Product-service systems in Egypt: a multi case evaluation of field repair

Product-Service Systems in Egypt: A Multi Case Evaluation of Field Repair

Abstract

Purpose – This paper aims to evaluate field repair within product-service system models operated by multinational manufacturers in the Egyptian emerging market to better understand the unique characteristics of this evolving market and to identify differences compared to established markets.

Design/methodology/approach – Case research was conducted on multinational manufacturers providing field repair services in Egypt. The sample is made up of twelve companies across different industries using convenience and purposive sampling. Data was collected using structured interviews.

Findings – There is no common model for field repair product-service systems provision in the Egyptian emerging market even within the same industry, which is influenced by several factors. One of these factors is the market type being emerging or established. However, some commonalities have been found between some industries such as computer, telecommunications, and document processing. Yet, there is no structural difference in the supply networks used to provide field repair service offerings in the Egyptian emerging market compared to established markets with the trend of outsourcing evident as a main attribute of a product-service system in emerging markets. The main differences between established and emerging markets are related to country, culture, and customer factors, which are market-based. Among the main challenges and risks that internationalized manufacturers face in Egypt, is the low level of customer awareness.

Research limitations/implications – Findings are limited to the studied cases and industries; yet, internationalized firms must deal with some unique challenges and difficulties in emerging markets.

Practical implications – This paper assesses product-service system requirements and provides deeper insights for companies looking to provide or expand manufacturing-based offerings into the Egyptian emerging market.

Originality/value – This paper contributes to the evolving research on product-service systems, particularly in emerging markets through identifying and describing different field repair product-service system models in the Egyptian emerging market.

Keywords: after-sales service, Egypt, emerging markets, field service, internationalization, product-service systems.

1. Introduction

The world's emerging markets have been identified as the focus of sustained research in the past two decades as they comprise the majority of the world's people and land, and are growing faster than the developed or established world (Kearney 2012). Due to increasing competition driven by globalization and advanced technologies, manufacturers from established markets continue to internationalize by operating in diverse environments and conditions such as emerging markets to grow effective international supply networks (Lorentz *et al.* 2013).

The internationalization process itself and the general move towards less developed countries (i.e. emerging markets and developing economies) is not a new tradition for organizations based in established markets. For example, Johanson and Vahlne (1977) designed the Uppsala internationalization process model for manufacturing firms to describe the required stages for internationalization and revisited it 32 years later (Johanson and Vahlne 2009) in light of changes in business practices and theoretical advances highlighting the importance of supply networks in the internationalization of firms. Based on this premise, further studies have been published such as Najafi *et al.* (2013) who highlighted the approach of manufacturers from established markets of using network of suppliers in emerging markets to gain access to knowledge concerning the kinds of adjustments which might be needed to sell their products in these markets. Limited evidence has been found in the literature of studies presenting internationalization of product-based service systems, a domain which is growing in importance globally.

A product-service system (PSS) is the inclusion of services with products through alternative product uses, which has seen a significant increase in interest from academia and business (Beuren *et al.* 2013). PSS can facilitate higher revenues, sustainable relationships with customers, and better environmental performance (Li, Kumar, *et al.* 2020). Although PSS has been well studied in recent times, there is a lack of research addressing the internationalization of PSSs, with the exception of one music industry study published by Parry *et al.* (2016). However, in contrast to traditional PSSs (e.g. a physical product with bundled services) this PSS focuses on digital music products accompanied with enhancing digital services. While the content of their work helps guide this paper, its core domain falls outside this study scope, which focuses on PSSs involving a physical product and its associated field repair services provided after the sale. Researchers have tended to investigate PSS in established markets, such as Bellandi *et al.* (2020), which appears insufficient given faster growing rates of emerging markets and developing economies (Sousa-Zomer and Miguel 2016).

PSS offerings typically include several types of services in which most take place after the physical product sale (Saccani *et al.* 2014) with field services constituting a major part of after-sales services

(Agnihothri and Mishra 2004). Field service involves sending service personnel to perform various tasks on geographically dispersed products (Lin *et al.* 2002), such as installation, maintenance, repair, and other such services at the customer site (Agnihothri and Mishra 2004). Repair service is acknowledged as one of the most important field services (Amini *et al.* 2005) that has a significant impact on obtaining competitive advantage and increasing profitability (Zhou *et al.* 2016, Onar *et al.* 2017).

The motivation for this study emanated from exploratory research meetings with a large US multinational computer manufacturer with significant field repair services worldwide. Initial meetings were held with the EMEA services operations director, the EMEA emerging markets services supply chain director, and the EMEA external service provider strategy manager. Field repair plays a major role in this organization business model and is considered its most important provided service. This manufacturer had already begun the PSS internationalization journey into emerging markets. Their goal was to better understand the Middle Eastern emerging markets although they are operating there since the 1990s, as it has higher growth potential than established markets. The directors highlighted their need and intention to better understand the unique characteristics of these evolving markets to improve the provision of outsourced field repair services associated with PSSs and to expand upon their existing operations in emerging markets with higher growth potential than established markets. Hence, this paper aims to examine field repair services associated with PSSs in one of the Middle Eastern emerging markets, Egypt, to identify the differences compared to established markets. Egypt was identified as one of the most targeted markets in the region by the case organization and it also where the author has background knowledge and access to a network of expertise on field repair services.

This paper assesses the structural setup and provision of PSSs in Egypt in terms of field repair services. A multi case evaluation of a number of existing multinational manufacturing-based organizations and their field repair service models is presented. The aim of this study is 1) to obtain an in-depth knowledge of field repair service practices and their associated service models across various industries in the Egyptian market, 2) to identify the motivation behind these practices, and 3) to assess the unique characteristics of field repair service provision in the Egyptian market when contrasted to established markets. Thus, this work contributes to the evolving research on PSS, particularly in emerging markets, by analyzing field repair service provision for different cases, representing a cross-case analysis for the similarities and differences, and identifying the current difficulties and potential improvements based on cultural and economic differences between

established and emerging markets. This provides deeper insights for those looking to provide and/or expand PSS offerings in the Egyptian emerging market.

The remainder of the paper is organized as follows. Section 2 reviews the literature focusing on internationalization in relation to emerging markets and the provision of PSSs within the after-sales field repair service domain, particularly in emerging markets. Section 3 presents the research design, research sample, and data collection. Section 4 presents and analyzes the multi case findings. Section 5 discusses the findings. Section 6 presents research conclusions.

2. Literature Review

This section highlights previous literature addressing internationalization towards emerging markets, particularly Egypt. This is then followed by an overview of PSS and its types and demonstrates the important role of field repair services. Finally, this section reviews the use of case studies in the field repair service literature.

2.1 Internationalization towards emerging markets

Schweizer *et al.* (2010) defined internationalization as a firm crossing borders. The early Uppsala internationalization process model (Johanson and Vahlne 1977) showed that manufacturers operating in established markets internationalize through expanding in new markets such as emerging markets and developing economies. Multinational organizations are constantly changing their location and ownership strategies to better fit the changing characteristics of environments and markets (Lorentz and Ghauri 2010). Developing new markets is the main driver for emerging markets entry, which is a strategic decision with potential sourcing, knowledge, and sales (Najafi *et al.* 2013).

Any internationalization strategy has to start from the analysis of main risks and opportunities to operate in a specific country (Caiazza 2012). Although market analysis is even more relevant for internationalization into emerging markets, few studies are focused on this topic (Caiazza 2012, 2014, 2016), particularly in Africa (Oguji and Owusu 2017). Through a systematic analysis of literature, Purkayastha *et al.* (2020) found that research on internationalization in the last decade was dominated by theory testing in the context of developed economies. The authors highlighted a rich research potential in the context of emerging markets. Moreover, Elbanna *et al.* (2020) highlighted internationalization initiatives research in the Arab world markets, including Egypt, as an interesting future research avenue. (Costa et al. 2020) suggested future studies need to consider how and, to what extent, the country where the company is located influences servitization strategies and processes.

The Uppsala internationalization process model was revisited and developed further in light of clear evidence of the importance of supply networks in the internationalization process (Johanson and Vahlne 2009). To operate in emerging markets, multinational firms must rely on distributors and other intermediaries to service local markets (Han *et al.* 2013), emphasizing the significance of supply network development. In an analysis of the internationalization of a number of food supply chains into emerging markets, Lorentz *et al.* (2013) identified the need to adjust the supply network configuration, practices, and policies in terms of network strategy and position; changes to firm boundaries; changes to product mobility; and changes to geographical configuration. Using a multi case study in an emerging economy, Priyono *et al.* (2020) demonstrated that networks improve a firms dynamic capabilities in internationalization; hence, support their ability to exploit foreign markets and acquire information, knowledge, and resources.

As multinational firms increasingly penetrate emerging markets, they are faced with various challenges and opportunities in managing their global operations (Han *et al.* 2013). Lower quality, poorly developed infrastructure, less availability of resources, local regulations (Lorentz *et al.* 2013), dramatic but unpredicted economic growth, little transparency in social and political systems, and shortages of market intermediaries (Han *et al.* 2013) are among the main emerging markets characteristics negatively affecting supply chain management. These characteristics expectedly require firms from established markets to redesign, adapt, or adjust their supply network configuration where business environments have a significant impact on network design (Lorentz *et al.* 2013).

Egypt is one of the most important emerging economies in the Middle East and Africa. It is the leading emerging market in North Africa (Urban and Hwindingwi 2016). In a recent systematic review of management research in the Arab world, Elbanna *et al.* (2020) found that Egypt has received the largest number of studies (24%). However, few studies have addressed internationalization towards the Egyptian market. Caiazza and Volpe (2015) investigated the impact of cross-cultural differences faced by Italian firms' operating in Egypt and found that cultural diversity exposes Italian enterprises to face several risks. Oguji and Owusu (2017) explored constructs derived from the Uppsala internationalization process model using a case study of five Finnish acquisitions in African countries, including Egypt, to identify the determinants of acquisition strategies utilized by the multinational Finnish enterprises. Narooz and Child (2017) conducted a comparative qualitative study of how decision-makers in internationalizing companies respond to relevant institutions in their domestic environment through networking activity in a developing economy (i.e. Egypt) and a developed economy (i.e. UK).

Caiazza (2012) and Caiazza (2014) highlighted risks and challenges that affect foreign companies in Egypt including the difficulty of market entry without local operators, lack of qualified manpower, high level in cultural differences from established markets, difficulty in accessing information, risk of inflation, uncertainty in local rules and legal system, inconsistencies and red tape, lack of coordination among authorities, bureaucratic inefficiency, and corruption. In addition, Egyptian workers scored negatively in the business ethics index (Elbanna *et al.* 2020). Hence, to operate in Egypt, foreign companies from established markets must develop a deep knowledge of local culture and traditions with a good understanding of cultural differences (Caiazza 2014) and must work with local firms/personnel on their diversity to achieve a successful integration (Caiazza and Volpe 2015).

2.2 Product-service systems

Although the internationalization process was primarily designed and implemented in the manufacturing domain, applications in other areas have been presented in the literature, including services (Menzies and Orr 2013, Castaño *et al.* 2016, Grönroos 2016); retail (Hultman *et al.* 2012); and Digital Music PSS (Parry *et al.* 2016).

PSS has been seen as a concept that helps businesses in building their competitive advantage and allows them to increase the added value provided to customers by expanding product offer with dedicated services (Salwin *et al.* 2020). Since the 1980s, manufacturers have been changing their strategies towards providing PSS (Li, Rich, *et al.* 2020). PSS have drawn significant attention as a driver for business innovation and manufacturing servitization (Kim 2020) and is attracting interest from practitioners and researchers alike (Chiu *et al.* 2019, Kim 2020, Salwin *et al.* 2020). The last two decades witnessed a growing body of literature devoted to PSS and recognizing its importance among different industries such as Manzini *et al.* (2001), Manzini and Vezzoli (2003), Tukker (2004), Baines *et al.* (2007), Durugbo *et al.* (2010), Garetti *et al.* (2012), Szwejczewski *et al.* (2015), Suh (2019), and Bellandi *et al.* (2020). However, many theoretical; methodological; and practical aspects involved in the process remain unresolved (Salwin *et al.* 2020).

According to Baines *et al.* (2007) and Szwejczewski *et al.* (2015), there are three different types of PSS which are described as follows. Product-oriented PSS, where the product ownership is transferred to the customer and additional services are provided by the manufacturer. User-oriented PSS, where the product ownership is retained by the manufacturer who sells its functionality to the customer via leasing, sharing, or pooling. Result-oriented PSS, where the manufacturer sells a capability or result to the customer. In a recent study, Chiu *et al.* (2019) discovered a new PSS type,

platform-oriented PSS, where the product form is intangible and provided through a virtual platform that enables numerous interaction between customers and other stakeholders in the system, e.g. service provider.

Once the PSS is deployed in the field, it is of critical importance that the deployed PSS is operational, meeting the contracted availability requirement promised to the customer (Suh 2019). Hence, field repair services constitute a major area of interest within the field of PSS. Since repair services are developed to support products' functions (Kim 2020), they play a key role in PSS provision.

2.3 Case studies

Gathering information from firms that already work in a specific field or market is a preferential way to evaluate such field or market. Thus, for manufacturers operating in established markets and exploring opportunities in emerging markets, multi case study is commonly used such as by Lorentz and Ghauri (2010), Lorentz *et al.* (2013), and Yang *et al.* (2013) and also recommended by Han *et al.* (2013) and Najafi *et al.* (2013). By analyzing four case studies of manufacturers in Taiwan, Yang *et al.* (2013) emphasized the role of after-sales services associated with PSSs in facing competition in a rapidly changing economy. Through reviewing case studies in PSS literature, Sousa-Zomer and Miguel (2016) found very few studies in emerging markets and developing economies with more focus on PSS solutions; e.g. coffee association. The authors analyzed two PSS solutions for bike sharing and water purification in Brazil and identified factors that influence PSSs including government policies, business opportunities, cultural aspects, and market consumption practices. Moreover, using six in-depth case studies conducted at leading manufacturers that offer PSSs in established markets, Szwejczewski *et al.* (2015) found that result-oriented PSS is not as universally applicable as previously thought and is not appropriate for every market situation.

Following a review of the field repair service literature, it was found that case research, as a research method, is highly utilized and widely accepted across several industries. In addition, single and multiple case studies were utilized to support the use of other research methods in field repair service literature including modelling, survey, and action research. Table 1 presents the case studies in the field repair service literature whether used as a primary or secondary methodology. The papers are categorized into six groups based on their industry.

Analysis of the case studies presented in Table 1, highlights the fact that single case studies are dominant. Emerging markets were presented in only two papers, in the UAE and India. Those studies are illustrated as follows. Aleksy and Stieger (2009) developed a case study to evaluate the general

applicability of utilizing mobile applications in industrial field service through the feedback of 20 service engineers from Germany and United Arab Emirates. Murali and Pugazhendhi (2015) investigated the importance and performance of after-sales service attributes using a home appliances manufacturer located in India.

Table 1: Case studies in the field repair service literature.

Group	Industry	Literature Reference
A	Computer	(Thomas 1980, Dzubow 1984, Cohen *et al.* 1990, Papadopoulos 1996, Byrne *et al.* 2013)
B	Home Appliances	(Blumberg 1991, Murali and Pugazhendhi 2015, Wickramasinghe and Mathusinghe 2016)
C	Capital Goods	(Wilson *et al.* 1999, Zackariasson and Wilson 2004, Lehtonen and Ala-Risku 2005, Hertz *et al.* 2011, Lehtonen *et al.* 2012, Daeuble *et al.* 2015, Macchi *et al.* 2016, Zhou *et al.* 2016)
D	Telecommunications	(Anim-Ansah *et al.* 2006, Voudouris *et al.* 2006, Lee *et al.* 2008, Mohamed *et al.* 2017)
E	Document Processing and Office Equipment	(Behara and Lemmink 1997, Bell *et al.* 1998, Watson *et al.* 1998, Rapaccini *et al.* 2008, 2014, Bijvank *et al.* 2010, Saccani *et al.* 2017)
F	Multi Industry, Others, or Unspecified	(Blumberg 1982, Armistead and Clark 1991, Hull and Cox 1994, Agnihothri *et al.* 2002, Amini *et al.* 2005, Saccani *et al.* 2007, Viehland and Yang 2007, Gaiardelli *et al.* 2007, Liao and Lee 2008, Aleksy and Stieger 2009, Legnani *et al.* 2009, Stieger and Aleksy 2009b, 2009a, Aleksy *et al.* 2009, Hertz *et al.* 2012, Finke *et al.* 2012, Tesfay *et al.* 2013, Hertz and Sproedt 2013, Tatila *et al.* 2014, Cheong *et al.* 2015, Rahimi-Ghahroodi *et al.* 2017, Vossing *et al.* 2018)

Of interest to this research, is the findings of Wilson *et al.* (1999) which identified the Far East market, which includes emerging markets, as more difficult for field repair service provision and different compared to established markets such as Europe and North America in terms of culture and communication patterns which rely on well-trained local personnel and an extensive use of independent service contractors. Despite studying the case of a major internationalized medical diagnostics manufacturer who has thousands of customers all over the world, Amini *et al.* (2005) opted only to focus on the US market, which is an established market. Based on these findings, it can be concluded that emerging markets have gained little attention in both field repair service and PSS literatures to date.

2.4 Research gap

Based on literature analysis, some general conclusions can be drawn. Manufacturers appear to be continuing their shift towards offering product-based services in the face of increasing competition. This move has led to increasing attention being paid to PSS from practitioners and researchers alike. However, little is known on how manufacturers offer after-sales services for their customers (Szwejczewski *et al.* 2015); in addition, they tend to search for more business opportunities, particularly through internationalization. Given both their increasing importance and high growth

potential, emerging markets are regarded as the most sought-after opportunities for manufacturers. However, the transition to PSSs in different contexts, emerging markets, remains a research gap and there is a lack of knowledge concerning the characteristics of PSS transition (Sousa-Zomer and Miguel 2016). Hence, there is a need for assessment and analysis of field repair services associated with PSSs in the emerging markets.

3. Research Methodology

3.1 Research design

Case research was selected as the most appropriate research method to conduct this study for the following reasons. As a field-based method, it allows for data collection which is the first step in addressing the aim of this paper. In order to evaluate practices of different manufacturers across various industries and to conduct a cross-case analysis, a multi case study was used.

The multi case study was conducted to gain detailed understanding of field repair service provision and the associated models operated by multinational manufacturing organizations in the Egyptian market. The unit of analysis of this work is the studied cases. It is worth noting that this study identified market types: developing, emerging, or established according to the Financial Times Stock Exchange (FTSE 2017) and Morgan Stanley Capital International emerging markets index (MSCI 2017).

The primary case organization from which this study emanated is operating in Egypt since 2000 and had already begun the PSS internationalization journey into the Egyptian market. However, driven by the markets' growth potential, the directors' intention is to improve the provision of outsourced field repair services associated with PSSs. The Egyptian market fits within the identified research gap as an important and well-recognized emerging market in the Middle East. Foreign firms have a great interest in operating business in Egypt given its substantial market outlets, emerging demand, significant market for supply of major raw materials (Caiazza 2012), and high potential for market growth (Caiazza 2014). Egypt possesses the fundamentals to become a business hub in North Africa and the Middle East and is the geographic center between two continents (Caiazza and Volpe 2015). In addition, Egypt is where the author has background knowledge and network of connections.

3.2 Research sample

The research strategy employed involved two forms of non-random sampling techniques, including convenience and purposive sampling, based on the authors research experience and familiarity with

the Egyptian repair service market (Patton 2002). A preliminary list of twenty targeted manufacturers had been created. Cases were chosen based on their conformance to the study scope. The chosen cases must be multinational manufacturers who offer PSS through selling products and provide associated field repair services. Also, they must have already begun the internationalization process into emerging markets with current operations in Egypt. Contact was made with all targeted manufacturers, asking for approval to collect the required data. A time frame of six months was set at the beginning of the study to conduct the interviews and collect the required data. Five cases who did not commit to the specified time frame or were not able to provide all the required information were ruled out of the study. In addition, due to confidentiality reasons three further cases asked to be excluded. Thus; through eliminations, the study sample size was reduced to twelve cases. These twelve cases comprise different industries with several degrees of product complexity. They also vary in terms of firm size, customer type, after-sales strategy, and service offerings, which ensures broad applicability in the study results. The relationships and interactions between those manufacturers and their customers are all B2B[1] with five cases having both B2B and B2C[2]. Table 2 presents the twelve case organizations, including the customer types, their main products, global number of employees, and home country (Origin). The cases are categorized into six groups based on their industry and field of operations.

3.3 Data collection

Using the multi case study approach, data was collected from each of the different cases relating to their specific field repair service models. Structured interviewing was used as the main data collection method in which an interview schedule was used as the research tool for collecting the required data. The interview structure has been developed to allow for the answering of twelve questions in approximately 60 minutes. Questions have been created carefully to assess the description of the field repair service provision and to present the potential differences while ensuring anonymity of the cases. An initial set of questions was derived from a comprehensive review of field repair services literature. In validating these questions, a number of meetings were held with the large US multinational computer manufacturer, from whom this research was motivated, in addition to several meetings with different companies both inside and outside of Egypt. Those meetings were held through different communication means including face to face meetings, conference calls, telephone

[1] B2B (Business to Business): refers to sales made to other businesses.

[2] B2C (Business to Consumer): refers to sales made to individual consumers.

calls, and emails with members based in Europe, Dubai, and Cairo as follows. These meetings involved, the global category manager and EMEA process analytics team supply chain consultant in Europe. The Middle East emerging markets senior program manager and deployment services director in Dubai and the country manager, large corporate accounts manager, and senior technical account manager in Egypt. Questions were amended as appropriate and the final set is presented in the appendix.

Table 2: Interviewed cases background.

Group	Industry	Case	B2B or B2C	Main Products	# of Employees	Origin
A	Computer	1	Both	Personal computers and Servers	100,000-150,000	USA
		2	Both	Personal Computers and Servers	More than 150,000	USA
		3	B2B	Information Storage Devices	50,000-100,000	USA
B	Home Appliances	4	Both	Air Conditioners	Less than 50,000	USA
		12	Both	Water filters	N/A	USA
C	Capital Goods	5	B2B	Earth Moving Machines	50,000-100,000	USA
		7	B2B	Food Processing Production Lines	Less than 50,000	Switzerland
		8	B2B	Slurry Equipment	Less than 50,000	UK
		11	B2B	Compressors, Industrial Tools and Assembly Systems	Less than 50,000	Sweden
D	Telecommunications	6	B2B	Telecommunication Equipment	More than 150,000	France
E	Document Processing and Office Equipment	10	B2B	Photocopiers	100,000-150,000	USA
F	Others	9	Both	Elevators and Escalators	100,000-150,000	Japan

For consistency and to ensure the quality of interaction between the interviewer and the interviewee, the interviews were conducted by a single interviewer, the researcher, and were all conducted face to face. During the interviews, the researcher was keen not to present any information regarding the collected data from previous interviews or from the reviewed literature to ensure unbiased results.

To minimize potential bias and to ensure the accuracy of the findings, structured interviews were conducted with two separate employees within each company. To ensure good quality of data, the interviewees were chosen carefully and were required to have direct knowledge and exposure to the service operations. The interviewed personnel had different roles with all engaged in field repair

service. Examples of interviewed personnel include after-sales directors, product support managers, service operations managers, field service supervisors, and field service engineers. Additionally, other data collection methods have been adopted to support the main data source, i.e. structured interviews, and to further improve the quality of data. Other sources include informal conversations and interactions during company visits, observations, and review of archival sources and documents. Using several informants and different data sources during data collection, allowed for triangulation (Voss *et al.* 2002) to check the internal consistency of data to further increase the validity of collected data.

4. Findings and Analysis

From a review of the data collected from the twelve companies, for each case, the PSS and its associated field repair service provision have been identified. Cross-case comparisons were then made to determine where similarities and differences existed.

Based on a systematic review of the field service literature, (Owida 2018, Owida *et al.* 2020) identified five main themes of field repair service. These themes are service offerings, supply network, service timeline, service delivery, and performance measurement. Following an initial thematic analysis of the collected data, the findings from this study have been categorized according to (Owida 2018, Owida *et al.* 2020) themes, with the exception of the service timeline, which based on analysis of the data was deemed unnecessary. The selected four themes are used hereafter in this section as organizing headings for data presentation and analysis. The following subsections will describe each of these four themes in more detail along with presenting an analysis of the findings, i.e. outcomes of the interviews and cross-case comparisons. Table 3 presents the main findings under the identified four themes for all the interviewed cases.

In addition, the last subsection presents current difficulties and suggested improvements illustrating issues within field repair service provision and potential opportunities for improvement. Comparisons are presented where relevant between PSSs in established markets and the Egyptian emerging market. However, it should be noted that a full comparison between the two market types is potentially restricted due to the unavailability of data across multiple organizations in established markets.

4.1 Service offerings

As shown in Table 3, it can be seen that field repair service within the twelve cases is provided through five different service modes: basic warranty, extended warranty, repair-based, leasing, and performance-based. The first three modes, *basic warranty*; *extended warranty*; and *repair-based*

modes (i.e. product-oriented PSS), are common among the twelve cases. The main exception in not offering these three modes is Case 6; in addition, Case 11 offers basic warranty and repair-based modes only. The reason Case 11 does not offer extended warranty is a strategic one based on the nature of its products (industrial tools), which are negatively affected by end-user misuse.

The fourth service mode, leasing, is considered as an important offering for some cases. According to the organizational strategy of a manufacturer, product leasing can be the only service offering, as shown in the findings of studying Case 6 (Table 3). In these instances, the manufacturer is wholly responsible for repairs as product ownership belongs to them (i.e. user-oriented PSS). Manufacturers also may offer product leasing to increase their sales. Although they offer the first three service modes, Cases 5 and 8 offer product leasing in addition for their earth moving machines and slurry equipment. Despite their high value, these products can be easily transported and do not require complicated installation. It was also found that on occasions manufacturers offer product leasing, to benefit from demand seasonality. Case 10 offers product leasing for its photocopiers at times when particular customers have larger printing and copying demand than usual. On the contrary, some manufacturers cannot offer product leasing because they are selling very large equipment and production lines that require complicated and costly installation and transportation, as observed in Cases 7 and 9. Other products cannot be leased due to a variety of other reasons such as a high risk of damage during uninstallation and transportation as well as their relatively low cost such as computer cases, home appliances cases (air conditioners and water filters), and Case 11 from capital goods industry group. It is noteworthy that leasing typically is more suited to the B2B sector.

For the same reasons of product leasing, manufacturers offer services through performance-based modes where the manufacturer sells a capability or a result to the customer who pays for the product performance (i.e. result-oriented PSS). Such modes allow the customer to transfer the risk of failures and down-time to the manufacturer. Other reasons for selling performance include encouraging customers to buy high cost products while avoiding their costly breakdowns. Examples of selling product performance include selling product usage which is based on the same concept of product leasing but cannot be offered unless usage is quantifiable such as the number of copied papers by a copier (Case 10) or the quantity of tonnage produced by equipment (Cases 5 and 8). Moreover, quantifiable product performance can be the number of operating hours of a machinery. Hence, selling product performance applicability is product specific. It is worth noting that, in selling product performance, the customer does not pay for the product up-time but only for its actual usage.

Table 3: Field repair service themes.

Group	Case	Service Offerings										Supply Network					Service Delivery						Performance Measurement															
		Service Modes					Additional Services					Actors					Process Activities						Manufacturer							Customer Evaluation for Service Delivery									
		Basic Warranty	Extended Warranty	Repair-based	Leasing	Performance-based	Single Response	Multiple Response	Resident Technician	Customer Can Stock Parts	Standby Product	Call Handlers	Off-field Technicians	Dispatchers	Field Technicians	Logisticians	Product-based Trigger	Customer-based Trigger	Phone Remote Support	Online Remote Support	Backup Parts at Customer Site	Customer Replaceable Units	Cost	Response time	Repair Time	Customer Satisfaction	Re-do Time	Customer Safety	Product Availability	Percentage of Deferred Calls	Response time	Repair Time	Customer Care	First Time Fix Rate	Parts Discounts	Cost	Product Availability	Down-Time
A	1	•	•	•				•				•	•	•	•	•		•	•			•	•		•				•	•	•		•				
	2	•	•	•				•				•	•	•	•	•		•	•			•	•	•						•	•						
	3	•	•	•				•					•		•	•	•	•	•	•		•		•	•	•					•							•
B	4	•	•	•			•					•			•	•		•					•			•					•	•						
	12	•	•	•			•					•			•	•		•								•			•		•						•	
C	5	•	•	•	•	•	•		•	•			•		•	•	•	•	•		•					•	•				•		•	•	•			
	7	•	•	•			•		•	•			•		•	•		•	•				•			•					•							•
	8	•	•	•	•	•	•		•	•			•		•	•		•	•		•		•		•	•			•		•	•				•	•	
	11	•		•			•					•			•	•		•					•		•						•							
D	6				•		•						•		•	•		•	•	•			•	•	•	•				•	•					•	•	
E	10	•	•	•	•	•		•	•	•	•		•		•	•		•	•			•		•					•									•
F	9	•	•	•			•		•	•		•			•	•		•								•		•			•							

Service offerings also include response time which can vary from minutes to days. Of the twelve cases, eight offer single response and four offer multiple response times as shown in Table 3. However, in case of offering single and unified response time to all customers, the response time is determined based on the severity of the failure (Cases 4, 6, 9 and 11). Multiple response times are offered by cases which have a large installed base of products along with different customer types (computer and document processing cases) due to the high volume of service calls they tend to receive in tandem with different response requirements (Cases 1, 2, 3 and 10). Multiple response offerings can fulfil different customer preferences and suit different situations. Hence, response time offering is designed based on manufacturer strategy, product type, possible failures, criticality of failures, and customer type.

It can be concluded that all cases consider various options for additional service offerings to create a competitive advantage over their competitors. Examples include a single computer manufacturer (Case 2) offering multi-vendor support to its customers to generate economies of scale from the service technologies they have developed as well as satisfying their customers who have different products from different manufacturers. In addition, a reliable online system for ticket submission is offered by Case 6 for failure reporting.

Based on an analysis of the twelve cases, it was found that five offer a resident technician (i.e. a technician that stays at the customer site for continued coverage) with response times typically in minutes. The function of the resident technician is threefold. Firstly, they monitor products to predict any problems prior to their occurrence. Secondly, they are able to resolve certain problems as they occur. Thirdly, they provide reliable diagnosis which enables correct identification of the required parts and recovery protocol on occurrence of a fault. This study found that the five cases that offer resident technicians did so for different reasons. Three heavy equipment manufacturers offer it for special customers who want to avoid critical and costly failures, an elevator and escalator manufacturer and a copier manufacturer offer it for special customers who have a large installed base of products in a single location, e.g. a large shopping mall with many operating elevators and escalators and a large school with many operating photocopiers during exams period. The copier manufacturer also offers a standby product for certain periods of time based on customer requests. These case organizations also allow their customers to buy and stock the most frequently failed parts to be used by the resident technician if required. Hence, passing inventory management of the spare

parts to the customer, while managing the maintaining control over the resource required (resident technician) to fix the problem in the least possible time.

It can be observed from Table 3 that the computer industry group provide similar service offerings including service modes and additional services. Likewise, no differences have been observed in service offerings between the two cases of home appliances industry group. In terms of service modes, cases from both industry groups (computer and home appliances); Case 7 from capital goods industry group; and Case 9 from Group F (elevators and escalators manufacturer) have identical offerings. On the contrary, mixed results have been observed within capital goods cases in terms of service offerings.

4.2 Supply network

Field repair service supply network structure varies from one case to the other; however, a number of key common actors have been identified and are presented as follows. Call handlers which are used to receive customer service requests when remote support is not in use; e.g. Cases 4, 9, 11, and 12; or used in a call center for dealing with a significant number of daily calls; e.g. Cases 1 and 2. Off-field technicians which are used when remote support provision is applicable; e.g. all cases except 4, 9, 11, and 12. Dispatchers which are used to assign calls to field technicians in the case of a significant number of daily calls; e.g. Cases 1 and 2. All cases tend to hire off-field technicians to reduce the number of field visits and improve field technician productivity; however, some product characteristics do not facilitate off-field diagnosis and repair which makes hiring off-field technicians less effective. Field technicians which are used by all cases to provide field repair services at the customer's premise. Logisticians which are used by all cases to manage and distribute parts inventory.

The computer industry group utilize the same actors apart from Case 3, which has a slightly different supply network given that it lies in the B2B sector. Several cases from other industry groups (capital goods, telecommunications, and document processing industries) that lie in the B2B sector share the same supply network with Case 3 for the same reason. The networks of the home appliances industry group are identical. The capital goods industry group have similar networks apart from Case 11, which has a slight difference related to the applicability of products' remote support, which leads to replacing off-field technicians by call handlers. Although several cases from the same industry group share similar networks, insourcing and outsourcing decisions are different.

Those actors can be insourced or outsourced with the majority of cases outsourcing both field repair service provision (all cases except 2, 6, and 11) and parts inventory (all cases except 2 and 11). Both Cases 3 and 8 use both strategies for field repair service provision; i.e. insourcing and outsourcing within the same market; while Case 8 uses both strategies for parts inventory. It can be concluded that all cases tend to outsource their operations; however, few cases opt to insource for strategic and confidentiality reasons. Some companies prefer not to provide the service through external parties to ensure the delivery of high service level (i.e. service quality), have full control on the process, keep ongoing relationships with customers, and/or preserve the service know how confidential.

4.3 Service delivery

Field repair service can be triggered either by a sensor implanted inside the product (Cases 3 and 5) or by a customer call (all cases). Case 3 uses such sensors to report failures through the web to reduce the negative effect of critical failures while Case 5 uses them to report failures through satellite to provide quick response for products operating in rural areas. Remote support is performed either through over phone or the web to diagnose and resolve the product failure if possible. Home appliances industry cases, in addition to Case 9 and Case 11, do not perform phone remote support because remote diagnosis and repair is not enabled for their products; which are air conditioners, water filters, elevators and escalators, and industrial tools. Phone remote support is enabled for all the cases of Groups A, D, and E (computer, telecommunication, and document processing industries) given their technological structure. Phone remote support is also enabled for earth moving machines, slurry equipment, and production lines given the presence of maintenance engineers at the customer site who can collaborate with the off-field technician to resolve the product failure (Cases 5, 7, and 8). This means capital goods industry group except Case 11. Moreover, online remote support is enabled only for information storage and telecommunication devices given their technological structure and type of their customers which only lies in the B2B sector (Cases 3 and 6).

A stock of critical parts is kept at the customer site to minimize delivery lead time. This strategy is implemented for special customers who operate heavy equipment products in rural areas and have either a well-trained maintenance engineer or a resident technician (Cases 5 and 8). Certain parts can be changed without the need of a field technician which are called Customer Replaceable Units (CRUs) or User Replaceable Units (URUs). Those parts are dispatched and delivered to the customer site based on a remote diagnosis recommendation. This is provided by all cases of Groups A and E

(computer and document processing industries) for particular parts that can be easily replaced by an end-user.

The computer industry group have the same service delivery process apart from Case 3, which has slight differences because it lies in the B2B sector. The home appliances industry group have similar delivery processes. Mixed observations have been found in the delivery process of the capital goods industry group.

4.4 Performance measurement

There are various operational, financial, and service quality measures that are used by the twelve cases to measure field repair service performance. Although response time is regarded as the most important performance measure in the field repair service literature, it was found that customer satisfaction is the most commonly used measure in all cases except 2, 10, and 11. It is also found that response time is commonly used for Groups A, B, and C (computer, telecommunications, and document processing industries) with a large installed base of products in urban areas. All cases who value customer feedback use surveys through different approaches such as phone calls or emails. Moreover, in line with its reported importance in literature, cost measure is used by half of the cases but from different industry groups. Other measures that are used by the cases include repair time, customer safety, product availability (i.e. up-time), and re-do time (i.e. time required to repeat an unsuccessful repair). Re-do time is extremely important for heavy equipment products operating in rural areas where repeat visits are costly and time consuming, as Case 5. It is worth noting that customer safety measure is found to be used only for elevators and escalators (Case 9).

On the other hand, customers have their own evaluation for field repair service according to their preference and the nature of product usage. Accordingly, different customers have different preferences. In line with its reported importance in literature, response time is found to be the most commonly used measure by customers to evaluate the delivered service performance (customers of all cases except 7 and 10). Rather than that, no dominant measure is used by customers of the twelve cases. However, down-time measure is used by customers of production line manufacturer (Case 7), which is a very important measure for such a case that can negatively affect the whole production line operation.

4.5 Current difficulties and suggested improvements

From an analysis of the data provided in the twelve cases in relation to difficulties and improvements, which are the last two open questions, a number of themes began to emerge. Thematic analysis of the data highlighted four primary themes under which all current difficulties could be organized (Product; Operation; Country; and Culture) and two under which suggested improvements could be organized (Operation and Customer). Table 4 summarizes the current difficulties with Table 5 summarizes the suggested improvements under the identified themes.

Table 4: Current difficulties for the twelve cases.

	Theme	Difficulty Details	Cases
Current Difficulties	**Product**	▪ Demand seasonality	4
		▪ Urgent service calls in rural areas	5
	Operation	▪ Lack of parts and tools	8
		▪ Complex products	5
		▪ Complex environment including multiple products from multiple vendors	3
		▪ Trade-off between service quality and service cost	1
	Country	▪ Low personal safety index	6
		▪ Higher costs for safety and security	6
		▪ Foreign currency exchange procedures	11
		▪ Customs restrictive procedures	11
		▪ Unqualified technicians	6, 12
	Culture	▪ Low customer awareness	2, 5, 7, 8, 9, 10, 12
		▪ Unqualified operators	5, 8
		▪ Unfollowing service instructions and recommendations or underperforming regular maintenance	5, 7
		▪ Uncooperative customers	2, 10
		▪ Delayed payments	8

Product specific difficulties are concerned with product function and characteristics while operation specific difficulties are concerned with the service delivery process. Although both types of difficulties can exist regardless of the market type, emerging or established, the effect and severity of such difficulties could be higher in emerging markets. For instance, urgent calls from rural areas are more difficult to handle due to the lack of high-level technology in Egypt, which can assist in resolving the product failure or at least reduce its severity. Likewise, operations specific difficulties, are more complicated in Egypt than in established markets and interlinked with other difficulties such as country and culture specific. For instance, exchange rates and customs difficulties (country specific) can lead to difficulties in the supply of parts and tools (operation specific). Similarly, shortage of skilled and qualified technicians (country specific difficulty) can complicate repairing complex products and products installed in complex environments (operation specific difficulties).

For instance, a manufacturer with a regional office located in Egypt and managing field repair services in other markets have to deal with a low personal safety index in certain countries which requires higher costs to ensure the safety and security of the field technicians. Foreign currency exchange procedures and customs restrictive procedures in Egypt could have significant influence on both service operations and parts logistics for certain industries. Moreover, finding qualified technicians is not an easy task and can be country specific.

Customer mind-set and a lack of awareness towards operating products was one of the most common difficulties found across the twelve cases, especially for the capital goods industry cases, which negatively affects repair service in several ways. Hiring unqualified operators, not following service recommendations, not changing consumables on time, and underperforming regular maintenance are among the biggest difficulties and the main reasons for both frequent failures and customer dissatisfaction. Some customers do not take the responsibility of performing regular maintenance and depend on unqualified third-party service organizations which lack the required skills and expertise. Although customer cooperation in reporting failures and the quality of fault description are vital for successful repair, some customers do not fully cooperate or hide important information such as working conditions which have a significant influence on the product down-time. Delayed payments are common in repair-based service modes for uncovered products.

Table 5: Suggested improvements by the twelve cases.

	Theme	Improvement Details	Cases
Suggested Improvements	**Operation**	▪ Providing continuous training and personal development	2, 5, 6, 8, 12
		▪ Full-service outsourcing in certain markets	6
		▪ Improving diagnosis and repair activities	1, 3, 8
		▪ Performing continuous analysis for failures	3
	Customer	▪ Encouraging regular maintenance	4, 7, 8, 9, 11, 12
		▪ Using secondhand equipment as a standby	8
		▪ Enhancing linkage with customers	5, 8, 11
		▪ Hiring third parties for currency exchange and customs procedures	11
		▪ Not providing service for out-of-warranty products	8
		▪ Assigning certain employee to be responsible for each product	10
		▪ Securing long-term service agreements	8

The first suggested improvement theme focuses on operation specific and opens with continuous training and personal development for technicians which can provide a solution for the unqualified technicians in the Egyptian market and other emerging markets. This can also lead to better service efficiency and keep service personnel up to date with the new products, new services, and new

failures. Five cases from different industry groups see room for improvement through providing better training for their service teams continuously.

Customer specific suggestions include encouraging and assisting customers to perform regular, predictive, proactive or condition-based maintenance for critical equipment to reduce failure frequency, which has been put forward by six cases including cases of home appliances industry, capital goods industry apart from Case 5, and Case 9 (elevators and escalators manufacturer). The use of second-hand equipment as standby for critical equipment to reduce the negative effect of down-time has also been used as an improvement strategy. Three capital goods cases have suggested enhancing engagement with customers and providing their operators with continuous training to keep strong linkage and to improve their awareness of operating products. This can lead to less failures, increased product life, and reduced costs for both parties. This study has found that customers should be educated where possible to create an awareness that regular maintenance is not necessarily an extra cost but can be an essential expense that will bring long-term cost savings. To overcome foreign currency exchange procedures and customs restrictive procedures in Egypt, it is recommended to hire local third parties with experience in dealing with such matters. Such services are common in Egypt and can be obtained easily. It is not recommended to provide repair-based service for uncovered products in emerging markets to avoid delayed payments. Encouraging customers to assign a certain employee to be responsible for each product can reduce failures and help in failures reporting. Finally, securing long-term service agreements with customers can lead to better service planning and improved service delivery.

5. Discussion

From an analysis of the literature, research addressing internationalization; PSS; and field repair service in the context of emerging markets is scarce. In relation to field repair, the majority of reviewed cases are in established markets. Only two studies were found that report that they looked at emerging markets. Based on an analysis of field repair service provision associated with PSSs of the twelve cases in the Egyptian market, the following conclusions have been drawn.

It has been found that there is a high degree of commonality in terms of service offerings when compared with field repair services associated with PSSs in established markets. However, different offerings are provided based on each case organizational strategy, product characteristics, target customer, market competitiveness, and size of installed base of products. For instance, offering a full

takeover of the product operations was mentioned in the literature (established markets) but was not found in the multi case study (the Egyptian emerging market). On the contrary, offering a standby product to the customer was found in the multi case study (the Egyptian emerging market) but was not mentioned in the literature (established markets). In some instances, less offerings are provided due to the available infrastructure and the level of technology adoption within the market.

Regarding PSS types, product-oriented PSS (i.e. basic warranty; extended warranty; and repair-based modes) is common in the Egyptian emerging market. Result-oriented PSS (i.e. leasing modes) and user-oriented PSS (i.e. performance-based offerings) are provided by few cases. The limited applicability of the latter is in line with Szwejczewski *et al.* (2015) findings. However, it is noteworthy that such offerings are applicable in the Egyptian emerging market. Platform-oriented PSS has not been observed in the studied cases.

In the Egyptian emerging market, no structural differences have been observed in relation to the actors involved in service supply networks according to those described in the extant literature. The network is structured according to two main factors, which demonstrates the importance of supply networks in field repair service provision. The first one is product specific where aspects such as product characteristics, operating conditions, failures severity, and service calls volume decide the supply network structure. Allocating field technicians within easy reach for highly possible severe failures products and using a call center and dispatchers for large installed base of products that have high failure rates are commonly considered in emerging markets as the case in established markets. The second factor is strategy specific where manufacturers determine whether to insource or outsource service provision. Outsourcing decisions depend on the availability of service providers in the market capable of providing the required services while meeting service level, which has an impact on the customer experience. However, local service providers that are willing to be trained or improved and international service providers are available in most markets nowadays. The majority of cases outsource their service provision in emerging markets to local firms and hire local personnel. Hence, a main attribute of a PSS in emerging markets is to outsource product-service provision in line with general outsourcing trends reported in the literature. This also emphasizes the importance of relying on local providers for less developed markets as suggested by Wilson *et al.* (1999).

Based on analysis of each individual case, the general set of activities that are performed during field repair service delivery in the Egyptian emerging market is similar to that of established markets.

However, based on cross-case analysis, each case performs certain activities based on its organizational strategy; product characteristics; operating conditions; user type and region; market competitiveness; and size of installed base of products, with some minor differences from established markets. For example, some capital goods cases eliminate parts delivery time through stocking backup parts at the customer site while computer and document processing cases eliminate field technicians' role through using CRUs, which allows for better service provision. To the best of the authors' knowledge, these examples were not mentioned in the literature; hence, considered as differences.

Various performance measures are found to be used across the twelve cases. Customer satisfaction, cost, response time, and repair time are the most commonly used within the twelve cases. Those measures are almost similar to the most frequently used measures in field repair service literature. However, each case identifies the most appropriate measures according to product characteristics and operating conditions. Moreover, product usage and operating conditions influence customer evaluation for the delivered services; however, response time is the most frequently used measure (all cases except two). Although the measures observed in the literature are more than those observed in the multi case study, re-do time, parts discounts, customer safety, and customer care were observed only in the multi case study.

Based on analysis of difficulties facing the twelve cases, product specific and operation specific difficulties that have been found in the Egyptian emerging market do exist in established markets as well. However, the effect and severity of such difficulties in emerging markets are higher and more difficult to be handled. Other difficulties, country specific and culture specific, have more influence in emerging markets and affect product and operation specific difficulties. Those found across the twelve cases are similar to those reported in emerging markets literature. For Egypt, shortage of qualified technicians is the most common country specific difficulty facing the twelve cases. Customer mind-set and lack of awareness are among the biggest cultural issues facing the twelve cases. Unqualified operators, underperforming regular maintenance, and uncooperative customers add to the complexity of cultural issues. In established markets, better availability of resources exists. Although several and various cultures exist in different established markets, higher levels of customer awareness exist in established markets than emerging markets. This study found that lack of customer awareness is the most important challenge for foreign firms in Egypt, which has not been discussed

in the literature to date. This is a significant finding and is an area that requires further focus into the future.

Based on an analysis of suggested improvements by the twelve cases, continuous training and development of service personnel are the most commonly suggested operational improvements with positive expectations of better training. Although this is common in both established and emerging markets, the difficulty to find qualified resources in the Egyptian emerging market increases the importance of continuous training. Improving diagnosis and repair activities is another important suggestion. The majority of cases suggest encouraging and assisting customers to follow service procedures and recommendations to reduce failure frequencies. Likewise, enhancing engagement with customers and providing continuous training to their operators can reduce both failure frequencies and costs for all involved parties. Some of the customer specific improvements suggested for the Egyptian emerging market are applicable in established markets as well. However, emerging markets potential growth and high economic growth rates, relative to established markets, particularly Egypt's recent governmental reforms, are expected to allow for more sales and to deliver more profits. Moreover, customer specific improvements are the most important type of improvement with relation to the Egyptian emerging market.

Some commonalities in field repair service practices found across different cases, particularly within computer, telecommunications, document processing industry groups. However, no uniform approach or best practice model for field repair PSS provision in the Egyptian emerging market exists. Each case uses a different approach according to different factors including its own size and organizational strategy, product characteristics, operating conditions, customer type (B2B, B2C, or both), market type (emerging or established), market characteristics (competitiveness, culture, and economy), and size of installed base of products. Market type, emerging or established is one factor of many, but an important one and can have an influence on other factors that define PSS practices such as culture and economy. Civilization and awareness of customers are examples of cultural characteristics that usually are more customary in established markets than in the emerging ones.

The study findings show mixed views over the four main themes of field repair service. While the high degree of commonality between service offerings in emerging and established markets was a surprising finding, the provision of less offerings in emerging markets due to infrastructure and/or technology constraints was expected. In addition, it was interesting to find that user-oriented PSS is

provided in the Egyptian emerging market. For the remaining themes, supply network; service delivery; and performance measurement, findings were in line with expectations. No structural differences between emerging and established markets have been observed, outsourcing decisions in emerging markets match the general outsourcing trends, a similar set of activities are conducted to deliver the service in emerging and established markets, and common performance measures are used among both market types. However, it was interesting, as already described above to find that there are a number of measures being used in the Egyptian emerging market while not observed in the extant literature.

6. Conclusions

This study presents a multi case evaluation of a number of existing multinational manufacturing-based organizations and their field repair service models, which has not been presented previously in the literature. Based on a detailed review of twelve cases in Egypt, it was possible to analyze field repair service provision of different cases; present a cross-case analysis for the similarities and differences; and identify the current difficulties and potential improvements based on cultural and economic differences between established and emerging markets. This work contributes to the evolving research on PSS, particularly in emerging markets. Among the greatest contributions that this work offers, is the conclusions regarding the similarity in field repair service provision in both established and emerging markets, which provides deeper insights for those looking to provide and/or expand PSS offerings into the Egyptian emerging market. However, it is noteworthy that service operations vary from one case to the other and from one market to the other.

The conclusion of this multi case study articulates that field repair service models associated with PSSs in the Egyptian emerging market follow those of established markets in terms of service offerings, supply network structure including participants and actors, outsourcing strategies, service delivery process, performance measures, product and operational difficulties, and operational improvements. On the other hand, the main differences between established and emerging markets are related to country, culture, and customer factors, which lead to differences in both challenges and possible improvements of each market.

Although internationalized manufacturers must deal with some unique challenges and difficulties in the emerging markets, this has no effect on the main structural setup and provision of field repair services associated with PSSs. Among the main challenges and risks that internationalized

manufacturers face in Egypt, is the low level of customer awareness. In addition, PSS characteristics are identified based on several factors. Although market type is an important factor, other factors are essential too. Thus, the applicability of PSS types is not identified based on the market type being emerging or established only.

The study findings are limited to the studied cases and industries. In addition, findings such as country and culture specific difficulties are also limited to the Egyptian market. However, it has been found that five of the studied cases have a regional office in Egypt that manages their operations in other emerging markets across the Middle East using similar structure for field repair services. Hence, there is a possibility that similar difficulties could exist in these emerging markets, particularly those that lie in the Middle East and share a similar culture with Egypt. However, further investigation is required by conducting interviews with employees working in the other Middle Eastern markets to identify differences and similarities with the Egyptian market. Low level of customer awareness and its effect on PSS provision in emerging markets is a new finding of this study. Thus, more research is needed to address this finding and to examine other challenges and risks in the emerging markets. Given that platform-oriented PSS type was not available in the studied cases, analyzing different cases and industries can be useful in identifying the applicability of this PSS type, which was newly discovered by Chiu *et al.* (2019). Finally, PSS is an evolving topic and has great research potential in the context of emerging markets.

Acknowledgement

We would like to express our gratitude to the twelve industrial organizations that were involved in this research for their collaboration. Author Cathal Heavey research was partially supported by the Science Foundation Ireland (SFI) under Grant Number SFI 16/RC/3918, co-funded by the European Regional Development Fund.

References

Agnihothri, S., Sivasubramaniam, N., Simmons, D. (2002) 'Leveraging technology to improve field service', *International Journal of Service Industry Management*, 13(1), 47–68.

Agnihothri, S.R., Mishra, A.K. (2004) 'Cross-training Decisions in Field Services with Three Job Types and Server-Job Mismatch', *Decision Sciences*, 35(2), 239–257.

Aleksy, M., Stieger, B. (2009) 'Challenges in the Development of Mobile Applications in Industrial Field Service', in *International Conference on Network-Based Information Systems*, 586–591.

Aleksy, M., Stieger, B., Vollmar, G. (2009) 'Case Study on Utilizing Mobile Applications in Industrial Field Service', in *IEEE Conference on Commerce and Enterprise Computing*, 333–336.

Amini, M.M., Retzlaff-Roberts, D., Bienstock, C.C. (2005) 'Designing a reverse logistics operation for short cycle time repair services', *International Journal of Production Economics*, 96(3), 367–380.

Anim-Ansah, G., Kern, M., Owusu, G., Voudouris, C. (2006) 'Field service planning as an enabler for field service optimisation', in *3rd International IEEE Conference Intelligent Systems*, 156–162.

Armistead, C., Clark, G. (1991) 'A Framework for Formulating After-sales Support Strategy', *International Journal of Operations & Production Management*, 11(3), 111–124.

Baines, T.S., Lightfoot, H.W., Evans, S., Neely, A., Greenough, R., Peppard, J., Roy, R., Shehab, E., Braganza, A., Tiwari, A., Alcock, J.R., Angus, J.P., Bastl, M., Cousens, A., Irving, P., Johnson, M., Kingston, J., Lockett, H., Martinez, V., Michele, P., Tranfield, D., Walton, I.M., Wilson, H. (2007) 'State-of-the-art in product service-systems', *Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture*, 221(10), 1543–1552.

Behara, R.S., Lemmink, J.G.A.M. (1997) 'Benchmarking field services using a zero defects approach', *International Journal of Quality & Reliability Management*, 14(5), 512–526.

Bell, D.G., Bobrow, D.G., Raiman, O., Shirley, M.H. (1998) 'Dynamic documents and situated processes: Building on local knowledge in field service', in *International Working Conference on Information and Process Integration in Enterprises*, 1–16.

Bellandi, M., Lombardi, S., Santini, E. (2020) 'Traditional manufacturing areas and the emergence of product-service systems: the case of Italy', *Journal of Industrial and Business Economics*, 47(2), 311–331.

Beuren, F.H., Gomes Ferreira, M.G., Cauchick Miguel, P.A. (2013) 'Product-service systems: a literature review on integrated products and services', *Journal of Cleaner Production*, 47, 222–231.

Bijvank, M., Koole, G., Vis, I.F.A. (2010) 'Optimising a general repair kit problem with a service constraint', *European Journal of Operational Research*, 204(1), 76–85.

Blumberg, D.F. (1982) 'Remote diagnostics for improving field service productivity', *Computer*, 15(11), 70–77.

Blumberg, D.F. (1991) 'Field service quality improves with technology: Experience at Frontier refreshment services', *National Productivity Review*, 11(1), 87–96.

Byrne, P.J., Heavey, C., Blake, P., Liston, P. (2013) 'A simulation based supply partner selection decision support tool for service provision in Dell', *Computers & Industrial Engineering*, 64(4), 1033–1044.

Caiazza, R. (2012) 'Internationalization in Egypt: Risks and Opportunities', *Chinese Business Review*, 11(09), 767–773.

Caiazza, R. (2014) 'Identifying international market opportunities: The case of Italian companies in Egypt', *Benchmarking: An International Journal*, 21(4), 665–674.

Caiazza, R. (2016) 'Internationalization of SMEs in high potential markets', *Trends in Food Science and Technology*, 58, 127–132.

Caiazza, R., Volpe, T. (2015) 'Interaction despite of diversity: Is it possible?', *Journal of Management Development*, 34(6), 743–750.

Castaño, M.S., Méndez, M.T., Galindo, M.Á. (2016) 'Innovation, internationalization and business-growth expectations among entrepreneurs in the services sector', *Journal of Business Research*, 69(5), 1690–1695.

Cheong, M.L.F., Koo, P.S., Babu, B.C. (2015) 'Ad-hoc automated teller machine failure forecast and field service optimization', in *IEEE International Conference on Automation Science and Engineering*.

Chiu, M.C., Chu, C.Y., Kuo, T.C. (2019) 'Product service system transition method: building firm's core competence of enterprise', *International Journal of Production Research*, 57(20), 6452–6472.

Cohen, M., Kamesam, P. V., Paul Kleindorfer, Lee, H., Armen Tekerian (1990) 'Optimizer: IBM's multi-echelon inventory system for managing service logistics', *Interfaces*, 20(January-February), 65–82.

Costa, H.T., Cahen, F.R., Santos, J.B. (2020) 'The influence of home-country institutions on servitization', *International Journal of Emerging Markets*, 15(4), 809–828.

Daeuble, G., Oezcan, D., Niemoeller, C., Fellmann, M., Nuettgens, M., Thomas, O. (2015) 'Information needs of the mobile technical customer service - A case study in the field of machinery and plant engineering', in *Proceedings of the Annual Hawaii International Conference on System Sciences*, 1018–1027.

Durugbo, C., Bankole, O.O., Erkoyuncu, J. a., Tiwari, A., Alcock, J.R., Roy, R., Shehab, E. (2010) 'Product-Service Systems across Industry Sectors: Future Research Needs and Challenges', in *Proceedings of the 2nd CIRP IPS2 Conference*, Linkoping, 535–542.

Dzubow, S.R. (1984) 'Simulation and strategic planning: A case study effectiveness evaluation', in *Proceedings of the 17th Annual Symposium on Simulation*, 65–78.

Elbanna, S., Abdelzaher, D.M., Ramadan, N. (2020) 'Management research in the Arab World: What is now and what is next?', *Journal of International Management*, 26(2), 100734.

Finke, G., Hertz, P., Schönsleben, P. (2012) 'Industrial field service network performance measurement Performance dimensions and indicators for service providers', in *9th International Conference on Service Systems and Service Management*.

FTSE (2017) FTSE Annual Country Classification Review [online], *FTSE Classification of Markets*, available: http://www.ftse.com/products/downloads/FTSE-Country-Classification-Update_latest.pdf [accessed 16 May 2017].

Gaiardelli, P., Saccani, N., Songini, L. (2007) 'Performance measurement systems in after-sales service: an integrated framework', *International Journal of Business Perfromance Management*, 9(2), 145–171.

Garetti, M., Rosa, P., Terzi, S. (2012) 'Life Cycle Simulation for the design of Product–Service Systems', *Computers in Industry*, 63(4), 361–369.

Grönroos, C. (2016) 'Internationalization strategies for services: a retrospective', *Journal of Services Marketing*, 30(2), 129–132.

Han, C., Dong, Y., Dresner, M. (2013) 'Emerging market penetration, inventory supply, and financial performance', *Production and Operations Management*, 22(2), 335–347.

Hertz, P., Finke, G., Verhasselt, S. (2011) 'A Process Reference Model for Service Delivery in After-Sales Field Service Networks', in *APMS International Conference-Advances in Production Management Systems*.

Hertz, P., Finke, G.R., Schönsleben, P. (2012) 'Industrial field service network planning: Existing methods in supply chain planning and modeling and their applicability for field services', in *9th International Conference on Service Systems and Service Management*.

Hertz, P., Sproedt, A. (2013) 'Service Supply Chain Planning for Industrial Services – Design and Application of a Decision Support Tool', in *International Conference on Advances in Production Management Systems*, 73–80.

Hull, D.L., Cox, J. (1994) 'The field service function in the electronics industry - Providing a link between customers and production marketing', *International Journal of Production Economics*, 37(1), 115–126.

Hultman, J., Johnsen, T., Johnsen, R., Hertz, S. (2012) 'An interaction approach to global sourcing: A case

study of IKEA', *Journal of Purchasing and Supply Management*, 18(1), 9–21.

Johanson, J., Vahlne, J.-E. (1977) 'The Internationalization Process of the Firm - A Model of Knowledge Development and Increasing Foreign Market Commitments', *Journal of International Business Studies*, 8(1), 23–32.

Johanson, J., Vahlne, J.-E. (2009) 'The Uppsala internationalization process model revisited: From liability of foreignness to liability of outsidership', *Journal of International Business Studies*, 40(9), 1411–1431.

Kearney, C. (2012) 'Emerging markets research: Trends, issues and future directions', *Emerging Markets Review*, 13(2), 159–183.

Kim, Y.S. (2020) 'A representation framework of product-service systems', *Design Science*, 1–40.

Lee, H., Shepherdson, J., Case, S. (2008) 'Delivering knowledge in the field: A telecommunications service provision and maintenance case', in *European and Mediterranean Conference on Information Systems*, 1–10.

Legnani, E., Cavalieri, S., Ierace, S. (2009) 'A framework for the configuration of after-sales service processes', *Production Planning & Control*, 20(2), 113–124.

Lehtonen, O., Ala-Risku, T. (2005) 'Enhancing on-site maintenance execution with ICT - A case study', in *5th International Conference on Electronic Business*, 882–895.

Lehtonen, O., Ala-Risku, T., Holmström, J. (2012) 'Enhancing field-service delivery: the role of information', *Journal of Quality in Maintenance Engineering*, 18(2), 125–140.

Li, A.Q., Kumar, M., Claes, B., Found, P. (2020) 'The state-of-the-art of the theory on Product-Service Systems', *International Journal of Production Economics*, 222.

Li, A.Q., Rich, N., Found, P., Kumar, M., Brown, S. (2020) 'Exploring product–service systems in the digital era: a socio-technical systems perspective', *TQM Journal*.

Liao, L., Lee, J. (2008) 'A reconfigurable embedded prognostics platform for machinery performance management', in *62nd Machinery Failure Prevention Technology*, 1–14.

Lin, Y., Hsu, A., Rajamani, R. (2002) 'A simulation model for field service with condition-based maintenance', in *Proceedings of the Winter Simulation Conference*, 1885–1890.

Lorentz, H., Ghauri, P.N. (2010) 'Demand supply network opportunity development processes in emerging markets: Positioning for strategy realization in Russia', *Industrial Marketing Management*, 39(2), 240–251.

Lorentz, H., Kittipanya-Ngam, P., Singh Srai, J. (2013) 'Emerging market characteristics and supply network adjustments in internationalising food supply chains', *International Journal of Production Economics*, 145(1), 220–232.

Macchi, M., Farruku, K., Holgado, M., Negri, E., Panarese, D. (2016) 'Economic and environmental impact assessment through system dynamics of technology-enhanced maintenance services', *International Journal of Industrial and Systems Engineering*, 23(1), 36–56.

Manzini, E., Vezzoli, C. (2003) 'A strategic design approach to develop sustainable product service systems: examples taken from the "environmentally friendly innovation" Italian prize', *Journal of Cleaner Production*, 11(8), 851–857.

Manzini, E., Vezzoli, C., Clark, G. (2001) 'Product-Service Systems: Using an Existing Concept as a New Approach to Sustainability', *The Journal of Design Research*, 1(2).

Menzies, J.L., Orr, S. (2013) 'The services internationalization process: An exploratory investigation of Australian service company internationalization to China', *Journal of Asia-Pacific Business*, 14(4),

287–311.

Mohamed, A., Bilgin, A., Liret, A., Owusu, G. (2017) 'Fuzzy logic based personalized task recommendation system for field services', in *International Conference on Innovative Techniques & Applications of Artificial Intelligence*, 300–312.

MSCI (2017) MSCI Emerging Markets Index [online], *Morgan Stanley Capital International*, available: https://www.msci.com/emerging-markets [accessed 16 May 2017].

Murali, S., Pugazhendhi, S. (2015) 'An importance and performance analysis of ASS attributes for home appliances manufacturing firms', *Vels Journal of Mechanical Engineering*, 2(2), 7–13.

Najafi, N., Dubois, A., Hulthén, K. (2013) 'Opportunism or strategic opportunity seeking? Three approaches to emerging country sourcing', *Journal of Purchasing and Supply Management*, 19, 49–57.

Narooz, R., Child, J. (2017) 'Networking responses to different levels of institutional void: A comparison of internationalizing SMEs in Egypt and the UK', *International Business Review*, 26(4), 683–696.

Oguji, N., Owusu, R.A. (2017) 'Acquisitions Entry Strategies in Africa: The Role of Institutions, Target-Specific Experience, and Host-Country Capabilities—The Case Acquisitions of Finnish Multinationals in Africa', *Thunderbird International Business Review*, 59(2), 209–225.

Onar, S.Ç., Oztaysi, B., Kahraman, C. (2017) 'Dynamic intuitionistic fuzzy multi-attribute aftersales performance evaluation', *Complex & Intelligent Systems*, 3(3), 197–204.

Owida, A. (2018) A Continuous Improvement Approach for Outsourced After-Sales Field Repair Services Contracting (*PhD Thesis, University of Limerick, Limerick, Ireland)* available online: https://ulir.ul.ie/handle/10344/7059.

Owida, A., Byrne, P.J., Heavey, C., El-Kilany, K.S. (2020) *Field Repair Service: A Systematic Review of the Literature (Working Paper)*.

Papadopoulos, H.T. (1996) 'A field service support system using a queueing network model and the priority MVA algorithm', *Omega, International Journal of Management Science*, 24(2), 195–203.

Parry, G., Bustinza, O., Vendrell-Herrero, F., O'Regan, N. (2016) 'Internationalization of product-service systems: Global, regional or national strategy?', *Foresight and STI Governance*, 10(1), 16–29.

Patton, M.Q. (2002) *Qualitative Research and Evaluation Methods: Integrating Theory and Practice*, 4th editio. ed.

Priyono, A., Nursyamsiah, S., Darmawan, B.A. (2020) 'Network-based dynamic capabilities in internationalisation of SMEs: Case studies in emerging economy', *International Journal of Trade and Global Markets*, 13(1), 11–20.

Purkayastha, A., Sharma, S., Karna, A. (2020) 'Theoretical foundations of antecedents of internationalization and moderators in multinationality–performance relationship What is missing?', *Cross Cultural and Strategic Management*.

Rahimi-Ghahroodi, S., Al Hanbali, A., Zijm, W.H.M., van Ommeren, J.K.W., Sleptchenko, A. (2017) 'Integrated planning of spare parts and service engineers with partial backlogging', *OR Spectrum*, 39(3), 711–748.

Rapaccini, M., Porcelli, I., Espíndola, D.B., Pereira, C.E. (2014) 'Evaluating the use of mobile collaborative augmented reality within field service networks: the case of Océ Italia – Canon Group', *Production and Manufacturing Research*, 2(1), 738–755.

Rapaccini, M., Visintin, F., Sistemi, A. (2008) 'A simulation-based DSS for field service delivery optimization', in *7th International Workshop on Modeling and Applied Simulation*, 116–122.

Saccani, N., Johansson, P., Perona, M. (2007) 'Configuring the after-sales service supply chain: A multiple case study', *International Journal of Production Economics*, 110(1–2), 52–69.

Saccani, N., Visintin, F., Mansini, R., Colombi, M. (2017) 'Improving spare parts management for field services: a model and a case study for the repair kit problem', *IMA Journal of Management Mathematics*, 28(2), 185–204.

Saccani, N., Visintin, F., Rapaccini, M. (2014) 'Investigating the linkages between service types and supplier relationships in servitized environments', *International Journal of Production Economics*, 149, 226–238.

Salwin, M., Kraslawski, A., Lipiak, J. (2020) 'State-of-the-Art in Product-Service System Design', in *The 10th International Conference on Engineering, Project, and Production Management*, Springer Singapore, 645–658.

Schweizer, R., Vahlne, J.E., Johanson, J. (2010) 'Internationalization as an entrepreneurial process', *Journal of International Entrepreneurship*, 8(4), 343–370.

Sousa-Zomer, T.T., Miguel, P.A.C. (2016) 'Exploring the critical factors for sustainable product-service systems implementation and diffusion in developing countries: an analysis of two PSS cases in Brazil', *Procedia CIRP*, 47, 454–459.

Stieger, B., Aleksy, M. (2009a) 'The role of knowledge management technologies in service business processes', in *Proceedings of the 4th International Conference on Digital Information Management*, 1–6.

Stieger, B., Aleksy, M. (2009b) 'Utilization of Knowledge Management for Service Business Process Improvement', in *Proceedings of the International Multiconference on Computer Science and Information Technology*, 171–175.

Suh, E.S. (2019) 'Product Service System Availability Improvement through Field Repair Kit Optimization: A Case Study', *Applied Sciences*, 9(20), 4272.

Szwejczewski, M., Goffin, K., Anagnostopoulos, Z. (2015) 'Product service systems, after-sales service and new product development', *International Journal of Production Research*, 53(17), 5334–5353.

Tatila, J., Helkio, P., Holmstrom, J. (2014) 'Exploring the performance effects of performance measurement system use in maintenance process', *Journal of Quality in Maintenance Engineering*, 20(4), 377–401.

Tesfay, W.B., Aleksy, M., Andersson, K., Lehtola, M. (2013) 'Mobile computing application for industrial field service engineering: A case for ABB service engineers', in *Local Computer Networks Workshops*, 188–193.

Thomas, P.L. (1980) 'DEC field service : An industry leader', *Behavior Researth Methods and Instruments*, 12(2), 263–264.

Tukker, A. (2004) 'Eight types of product-service system: Eight ways to sustainability? Experiences from SusProNet', *Business Strategy and the Environment*, 13(4), 246–260.

Urban, B., Hwindingwi, R. (2016) 'The influence of institutional factors on MNC's triple bottom-line reporting: A focus on African emerging markets (AEMs)', *International Journal of Emerging Markets*, 11(4), 497–513.

Viehland, D., Yang, C. (2007) 'Bringing the Mobile Workforce to Business: A Case Study in a Field Service Organization', in *6th International Conference on the Management of Mobile Business (ICMB)*, 39–39.

Voss, C., Tsikriktsis, N., Frohlich, M. (2002) 'Case research in operations management', *International Journal of Operations & Production Management*, 22(2), 195–219.

Vossing, M., Wolff, C., Reinerth, V. (2018) 'Digitalization of Field Service Planning: The Role of

Organizational Knowledge and Decision Support Systems', in *International Conference on Exploring Service Science*.

Voudouris, C., Owusu, G., Dorne, R., McCormick, A. (2006) 'FOS: An advanced planning and scheduling suite for service operations', in *International Conference on Service Systems and Service Management*, 1138–1143.

Watson, E.F., Chawda, P.P., McCarthy, B., Drevna, M.J., Sadowski, R.P. (1998) 'A Simulation Metamodel for Response-Time Planning', *Decision Sciences*, 29(1), 217–241.

Wickramasinghe, V., Mathusinghe, K. (2016) 'After-sales services of home appliances: evidence from Sri Lanka', *International Journal of Consumer Studies*, 40, 115–124.

Wilson, T.L., Bostrom, U., Lundin, R. (1999) 'Communications and Expectations in After-Sales Service Provision : Experiences of an International Swedish Firm', *Industrial Marketing Management*, 28(4), 381–394.

Yang, P.Y., Luo, L., Li, C.J., Yang, Y., Lee, S.H.T. (2013) 'The rise of the manufacturing service industry: the perspective of value-added chain model', *Chinese Management Studies*, 7(3), 403–418.

Zackariasson, P., Wilson, T.L. (2004) 'Internetworked after-sales service', *Industrial Marketing Management*, 33, 75–86.

Zhou, R., Hu, Y., Xiao, S., Wen, J. (2016) 'A multi-agent based decision-making approach for field service delivery of IPS2', *Procedia CIRP*, 47, 228–233.

Appendix

Table A1: Interview questions and their purpose.

#	Question	Purpose
1	Do you provide after-sales repair services to your customers?	To reassure that the interviewed case provides field repair service
2	The provided repair services are field-based or facility-based?	
3	How do you get paid for the provided field repair services?	To identify the field repair service offerings
4	What are your field repair service offerings?	
5	What is the structure of your field repair service supply network?	To identify the involved participants in the field repair service supply network structure
6	Do you insource or outsource your field repair services, or you do both?	To identifying the manufacturer strategy regarding supply network setting
7	Do you stock your parts internally or externally?	
8	Would you please explain the provision of your field repair service delivery process (i.e. showing the required activities; their sequence; and the different possible interactions, decisions, and flows)?	To describe the field repair service delivery process and explain in detail showing all activities performed during service provision
9	How do you measure your field repair services performance?	To identify the performance measures used by the manufacturer and considered by the customer
10	How do customers evaluate your service delivery?	
11	What are the biggest difficulties you face during service provision?	These are opinion-based questions that aim at getting broader view on the field repair service
12	What are your suggestions for improving your service delivery?	