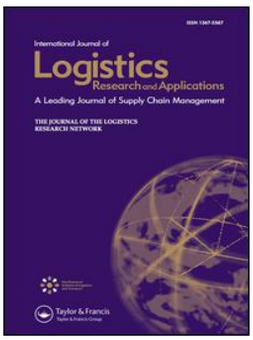

Taylor & Francis
Taylor & Francis Group

International Journal of Logistics Research and Applications

A Leading Journal of Supply Chain Management

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/cjol20

Facilities management supply chain: collaboration of FM functions, flows and parties in the apparel sector

F. N. Abdeen & Y. G. Sandanayake

To cite this article: F. N. Abdeen & Y. G. Sandanayake (2020): Facilities management supply chain: collaboration of FM functions, flows and parties in the apparel sector, International Journal of Logistics Research and Applications, DOI: 10.1080/13675567.2020.1800607

To link to this article: https://doi.org/10.1080/13675567.2020.1800607

Published online: 29 Jul 2020.

INTERNATIONAL JOURNAL OF LOGISTICS: RESEARCH AND APPLICATIONS
https://doi.org/10.1080/13675567.2020.1800607

Taylor & Francis
Taylor & Francis Group

CASE REPORT

Facilities management supply chain: collaboration of FM functions, flows and parties in the apparel sector

F. N. Abdeen and Y. G. Sandanayake

Department of Building Economics, University of Moratuwa, Moratuwa, Sri Lanka

ABSTRACT

This study aims to investigate the main functions of Facilities Management (FM) supply chain, upstream, midstream, and downstream activities, main parties and different flows in the apparel sector. The study followed a qualitative research approach based on case study design for empirical investigation. Data gathered from three case studies were analysed using content analysis. The research findings indicate that FM, being a multi-disciplinary function, owns a supply chain that integrates supply chains of maintenance, repair and refurbishment, energy, and water management, building services and operations, health, safety and hygiene, and housekeeping. The individual supply chains comprise its unique as well as common forms of information, services/products, and finance flows involved at upstream, midstream, and downstream of the supply chain. This research developed a holistic supply chain for FM by integrating the five main supply chains. The findings can be used by facilities managers to ensure seamless service delivery in FM.

ARTICLE HISTORY
Received 1 May 2019
Accepted 20 July 2020

KEYWORDS
Facilities management; Supply chain; Facilities management supply chain; Apparel sector

1. Introduction

Sri Lankan apparel industry had a modest initiation around the 1960s, producing textiles for the local market (Board of Investment [BOI] 2018). Following the economic liberalisation in 1977, the apparel sector took-off and served as a significant contributor to the export market. The apparel industry has many characteristics, which include demand uncertainty (Jin 2004), short product life cycle, high volatility, low predictability, and high level of impulse purchase (Bruce, Daly, and Towers 2004). Coleman (2018) highlighted the importance of talented and skilled Facilities Management (FM) team, which creates knowledge and skilled resources to complement the dedicated operations and thereby support during peak demands in manufacturing facilities. Facilities managers are generally involved in functions such as waste management, health and safety, compliance, energy management, maintenance, security, and cleaning (British Institue of Facilities Management [BIFM] 2017b). Ancarani and Capaldo (2006) stated that security, catering, cleaning, and waste management and recycling are among frequently outsourced FM functions.

The FM market has become dynamic, comprising of FM contractors, in-house and outsourced FM teams, FM suppliers, FM consultants, and professional FM institutions (Cardellino and Finch 2006). According to Terrantroy (2017), sharing information among different parties had become a significant issue on FM due to the involvement of multiple parties. Also, Nardelli and Rajala (2018) have highlighted the requirement of managing relationships in an outsourced setting and the participation of different parties in the FM. In this context, facilities managers are required to perform in a fragmented structure by integrating and coordinating multiple parties in the supply

CONTACT F. N. Abdeen nisharaabdeen04@gmail.com

chain (Loosemore and Hsin 2001; Steenhuizen et al. 2014). The above concerns made by different authors necessitate the requirement of a systematic supply chain to manage multiple parties, various flows, and relationships in FM. Alexander et al. (2004) described FM supply chain as a system facilitating the delivery of FM functions and products to support the core objective of an organisation. However, the network structure of the FM supply chain symbolises the advanced FM supply chain with the involvement of complex variables and interrelationship (Pitt et al. 2014).

Nevertheless, the FM supply chain has been taken for granted by many entities, merely due to the negative perception of FM as a non-critical service (Pitt et al. 2014). According to Nazali Mohd Noor and Pitt (2009), managing service delivery issues prevailing in the supply chain could make a positive contribution to the organisational supply chain. Moreover, Patrick Hunter, the Director of Business Development presenting his view to FM World magazine, highlighted that the demand for FM in a manufacturing facility would vary based on the nature of the production (BIFM 2017a). Hence, neglecting the FM supply chain by considering it merely as a supportive function would greatly impact apparel factories due to the complex nature of the core business.

Although FM functions are extensively investigated in different manufacturing settings, the FM supply chain is rarely investigated in mainstream literature. In the multiple contract management environment, Pitt (2012) presented the process for designing and making decisions of FM service supply chain network in five steps as, (a) examination of the needs of facility services, (b) identifying available options in delivering and processing the services, (c) modelling structures of FM supply chain network, (d) evaluating all possible models for their optimisation, and (e) selecting the model with the best optimisation. However, their focus was on an optimum technique, which can be applied by clients and FM service providers, where FM functions are outsourced. Moreover, Scupola (2012) tested the factors affecting the adoption of ICT in Danish FM supply chain, and Nelson and Sarshar (2011) performed a study by applying Integrate to Innovate (i2i) model, which is used to evaluate the FM supply chain relationships. Although the above researchers investigated the FM supply chain, their focuses were limited to FM supply chain process, strategic issues, challenges, and risks.

However, there is a dearth of investigations on parties involved in the FM supply chain, its functions, and flows and relationships in the apparel sector. Therefore, the research question was set as 'what are the functions, flows, and relationships available in the FM supply chain in the apparel sector?' It is vital to identify the nature of the FM supply chain to effectively manage the FM supply chain and optimise its performance in the apparel sector. Hence, this study aims to explore the nature of FM supply chain, its functions, flows and relationships together with barriers for successful functioning and strategies to overcome such barriers in the apparel sector.

The remainder of the paper is organised as follows: Section 2 of the paper presents the literature review on FM and FM supply chain and the need for identifying the nature of the FM supply chain, while Section 3 presents the methodology followed by the study. Section 4 presents the study findings by providing a comprehensive picture of the FM supply chain, and finally, discussions, conclusions and recommendations along with theoretical contributions, practical implications, and future research are presented in Section 5 and Section 6, respectively.

2. Literature review

2.1. Facilities management

EuroFM (2019) defined FM as '*the integration of processes within an organization to maintain and develop the agreed services, which support and improve the effectiveness of its primary activities*'. However, the International Facility Management Association (IFMA 2019) defined FM as a profession that encompasses multiple disciplines to ensure the functionality of the built environment by integrating people, place, process, and technology. Accordingly, Abdeen and Sandanayake (2018) defined FM as '*a multi-disciplinary approach that covers a wide range of processes, services, activities,*

and facilities to ensure the functionality of the built environment by integrating people, places, process, and technology'. The definition itself highlights the complex nature of FM discipline and the necessity of a mechanism to optimise its functions. However, the common perception of FM primary function is confined to support the organisation's core activities (Chotipanich 2004; Steenhuizen et al. 2014). According to Hendriks (2013), operational level of FM is more visible compared to strategic and tactical levels. Chotipanich (2004) stated that FM functions are designed to suit organisational requirements, and the organisation would rarely require all the services available under the domain of FM. The literature review findings revealed several functions under the domain of FM and its supply chain. Since FM is a multi-disciplinary approach (Alexander et al. 2004), identifying the FM functions is necessary to conduct the study. Hence, a comprehensive literature review on FM functions was undertaken as summarised in Table 1.

The comprehensive review of literature on FM functions revealed that FM involves a wide range of functions undertaken within a broader spectrum of different facilities. Accordingly, health and safety management, waste management, energy management, building maintenance, workplace security, cleaning, catering pest control, gardening and parking management can be identified as highly cited FM functions. The functions identified in Table 1 were used for the empirical investigation to gain a broader understanding of the FM functions in the apparel manufacturing facility.

2.2. FM supply chain

Li (2005) defined the supply chain as '*A series of business processes in which products or services are produced and delivered to customers through value-adding activities*' (p. 1). According to Mentzer et al. (2001), the supply chain could be divided into three categories, based on the channel relationship, as a direct supply chain, extended supply chain, and ultimate supply chain. The direct supply chain consists of the central organisation, customer, and the supplier (Felea and Albastroiu 2013). McCormack and Johnson (2016) stated that a supply chain extending beyond the organisation boundaries is considered as the extended supply chain. An ultimate supply chain comprises of all

Table 1. Literature summary of FM functions.

	Sources (references given below)																	
FM functions	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Procuring Services	X																X	
Health and Safety Management	X	X							X				X		X	X		
Waste Management	X	X		X	X		X	X	X				X					
Energy Management	X	X		X	X	X		X		X	X				X	X	X	
Water Management	X	X														X		
Building Maintenance	X	X	X	X		X	X	X	X		X	X	X		X			X
Workplace Security	X	X		X	X	X	X	X	X		X		X	X	X	X	X	
Cleaning		X	X	X	X	X	X		X		X	X	X	X	X		X	X
Catering	X	X	X	X	X				X		X	X	X			X	X	
Pest Control										X			X	X	X	X		
Gardening				X	X				X					X			X	
Parking Management				X		X				X			X		X			
Reception			X	X					X								X	
Managing Building Services				X										X	X			
Asset Management												X		X				
Housekeeping										X			X	X		X		
Hygiene Services													X	X	X			
Repair Plants and Equipment		X											X			X		X
Facility Refurbishment																X		X

Sources: [1] White (2013); [2]Facility Management Association of Australia Ltd (FMA Australia 2012); [3] The Business Services Associaiton (2014); [4] Roy (2017); [5] Ancarani and Capaldo (2006); [6] Loosemore and Hsin (2001); [7] Arayici, Onyenobi, and Egbu (2012); [8] Yu, Froese, and Grobler (2000); [9] Tucker and Pitt (2009); [10] IFMA (2019); [11] Kulatunga, Liyanage, and Amaratunga (2010); [12] Boateng (2011); [13] Musa and Pitt (2009); [14] Hendriks (2013); [15] Blue-Eye Training Ltd (2014); [16] Chotipanich (2004); [17] Vetráková, Potkány, and Hitka (2013); [18] Patanapiradej (2006).

organisations involved in the upstream and downstream flow of products, services, finance, and information (Mentzer et al. 2001). Moreover, Olugu, Wong, and Shaharoun (2011) identified three (03) main elements of the SC process as Upstream (considers all aspects related to suppliers), Midstream (considers internal SC of the organisation), and Downstream (considers all aspects related to customers).

A supply chain from FM perspective can be defined as *'the system used in the delivery of services to support the business objectives of an organisation'* (Nazali Mohd Noor and Pitt 2009, 284). According to Then (1999) and Nielsen, Jensen, and Jensen (2012), the FM focuses on facilitating demand and supply of services and physical resources that need to deliver the core products or services of the business. Moreover, Koksal (2011) stated that FM is a coordinating mechanism that matches demand and supply of various facility services to ensure effectiveness. Based on the above discussions, the FM supply chain can be considered as a system, which facilitates customer demands through the involvement of various supply sources. Vanichkobchinda (2010) stated that with the variety of service level and material supply, the importance of managing the FM supply chain is inevitable. Moreover, managing the FM supply chain would assist in supply base reduction, develop long-term contracts, heighten in-house FM team's proficiencies, develop buyer-supplier relationships, and enhance supplier involvement, cross-functional interactions, and trust and commitment (Nazali Mohd Noor and Pitt 2009). Although several authors have discussed the FM supply chain, none have attempted to identify a detailed supply chain with its components such as functions, parties, and flows. Supply chain had been a significant concept for study in several fields such as construction (Cox, Ireland, and Townsend 2006), hotels (Al-Aomar and Hussain 2017), and health care (Mettler and Rohner 2009). Despite the importance of supply chain in FM, no effort had been put to investigate the nature of FM supply chain in the apparel sector. In order to address this setback in prevailing literature, this study investigated the nature of FM supply chain in apparel manufacturing factories.

3. Research methodology

The literature review manifested a lack of an in-depth investigation into the nature of FM supply chain, including its functions, flows, and relationships, which assisted in setting the aim of the study. In the Sri Lankan context, a lack of studies regarding FM supply chain management in the apparel sector is noted. According to Creswell (2013), a qualitative approach is highly suitable, if limited research work is performed in the study area, and further exploration is in need. Further, Naoum (2012) recommends a qualitative approach if the researcher expects to obtain participants' views and opinions. Since the study required a thorough investigation of the FM supply chain and knowledge and expertise of professionals, the qualitative approach was employed in the study using a case study strategy to enable an in-depth investigation of the FM supply chain.

The apparel industry is considered as one of the highest contributing sectors with a sustainable growth over four decades, accounting for 44% of total exports and contributing to 33% of manufacturing employment (International Trade Administration 2019). Therefore, undertaking studies concerning apparel factories by making the supply chain a focal point is crucial to maintain the industries momentum within the country. Further, FM plays a vital role in apparel factories for ensuring the proper functioning of the facility and thereby supporting its complex operations. Hence, the study considered apparel factories as case studies, and data were collected under a multiple case study approach, from three (03) leading apparel factories in Sri Lanka. A multiple case study approach was selected for this study as the results generated were not unique to a particular case, and conducting multiple case study was critical to deriving a reliable and robust FM supply chain model. The unit of analysis was considered as departments that practice FM functions or related functions in apparel factories. An embedded multiple unit analysis helped to gather the necessary data.

Interviewing, observing, collecting, examining, and feeling are several methods that could be used in collecting data in case studies (Yin 2016). The primary data collection methods used in this study were interviews with experts, observation, and document review. Semi-structured interviews were mainly held among respondents involved in delivering FM-related functions. The use of semi-structured interviews enabled the researcher to capture implicit verbal expressions and clarify questions during interviews. The duration of interviews varied between 1.5 and 2 hours and was supported by a data collection tool. Respondents were mainly inquired on the current practices of managing the FM supply chain, primary FM functions in an apparel factory with reference to Table 1, the nature of FM supply chain in terms of parties, and flows and relationships and barriers in establishing an effective FM supply chain and mitigation strategies. The same data collection tool was utilised in recording observations by focusing on roles, responsibilities, and relationships between various parties relating to FM function-specific activities and actions. Owing to the number of interviews performed within the cases, frequent visits were made to factories providing more opportunities for observations

Table 2. Case study profile.

Description	Case A	Case B	Case C
Ownership of the organisation	Privately owned	Privately owned	Privately owned
Core business	Apparel Manufacturing	Apparel Manufacturing	Apparel Manufacturing
Products manufactured	Sportswear- jockstrap and sports bra, shorts, track suits	Casual wear- woven bottoms, basic pants, cargo pants, 5-pocket jeans, shorts and skirts	Woven garments, including dresses, jackets, pants, skirts, shorts, blouses, nightwear and children's wear,
Customers	Nikie, Lulu Lemon, Patagonia, Columbia, Calvin Klein	Marks & Spencer and GAP	Marks & Spencer, Tesco, True Religion, Levi's, Ralph Lauren and Tommy Hilfiger.
Standards complied	ISO 140001, OSHAS 18001, ISO 9001, ISO 5001	ISO 140001, OSHAS 18001, ISO 9001, ISO 5001	ISO 140001, OSHAS 18001, ISO 9001, ISO 5001
Number of employees	2000	1200	3000
Respondent: Designation (Experience)	A1: Senior Executive – Administration (5 years) A2: Senior Executive – Health and Safety (5 years) A3: Head of Department – Engineering (15 years) A4: Senior Executive – Maintenance (8 years) A5: Senior Executive – Sustainability (5 years)	B1: Senior Executive – Administration (12 years) B2: General Manager – Compliance, Health & Safety (11 years) B3: Manager – Engineering (6 years) B4: Senior Executive – Security (8 years)	C1: Senior Executive – Administration (6 years) C2: General Manager- Compliance, Health and safety (12 years) C3: General Manager- Engineering (10 years)
Documents Reviewed	Energy management policy Waste management plan Waste collector evaluation Onsite service provider policy Change management policy Agreements with service Providers Year calendar plan Contractor evaluation	Agreements with service Providers Standard operating Procedures Waste management policy Energy management Policy Waste collector evaluation Reports on standards	Waste handling procedures Procedure for monitoring Energy and water use Agreements with service Providers Security manual Building monitoring records Audit tools and actions plans
Observations Made	Daily routines Procedures followed in undertaking FM related functions Trainings and mock drills provided by suppliers	Daily routines Placement of outsourced representative Procedures followed in undertaking FM related functions Trainings and mock drills provided by suppliers	Daily routines including morning meetings Procedures followed in undertaking FM related functions Trainings and mock drills provided by suppliers

during ordinary working hours (7.30 am to 5 pm). The same period was utilised to review the documents and record the findings. Table 2 presents the case study profile. Content analysis was used to analyse the data gathered from interviews, observations and document review. Research findings allowed to draw conclusions and make recommendations. This study was conducted from January 2017 to December 2018.

4. Findings and discussion

4.1. Current practices in managing the FM supply chain

A lack of studies on identifying the nature of the FM supply chain was evident during the literature review. Hence, the study was directed towards developing a generic FM supply chain model to explain the nature of the FM supply chain in the apparel sector. Accordingly, the importance was given in ascertaining the current practices of managing the FM supply chain. The findings were based on the analysis of opinions, observations, and document review carried out in cases A, B, and C.

The respondent A3 commented on the current practices, mainly by focusing on machine maintenance, construction, service agreement, training, and quotation evaluation. It was evident that several practices in the FM supply chain such as maintaining service agreements, maintaining contactor rating systems, and evaluating at least three quotations before purchasing service or product in case B is similar to case A. Compared to cases A and B, the respondent from case C commented on different practices of FM supply chain. Accordingly, divisional level maintenance agreements are followed for the maintenance services of the factory. As per the discussion, in all three cases, some standard practices prevail in managing the FM supply chain. Some additional practices, unique to cases, are visible in individual cases.

In summary, the FM supply chain practices can be identified as maintaining supplier or contractor lists, evaluate quotations, maintain agreements, develop strategies to maintain spare parts, procure machines at fixed prices, grade contractors, and obtain training from manufactures through relationships. The documents reviewed on agreements, procedures, contractor evaluations, policies, audit tools, and action plans further verified the above findings. Training provided to internal staff by external parties were witnessed during the observations.

The concept of SCM is not novel to FM. The idea has been practised within the discipline though it is not frequently emphasised. Being in a position of involving several parties to support the core function, the facilities manager in an apparel factory has a colossal job role. In such an environment, implementing supply chain concepts to control and monitor FM services, products, information, and cash and finance flows are mandatory. However, the current practices are ad-hoc in nature, and no such effort had been made to optimise the FM supply chain by benchmarking the good practices currently prevailing in the industry. This is mainly due to the lack of efforts made to establish the nature of FM supply chain and identify related flows, which would assist in decision making.

4.2. FM supply chain: functions, flows, and relationships

Identifying the FM functions in apparel factories is crucial to understand the related flows and relationships in a FM supply chain. The FM functions identified in Table 1 were presented to respondents in all three cases and requested to group them logically according to their current practice. The findings were shared among all respondents in the three rounds before clustering into five major FM functions as follows:

1. Maintenance, repair, and refurbishment – Maintenance, Repair plants and equipment, Facility refurbishment
2. Energy and water management – Energy management, Water management

3. Building services and operations – *Procuring services, Workplace security, Catering, Parking management, Managing building services, and Reception*
4. Health, safety, and hygiene – *Hygiene services, Safety management*
5. Housekeeping – *Waste management, Cleaning, Pest control, Gardening*

During the third round, all respondents agreed that all aforementioned major functions apply to apparel factories. The above clustering was further verified while observing daily routines and procedures and reviewing documents such as service agreements, procedures, and reports. For example, it was observed that both energy management and water management related training and monitoring were done simultaneously. A review of service agreements on housekeeping services provided evidence for the inclusion of waste management, cleaning, pest control, and gardening under the term housekeeping. This process assisted in clearly establishing the FM functions necessary for empirical investigation in subsequent stages.

Following the process of determining the FM functions, the study extended to identify upstream, midstream, and downstream functions, and various flows and their relationships of the aforementioned five major FM functions to develop the FM supply chain. In order to generate the findings, interviews were mainly utilised while detailed document review on agreements, policies and procedures, evaluation criteria, audit tools, reports, and action plans were performed to determine the information flow.

The authors developed a typical supply chain model for all five (05) FM functions to facilitate the empirical investigation, as shown in Figure 1.

During data collection, Respondents A3, A4, A5, B2, B3, B4, C2, and C3 revealed that although FM functions are the responsibility of FM department at current context, mainly, the Engineering (maintenance, repair and refurbishment, energy and water management) and Administrative departments (building services and operations, health safety and hygiene, housekeeping) of apparel factories undertake these functions. Therefore, the focal points of the supply chain in the current context is the Engineering and Administrative departments. According to respondent A2, *'At midstream, these two main departments interact with other internal departments to finally deliver the requested product or FM services to the internal and external customers'*. All respondents representing the administration, engineering, health and safety, and sustainability disciplines identified the internal departments and external customers who utilise the facility as main customers of the supply chain. Similarly, the respondents stated that the suppliers of the FM supply chain would differ according to FM functions performed. In terms of the flows, respondent C3 stated that *'the contents of information, product, service, and finance flows would vary based on the different functions they perform, as the focus of the function differs from one to another'*.

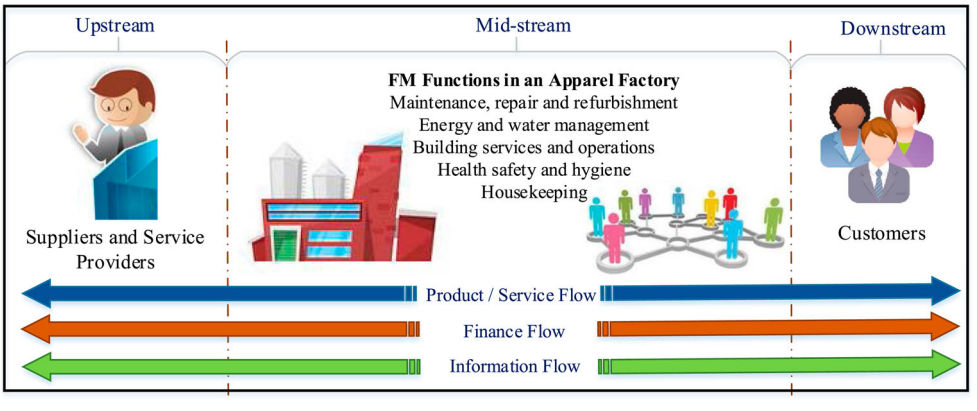

Figure 1. A typical FM supply chain of the apparel sector.

All respondents agreed that looking in to the supply chains of different FM functions is of utmost important to develop an integrated FM supply chain. Therefore, a detailed analysis was carried out on upstream, downstream, and midstream activities, parties and flows relevant to maintenance, repair and refurbishment, energy and water management, building services and operations, health safety and hygiene, and housekeeping supply chains, which are comprehensively discussed in the following sections.

4.2.1. Maintenance, repair, and refurbishment of the supply chain

According to respondents A3, B3, B5, and C3, maintenance and repair and refurbishment supply chains play a significant role in apparel factories since the factories cannot afford to bear downtime losses caused by inefficient machinery or poor maintenance practices. To determine the nature of maintenance, and repair and refurbishment supply chain, the study investigated the upstream, midstream, and downstream activities and the various parties involved along the supply chain. The investigation was extended further to identify product/service, finance, and information flow along the supply chain. Table 3 shows the research outcome.

AAs evident in Table 3, suppliers of the supply chain mainly comprise parties involved in facilitating maintenance, repairs, test, surveys, and providing spare parts. However, respondents recognised the finance department as the main party involved in the sourcing process at midstream. According to A4, *'during the sourcing process of services and products, the Finance department plays a main role and forms the direct contact point with suppliers, whereas indirect relationships are maintained with the Engineering department'*. According to respondents, after purchasing the products and services, those need to be delivered to the internal customers (all departments) and external customers (apparel customers, neighbours, and interest groups) of maintenance, repair, and refurbishment supply chain. The respondents' opinions signified that all internal departments collaborate with the Engineering department. This process mainly occurs at the midstream. The internal departments play a dual role here as internal suppliers and internal customers.

According to Table 3, the information flow is continuous and exchange across upstream, midstream, and downstream in bi-directional form. The unique feature of service and product flow of repair and refurbishment supply chain is that although products (spare parts, machinery) and services (training, consultancy) are purchased from upstream suppliers, they only receive maintenance services when it comes to the delivery of services to internal departments and external customers. It was further determined that products flow is bi-directional as the product purchase has the possibility of returning. However, a service flow is unidirectional as services cannot be returned once it is consumed. Moreover, respondents' opinions highlighted the bi-directional form of the finance flow. For example, B3 noted that *'with relevant to finance flow, in addition to the payments made for products and services purchased, Engineering department would be responsible for any compensation made to customers due to the negligence of the particular department'*.

4.2.2. Energy and water management supply chain

Energy and water management is a predominant function in factories in which the use of energy and water is high. Respondents noted that in the current context, with emerging sustainability approaches, facilities managers are required to focus more on energy and water management aspects. A thorough investigation was carried out on the upstream, midstream, and downstream activities to understand and develop energy and water management supply chain. Table 4 presents the relevant product, service, information, and finance flows of the energy and water management supply chain.

When considering the parties involved in energy and water management supply chain, the midstream and downstream parties are similar to other FM supply chains. The unique feature of the parties involved in upstream is that these parties, in many instances, represent government bodies and authorities. Respondents A3, A5, B3, and C3 highlighted the dual roles played by apparel customers as supplier and customer. According to B3, '*apparel customer at the particular supply chain is considered as a supplier too as they set compliance requirements that should be met by the team involved*

Table 3. Activities, flows and parties involved in maintenance, repair and refurbishment supply chain.

Supply chain	Activities	Parties	Information flow	Service flow / product flow	Finance flow
Upstream	Maintenance and repairs carried out by service providers Supply of spare parts Tests and surveys carried out by service providers	Manufactures, suppliers and agents of spare parts, machinery and equipment Service providers and maintenance contractors Suppliers of building services Laboratories and qualified surveyors Chemical suppliers Design team of new or refurbishment projects	Maintenance procedure and precautions Spare part specification Terms and conditions of maintenance agreements Evaluation criteria and results Findings and recommendations on tests Client requirements and cost estimates	Consultancy services Training services Maintenance services Spare parts Machinery and equipment Construction materials	Payments made for test, surveys, spare parts, maintenance and consultancy services
Mid-stream (internal departments of the Apparel factory)	Evaluating contractors Forming and renewing agreements	Finance division with the involvement of Engineering department			
	Procuring equipment's and services		Audit findings Data sharing Information related to resources (asset, workforce)		
	Undertaking internal audits Reporting data	Corporate and divisional teams			
	Supply of HR	HR department	Customer satisfaction		
	Forwarding requests made by external customers and apparel customers		Complaints (Issue, place, time) Service required Progress of complain		
	Provision of maintenance and repairs requirements	Engineering department			
	Receiving maintenance and repairs requirements	All departments		Maintenance services	Compensations provided for incidents
Downstream	Requesting and receiving maintenance and repairs requirements	Apparel customers Neighbours Interest groups			

in water and energy management to ensure future business'. This dual role of apparel customers is common among the supply chains of building services and operations, health, safety and hygiene, and housekeeping in relation to supply chain's individual context.

The midstream activities and process and parties of energy and water management supply chain are similar to maintenance, repair, and refurbishment supply chain. The study revealed that although several services and products are procured at upstream, the main services delivered to internal and external suppliers are training services, energy management related services, and utility services. Unlike in other four (04) supply chains, this supply chain involves a cash in-flow through energy and water savings.

Table 4. Activities, flows and parties involved in energy and water management supply chain.

Supply chain	Activities	Parties	Information flow	Service flow / product flow	Finance flow
Upstream	Supply and installation of energy efficient and water efficient equipment and systems Provision of energy audit, water audit and training services Certifications provided by service providers	Utility service providers such as CEB and NWS&DB Auditors National bodies and regulatory authorities such as BOI, CEA Suppliers of energy efficient equipment Apparel customers	Information on energy and water compliance requirements Terms and conditions for procurement Audit Evaluation criteria and results Design specifications and cost estimates	Consultancy services Training services Energy Management related services Utility services and supplies Equipment and fittings	Utility bill payments Cost of purchasing energy and water efficient equipment Audit and system certification expenses
Mid-stream	Evaluating contractors Forming and renewing agreements Procuring equipment's and services	Finance division with the involvement of Engineering department			
	Undertaking internal audits Reporting energy and water data	Corporate and divisional teams	Audit findings Data sharing Information related to resources (asset, workforce)		Energy and water savings
	Supply of HR Forwarding requests made by external customers and apparel customers	HR department			
	Provision of energy and water necessities	Engineering department	Customer satisfaction Complaints (Issue, place, time) Service required Progress of complain	Training services Energy Management related services Utility services	
	Receiving energy and water necessities	All departments			
Downstream	Requesting and receiving energy and water necessities	Apparel customers Neighbours Interest groups			

4.2.3. Building services and operations supply chain

Interviewees endorsed that the building services and operations function is made out of procuring services, workplace security, catering, parking management, managing building services, reception, and asset management. Hence, it forms a major part of FM functions, which proves its undeniable contribution towards developing the FM supply chain. Therefore, upstream, midstream, and downstream activities and relevant product, service, information, and finance flows of building services and operations supply chain were determined through case studies and presented in Table 5.

Distinct from other supply chains identified for maintenance, repair and refurbishment and energy and water management, the supply chain for building services and operations revolves around the administrative department. As respondents A1, B1, B4, and C1 highlighted, the administrative department overlooks building services and operations, although those functions are related to FM. A1 stated that *'as catering and security services are completely outsourced, the HR department does not involve in supplying human resources to proceed with the function'*. Moreover, as per B4, *'HR department maintains a direct relationship with customers, whereas the administrative department has only an indirect relationship'*. However, the internal process of complaints handling and service procurement remains to be similar to supply chains of other four (04) main functions.

Table 5. Activities, flows, and parties involved in building services and operations supply chain.

Supply chain	Activities	Parties	Information flow	Service flow / product flow	Finance flow
Upstream	Supply and installation of building services Conduct inspection by PHI External audits of kitchen and canteen Provision of security services Provision of catering services	Public Health Inspector (PHI) Building service suppliers Security service providers Catering service providers Apparel customers	Terms and conditions in agreements Information on building services specifications and cost estimates Audit Evaluation criteria and results Hygiene and food safety conditions and recommendations	Consultancy Training services Catering Security Car parking	Payments for tests and outsourced services
Mid-stream	Evaluating contractors Forming and renewing agreements Procuring equipment's and services	Finance division with the involvement of administrative department			
	Undertaking internal audits Reporting data Forwarding requests made by external customers and apparel customers	Corporate and divisional teams HR Department	Audit findings Data sharing Information related to resources (asset, workforce)		
	Provision of catering, security services, car parking services	Administration department	Customer satisfaction Complaints (Issue, place, time) Service required	Catering services Security services	Compensation
	Receiving catering and security services	Internal customers (All departments)	Progress of complain	Car parking services	
Downstream	Requesting and receiving catering and security services	External customers (apparel customers)			

Information flow in particular to hygiene and food safety conditions and services provided on catering, security and car parking remains to be unique characteristics of the supply chain. Other forms of information continue to be similar among the supply chains. Services such as catering services, security services, and car parking services procured from upstream are cascaded to downstream to meet customer requirements. Payments made to suppliers and compensations made to customers remains to be common with the rest of the supply chains.

4.2.4. Health, safety, and hygiene supply chain

Several statutory laws govern health, safety, and hygiene functions in apparel factories to ensure the workers' wellbeing. Therefore, the facilities manager is under the immense pressure of providing health, safety, and hygiene of the factory floor. Determining the overall FM supply chain, therefore, requires a noteworthy input from health, safety, and hygiene supply chain. Table 6 presents the parties, activities, product, service, information, and finance flows at upstream, midstream, and downstream of health, safety, and hygiene supply chain.

Similar to building services and operations supply chain, the health, safety, and hygiene is another major FM function mainly handled by the administrative department. The study revealed that the health, safety, and hygiene supply chain has direct and indirect relationships with suppliers and

Table 6. Activities, flows, and parties involved in health, safety, and hygiene supply chain.

Supply chain	Activities	Parties	Information flow	Service flow / product flow	Finance flow
Upstream	Audits and test carried out by external parties Purchasing of personnel protective equipment	Auditors and teams of apparel customers Suppliers of PPP (Personnel Protective Equipment)	Information on health, safety and hygiene compliance requirements Guidelines and Terms and conditions for procurement	Consultancy service PPP	Payments for audits, tests and purchases Non-compliance losses
Mid-stream	Evaluating contractors Forming and renewing agreements Procuring equipment's and services	Finance division with the involvement of administrative department	Audit Evaluation criteria and results Design specifications and cost estimates		
	Undertaking internal audits Reporting data	Corporate and divisional teams	Audit findings Data sharing		
	Supply of HR Forwarding requests made by external customers and apparel customers	HR Department	Information related to resources (asset, workforce)		
	Train internal employees on health, safety and hygiene Carry out assessments and reviews	Administration department	Customer satisfaction Complaints (Issue, place, time) Service required Progress of complain		
	Receiving complaints and requirements	Internal customers (All departments)		Health, safety and hygiene PPP	Compensation
Downstream	Requesting and receiving services	External customers (apparel customers)			

customers, and few of the internal processes (i.e. souring and handling complaints and requirements) similar to building services and operations supply chain. The product flow is unique in health, safety, and hygiene, while service flows (consultancy, training), finance flows (audit and system certifications and compensation), and information flows (complaints requirements, terms and agreements, complaints, design specification, and audit findings and recommendations) are similar to the other four (04) supply chains.

4.2.5. Housekeeping supply chain

Housekeeping forms another core function under FM. According to respondents, it deals with most of the soft FM aspects. This function involves several activities, which need to be carried on time. Respondents noted that '*ensuring the on-time purchase of detergents and other materials and maintaining adequate stocks is a must to ensure the cleanliness of the facility*'. Hence, housekeeping function and its interrelated activities cannot be disregarded in determining the FM supply chain. Therefore, the study investigated the upstream, midstream, and downstream activities, parties and flows of housekeeping functions and summarised in Table 7.

The opinions of respondents A1, B1, and C1 revealed housekeeping as a function overlooked by administrative department, though it is similar to building services and operations and health, safety and hygiene. Although the internal processes mainly focus on complaints and sourcing, and the direct and indirect relationships with suppliers and customers remain to be common with other supply chains, few unique characteristics prevail in terms of product flow, service flow, and parties. The services mainly comprise of cleaning, gardening, and pest control, for which the main product flow involved is cleaning equipment and waste. Another unique characteristic of the supply chain is

Table 7. Activities, flows, and parties involved in housekeeping supply chain.

Supply chain	Activities	Parties	Information flow	Service flow / product flow	Finance flow
Upstream	Supply cleaning and waste management equipment Provision of cleaning services Provision of pest controlling services	External pest controllers Cleaning service providers Curators Apparel customers	Information on health, safety and hygiene compliance requirements Guidelines and Terms and conditions for procurement Audit Evaluation criteria and results Design specifications and cost estimates	Cleaning service Pest controlling services Cleaning equipment	Payments for audits, tests and purchases Non- compliance losses
Mid-stream	Evaluating service providers Forming and renewing agreements Procuring equipment's and services	Finance division with the involvement of administrative division	Audit findings Data sharing Information related to resources (asset, workforce)		
	Undertaking internal audits Reporting data	Corporate and divisional teams			
	Provision of training for cleaners Carrying out audits	Administration department	Customer satisfaction Complaints (Issue, place, time) Service required Progress of complain	Cleaning service Pest controlling services Waste	Compensation
	Provision of cleaning services Forwarding requests made by external customers and apparel customers	HR department			
	Receiving of cleaning services	Internal customers (All departments)			
Downstream	Requesting and receiving cleaning services	External customers (apparel customers, neighbours, interest groups, waste collectors)			

the involvement of waste collectors both as an external supplier and an external customer. Respondent C1 noted that

> wastes, which are hazardous in the apparel factory, is required to be disposed safely through approved waste collectors for which the factory will have to bear the cost. At certain points, since certain buyers use fabric wastes as a by-product, the buyer will have to purchase the waste at their own cost.

Therefore, it was determined that waste collectors, similar to apparel customers, play a dual role as suppliers and customers.

As discussed above, this study identified the unique and typical characteristics of the supply chains of five FM functions that form the overall FM supply chain. However, the respondents highlighted the importance of having a single entity to handle FM functions to enhance the efficiency of the FM supply chain. Hence, this research finally combined all the FM supply chains, as mentioned above, into a holistic FM supply chain, and presented in the next section.

4.3. FM supply chain in apparel factories

Supply chains of the five major FM functions were separately investigated in the previous sections to have a comprehensive understanding before developing the overall FM supply chain. Figure 2 presents the holistic FM supply chain model developed by incorporating the above findings. It shows the upstream, midstream, and downstream parties and their relationships. Tables 3–7 provide the product/service, finance, and information flows.

Upstream of the supply chain mainly comprises of external suppliers of all FM functions, whereas the midstream shows the collaboration between internal departments, and the downstream consists of external customers. Throughout the supply chain, the information, products, and finances flow remain bidirectional, while the services flow is unidirectional.

Further to Figure 2, it can be concluded that the upstream of the FM supply chain mainly comprises the supply of products and expert/consultancy services, compliance requirements provided by regulatory bodies and apparel customers audits carried out by external auditors and surveyors, and certifications and tests done by authorised bodies. The above parties need information such as services required, products required and specifications, terms and agreements, and audit findings and recommendations for their smooth functioning. Moreover, products such as machinery, equipment,

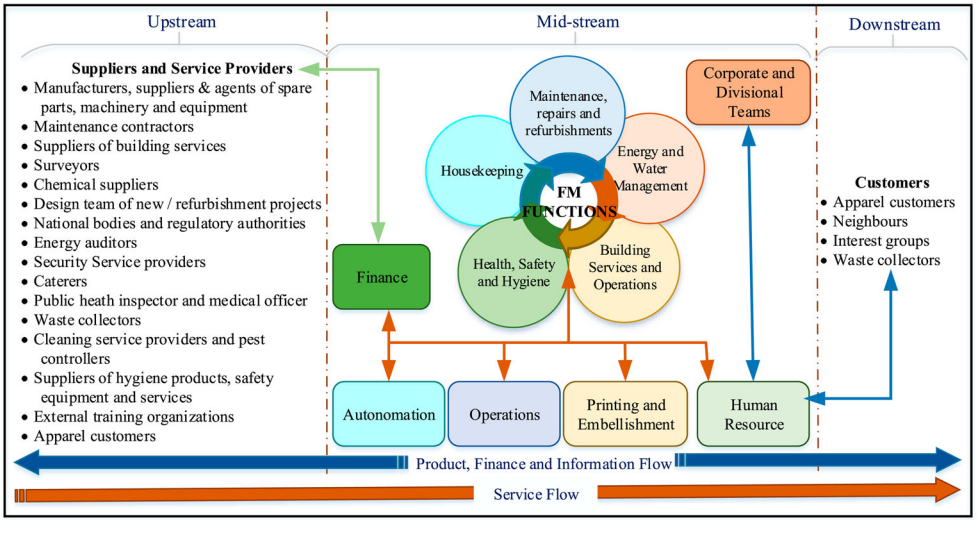

Figure 2. FM supply chain- a holistic model.

spare parts, chemicals, and waste, and services such as consultancy, training, catering, and security are purchased from suppliers and service providers. Expenses for such purchased items and services are the leading finance outflows at the upstream.

Evidently, the midstream or internal supply chain should be functional for operating the upstream activities. Therefore, the midstream of the FM supply chain is a network created through multiple party engagement in different FM functions as identified in Section 4.2. Souring of products and services, i.e. evaluating service providers, forming and renewing agreements, and procuring equipment and services are mainly carried out through finance division, while the HR department manages the complaints forwarding. Further, activities such as receiving complaints, providing FM service requirements, and training occur at midstream. The midstream information sharing can be identified under three categories as, (a) between internal departments and suppliers (e.g. design criteria, suppliers' terms and agreements, cost estimates, and audit findings), (b) between internal departments (e.g. data sharing, audit findings and information related to resources), and (c) between internal departments customers (e.g. complaints, service requirements, and status of the complaints lodged). Services and products procured at upstream cascades down to midstream to meet internal department requirements.

At downstream, the main customers are apparel customers, neighbours, interest groups, and waste collectors, while the main activity involved is in requesting and receiving FM services. Moreover, downstream apparel customers seek catering facilities and housekeeping assistance during their visits to the factories. Also, the FM division receives complaints about noise, pollution, and disturbances, from the neighbours and interest groups. Hence, the above can be highlighted as key in-flows and out-flows at the downstream.

The study is further extended to investigate the barriers to establishing an effective FM supply and strategies to overcome such impediments.

4.4. Barriers for establishing an effective FM supply chain and mitigation strategies

The respondents have identified several barriers affecting the FM supply chain, i.e. financial barriers, people management barriers, barriers due to improper systems, barriers at government level, and barriers caused by suppliers.

Barriers at the government level and barriers caused by suppliers were mainly pointed out in all three case studies. In order to maintain a seamless supply chain, it is paramount to adhere to organisational requirements. From FM perspectives, facilities managers are currently facing difficulties in finding suitable suppliers who adhere to such conditions (A3, B3, and C3). Further, in apparel factories, it is essential to maintain building services efficiency. If periodic maintenance is neglected, the effectiveness of the machinery would be at stake, and the whole production process would be interrupted due to a poor working environment. In such a context, it is vital to ensure proper supplier relationships and effective maintenance of such relationships. Respondents A1, B1, and C1 highlighted that *'maintaining supplier relationships and collaboration is an essential tool for success in the supply chain'*. In order to overcome the barriers created by suppliers, respondents from administrative, engineering, sustainability, security and health and safety disciplines proposed various strategies. Accordingly, the strategies identified were *internally developing efficient and reliable suppliers' lists, maintain stock for critical items, and maintaining good relationships with suppliers*.

The government-level barriers highly impact on maintaining a smooth supply chain process. Facilities managers are required to tackle with several stakeholders at the government level on a daily basis. For example, when obtaining a licence for scheduled waste management, there were delays due to inefficient practices. Respondents A3, A5, B3, and C3 pointed out this issue and the respondent A3 further added that *'although there are many requirements for factories to meet energy targets, lack in terms of regulations on energy efficiency equipment prevails. Hence, the overall supply chain process is incapable of meeting standards and benchmarks'*. In order to overcome the external barriers created at the government level, respondents A3, A5, B3, B3, C1, and C3 suggested that

'*authorities should promote energy conservation mechanisms and introduce waste management and pollution minimisation policies*'.

Cultural issues are the leading cause of people management barriers. FM comprises of several functions, which requires employee's assistance. Respondents A1, A2, B1, B2, B3, and C2, had a common opinion that if employees do not complain about service failures on time, late complaints could exaggerate the cost and finally impact the entire system. This was observed during the data collection process, in which an employee was complaining about a furniture breakdown happened a few days back. According to respondent A3, *'in a factory environment where people with various backgrounds and attitudes are involved, developing a sense of involvement is difficult. However, this creates a major impact on the FM supply chain'*. To overcome this barrier, incorporating *change management procedures and carrying out awareness sessions* were highlighted by the respondents. Respondent B3 noted that

> when the occupants are frequently made aware of the systems, the possibility of them to disregard the initiatives made are minimal. Further, if the occupants' consent could be obtained before implementing any systems, the occupants would feel a sense of importance and thereby try to follow the systems as they had agreed earlier.

Financial barriers and barriers due to improper systems are two other internal barriers that impact the FM supply chain. All respondents had a common opinion on the adverse impact of finance, and C2 stated,

> when capital investments, both long term and short term, are rejected or cancelled, a facilities manager would be in a position, where he would not be able to go ahead with any action. This may delay the whole process, including purchases and meeting customer needs.

According to respondents from cases A, B, and C, *pre-planning financial requirements and producing proper estimates* would assist in a greater extent to overcome the barrier. Ad-hoc requirements would not, however, be entertained by organisations in many instances. For the improper systems, *proper coordination system is mandatory* for the smooth functioning of the supply chain. For example, respondents B1 and C1 believe that the unavailability of an appropriate mechanism of coordination would delay lodging complaints and forwarding complaints. The allegations not tackled on time or delays in meeting requirements will dissatisfy the ultimate customer of FM services. To overcome this issue, the respondents suggested *introducing standard reporting mechanisms and online systems*.

5. Discussion

This study identified the FM supply chain in detail by laying down its parties, flows, and relationships corresponding to each FM function undertaken in apparel factories (i.e. Maintenance, repairs and refurbishments, Energy and water management, Building services and operations, Health, safety and hygiene, and Housekeeping). It finally mapped the overall FM supply chain by integrating the parties, flows, and relationships by concerning each FM function performed in factories. Although the literature review findings in Table 1 provide an overview of FM functions, it does not cover FM functions explicitly related to factories. With that gap in the literature, the study initially focused on determining the key FM functions relating to apparel factories. Chotipanich (2004) stated that the FM functions performed would vary based on the organisational requirements. Accordingly, a detailed list of FM functions in apparel factories was identified and categorised under five major FM functions based on expert opinion. Authors such as White (2013) had mainly classified FM functions under organisational management, maintenance management, and managing office workplace, whereas Kulatunga, Liyanage, and Amaratunga (2010) and Boateng (2011) considered hard and soft FM categorisation for clustering FM functions. Maintenance and operations management, property management and services are another categorisation introduced by Yu, Froese, and Grobler (2000). However, the motivation of this study was to derive the nature of FM supply chain for which a more transparent, rigorous, and detailed classification applicable for apparel factories was required. The five categories of FM functions, i.e. (a) maintenance, repair, and refurbishment, (b) energy and

water management, (c) building services and operations, (d) health, safety, and hygiene, and (e) housekeeping derived through the study provided a broad basis for empirical investigation.

In terms of the FM supply chain, although the key literature findings revealed that authors such as Pitt (2012), Pitt et al. (2014), Scupola (2012), and Nelson and Sarshar (2011) had researched in the area of the FM supply chain, their studies had not explicitly focused on developing the FM supply chain by providing the readers with an in-depth understanding on the nature FM supply chain. However, this study has identified the overall FM supply chain that spans into a broader spectrum with the involvement of parties at upstream, midstream, and downstream along with information, finance, service, and product flows, while creating direct and indirect relationships. In terms of parties, disparate from key literature on manufacturing and service supply chains, it was determined that internal customers form a majority of the customer base of FM supply chain in apparel factories compared to external customers. Further, apparel customers (i.e. organisations placing orders for tailoring branded products) plays a dual role in this context. The party considered as a supplier, who forwards various requirements in one instance is considered as a customer receiving FM services in another case. Moreover, waste collectors also play a similar dual role, in which, they act as a service provider by collecting garbage at certain instances, and in another situation, they act as a customer by purchasing material and food waste.

The current research, diversifying from the previous studies on the FM supply chain, further identifies the barriers in establishing an effective FM supply chain and the mitigation strategies. The barriers were identified from five perspectives as financial barriers, people management barriers, barriers due to improper systems, barriers at government level, and barriers caused by suppliers. Some authors (Fawcett, Magnan, and McCarter 2008; Park and Ungson 2001) have identified managerial complexities and inter-firm rivalry as main challenges hindering the supply chain. These findings are in the context of product supply chains. Yet, considering the current study findings, the main barrier emerging from the supplier perspective is the inability of finding suitable suppliers with critical requirements related to FM. Findings of Fawcett, Magnan, and McCarter (2008) further suggest that technology and cultural issues are the main barriers that hinder collaboration between partners in a setting of the large manufacturing supply chain. However, the current study understands that in the FM supply chain, these two barriers, along with financial barriers, are internal barriers hindering the effectiveness of FM supply. Mainly, this is because the advancement of FM supply chain concerning any other supply chain is primitive, and hence, at the initial stage, the barriers to be addressed are mainly formed internally. However, with the emerging scope, focus, and understanding of the FM supply chain, the barriers and challenges would become wider, providing more avenue for research. The study had proposed strategies to overcome the barriers identified from the FM context.

The current study has in overall contributed to the existing literature through bridging the knowledge gap by developing a detailed FM supply chain and providing a broader view on the parties, flows, and relationships, along with barriers for establishing an effective FM supply chain and mitigation strategies. The developed FM supply chain could be adopted by FM practitioners and other parties keen on ensuring continuous production flow to maximise the stakeholders' satisfaction.

6. Conclusions and recommendations

Managing the supply chain has a profound impact on an environment with complexities and multiple party involvement. The supply chain has been utilised in many areas which are crucial to organisation performance. FM that forms an integral part of an organisational environment is one such area requiring an established supply chain management. The analysis process revealed that apparel factories carry out several practices to ensure smooth functioning of the FM supply chain. Some practices were common in all three cases; however, several differences prevail in terms of certain practices. The practices could be summarised as maintaining supplier or contractor lists, evaluating at least three quotations, keeping agreements, strategies to manage spare parts, machinery

procurement at fixed prices, grading of contractors, and training obtained from manufactures due to good relationships. However, the possibility of further improvement of the FM supply chain. was identified for which establishing the nature of FM supply chain was vital.

Based on the empirical findings, this study developed a holistic FM supply chain for apparel sector by integrating supply chains of (a) maintenance, repair and refurbishment, (b) energy and water management, (c) building services and operations, (d) health, safety, and hygiene, and (e) housekeeping related FM functions. Accordingly, the upstream, midstream and downstream activities, information flow, service/product flow, finance flow, and parties of FM functions were identified. Several barriers related to financing, people management, improper systems, suppliers, and government policies were identified as causes, which could impact the effectiveness of FM supply chain, and strategies were proposed to overcome the identified barriers. The study findings would make several contributions to both theory and practice.

6.1. Theoretical contributions

The research adds up to the knowledge by providing a clear understanding on the nature of the FM supply chain, its upstream, midstream, and downstream activities, parties involved, information flows, service/product flows, and finance flows of FM supply chain in apparel factories. Previous studies have not focused on the above dimensions in deriving the FM supply chain. This deficiency led this study to demonstrate the nature of FM supply chain by integrating its upstream, midstream, and downstream activities, parties involved, information flows, service/product flows and finance flows. Hence, this study complements the existing studies on the FM supply chain by providing additional insights along with barriers and strategies to overcome the obstacles in the FM supply chain. Furthermore, the proposed FM supply chain may contribute to future theoretical and empirical studies related to the FM supply chain.

6.2. Practical implications

It is challenging for the apparel sector to determine the FM supply chain due to its multi-disciplinary nature and adapt more relevant practices to enhance the efficiency and effectiveness of the overall supply chain. The proposed FM supply chain provides a clear insight for the nature of the supply chain along with upstream, midstream, and downstream activities, parties involved, and information, service/product and finance flows. The findings of the study can be utilised by facilities managers and other professionals engaged in the apparel industry to ensure a seamless service delivery within their facilities. Further, the study identifies the barriers that hinder the FM supply chain and proposes strategies to overcome such barriers, which will assist practitioners in foreseeing the challenges and having adequate controls in place.

6.3. Future research

The holistic FM supply chain model developed in this study can be further extended and tested by applying to other industries. Further, due to the prevailing potential in the area of FM supply chain and the lack of a performance measurement systems to evaluate the performance of the supply chain, a valuable research avenue would be on developing a performance measurement system to assess FM supply chain performance. Such research endeavour is a possible solution for continues improvement of FM supply chain, which involves a high degree of complexities.

Disclosure statement

No potential conflict of interest was reported by the authors.

References

Abdeen, F. N., and Y. G. Sandanayake. 2018. "Facilities Management Supply Chain: Functions, Flows and Relationships." *Procedia Manufacturing* 17: 1104–1111.

Al-Aomar, R., and M. Hussain. 2017. "An Assessment of Green Practices in a Hotel Supply Chain: A Study of UAE Hotels." *Journal of Hospitality and Tourism Management* 32: 71–81.

Alexander, K., B. Atkin, J. Bröchner, and T. Haugen. 2004. *Facilities Management: Innovation and Performance*. 1st ed. London: Routledge.

Ancarani, A., and G. Capaldo. 2006. "Supporting Decision-Making Process in Facilities Management Services Procurement: A Methodological Approach." *Journal of Purchasing and Supply Management* 11: 232–241. doi:10.1016/j.pursup.2005.12.004.

Arayici, Y., T. Onyenobi, and C. Egbu. 2012. "Building Information Modelling (BIM) for Facilities Management (FM): The MediaCity Case Study Approach." *International Journal of 3-D Information Modeling* 1 (1): 55–73.

BIFM (British Institute of Facilities Management). 2017a. Factory Reset. Accessed August 24, 2018, from FM World website: http://www.fm-world.co.uk/features/feature-articles/factory-reset/.

BIFM (British Institute of Facilities Management). 2017b. The Role of Facilities Management. Accessed October 29, 2018. http://www.bifm.org.uk/bifm/professionaldevelopment/prostandards/fmfunctionalareas/theroleoffacilitiesmanagement.

Blue-Eye Training Ltd. 2014. Overview of Facilities Management- Sample Tuition Workbook. Accessed October 20, 2018. https://docplayer.net/6635315-Overview-of-facilities-management-sample-tuition-workbook.html.

Boateng, E. 2011. "The Future of Facility Management in Finland." Bachelor's Thesis. Jamk University of Applied Sciences, Finland.

BOI (Board of Investment). 2018. Key Sectors For Investment – Apparel. Accessed September 16, 2018, from BOI Sri Lanka website: http://www.investsrilanka.com/news/ story/4202/Govts-new-Hambantota-Port-deal-with-China-will-deliver-economic-transformation-Malik.

Bruce, M., L. Daly, and N. Towers. 2004. "Lean or Agile: A Solution for Supply Chain Management in the Textiles and Clothing Industry?" *International Journal of Operations & Production Management* 24 (2): 151–170. doi:10.1108/01443570410514867.

The Business Services Associaiton. 2014. *The Strategic Role of Facilities Management*. (p. 2). Accessed February 14, 2019. https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/bps/deloitte-uk-strategic-role-of-facilities-management.pdf.

Cardellino, P., and E. Finch. 2006. "Evidence of Systematic Approaches to Innovation in Facilities Management." *Journal of Facilities Management* 4 (3): 150–166.

Chotipanich, S. 2004. "Positioning Facility Management." *Facilities* 22 (13/14): 364–372. doi:10.1108/02632770410563086.

Coleman, K. 2018. Drawing the Line on Facilities Management at Manufacturing Sites. Accessed August 24, 2018. https://www.isg-one.com/articles/drawing-the-line-on-facilities-management-at-manufacturing-sites.

Cox, A. W., P. Ireland, and M. Townsend. 2006. *Managing in Construction Supply Chains and Markets: Reactive and Proactive Options for Improving Performance and Relationship Menagement*. London: Thomas Telford.

Creswell, J. W. 2013. "A Framework for Design." In *Research Design: Qualitative Quantitative and Mixed Methods Approaches*, 4th ed. doi:10.1007/s13398-014-0173-7.2.

EuroFM. 2019. European Facility Management Network. Accessed July 2, 2018, from https://www.eurofm.org/.

Fawcett, S. E., G. M. Magnan, and M. W. McCarter. 2008. "Benefits, Barriers, and Bridges to Effective Supply Chain Management." *Supply Chain Management: An International Journal* 13 (1): 35–48.

Felea, M., and I. Albastroiu. 2013. "Defining the Concept of Supply Chain Management and its Relevance to Romanian Academics and Practitioners." *Amfiteatru Economic* 15 (33): 74.

FMA Australia (Facility Management Association of Australia Ltd). 2012. *Facilities Management Good Practice Guide: Multi-unit Residenatial*. Accessed August 24, 2018. https://www.melbourne.vic.gov.au/SiteCollectionDocuments/good-practice-guide-facilities-management.pdf.

Hendriks, R. 2013. "Perceptions of Facility Management in Europe A survey of Finland, Germany and the UK." Bachelor's Thesis. Jamk University of Applied Sciences, Finland.

IFMA (International Facility Management Association). 2019. What Is FM – Definition of Facility Management. Accessed July 2, 2018. https://www.ifma.org/.

International Trade Administration. 2019. Export Solutions. Accessed November 2, 2019. https://www.export.gov/article?id=Sri-Lanka-Textiles.

Jin, B. 2004. "Achieving an Optimal Global versus Domestic Sourcing Balance under Demand Uncertainty." *International Journal of Operations & Production Management* 24 (12): 1292–1305.

Koksal, T. 2011. "FIDIC Conditions of Contract as a Model for an International Construction Contract." *Business and Management Review* 1 (2): 32–55.

Kulatunga, U., C. Liyanage, and D. Amaratunga. 2010. "Performance Measurement and Management in Facilities Management." *Facilities* 28 (5/6): 1–5.

Li, D. 2005. "e-Supply Chain Management." In *WIT Transactions on State of the Art in Science and Engineering*, vol. 16. doi:10.2495/978-1-85312-998-8/10.

Loosemore, M., and Y. Y. Hsin. 2001. "Customer-Focused Benchmarking for Facilities Management." *Facilities* 19 (13/14): 464–476. doi:10.1108/EUM0000000006204.

McCormack, K. P., and W. C. Johnson. 2016. *Supply Chain Networks and Business Process Orientation: Advanced Strategies and Best Practices*. 3rd ed. Oxfordshire: CRC Press.

Mentzer, J. T., W. DeWitt, J. S. Keebler, S. Min, N. W. Nix, C. D. Smith, and Z. G. Zacharia. 2001. "Defining Supply Chain Management." *Journal of Business Logistics* 22 (2): 1–25.

Mettler, T., and P. Rohner. 2009. "E-procurement in Hospital Pharmacies: An Exploratory Multi-Case Study from Switzerland." *Journal of Theoretical and Applied Electronic Commerce Research* 4 (1): 23–38.

Musa, ZN, and M Pitt . 2009. "Defining facilities management service delivery in UK shopping centres." *Journal of Retail and Leisure Property* 8 (3): 193–205.

Naoum, S. G. 2012. *Dissertation Research and Writing for Construction Students*. 3rd ed. Oxfordshire: Routledge. ISBN: 0415538440.

Nardelli, G., and R. Rajala. 2018. "The Evolution of Facility Management Business Models in Supplier-Client Relationships." *Journal of Facilities Management* 16 (1): 38–53.

Nazali Mohd Noor, M., and M. Pitt. 2009. "The Application of Supply Chain Management and Collaborative Innovation in the Delivery of Facilities Management Services." *Journal of Facilities Management* 7 (4): 283–297.

Nelson, M. L., and M. Sarshar. 2011. *Supply Chain Management in Facilities Management–Using the I2i Model*. Salford: University of Salford.

Nielsen, S. B., P. A. Jensen, and J. O. Jensen. 2012. "The Strategic Facilities Management Organisation in Housing: Implications for Sustainable Facilities Management." *International Journal of Facilities Management* 3 (1): 1–15. http://www.ijfm.net/index.php/ijfm/article/view/43.

Olugu, E. U., K. Y. Wong, and A. M. Shaharoun. 2011. "Development of Key Performance Measures for the Automobile Green Supply Chain." *Resources, Conservation and Recycling* 55 (6): 567–579.

Park, S., and G. Ungson. 2001. "Interfirm Rivalry and Managerial Complexity: A Conceptual Framework of Alliance Failure." *Organization Science* 12 (1): 37–53. doi:10.1287/orsc.12.1.37.10118.

Patanapiradej, W. 2006. "The Scope of Facility Management." *Nakhara: Journal of Environmental Design and Planning* 1: 75–90.

Pitt, M. 2012. *Designing and Managing the Strategic Facilities Management Supply Chain : Risk and the Critical Node Operational Model*, 167–172.

Pitt, M., S. Chotipanich, R. Amin, and S. Issarasak. 2014. "Designing and Managing the Optimum Strategic FM Supply Chain." *Journal of Facilities Management* 12 (4): 330–336. doi:10.1108/JFM-08-2013-0043.

Roy, P. 2017. Changing Role of Facility Manager in the Smart world. Accessed August 3, 2019. https://www.cleanindiajournal.com/changing-role-of-facility-manager-in-the-smart-world/2/.

Scupola, A. 2012. "ICT Adoption in Facilities Management Supply Chain: The Case of Denmark." *Journal of Global Information Technology Management* 15 (1): 53–78.

Steenhuizen, D., I. Flores-Colen, A. G. Reitsma, and P. Branco Ló. 2014. "The Road to Facility Management." *Facilities* 32 (1/2): 46–57. doi:10.1108/F-09-2012-0072.

Terrantroy, C. 2017. Your Top Five Facilities Management Challenges and How to Solve Them. Accessed March 29, 2019. https://www.aconex.com/blogs/2017/04/facilities-management-challenges-solutions.html.

Then, D. S.-S. 1999. "An Integrated Resource Management View of Facilities Management." *Facilities* 17 (12/13): 462–469. doi:10.1108/02632779910293451.

Tucker, M, and M Pitt. 2009. "Customer performance measurement in facilities management: A strategic approach." *International Journal of Productivity and Performance Management* 58 (5): 407–422.

Vanichkobchinda, P. 2010. "Applying Logistics and Supply Chain Management Strategy to Improving Operation Efficiency in Facility Management and Maintenance." In *Proceedings of the 2nd International Conference on Logistics and Transport & the 1st International Conference on Business and Economics*, 1–8. Queenstown, New Zealand: UTCC Engineering Research Papers.

Vetráková, M., M. Potkány, and M. Hitka. 2013. "Outsourcing of Facility Management." *Economics and Management* 1: 1–13.

White, A. D. 2013. "Strategic Facilities Management." In *Royal Institution of Chartered Surveyors (RICS) Guidance Note*. 1st ed, 1–64. Coventry.

Yin, R. K. 2016. *Qualitative-Research-From-Start-To-Finish*. 2nd ed. New York: The Guilford Press. ISBN: 978-1-4625-1797-8.

Yu, K., T. Froese, and F. Grobler. 2000. "A Development Framework for Data Models for Computer-Integrated Facilities Management." *Automation in Construction* 9 (2): 145–167.