⊖SCM

Supply Chain Management Integration in Maintenance and Repair Services Sector

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ABSTRACT

The paucity of studies in the field of supply chain management (SCM) focusing on repairing and maintenance operations within the services sector is an undeniable reality. It is important to explore how operations of maintenance and repair services (MRS) are nowadays structured and positioned to understand their contributions to SCM effectiveness. This research explored the integration level between internal functional areas of services organisations and principal business processes of suppliers and customers. The research also identified key barriers faced by SCM practitioners when deploying SCM best practices and models across the repair services providers. The primary data was collected from 89 SCM leaders and managers from organizations working in a Middle-Eastern country through the use of an online survey. The results revealed that there is a good level of internal integration between main business functional areas within MRS operations, e.g. material planning, purchasing, logistics, contracts, finance, and sales, with exception of reverse logistics, an important business function to the effective management of product services supply chain (PSSC). The study also revealed a partial level of external supply chain integration among local PSSCs participants, wherein only three SCM business processes; i.e. suppliers' relationship management, order fulfilment, and service delivery management, are significantly integrated at interorganizational levels. Other crucial processes of SCM for PSSCs; customer relationship, services demand, services capacity, resources management, product and information flow management, and service product development, were all identified with a medium level of integration among local operations, which prevent local MRS organisation from generating additional values in terms of services and products quality improvement, product lifecycle management, and development of innovative services solutions to the market. The study also revealed that organizational cultures, resources availability, lack of vision and comprehension from top management, and absence of trust and collaboration within SCM participants are the main obstacles associated with the deployment of models and SCM best practices within repairing services operations.

Keywords: *supply chain management, product-service supply chain, maintenance and repair services, supply chain integration, obstacles, Middle East*

1. INTRODUCTION

A supply chain is a complex network of entities that perform several interrelated and depending tasks to produce and deliver products or services to the market. This involves, but not limited to, activities of; sourcing, purchasing, storage, production, transportation, delivery, maintenance and repair (Tsadikovich et al., 2016). A reliable and efficient process of coordination along the jobs and tasks executed by each participant is a key element to achieve efficiency and effectiveness of a supply chain and thus develop and sustain business operational performance (Hong-mei and Chi, 2011). Highest level of coordination among SC participants is obtained through the existence of a seamless supply chain integration a concept that recognizes an efficient control and management of critical flows of material and information throughout all SC nodes, i.e. the participants, from the main suppliers until the end-customer, which require the establishment of collaboration and cooperation to develop an active process of communication, wherein critical information and data is shared, and also an effective coordination of operational activities related to the provision of services (Prajogo and Olhager, 2012).

Due to constant pressures generated by markets for innovative solutions and cost reductions, added to the creation of competitive advantage for businesses to succeed, the process of having an integrated supply chain becomes crucial to the maintenance industry. As an example, repair and overhaul market for repairing services in aircrafts has dropped from 43 billion USD to 34.6 billion between 2001 and 2003 (MacDonnell and Clegg, 2007). Although a complete integration in supply chains, i.e. involving internal functional processes integration along with backward and forward integration with main suppliers and customers, which theoretically defended in scientific literature of SCM, is rare to exist in practice (Ling et al., 2014). The use of automated systems, an active communication, and optimization and integration of business processes at intra and inter-organizational levels are the main facilitators to obtain an internal and external integration in SCs. The integration between entities in a service supply chain (SSC), which enable a fast, responsible and reliable exchange of

transactions between manufacturers and maintenance service providers, should be understood by original manufacturers and providers of maintenance services as a key element to be incorporated in their business strategic model due the direct benefits that is generated in operational performance in terms of productivity, demand identification, resource availability, quality and service performance monitoring and development, payments control, and management of service level agreements (Ellram et al., 2004, Maull et al., 2014).

1.1 The Problem

The scarcity of studies covering the subject of SCM in operational environments of maintenance and repairing services focusing on integration of business processes and communication, critical elements from supply chain management, is a present reality (Uusipaavalniemi and Juga, 2009, Maull et al., 2014). Thus, it is important to develop a study that explores ways to improve the level of knowledge regarding the standard practices of SCM applied by organisations that operate in the market of repairing and maintenance services. Also, to understand the current level of integration of business processes among SSC participants and explore the main obstacles to achieving an integrated supply chain. These were the principal motivations that underpins the development of the study encompassed by this research aiming at the development of knowledge through the use of organized lens to comprehend the current practices of SCM applied by providers of repairing services to better manage Product Service Supply Chain (PSSC) within the organisational boundaries and across their strategic business partners. This study will endeavour to answer the following two main questions:

- *Research Question 1. What is the current level of integration between internal functional areas of services organisations and among main business processes with suppliers and customers?*
- *Research Question 2. What are the main barriers faced by practitioners in the field of operations and supply chain management when deploying SCM best practices and models across the repair services providers?*

Answers to the above two main questions will provide a better understanding of SCM operational model and level of SC integration within maintenance and repair services operations and will enable the identification of key obstacles to the achievement of an effective integration of PSSC at both internal and external levels.
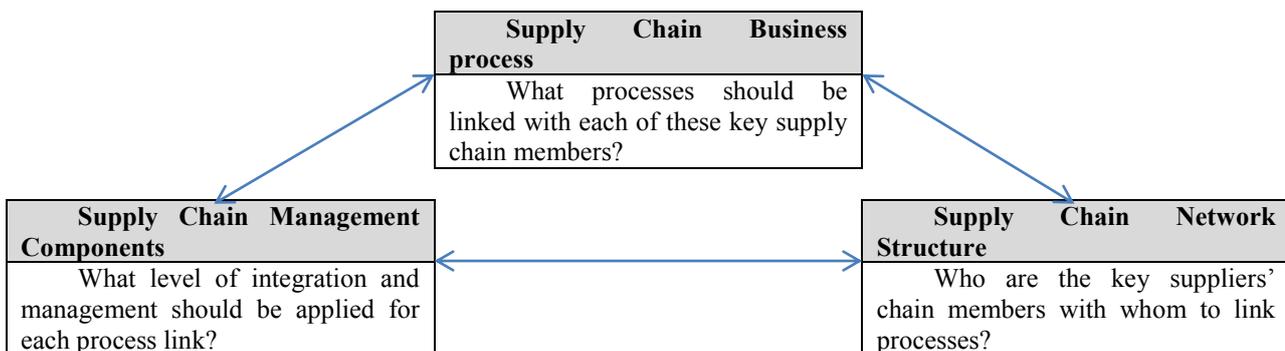
2. LITERATURE REVIEW

Supply chain is a concept that was first used almost four decades ago (Burns and Sivazlian, 1978), and nowadays is a distinguished term that appears in more than two thousand publications per year (Braziotis et al., 2013). Although there is still no generic consensus regarding how to define SC (Corominas et al., 2015), a recognized definition of the concept is provided by Chopra and Meindl (2013) that describes SC as a network of entities, from suppliers of raw material until the end customers, including producers, manufacturers, transporters, distributors, retailers and resellers, involved and working directly or indirectly to attend and satisfy the market demand and the customer needs. The interest in studying the concept of SC has evolved during the last years with innumerable studies using the terms supply chain and supply network in an interchangeable way. However, there are important differences in the characteristics and attributes from the two terminologies in their levels of complexities, which can be low and high, their designs, which can assume a linear or non-linear shape, their configurations, which can be based on stable or dynamic structures, and their focal point, which can be centred on products or in relationships respectively (Khalaj et al., 2014; Cui, 2015; Tsinopoulos and Mena, 2015; Modrak and Bednar, 2016).

2.1 Service Supply Chains

The services sector is growing at a fast rate during the last years promoting remarkable improvements to the enhancement of economies and is observed as a major part of the workforce in some countries (Prajogo, 2006). Characterized by intensive interactions with customers and direct linked with operational performance level, service is identified as a crucial activity within an organisation due the impacts that are generated in the client retention. However, due to historical facts, the attention and studies of SCM within service operations still trail behind the manufacturing operations (Giannakis, 2011).

According to Arlbjorn et al. (2011), the concept of SSC assumes a larger scope if compared with manufacturing SC once it involves different types of businesses, from the governmental services, finance, and insurance companies to retails, suppliers of spare parts and third-party service providers.

Supply Chain Business process		
What processes should be linked with each of these key supply chain members?		

Supply Chain Management Components	Supply Chain Network Structure
What level of integration and management should be applied for each process link?	Who are the key suppliers' chain members with whom to link processes?

Figure 1 Elements and key questions from SCM Framework (Lambert et al., 1998, p. 4)

As argued by Sampson and Spring (2012), SSC can be understood and analysed from four distinct managerial perspectives; as sourcing for services, production of services, the applicability of services to move, delivery and return the products from end customers, and from the perspective of the client. The study from Wang et al. (2015) defends the essential role of services in the performance of SCs and highlights the existence of two types of SSC in the context of service supply chain management; the service only supply chain (SOSC) and the Product Service Supply Chain (PSSC). Within an SOSC, the final product that is produced by the business is a complete service. In PSSC, the physical product is managed by the SC together with substantial participation of services provision.

2.2 Supply Chain Management Integration

A comprehensive definition of SCM was presented in 1998 as the "integration of key business process from end user through original suppliers that provide products, services, and information that add value for the customer and other stakeholders" (Lambert et al., 1998, p. 1). Based on this definition, the success of an organisation depends on the integration and effective management of the critical business processes, within the company boundaries, and along strategic partners from the SC. The business processes integration within an SC can be characterized into four different stages of development: fragmented operations inside an organisation, limited integration among the functional areas of a company, complete internal integration of entire planning process, and the fully integration of planning process with the upstream and downstream strategic members of the SC. Therefore, the essence of SCM depends on the existence, and combination, of three main elements; the structure of the SC network, the business processes, and the managements components of the SC. The scope and dimensions of management is a resultant from the answers given to key questions related to each one of the three elements, as illustrated in Figure 1, which reflects the initial SCM framework proposed by Lambert et al. (1998).

As argued by Jespersen and Skjott-Larsen (2005), the structure of an SC network not always shall involve all participants due to the restrictions of resources availability and level of structural complexity; therefore, it is essential to establish crucial alliances with strategic partners that contribute positively to the business competitiveness. Only important business processes should be integrated with the SC strategic members. This may include; orders processing, distribution of products, customer service, new products development, contracts development, and acquisition. Management components are those business processes and the responsibilities of the firms along the SC that will define how individual processes within a supply chain will be integrated, conducted and controlled.

2.3 Research gap

Nowadays, the participation of service sector is achieving a remarkable mark of almost 80 percent in the gross domestic production of some developed and developing countries (The World Bank, 2016). Due to the relevant participation and contribution from services provider organisations in the global economy, several studies have emerged with proposals of conceptual models and frameworks for the management of service supply chains ranging from the generic model of SCM to SSC (Ellram et al., 2004) and the model of SCM proposed by Xu et al. (2014) that focuses on the management of a PSSC. This concept can be identified along several academic studies as the servitization of manufacturing, which is aimed at extending the value chain from a product manufacturer by delivering additional value to customers through the integration and provision of services along the manufactured product (Baines et al., 2009; Lightfoot et al., 2013; Weeks and Benade, 2015). The attention from academics and practitioners has been along the last decades significantly focused on the manufacturing sector due the unquestionable contribution of this sector to the development of the global economy (Ellram et al., 2004). However, the recognition of the contribution originated from the service sector to the growth of economies in developed countries is expanding.

3. METHODOLOGY
3.1 Data collection methodology and method

This research assumed an ontological position of relativism by accepting that there are many truths (Easterby-Smith et al., 2012). The research methodology adopted for this research was chosen according to the ontological and epistemological perspectives assumed by the study, and by understanding the effects that are generated in the design and conduction of the research, the influences over the type of data, samples, and unit of analysis, and also in defining the kind of evidences that were required to be gathered and how to be interpreted to obtain the answers to the central questions that are investigated by the research.

The research adopted a non-experimental method design through the use of a web-based survey that was sent to selected participants who were middle and senior level management professionals from the SCM field e.g. logistics, purchasing, planners and operations managers from companies operating in the service sector in a country from region Middle East. The research data was provided by the random sampling of respondents regarding the business processes and practices of SCM currently deployed within their operations.

Easterby-Smith et al. (2012) advocate that exploratory surveys can be used to establish the comprehension regarding the existence of organisational and group behaviour patterns from numerical data by collecting and analysing the opinions, experiences, and values from the research participants. Also, a purely observational study helps in getting clear results regarding the predominance of behaviour and management practices patterns (Thompson and Panacek, 2007). For data validity and reliability, exploratory factor analysis, a technique from the multivariate statistic procedure of factor analysis, was the tool utilized to examine the psychometric properties of the instrument and to validate the scales constructs. Also, the test of reliability was performed using the techniques of Cronbach's coefficient alpha for Likert multi-points scales (Ding &Beichner, 2009; Shuttleworth, 2009).

The technological platform QuestionPro was utilized to develop and distribute the survey questionnaire through the Internet network (QuestionPro, 2016). The selected research participants were contacted through emails that highlighted the address to access the server database where the survey

questionnaire and the answers from participants were processed and securely stored. Hosted by QuestionPro service provider, the platform enabled the continuous and protected access, with login credentials, during the entire period of data collection and initial evaluation.

3.2 Instrument design

It is recommended to use an existing instrument to collect data (Brislin, 1986) but no single instrument was found during the process of literature review that entirely matched with the present research objective; therefore, a quantitative design method was utilized to develop the survey instrument to collect data for this research. The aim was to support the identification of patterns and causal relations among variables and concepts under study. To achieve the research objectives, and in alignment with the adopted research methodology, a constructionist research design utilizing a survey was developed and applied as the primary instrument to collect the primary data for this research. The survey assumed a structured model with closed-ended questions, as multiple choices with single and multiple answers, and multi-point Likert scale questions, wherein the primary variables were presented to gather specific and defined responses that facilitated their frequency analysis. The identification of the integration level between selected internal functional areas and business process along strategic suppliers and primary customers were made

through two questions consisting of eleven items each. A percentage analysis was performed on the collected data and a comprehension was obtained regarding how is the degree of internal integration between functional areas within organisations and along principal suppliers and customers through integration of critical business processes. Participants were asked to share their opinion about the level of integration between certain internal functional areas as shown on **Table 1**.

Participants were also asked to provide their views about the level of business processes integration with their suppliers and main customers (Lambert et al., 1998; Baltacioglu et al., 2007; Zhou et al., 2011; Grimm et al., 2015), as shown on **Table 2**.

The main barriers to an effective implementation of SCM practices along the organisations were identified through the use of percentage analysis of a single five-point Likert scale. The participants expressed their opinions regarding the level of impact that is caused by a group of eight pre-selected factors (Fawcett et al., 2008; Lambert, 2014; Grimm et al., 2015). A set of questions individually highlighted each factor under a five-point Likert scale, from not a barrier to major barrier. Through the analysis of gathered information, a comprehension regarding the main obstacles recognized by practitioners along their operations of PSSCs within the selected country has emerged as shown on **Table 3**.

Table 1 Construct used to gage the level of internal processes business integration

	Don't know	Not Integrated	Partially integrated	Integrated	Fully Integrated
Material Planning and Sales	❏	❏	❏	❏	❏
Material Planning and Logistics	❏	❏	❏	❏	❏
Material Planning and Purchasing	❏	❏	❏	❏	❏
Purchasing and Finance	❏	❏	❏	❏	❏
Purchasing and Logistics	❏	❏	❏	❏	❏
Purchasing and Contracts	❏	❏	❏	❏	❏
Finance and Sales	❏	❏	❏	❏	❏
Finance and Contracts	❏	❏	❏	❏	❏
Finance and Logistics	❏	❏	❏	❏	❏
Finance and Reverse Logistics	❏	❏	❏	❏	❏
Reverse Logistics and Contracts	❏	❏	❏	❏	❏

Table 2 Construct used to gage the level of integration with your suppliers and main customers

	Strongly integrated	Partially integrated	Not at all integrated
CRM (Customer Relationship Management)	❏	❏	❏
SRM (Supplier Relationship Management)	❏	❏	❏
Customer Service Management	❏	❏	❏
Service Demand Management	❏	❏	❏
Service Capacity and Resource Management	❏	❏	❏
Service Delivery Management	❏	❏	❏
Order Fulfilment management	❏	❏	❏
Product Flow Management	❏	❏	❏
Information Flow Management	❏	❏	❏
Product or Solution Development Management	❏	❏	❏
Reverse Logistics Management	❏	❏	❏

Table 3 Construct used to collect data about potential barriers to SCM deployment

	No barrier	Minor barrier	Neutral	Moderate barrier	Major barrier
Organisational culture	❏	❏	❏	❏	❏
Availability of resources	❏	❏	❏	❏	❏
Lack of vision from top management	❏	❏	❏	❏	❏
Lack of comprehension from high management	❏	❏	❏	❏	❏
No commitment from management	❏	❏	❏	❏	❏
Absence of trust among the chain participants	❏	❏	❏	❏	❏
Absence of collaboration between businesses partners	❏	❏	❏	❏	❏
Existence of functional silos	❏	❏	❏	❏	❏

4. RESULTS AND DISCUSSION

4.1 Data Collection Overview and Demographic Information

The achievement of research objectives was obtaining through the process of collecting the responses from professionals working in the field of supply chain management along services organisations that operate in the selected marketplace. The participants contact details including email address, positions, and phone numbers, were gathered from the social network LinkedIn which demonstrated to be an excellent source of potential participants for research management surveys. After the conclusion of the selection process, a total of 342 potential participants were selected and contacted through an invitation email to participate in the research by filling the questionnaire survey. Reminder emails for survey participation were sent one and two weeks later to all participants that didn't reply to the initial invitation and the first reminder.

The process of data collecting started on May 29th, 2016 and was concluded on June 11th, 2016. At the end of data collection process, 131 questionnaires were returned by the participants. From the total number of returned questionnaires, 42 questionnaires were discarded for not presenting all questions completed, which originated a final number of 85 surveys fully completed and usable for this research, which represented a return rate of approximately 25 percent. The majority of the participants' gender was males with age between 26 and 55 years. A high frequency of participants with master degree (48.3 percent), followed closely by bachelor degree (40.4 percent), shows that SCM demand for professionals with relevant scientific knowledge in the discipline of operations and managerial field. Professionals occupying high management positions represented 32.6 percent from the total amount of participations, with 48.3 percent of participation from middle-level positions.

The presence of companies from the private sector was very representative with 92.1 percent from participations. The analysis results revealed that the main operational sector from the participants were manufacturing (18.1 percent), retailing (15.8 percent) and maintenance (12.9 percent), with customers distributed mainly along retailing (15.2 percent), government (13.6 percent), manufacturing (12.1 percent), construction (11.1 percent) and mining (10.6 percent). Although some respondents have identified themselves as manufacturing and retailing organisations based on the

operational activity performed by the organisation headquarter located overseas, the local operations are in reality focused on the provision of services, involving from sales, logistics, support, and project management until maintenance, and repairing services. During the analysis of the organizations' activities, adjustments were performed along 16 answers due the fact that some participants answered the question as "manufacturing only" as their business activity; however, after further investigation regarding their organisations profiles and operational activities, these organisations were reclassified as "services provider" and "product-services organisations" once they produce and deliver relevant groups of services activities as sales, distribution, after-sales services and support, research and development, and project management. The final result revealed that 64 percent of participants were identified as product-service providers and 36 percent identified as service providers, with a majority of organisations classified as large business operations, i.e. with more than 250 employees (61.8 percent), followed by middle size operations with 50-249 employees (25.8 percent) and small business size with 10-49 employees (11.2 percent).

4.2 Reliability test for integration between functional areas and business processes

The instrument of twenty-two items captured the existence and current level of integration between the internal functional areas from participant's organisations and the degree of integration of SCM business process along with their primary customers and strategic suppliers. The original five points scale for the question about the integration between internal functional areas was recoded to a new reduced Likert scale of three-points. The answers initially registered under "don't know" become "not integrated", and answers of "fully integrated" were assumed as "integrated"; therefore, generating a similar structural scale with the question asking about business integration with suppliers and customers. The original three-point scales from the question asking about business integration with suppliers and customers was reordered to assume the same condition from the question asking about the internal business integration, i.e. the value 1 for "not integrated", value 2 for "partially integrated", and value 3 for "integrated". As result from the recode process from question 18 and 24, each item from this construct under assessment assumed a Likert scale of three points: (1) as not integrated, (2) as partially integrated, and (3) as integrated; therefore, allowing the final score of this item to range from 22 to 66. The Cronbach's Alpha coefficient of reliability from this scale was 0.913, which

Table 4 SPSS Output for integration between functional areas and business processes

Statistics for Scale	No. of items	Mean	Variance	SD		
	22	49.35	95.093	9.752		
	Mean	**Minimum**	**Maximum**	**Range**	**Max/Min**	**Variance**
Item Means	2.243	1.753	2.629	0.876	1.500	0.052
Item Variances	0.557	0.395	0.765	0.370	1.935	0.007
Inter-Item Correlations	0.324	-0.136	0.824	0.960	-6.057	0.036

Item-Total Statistics	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Material Planning & Sales	47.09	86.037	0.541	.	0.909
Material Planning & Logistics	46.83	86.733	0.580	.	0.908
Material Planning & Purchasing	46.80	89.209	0.414	.	0.911
Purchasing & Finance	46.85	89.035	0.427	.	0.911
Purchasing & Logistics	46.72	88.568	0.518	.	0.910
Purchasing & Contracts	46.90	88.524	0.433	.	0.911
Finance & Sales	47.02	89.909	0.295	.	0.915
Finance & Contracts	46.96	89.953	0.350	.	0.913
Finance & Logistics	46.84	87.566	0.529	.	0.909
Finance & Rev Logistics	47.44	85.704	0.533	.	0.909
Rev Logistics & Contracts	47.60	87.289	0.459	.	0.911
CRM	47.22	87.79	0.503	.	0.910
SRM	47.19	86.361	0.559	.	0.909
Customer Services Mgmt.	47.11	87.169	0.562	.	0.909
Services Demand Mgmt.	47.22	84.699	0.728	.	0.905
Service Capacity & Resource Mgmt.	47.28	85.341	0.662	.	0.906
Service Delivery Mgmt.	47.11	84.692	0.708	.	0.905
Order Fulfilment Mgmt.	47.08	84.914	0.680	.	0.906
Product Flow Mgmt.	47.15	84.603	0.729	.	0.905
Information Flow Mgmt.	47.20	86.709	0.576	.	0.908
Product Development Mgmt.	47.26	87.103	0.588	.	0.908
Reverse Logistics Mgmt.	47.44	86.204	0.586	.	0.908
Reliability Cronbach's coefficient for the 22 items	**0.913**				

reflects an excellent level of internal consistency reliability and homogeneity among the items of this construct. The scale mean was 49.35, with a variance of 95.093, and a standard deviation of 9.752. The detailed item analysis output obtained from SPSS for this twenty-two items scale is represented on **Table 4**.

4.3 Reliability test for main barriers for SCM implementation

The instrument of eight questions accessed the comprehension from the participants regarding the main obstacles faced by organisations to implement SCM best practices and models. Each item used a five-point Likert scale: (1) no barrier, (2) minor barrier, (3) neutral, (4) moderate barrier, and (5) major barrier, to represent most significant barriers identified in the reviewed literature. The final score of this item could range from 8 to 40. The scale mean was 34.21, with a variance of 34.533, and a standard deviation of 5.877. Cronbach's Alpha coefficient of reliability obtained from this scale was 0.894, reflecting a good level of internal consistency and reliability for the scale. The detailed item analysis output obtained from SPSS for this six-item scale is represented on **Table 5** and shows to what intensity the listed items are recognized by professionals from SCM discipline as significant barriers to the deployment of SCM along the business operations of organisations operating in the selected country.

Table 5 SPSS output for main barriers to SCM implementation

Statistics for Scale	No. of items	Mean	Variance	SD		
	8	34.21	34.533	5.877		
	Mean	Minimum	Maximum	Range	Max/Min	Variance
Item Means	4.277	4.090	4.438	0.348	1.085	0.018
Item Variances	0.940	0.807	1.058	0.251	1.311	0.011
Inter-Item Correlations	0.515	0.352	0.842	0.490	2.393	0.013
Item-Total Statistics	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted	
Organisational Culture	30.08	27.210	0.587	0.408	0.889	
Availability of Resources	30.03	26.783	0.629	0.485	0.885	
Lack of vision from top management	29.78	25.653	0.767	0.763	0.871	
Lack of comprehension from high management	29.84	25.589	0.804	0.781	0.868	
No commitment from management	29.79	27.283	0.682	0.607	0.880	
Absence of trust among chain participants	29.90	27.137	0.627	0.616	0.885	
Absence of collaboration among business partners	29.96	27.475	0.664	0.532	0.882	
Existence of functional silos	30.12	27.587	0.638	0.465	0.884	
Reliability Cronbach's coefficient for the 8 items	**0.894**					

4.4 Factor analysis

Table 6 demonstrates the result of a factor analysis in the construct of integration between functional areas and critical business processes. A single factor was identified and extracted from the construct, and the calculated loading factor from each item ranged from 0.283 to 0.807, which confirms the contribution of each instrument item to the understanding regarding the level of integration between internal functional areas of participants' organisations, and business processes along the principal suppliers and customers. "The signs of the loadings show the direction of the correlation and do not affect the interpretation of the magnitude of the factor loading or the number of factors to retain" (Kline, 1994, cited in An Gie and Sean, 2013, p.84). The variable with factor loading lower than 0.3 was kept due probable low endorsement rate given to the current practice from SCM of integration level between specific functional areas, and the statistical significance of this variable in relation to a small sample size (Elwyn et al., 2003).

Table 6 Factor Analysis for integration between functional areas and process

Construct	Scale Item	Factor Loading	Percentage of Variance
Integration between functional areas and processes	Material Planning & Sales	0.556	95.093
	Material Planning & Logistics	0.606	
	Material Planning & Purchasing	0.446	
	Purchasing & Finance	0.400	
	Purchasing & Logistics	0.514	
	Purchasing & Contracts	0.428	
	Finance & Sales	0.283	
	Finance & Contracts	0.328	
	Finance & Logistics	0.529	
	Finance & Rev Logistics	0.549	
	Rev Logistics & Contracts	0.481	
	CRM	0.596	
	SRM	0.643	
	Customer Services Mgmt.	0.654	
	Services Demand Mgmt.	0.807	
	Service Capacity & Resource Mgmt.	0.744	
	Service Delivery Mgmt.	0.796	
	Order Fulfilment Mgmt.	0.778	
	Product Flow Mgmt.	0.804	
	Information Flow Mgmt.	0.669	
	Product Development Mgmt.	0.684	
	Reverse Logistics Mgmt.	0.677	

Table 7 Factor Analysis for barriers to SCM deployment

Construct	Scale Item	Factor Loading	Percentage of Variance
Barriers for SCM deployment	Organisational Culture	0.675	34.533
	Availability of Resources	0.715	
	Lack of vision from top management	0.841	
	Lack of comprehension from high management	0.867	
	No commitment from management	0.771	
	Absence of trust among chain participants	0.725	
	Absence of collaboration among business partners	0.749	
	Existence of functional silos	0.725	

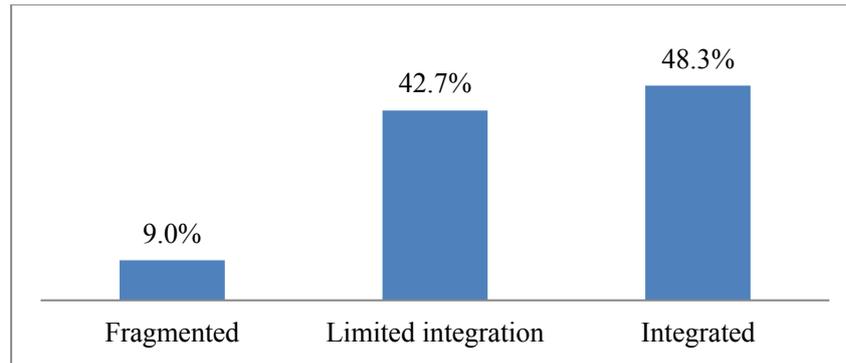**Table 8** Frequency analysis for integration between internal business functions

Mean	Variance	Std. Deviation
2.39	0.423	0.650
	Frequency	**Percent**
Fragmented	8	9.00%
Limited Integration	38	42.70%
Integrated	43	48.30%

Table 9 Item Statistics for integration between functional areas and business processes

Item	Description	Mean	Standard Deviation	Item Skewness	Item to Total Correlation	Mode
1	Material Planning & Sales	2.26	0.833	-0.520	0.541	3
2	Material Planning & Logistics	2.52	0.725	-1.159	0.580	3
3	Material Planning & Purchasing	2.55	0.691	-1.242	0.414	3
4	Purchasing & Finance	2.49	0.693	-1.028	0.427	3
5	Purchasing & Logistics	2.63	0.629	-1.488	0.518	3
6	Purchasing & Contracts	2.45	0.739	-0.947	0.433	3
7	Finance & Sales	2.33	0.809	-0.667	0.295	3
8	Finance & Contracts	2.39	0.701	-0.723	0.350	3
9	Finance & Logistics	2.51	0.709	-1.096	0.529	3
10	Finance & Rev Logistics	1.91	0.874	0.178	0.533	1
11	Rev Logistics & Contracts	1.75	0.830	0.494	0.459	1
12	CRM	0.12	0.720	-0.190	0.503	2
22	Reverse Logistics Mgmt.	1.91	0.763	0.154	0.586	2
16	Service Capacity & Resource Mgmt.	2.07	0.751	-0.111	0.662	2
21	Product Development Mgmt.	2.09	0.685	-0.116	0.588	2
15	Services Demand Mgmt.	2.12	0.736	-0.199	0.728	2
20	Information Flow Mgmt.	2.15	0.732	-0.235	0.576	2
13	SRM	2.16	0.782	-0.285	0.559	3
19	Product Flow Mgmt.	2.2	0.741	-0.345	0.729	2
14	Customer Services Mgmt.	2.24	0.707	-0.373	0.562	2
17	Service Delivery Mgmt.	2.24	0.754	-0.423	0.708	3
18	Order Fulfilment Mgmt.	2.27	0.765	-0.504	0.680	3

Table 10 Item Statistics for main barriers to SCM deployment

Item	Description	Mean	Standard Deviation	Item Skewness	Item to Total Correlation	Mode
1	Organisational Culture	4.13	1.025	-1.379	0.587	5
2	Availability of Resources	4.18	1.029	-1.460	0.629	5
3	Lack of vision from top management	4.44	1.011	-2.124	0.767	5
4	Lack of comprehension from high management	4.37	0.981	-1.916	0.804	5
5	No commitment from management	4.43	0.903	-1.907	0.682	5
6	Absence of trust among chain participants	4.31	0.984	-1.625	0.627	5
7	Absence of collaboration among business partners	4.26	0.899	-1.596	0.664	5
8	Existence of functional silos	4.09	0.913	-1.099	0.638	4

Figure 2 Frequency distribution analysis regarding the level of integration among internal functional areas of services organisations

Table 7 exhibits the results of factor analysis from the construct covering the barriers for implementation of SCM best practices. A single factor was identified during the factor analysis test. The loading factor from each item under the extracted factor was calculated through the component matrix and the outcomes ranged from 0.675 to 0.867, which confirms the contribution of each instrument item to the measurement of experiences and opinions from the respondents regarding the obstacles to the implementation of best practices from SCM along services operations.

4.5 Item Statistics for Integration between functional areas and business processes

A frequency analysis was performed on the question developed to identify the level of integration among the functional areas of participants' operations. The results identified a mean of 2.39 with a standard deviation of 0.650, as showed on **Table 8**. The majority of the respondents recognized as "integrated" the current level of integration among functional areas, which represents 48.3 percent from the total. 42.7 percent of participants answered as having a limited level of integration, and 9 percent and fragmented level of integration.

Table 9 provides the details of the item statistics analysis of this scale, which revealed a mean of 49.35, a standard deviation of 9.752, and a variance of 95.093. The means average from the items was 2.15, with values ranged from 0.12 to 2.63. All items had a mean below 2.7. The low mean average indicates that most of the respondents tended to answer on the left side of the Likert scale. The item-to-total correlation for almost all items was above 0.4. The item-to-total correlation from item 7 and 8 were 0.2955 and 0.350 respectively, i.e. values below the minimum acceptable value of 0.40. The items 1, 2, 3, 5, 6, 7, 8, 9 and 18 had their item skewness values above - 0.5, indicating a distribution skewed to the left (Brown, 2016).

4.6 Item Statistics for Main barriers for SCM implementation

Table 10 shows the details of scale statistics analysis. The scale had a mean of 49.35, a standard deviation of 9.752, and a variance of 95.093. The means average from the items was 4.28, with values ranged from 4.09 to 4.44. Half of the items had a mean above the means average. The results of the means average indicate that most of the respondents answered at the right side of the Likert scale. The item-to-

total correlation for almost all items was above 0.4. All items had an item skewness values above -0.5, indicating an asymmetrical distribution highly skewed to the left. Almost all items had a mode 5, with the exception of item 8 with mode 4.

4.7 Discussion of the analysed data

4.7.1 Level of integration between the internal functional areas of services organisations and among the business processes with suppliers and customers?

The data collected through the construct of multiple options with single answer revealed that local services operations present a very good level of integration among internal functional areas based on the perceptions of survey participants. From the total amount of answers, 48.3% answered as having the planning process fully integrated between all business functional areas, 42.7% as having a limited integration, and 9% as having a fragmented operation in terms of integration, as shown on **Figure 2**.

The main construct with the two multi-point Likert scales, with their items means and modes, was applied to support the comprehension regarding how are the current levels of integration among particular functional areas within the organisations and between business processes along supply chain main participants:

1. *The level of integration among the selected functional areas revealed that items 1, 2, 3, 4, 5, 6, 7, 8, and 9 had a mode 3, which represents a level 3 "Integrated" from Likert scale, while items 10 and 11 had a mode 1, which represents a level 1 "Not Integrated".*
2. *The resulting analysis from the integration of business process along suppliers and customers showed items 13, 17 and 18 had a mode of 3, which represents a level 3 "Integrated" from Likert scale. Remaining items 12, 14, 15, 16, 19, 20, 21, and 22 had a mode 2 that represents a level 2 "Partially Integrated" from the scale.*

The majority of respondents recognized in having a good level of integration across internal functional areas, therefore supporting the comprehension regarding the benefits of having functional areas and planning process internally integrated to develop the business performance and efficiency. The factor of internal integration among main functional areas was confirmed by this research as existent in the majority of the services organisations participants. A similar result was obtained from the study done in the

manufacturing sector, where a relevant level of internal functional integration was also identified in the majority of the participants from ten different countries studied regarding the level of SC integration (Danese and Bortolotti, 2014). An exception of internal functional integration was revealed by this study wherein reverse logistics, a crucial function from SCM for the management of PSSC, is currently non-explored by the majority of local organisations.

Regarding external integration, the results showed that local services providers had achieved a significant level of processes integration with other participants from PSSCs in only three SCM business processes: suppliers' relationship management, order fulfilment, and service delivery management respectively, revealing a partial level of external SC integration among the participants of local PSSCs. Similar results were also obtained from the research of Danese and Bortolotti (2014), and opposite results were obtained from the studies of Zailani et al. (2015) wherein relevant levels of integration between key business processes to the management of the demand in SSC were revealed within the Malaysia tourism sector, and Lii and Kuo (2016), which revealed major levels of internal and external integration along SCs within Taiwan electronic manufacturing industry. Although perceived and recognized as crucial by professionals from the SCM field, the important business processes of CRM, customer services, services demand, services capacity and resources management, product and information flow, and service product development, were all identified in having a medium level of integration among PSSCs, as illustrated in **Figure 3**.

The business process of reverse logistics had the lowest level of integration among main PSSC participants, which supports the finding regarding the non-existence of this business function within the operations from the majority of local services providers. The absence of integration from this process in PSSCs, which nowadays become a strategic element in SCs from manufacturing sector (Chan et al., 2012; Punyapon and Prangtip, 2015; Ravi and Shankar, 2015), generates a considerable barrier in the creation of value and negatively impacts the organisation image, level of retention and relationship with customers, and profitability along the SC (Mollenkopf et al., 2007). The attention from local services organisations on establishing a strong level of integration among SCM business processes of SRM, order fulfilment and service delivery with OEM and suppliers of parts revealed the dependence from local services providers with original equipment manufacturers (OEM), distributors and resellers, which indicates the business strategic objective of growing the sales volume without major attention to the co-creation of value, long-term operational and environmental sustainability, efficient management of demand oscillations, and development of service level through collaborative relationship with other repairing services providers and end-customers.

The business process of CRM shall be understood as a crucial element for the creation of value and trust among services provider and customers once it promotes the development of long-term relationships with the client and therefore major profits to the business. The effective management of demand, resources and capabilities within a PSSC directly impacts the level and quality of the service production and therefore in the customer perception regarding the level of business operational efficiency. Managers should realize that effective management of information flow throughout strategic business partners in PSSCs is the foundation to obtain an integrated supply chain and, therefore, technological platforms for e-business to share the data should exist to obtain not only an effective process of collaborative planning, forecasting and replenishment, but also to collect and share relevant market intelligence regarding a forecasted demand, expectations and performance feed-backs. Managers from service organisations should comprehended the process of reverse logistics as a crucial element within repairing and maintenance operations to leverage the business competitive advantage through the development of performance in both environmental and financial dimensions. The research identified that product service development process is also not strongly integrated by local services provider organisations with product suppliers and customers, therefore reducing the achievement of major gains along PSSCs by non-exceeding the customer expectations regarding improvements in the quality of the products and services and in the generation of innovative solutions.

4.7.2 Barriers for implementation of best practices from SCM

A single multi-point Likert scale was utilized as the primary item components in the development of this construct, as indicated in **Table 3**. The mean and mode from each item are shown in **Table 10**. This scale was applied to support the comprehension regarding what are the main barriers or obstacles faced by practitioners from the discipline regarding the implementation of effective SCM. All items from the scale had a mode five that represents a level 5 "Major barrier" from Likert scale, with the exception of item 8 that had a mode 4, which represents a level 4 "Moderate barrier" from the scale. The primary goal of this question was to identify the main obstacles faced by local practitioners of the service sector to the implementation of SCM processes and best practices within their services organizations and along PSSC participants. Based on the analysis of the respondents' answers, all main barriers identified by previous studies along the manufacturing sector were also confirmed as a obstacles faced by professionals from services sector, as the local culture of organisations, limited availability of resources, a narrow vision and non-comprehension from top management regarding the significant benefits that can be obtained from the applicability of best practices from SCM for an effective management of PSSCs, the absence of collaboration and trust among supply chain participants, and the no commitment from organisations managers.
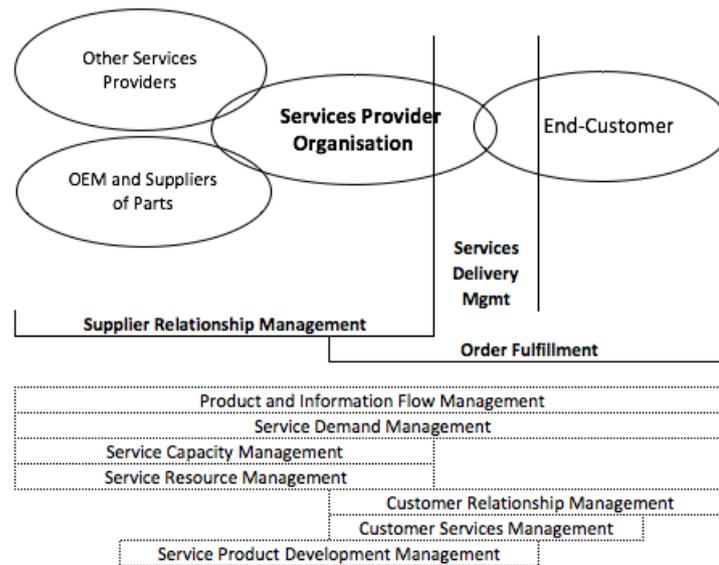
Figure 3 SCM framework from local PSSCs

A similar result was obtained from the study of Indian telecommunications sector, wherein SC integration was also identified as a barrier for SCM deployment (Pramod et al., 2016); however, the lack of knowledge was not one of the main barriers perceived by Malaysian tourism organisations to the implementation of SCM practices (Krishnapillai et al., 2011). Nonetheless, the existence of interdepartmental silos within the organisation boundaries is an obstacle that was not recognized by the majority of the respondents as a major barrier to the implementation of best practices from SCM, which confirms the finding regarding the good level of integration identified among the majority of the functional areas within local services organisations.

5. CONCLUSIONS

Improvements of operational performance can be achieved by maintenance services providers through a better understanding of several points that are critical for leading organisations in the journey of obtaining an effective management of an integrated PSSCs through the comprehension and deployment of crucial business processes and managerial functions such as reverse logistics, customer relationship management, information and services network management, along their internal operational framework and extended throughout the supply chain strategic partners and collaborators. This will lead to developing effective business operations through an efficient management of demand, production capacity and resources availability. Thus, allowing businesses to create the required innovations to support the development of efficiency, quality and the level of services.

Research exploring the applicability of SCM and supply chain integration in services business of maintenance industry is still scant. Most of existent research is within; healthcare, tourism, logistics and education (Sakhuja and Jain, 2012; Xinping, 2013). Therefore, further comparison of this study results with empirical evidences from existing literature become limited. The results from this research revealed a good level of internal integration across internal functional areas and this is probably supported by strong levels of communication across departments operating in a

multicultural environment. Managers and services organisations should strive to minimize the existing barriers revealed by this research to effectively achieve a PSSC backward and forward integration. The absence of trust and collaboration within supply chain participants, which can be due to a poor level of external communication along the participants, is considered as one of the main obstacle to the deployment of models and best practices of SCM to develop an integrated PSSC. Therefore, great attention should be given to the implementation of technological platforms of communication to improve the levels of coordination and collaboration. This should support the building of crucial element of trust along the dyadic relationships between buyers and sellers.

5.1 Practical and theoretical contributions

The findings from this study can assist managers and top leaders from the service sector to better evaluate their current state of knowledge regarding the discipline of SCM, the barriers for its implementation, and the use of practical frameworks and models to support the deployment and integration of key business functions and processes within their operations and along main SC participants.

The theoretical contribution of this research involve the advancements in the understanding of how the concept of SCM, including business processes, functions, and structure, is currently developed and deployed by major local services organisations. Also, to understand the management of their PSSC and the effective provision of maintenance services, which was captured through the comprehension of current SCM operational framework revealed by the study. The current model lacks in robustness and range in terms of adherence to main SCM principles. The concept of SCM and integrated supply chain are not fully deployed among organisations from services sector. Several key business processes including; communication and information sharing process along main SC business partners, a cornerstone from SCM to obtain SC integration, is also still not strongly explored. Although the results of this study confirmed that obstacles associated with SCM implementation identified in the literature of manufacturing

industry are also present within the services sector, an important exception was revealed regarding the non-existence of internal silos within internal operations of services provider organisations.

5.2 Managerial implications

A fully integrated supply chain cannot be achieved by having few business processes integrated along upstream or downstream SC members. Management must evaluate their current operational model and strive to find and integrate key SCM business processes along all principal participants to achieve the potential benefits from an integrated supply chain. This can include; cost reduction, generation of added value, reduction of cycle time, and development of competitive advantage (Halldorsson et al., 2007; Oliveira et al., 2016; Pimenta et al., 2016). This will help businesses focus on developing an entire PSSC to operate as a unique entity guided to fulfil the market demand for maintenance services. One of the major challenges that managers likely to face in the journey of obtain an integrated supply chain is the modification of the current group of business processes in order to adopt the concept and support the intra and inter-organisational integration. This will involve the redesign of business processes, redesign of supply chain structure, and design of e-business process (Palma-Mendoza and Neailey, 2015).

This research focused on gathering the perceptions and evidence from professionals who work in functions that are directly related to the discipline of the SCM from the service providers in a country where the presence and influence from the manufacturing industry is limited. This could explain the lack of applicability of SCM principles for SC integration and the strong influence exerted by OEMs over local services providers; therefore, blurring the identification and exploration of external factors that could exerted a direct impact on the applicability of best practices from SCM along PSSCs. The majority of this study's participants were managers from large size operations; therefore, the results of this study could reveal a different scenario if involvement is extended to the management from small and medium sizes organizations. Although the findings of this study improved the comprehension regarding the current model of PSSC integration and barriers for its deployment, the methods for data collection and analysis cannot reach the required spectrum to generalize results; therefore, further research along services organisations from other sizes and countries should be executed to further understand the level of supply chain integration along PSSCs participants and thus reduce the biases of conclusions caused by differences of operational environments and resources unavailability.

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