European Research on Management and Business Economics 22 (2016) 147–154

European Academy of Management and Business Economics

European Research on Management and Business Economics

www.elsevier.es/ermbe

Improving supply chain information sharing using Design for Six Sigma

Erin M. Mitchell, Jamison V. Kovach*

Department of Information and Logistics Technology, University of Houston, 312 Technology Building, Houston, TX 77204, USA

ARTICLE INFO

Article history:
Received 24 September 2014
Accepted 3 February 2015
Available online 14 April 2015

JEL classification:
L91
R49
M11

Keywords:
Design for Six Sigma
Supply chain
Transportation
Information sharing
Case study

ABSTRACT

Accurate and reliable information is needed to support decision-making processes. Due to the large number of participants typically involved in supply chain operations, organizations often find that it is difficult to effectively share information within a supply chain; hence, this research examined ways to improve information sharing within supply chain operations for one marine transportation services organization. An action research, case study approach used the Design for Six Sigma (DFSS) methodology to design an information technology solution that effectively communicates information between the layers within the supply chain regarding the movement of materials via inland tank barges. The comparative analysis of verification and baseline measurements conducted suggests this project was successful because the new process fulfilled the needs of the work environment for which it was designed. For the organization that participated in this research, the successful adoption of the new approach for information sharing improved communication and decision making within their supply chain.

1. Introduction

Supply chain management adds value to an organization through the effective integration and alignment of various business functions in pursuit of achieving strategic objectives (Pettersson & Segerstedt, 2013; Sahin & Robinson, 2005). Given the globalization of corporations and the increase in computing power and e-commerce, co-location of supply chain functions is no longer a necessity for many organizations. However, this shift in global logistics presents its own set of challenges, and these issues have effectively elevated the importance of supply chain coordination and information sharing (Fiala, 2005; Hugos, 2011; Mesmer-Magnus & DeChurch, 2009). Supply chain functions generate value through the cohesion of the independent activities within these business operations (Zhu, Gavirneni, & Kapusciniski, 2010). Ensuring that decisions can be made using correct and up-to-date information is imperative for efficient supply chain performance (Manuj & Sahin, 2011).

Like other areas of business, supply chains can utilize technology to enrich their business processes and communicate more effectively (Sahin & Robinson, 2002). The availability of real-time forecast information, demand data, and shipment progress through tailored information technology (IT) applications increases the flexibility and capability of functions along many points of the supply chain (Ye & Wang, 2013). This information provides functions within the supply chain the opportunity to plan, react, and take preventative action to counterbalance fluctuations and delays encountered en route to final delivery of the finished product. However, for this information to be meaningful and help the organization, it must be effectively communicated and shared with all supply chain functions, which can be challenging for some organizations (Liu & Kumar, 2011).

Transportation is the single largest logistical cost for most organizations, and these expenses significantly impact a supply chain's fiscal effectiveness (Goldsby & Martichenko, 2005). As the most widely used method of transportation, marine shipping presents a unique set of challenges for logisticians, schedulers, and other supply chain functions (Mangan, Lalwani, & Fynes, 2008). The efficiency of the shipping process affects more than the separate organizations that operate individual vessels, including the customers of the finished products. Therefore, improvements made to logistics within the marine transportation field often have a large effect on many other existing supply chains. Domestic inland barging focuses specifically on the movement of cargoes along the inland

* Corresponding author.
E-mail address: jvkovach@uh.edu (J.V. Kovach).

http://dx.doi.org/10.1016/j.iedee.2015.02.002

river systems of the U.S., and a large portion of this work involves the transportation of petroleum products (Mudrageda & Murphy, 2008). Specialized inland barges are utilized to move bulk cargoes between terminals, refineries, and end customers/consumers. The movement of a single cargo requires many decisions, the coordination of several supply chain functions, and commonly involves many different organizations.

It is interesting to note that little research has been conducted that examines the use of structured improvement methods to redesign supply chain operations. This research attempts to fill this gap in the literature, and it specifically focuses on designing a system to improve the communication of information through a multi-tier supply chain system within a marine transportation services organization. Using an action research approach (Coughlan & Coghlan, 2002; Kemmis, McTaggart, & Nixon, 2014; Reason & Bradbury, 2008), researchers worked closely with the Transportation Coordinators within this organization to determine the best way to utilize an IT communication solution (i.e., a SharePoint site) to support their operations. To develop this new approach for sharing information, the team of researchers and employees from the organization used the Design for Six Sigma (DFSS) methodology, a structured method for building quality into products/services in order to achieve Six Sigma (i.e., virtually defect/error free) performance (Hasenkamp, 2010; Schroeder, Linderman, Liedtke, & Choo, 2008; Tjahjono et al., 2010). While the literature contains several examples about how DFSS has been used in services, this case study uniquely demonstrates how this approach can be applied to value-enabling elements within service-based operations such as a communication/information sharing process.

The following section provides some background information concerning topics related to this research. Then, the case study is presented. This discussion includes further information about the organization in which this research was conducted, as well as details regarding how the DFSS methodology was implemented, including the tools and techniques used. Finally, some concluding remarks are offered that summarize the benefits of this research to the organization involved in this case study and beyond.

2. Background

2.1. Information sharing

It is well documented that the need for accurate information in a supply chain context is essential. Madlberger (2009) states that the vital issue for supply chains is the unevenness of information between supply chain functions. Hung, Ho, Jou, and Tai (2011) describe the necessity to obtain important information in a timely and accurate fashion. That is, the sharing of data levels the playing field between functions and aids management in gathering situational-information (Mesmer-Magnus & DeChurch, 2009). However, because many supply chains contain third parties or several groups within the same organization, the information that they communicate to the other parties is only as effective as the commonality that binds them (Posey & Bari, 2009). For example, specific and complicated data may only be useful to share if it can be deciphered easily by the other functions within the supply chain.

Several previous researchers have indicated that decision making and overall supply chain performance improve when information is shared between functions (Li, Lin, Wang, & Yan, 2006; Simatupang & Sridharan, 2008). The sharing of information is said to improve supply chain agility and visibility, and therefore positively impacts supply chain stability. While previous research suggests that there are few downsides to information sharing between supply chain functions, Hall and Saygin (2012) argue that simply the act of transferring data between activities will not improve supply chain performance unless the information is accompanied by more robust requirements for collaboration/cooperation. Existing purely in a vacuum, without high levels of trust and communication between parties, information sharing would be moot. To be meaningful, information needs to be presented clearly and in a fashion that can be easily understood by the audience (Cantor & Macdonald, 2009). Otherwise, large amounts of information may tax other functions and waste time and resources in attempting to decipher it.

2.2. Communication and collaboration

Communication is a critical task for each function within a supply chain. Increased perceptions of trust between supply chain entities help to build stable relationships and contacts that are more likely to communicate effectively. As Wagner and Buko (2005) describe, the more intensely and often that people communicate across the supply chain, the more clear organizational goals and objectives become, which may increase the overall level of coordination across supply chain functions.

To reach the optimal levels of coordination within a supply chain, the objectives of the organization as a whole must be understood and shared by all functions (Hugos, 2011). These mutual values guide business practices and drive efficiency. A lack of coordination may occur when necessary information is not available to make decisions and when functions operate without the guide of system-wide objectives (Sahin & Robinson, 2005). However, supply chain management is facilitated by clearly defined reporting structures and easily accessible information networks; hence, individual supply chain functions should be focused on high-level organizational interests to ensure alignment of the supply chain as a whole.

2.3. Supply chain improvement methods

Existing research addresses both theory and application (via case studies) of Six Sigma principles to solve problems in transportation and supply chain fields. For example, Nooramin, Ahouei, and Sayareh (2011) applied this approach to improve marine container terminal operations. Also, Antony, Kumar, and Banuelas (2006) documented research done using Six Sigma to reduce the number of injuries for work done with marine containers. Similarly, Chang and Wang (2008) used a case study to show the benefits of a Six Sigma improvement model on replenishment forecasting.

While the Six Sigma methodology has proven to be a successful process improvement approach, unfortunately it does not target fundamental changes to the structure of the underlying production/service process (Edgeman & Dugan, 2008). To address this issue, Six Sigma applications have grown to include the design and redesign of both products and services, which is known as DFSS (El-Haik & Roy, 2005). DFSS focuses on building quality into products/services by identifying what customers want/need, translating these into critical-to-quality characteristics, deploying these through specific aspects of the product/service design, and verifying that the final design appropriately addresses the original intent (i.e., to fulfill customers' needs) (Mast, Diepstraten, & Does, 2011; El-Haik & Al-Aomar, 2006; Yang & El-Haik, 2003). Previous discussions in the literature have pointed out that as there is no standard framework to guide the use of the DFSS methodology (Watson & DeYong, 2010); yet, Yang (2005) suggests that the DMADV (Define, Measure, Analyze, Design, and Verify) methodology is appropriate to use when designing service processes, as it specifically addresses redesigning processes, which is a common occurrence in service-based organizations.