies and Measures	
• How satisfied are you with the current public policy regarding SCM and IT?	• How important are the following future measures for supporting your company effort in SCM and IT?

Companies' Size

The size of participated companies is shown in Fig. 9. The majority of the participated companies' size is 1-99

employees. Most of the businesses in the Bemidji area are small-to-medium size.

Fig. 10 summarises the strategy for evaluating customer service. The most effective strategies used by the

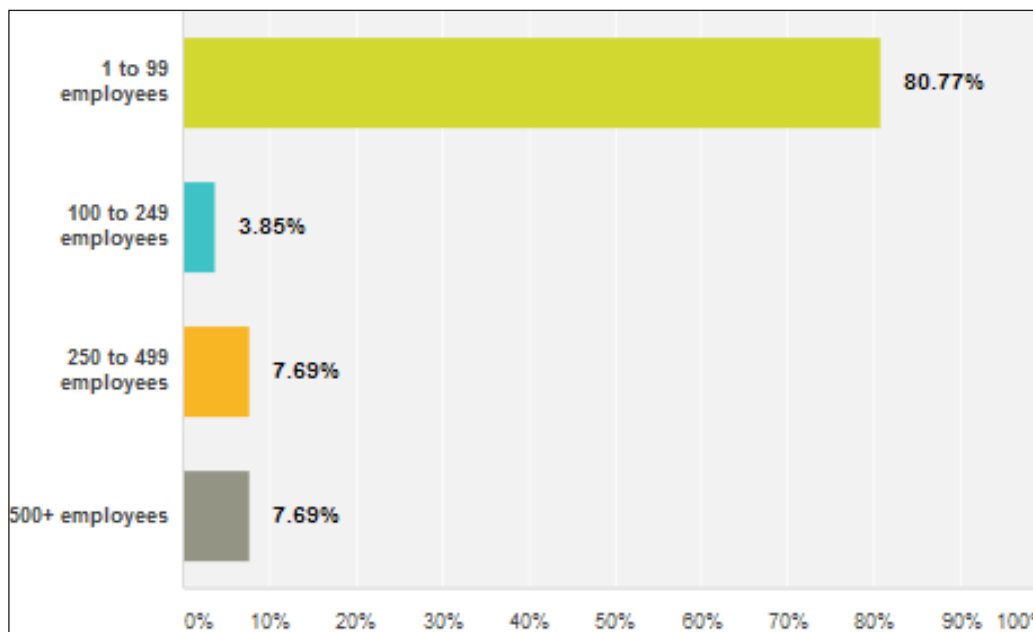


Fig. 9. The Size of the Participated Companies

companies are total cycle time, customer feedback, and percent of correctly delivered products/services.

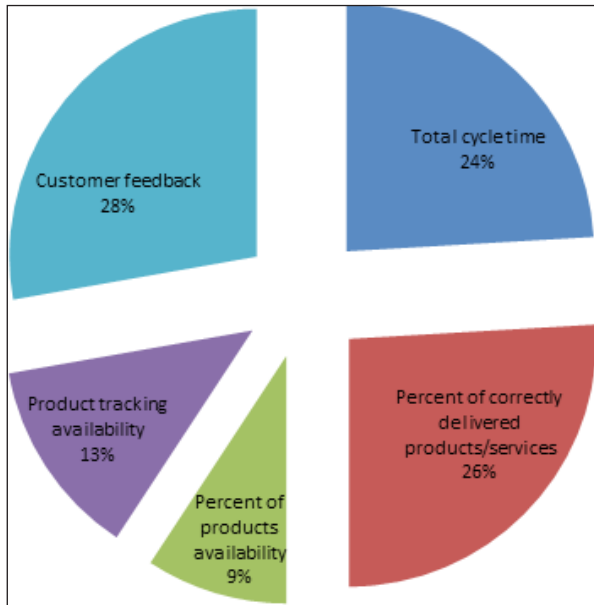


Fig. 10. Strategies Used for Evaluating Logistic Customer Service

Supply Chain Management Strategies

The top three techniques used for managing the SC are: close partnership with suppliers, close partnership with customers, and outsourcing. Benchmarking is not an

appropriate strategy to be used by most of the companies. The result of this question is summarised in Fig.11.

The majority of the companies (56%) believe that they are successful in managing its supply chain.

In order to manage the SC better, the companies claim that their companies need partnership with few suppliers and close partnership with customers. Fig.13 summarises the result for this question. The result confirms that the companies value the relationships with suppliers and customers. The companies consider the third party logistics strategy as not appropriate for them. This result should be investigated in future research to understand why the companies in the area do not consider 3PL as an appropriate strategy for them.

The three charts shown in Fig. 14, 15, and 16 are related to the issue that the majority of the companies have problems with developing strategic plans for their SCM. It has been found that the majority of the companies (68%) do not have a separate logistics department. Not having a specialised people or department may affect their SC performance in the future. Fig. 15 demonstrates that the majority of the companies do have a clear logistics strategic plan. From Fig.16, the majority of the companies believe that they do not provide SCM courses or training programs to their employees. This confirms the results that the companies in the area do not use benchmark or 3PL strategies that require having specialised employees to develop plans to improve the SCM performance in the long term.



Fig. 11. The Current Supply Chain Management Strategies

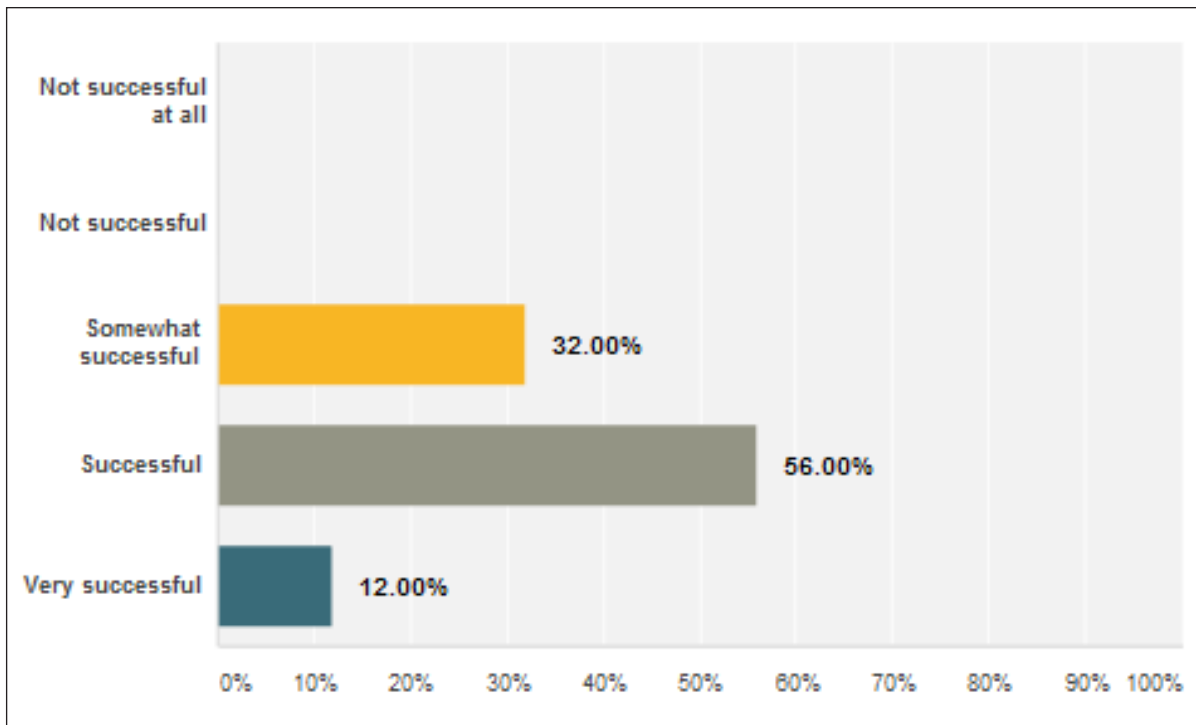


Fig. 12. The Success of Managing SCM

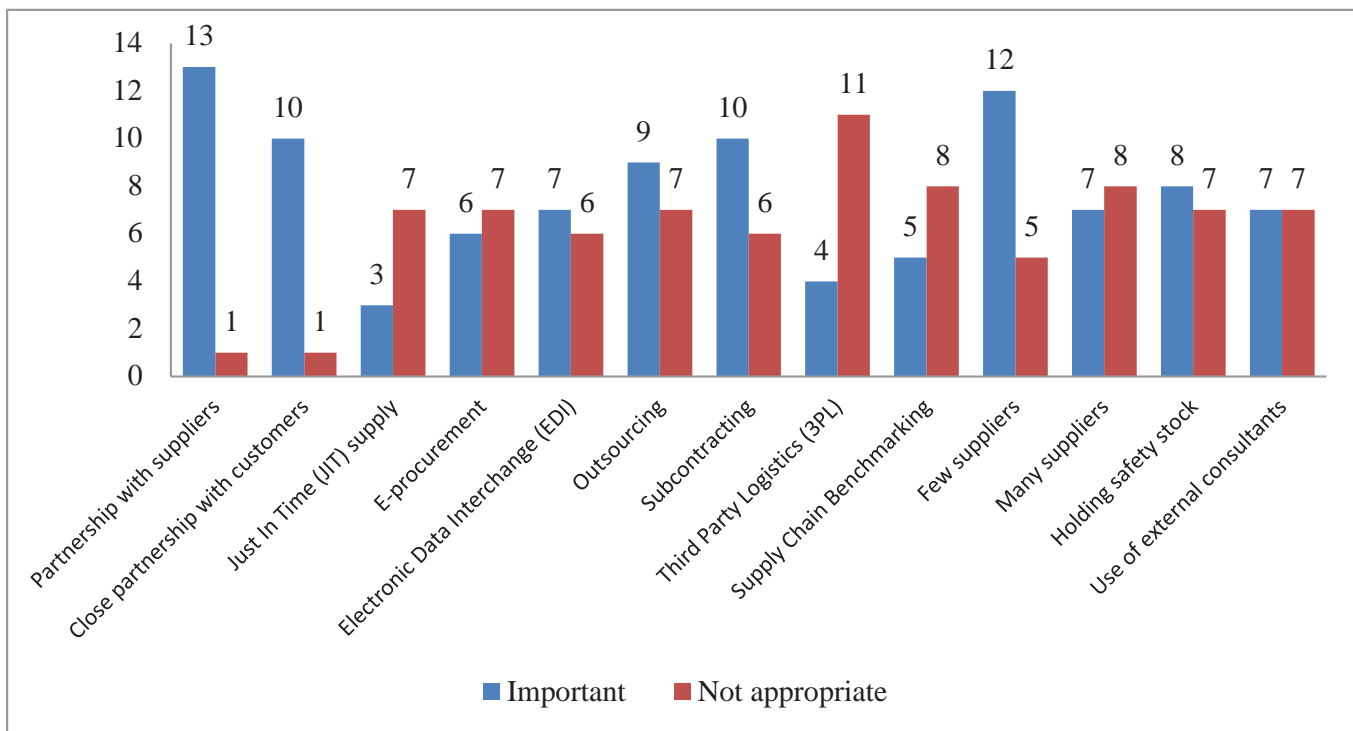


Fig. 13. Strategies that are Important to Better Manage the SCM

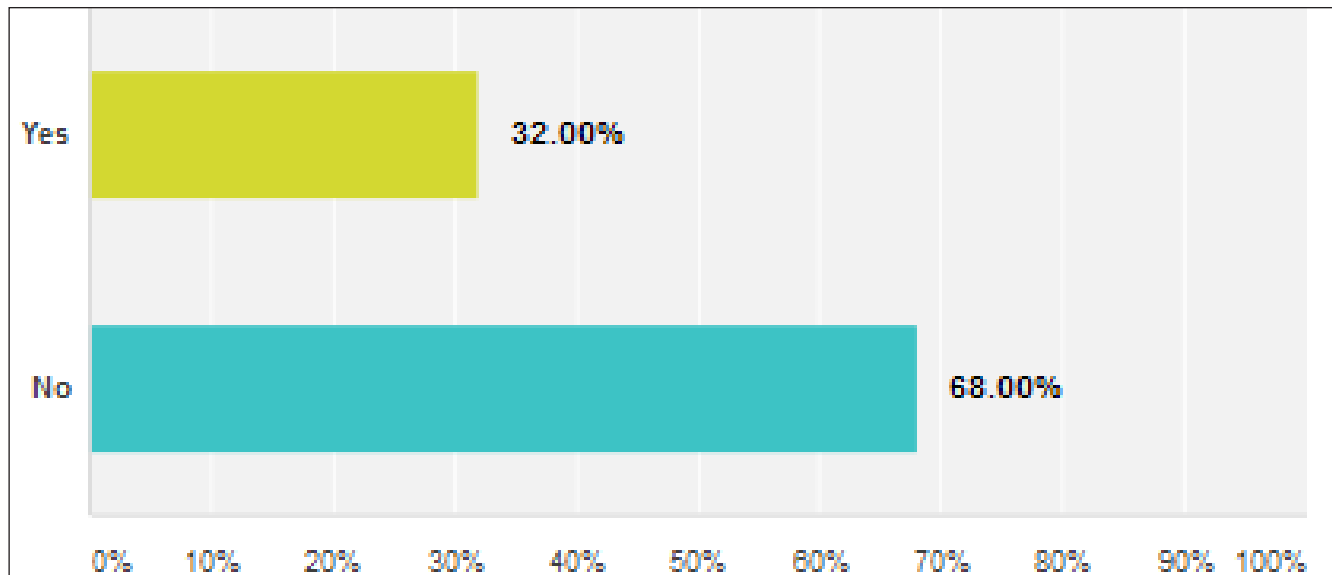


Fig. 14. Separate Logistics Department

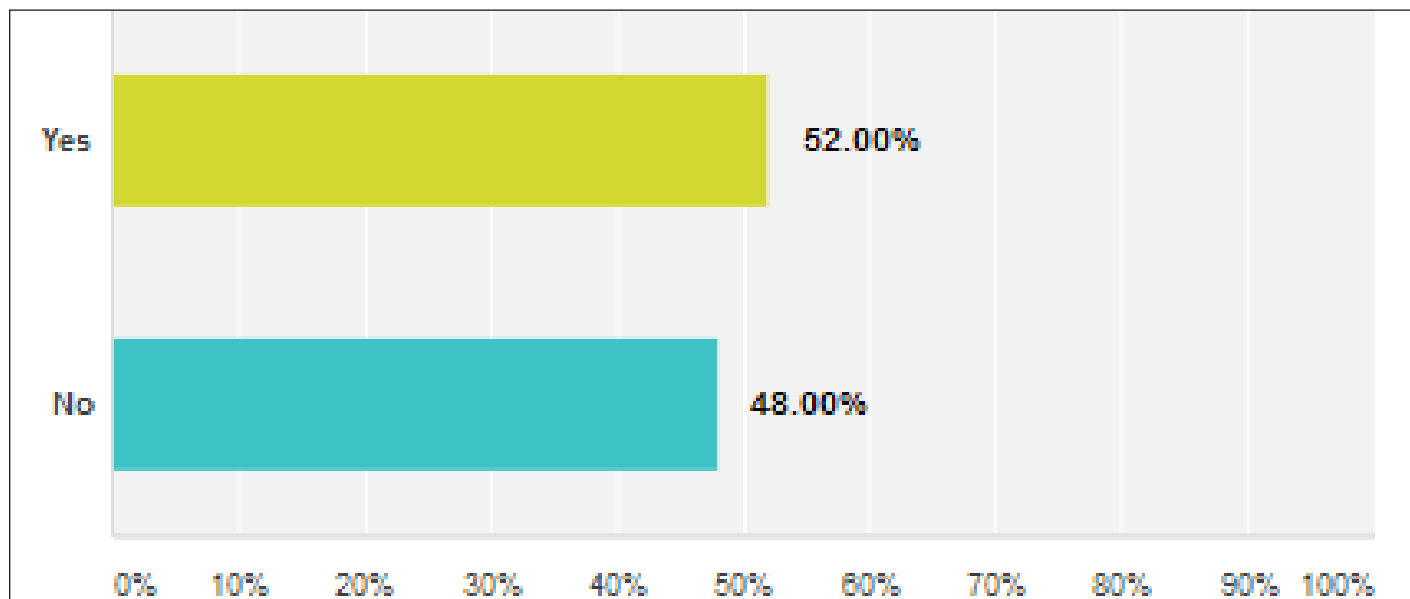


Fig. 15. The Clarity of Logistics Strategic Plan

Current Use of SC Minformation Systems

As displayed in Fig. 17, the most popular four technologies that are currently in use to manage the SC are: bar coding, just in time, warehouse management system (WMS), and material requirements planning (MRP). None of the companies is using the Radio Frequency Identification (RFID).

Benefits of Using the LCSM information Systems

It has been asked the participated companies that are using SCM information systems about the benefitsof using the systems. The companies consider that using the SCM information systems benefited them a lot by

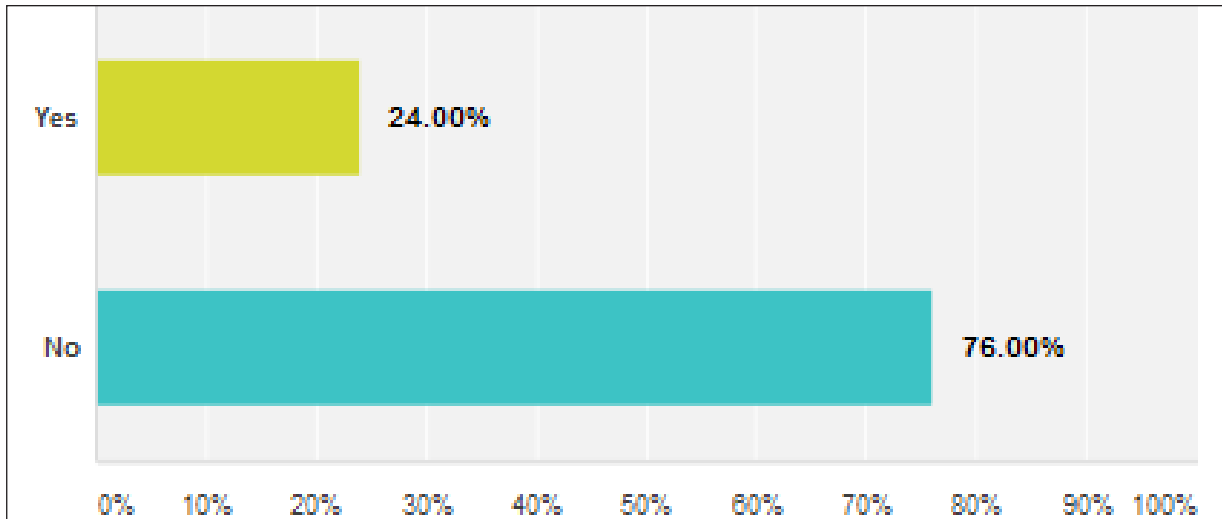


Fig. 16. Providing SCM Training to Employees

achieving: better operational efficiency, reduce lead-time in production, cost saving, more accurate costing, and flexibility. The results are summarised in Fig. 18.

systems: resources shortages i.e. no maintenance and update, skills shortages, hidden cost, and integration with existing system.

Problems of Using the SCM Information Systems

Future Use of SCM Systems

Fig. 19 shows that the companies are facing the following serious problems when using SCM information technology

The most three popular systems that are used by the companies are planning to implement within the next 2 years are: customer relationships management (CRM), supplier relationships management (SRM), and warehouse

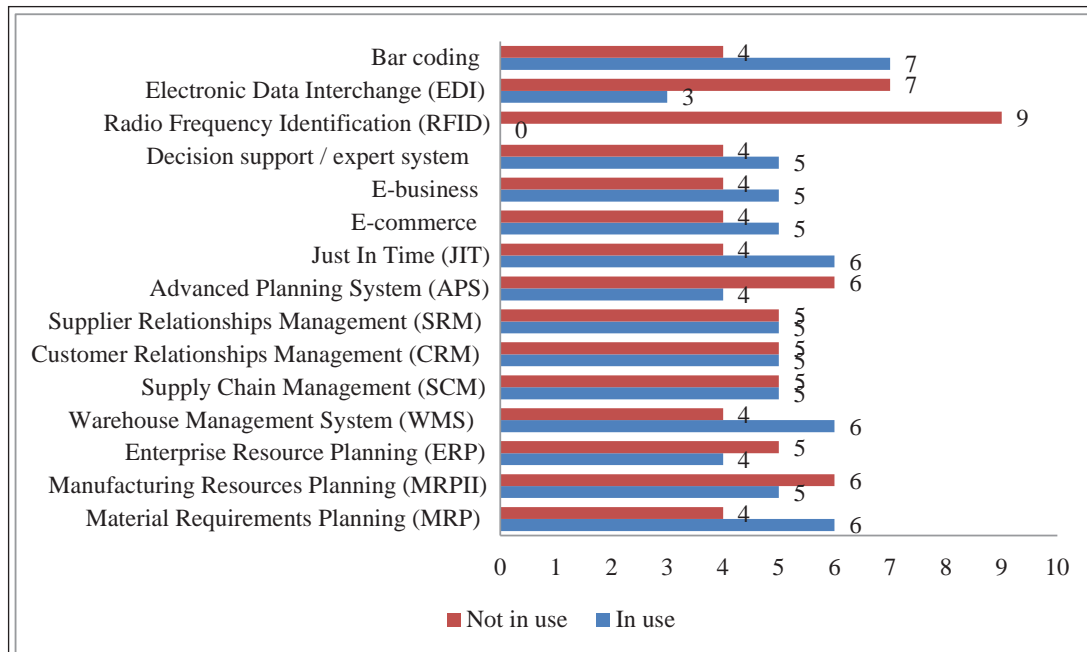


Fig. 17. Current Use of SCM Information Systems

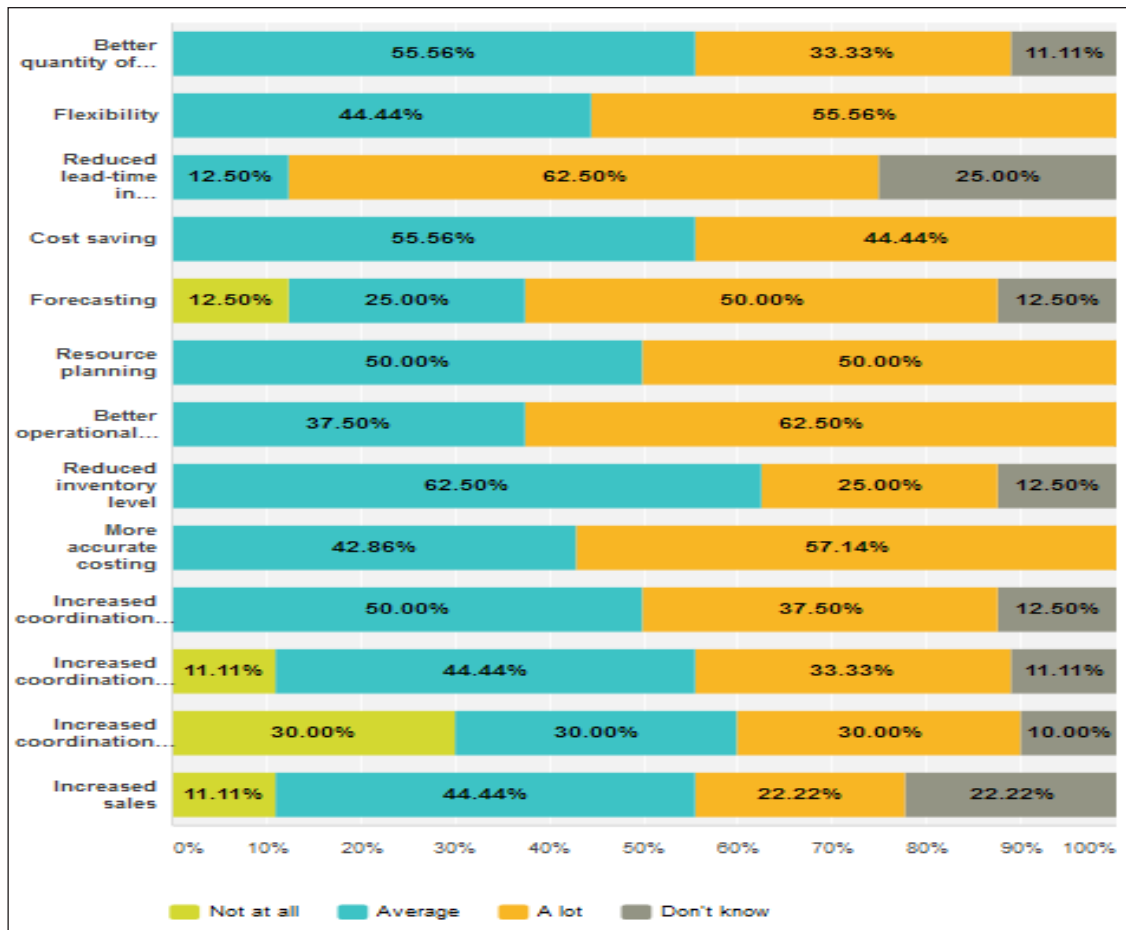


Fig. 18. The Benefits of Using the CSM Information Systems

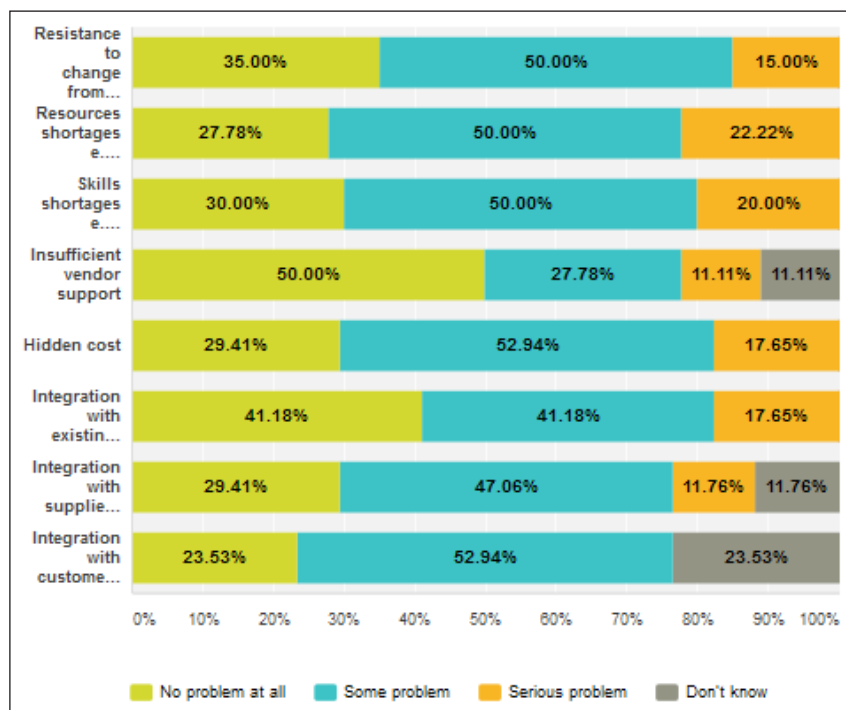


Fig. 19. Problems of Using SCM Systems

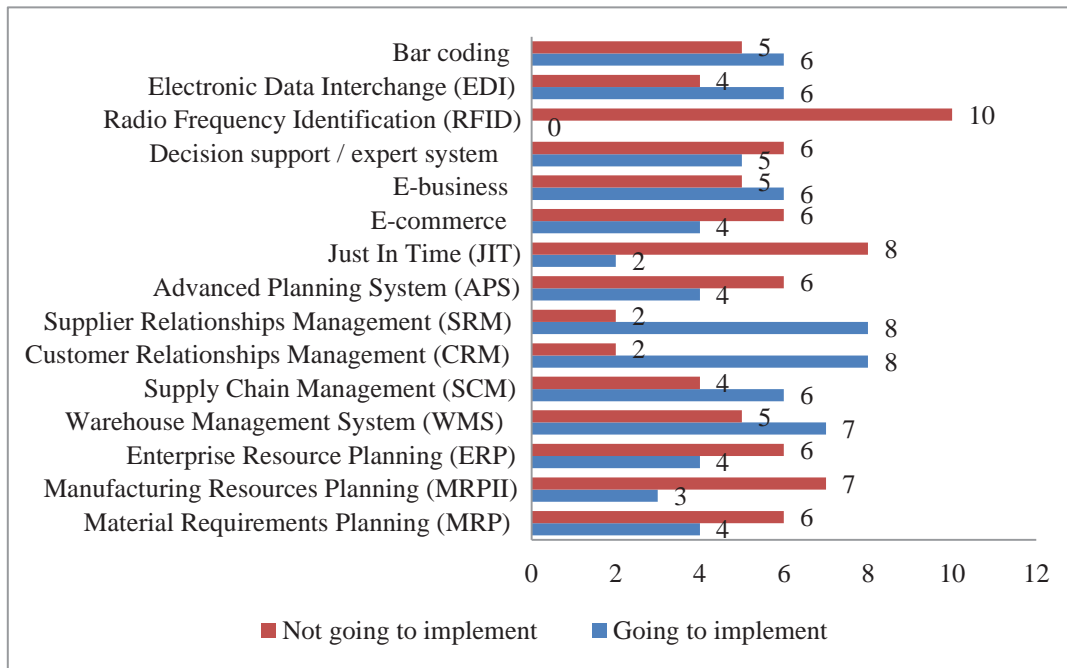


Fig. 20. Future Use of SCM Systems

management system (WMS). None of the companies are planning to implement Radio frequency identification (RFID) within 2 years.

Policies Regarding SCM

Fig. 21 summarises the companies’ satisfaction with the current public policy regarding SCM. The majority of

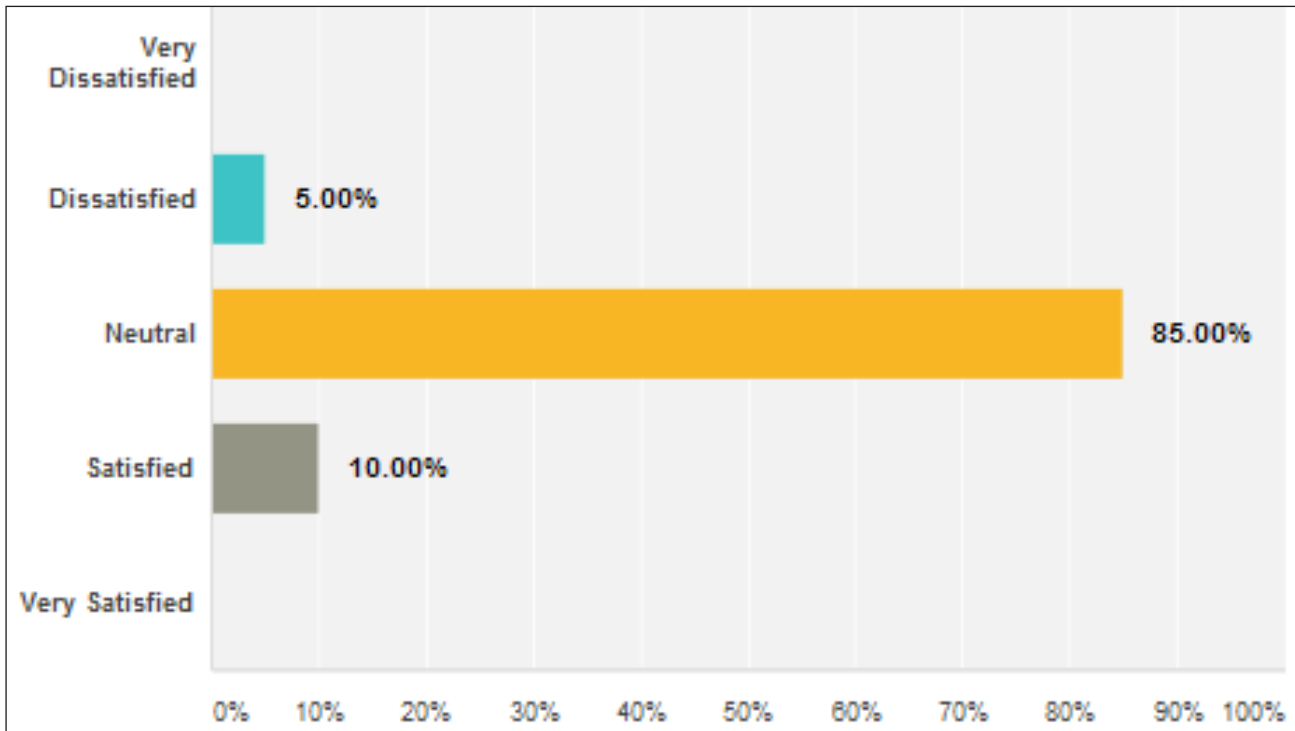


Fig. 21. Satisfactions with Current SCM Policies

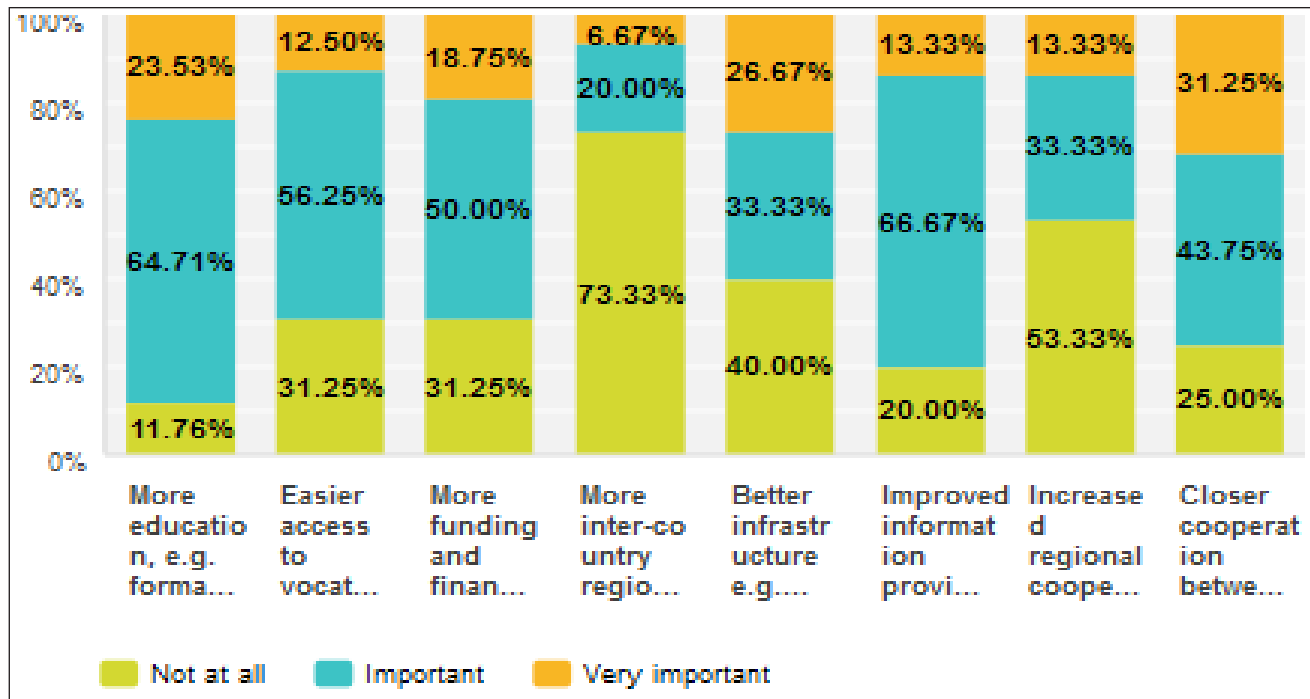


Fig. 22. Measures to Improve the Future of SCM

the companies are neutral or satisfied with current public policies.

Measures to Improve the Future of SCM

Fig. 22 shows that the most three important measures for supporting the companies' effort to improve their SCM: more education, improved information provision, and closer cooperation between companies and government.

Summary of the Findings

This section presents the finding of the current and future status of the SCM in Bemidji, MN. These findings can be summarised in the following points:

- ◆ The companies are focusing on developing a better relationship with suppliers and customers.
- ◆ The companies currently are focusing on building more relationships with few suppliers.
- ◆ The majority of the companies do not have a separate logistics department.
- ◆ The majority of the companies claim that they have a clear logistics strategic plan.

- ◆ The companies do not provide enough training to their employees.
- ◆ The companies agreed that bar coding, warehouse management system (WMS), and material requirements planning (MRP) systems are currently in use for their SCM.
- ◆ The surveyed companies agreed the systems are using the systems are helpful in achieving more accurate costing and better operational efficiency.
- ◆ The surveyed companies agreed that the systems are not efficient in improving coordination with suppliers or customers.
- ◆ The companies are facing the following serious problems when using SCM technology systems: resources shortages, skills shortages, hidden cost, and integration with existing systems.
- ◆ The companies agreed that implementing customer relationships management (CRM) is important to meet the future SCM challenging.
- ◆ None of the surveyed companies are going to implement RFID technology in the coming 2 years.
- ◆ The majority of the companies are neutral or satisfied with current public policies.

- ◆ More education, easier access to education, improving information provision, and closer cooperation between companies and government are important measures for improving the future of SCM for the companies.

DISCUSSION

Based on the results of this study, it can be found that the companies are currently focusing their partnerships on dealing with suppliers more than customers. Thus, it can be said that building strong relationships with suppliers has been more important in their SC than building strong relationships with customers. Also, like this relationship means that the companies are focusing on the production more than the market orientation. In order to be more successful in the future, these companies should focus on understand the market needs and build stronger relationships with customers.

In the future, companies will be strengthening their relationship with their customers by implementing customer relationships management (CRM) system to meet the future SCM challenging. This indicates that in the future, the companies are shifting from production focus to customer ad market focus. This demonstrates their understanding to the importance of the customers' satisfaction.

The 3PL strategy is one of the most important strategies that are used in both local and international supply networks around the world (Wasatkar & Jadhav, 2012; Ketikidis, Koh, Dimitriadis, Gunasekaran, & Kehajova, 2008). The result of the survey indicates that only 5% of the Bemidji area companies are partnering with 3PL companies. This result gives a glance that the companies are not aware of the importance of the using 3PL strategy. Providing training sessions to their employees on 3PL may increase their awareness toward using this strategy, which will increase SC efficiency and improve customers' satisfaction.

Another interesting result is that RFID technology is not appropriate for the companies and none of them will be implementing this technology in the next 2 years. This result might be because of the high cost of the technology or efficiency of the technology.

Companies agreed the current information systems are not efficient in improving coordination with suppliers or customers. For future implementation, there is a need for systems that enable companies to share information

with partners and this will help them better planning and coordination. This confirms the result about the integration problems. From Fig.19, integration is a problem that is faced by the companies. It could be happening of using the standard package systems more than the custom made system.

CONCLUSION

This research clarifies the current and future status of the SCM in Bemidji, MN. Currently the companies' strategies are focusing on building relationships with suppliers more than customers. In the future, they will build stronger relationships with customers through implementing Customer Relationships Management (CRM) and will maintain their relationships with suppliers. The information systems benefit the companies by achieving better operational efficiency, reduce lead-time in production, cost saving, more accurate costing, and flexibility. Also, the companies need to have access to more SCM education and training to improve their SCM efficiency. For future research, it is recommended to investigate the reasons behind why the companies are considering the 3PL, benchmarking, and RFID as not appropriate practices for them. Also, the integration problem affects level of sharing information with partners and therefore there is a need to be investigated in further research.

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