Multimodal Transportation 2 (2022) 100064

Contents lists available at ScienceDirect

Multimodal Transportation

journal homepage: www.elsevier.com/locate/multra

Full Length Article

Investigation of the drivers of logistics outsourcing in the United Kingdom's pharmaceutical manufacturing industry

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ARTICLE INFO

Keywords:
Logistics outsourcing
Logistics service providers
Third-party logistics
Transport
Pharmaceutical manufacturers
UK

ABSTRACT

Logistics outsourcing is a practice commonly used by firms to allow them to access capabilities that they lack internally. Although the main drivers of outsourcing in general are fairly well known, the question of what explains logistics outsourcing decisions within the UK pharmaceutical manufacturing industry, in particular, remains under-researched. Therefore, this study aims to bridge the aforementioned gap in the literature. We surveyed 49 drug manufacturers located in the UK using a web-based questionnaire. The data collected were analysed using logistics regression, exploratory factor analysis, and t-tests. We found that UK drug manufacturers regard improving quality and reliability and reducing logistics costs as the most significant reasons for outsourcing logistics services. We also found a direct positive relationship between the service provider's techno-commercial offerings and delivery performance, and the likelihood of being selected to provide these services. We further explored materials transportation, product delivery, research and development, and clinical trials, which are among the most frequently outsourced logistics activities in the UK pharmaceutical manufacturing industry. The study contributes to the wider literature on logistics outsourcing, and more specifically to that on the UK pharmaceutical manufacturing industry. Findings from this research can also be used to guide outsourcing practitioners' decisions about the selection of logistics service providers. In addition, the study can help to enhance the service providers' understanding of why firms buy logistics services and which services they are likely to buy.

1. Introduction

Pharmaceuticals account for a large proportion of public expenditure in the United Kingdom (UK). According to the Office for National Statistics (ONS, 2021), the United Kingdom's spending on health had reached £214.4 billion in 2018, 12.3% (£26.37 billion) of which was spent on pharmaceuticals (OECD, 2021). Given the substantial sums of money involved, it is essential to have well-developed and efficient supply chain systems for pharmaceutical product (PP) sourcing, manufacturing, storage, and delivery in place.

In recent years, there has been a growing interest within the pharmaceutical industry in leveraging other firms' resources (Çelik, 2017; Kumar and Jha, 2019; Roscoe et al., 2020). This is largely due to fierce competition within the pharmaceutical prod-

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https://doi.org/10.1016/j.multra.2022.100064
Received 26 May 2022; Received in revised form 2 August 2022; Accepted 11 September 2022

ucts (PP) market, which continually drives prices downwards, thus putting the pharmaceutical firms under pressure to reduce costs (Aktas et al., 2011; Rajesh et al., 2013), increase the flexibility of their manufacturing (Liao et al., 2010; Zhu et al., 2017), and decrease inventory requirements (Ehie, 2001). In light of these constraints, logistics outsourcing (LO) offers a means of relieving some of the pressure on the user firms. Therefore, logistics outsourcing can be regarded as an alternative to the traditional model of a vertically integrated firm (Boyson et al., 1999), allowing the user firm to focus on its core business while delegating the non-core elements to external partners known as third-party logistics (3PL) or logistics service providers (LSPs). Although the reasons for logistics outsourcing in general are relatively well known (Aktas et al., 2011; Fadile et al., 2018; Liao et al., 2010; Rajesh et al., 2013; Zhu et al., 2017), the specific motivations for the UK's pharmaceutical manufacturers to outsource logistics activities remain largely unexplored. Therefore, we developed and validated a survey with which to collect quantitative data from pharmaceutical manufacturers operating in the UK to examine their reasons for outsourcing various logistics functions.

The remainder of this paper is organised as follows. Section 2 reviews the existing literature regarding logistics outsourcing, the criteria used to evaluate and select 3PLs, and outsourced logistics activities. Section 3 explains the methodology used for this research. Section 4 presents the results of the analysis, and Section 5 summarises the conclusions of the research and provides policy implications.

2. Literature review

2.1. Defining logistics outsourcing

Logistics outsourcing falls within the remit of the broader research area of outsourcing, which has attracted a great deal of interest from scholars (Aktas et al., 2011; Gadde and Hulthen, 2009; Jaafar and Rafiq, 2005; McKinnon, 2003; Rabinovich et al., 1999; Rajesh et al., 2013; Razzaque and Sheng, 1998; Zhu et al., 2017). However, logistics outsourcing is still not very well understood, as it means different things in different contexts (Baglio et al., 2017). Therefore, a wide range of definitions of logistics outsourcing can be found in the literature. One of the most widely cited definitions is provided by Hsiao et al. (2011), who referred to logistics outsourcing as the process by which a firm involves external organisations in delivering services within an agreed budget and timeframe. In the same vein, Chase et al. (2004) defined logistics outsourcing as an act of moving some of an organisation's internal activities and decision responsibilities to external service providers.

Barrett and Baldry (2003) suggested that logistics outsourcing is the process through which an organisation employs the service provider under a contract to undertake a function that had previously been performed internally; and transfers to that provider the relevant assets, including people and management responsibility. Although the boundaries of the outsourcer's responsibilities appear to be clearly delineated, it has been argued that overdependence on external partners could lead to the user firm losing control of the operations (Waters and Rinsler, 2014), the loss of expertise and information (König and Spinler, 2016), and may have financial implications in the event of technical, technological, and administrative problems (Marinkovic et al., 2020).

2.2. Reasons for logistics outsourcing

One area of controversy in the literature on logistics outsourcing revolves around what triggers the decision to externalise activities to LSPs. While companies can outsource numerous non-core functions, their reasons for outsourcing vary. Several previous studies have indicated that cost reduction, service improvement, and the need to focus on core business functions are key drivers for outsourcing logistics services (Aktas et al., 2011; Fadile et al., 2018; Kakabadse and Kakabadse, 2005; Liu et al., 2015; Rajesh et al., 2013; Wei, 2005; Zhu et al., 2017; Yeung et al., 2012). This implies that logistics activities that have traditionally been performed internally, such as warehousing (Rajesh et al., 2013) and transportation (McKinnon, 2003; Khan et al., 2017), are increasingly being carried out by external partners, thus, reducing the capital investment (Rahman, 2011; Sahay and Mohan, 2006; Vogel and Getz, 1997) associated with warehouses and vehicles (Rajesh et al., 2013). Although many scholars recognise that outsourcing can reduce logistics costs and other expenses (Aktas et al., 2011; Fadile et al., 2018; Kakabadse and Kakabadse, 2005; Rabinovich et al., 1999; Rajesh et al., 2013; Zhu et al., 2017), others have argued, to the contrary, that logistics outsourcing does not always significantly reduce the expected costs, and in some cases it can even increase transaction costs (Aktas and Ulengin, 2005; Beaumont and Sohal, 2004).

In addition to costs, services, and core competencies, several other factors are also regarded as reasons for outsourcing logistics functions. These factors include the opportunity for an organisation to increase its competitive advantage (Elmuti, 2003; Liao et al., 2010; Rajesh et al., 2013), to improve the service quality and reliability (Aktas et al., 2011; Zhu et al., 2017), and to offer greater flexibility (Liao et al., 2010; Rajesh et al., 2013; Zhu et al., 2017) in terms of dealing with external forces, such as regulation and technology (Chambers et al., 2009), fluctuating demand (El Mokrini et al., 2015), expanding into foreign markets (McKinnon, 2003; Razzaque and Sheng, 1998), overcoming restrictive practices and industrial action (McKinnon, 2003), PP concerns (Singh et al., 2016) and geopolitical disruption such as Brexit (Roscoe et al., 2020). Firms may also outsource their logistics activities to third-party providers in an effort to increase capacity, productivity, efficiency, and profitability (Elmuti, 2003). In the pharmaceutical industry, PP development and manufacturing are viewed as costly and time-consuming (Chambers et al., 2009). Therefore, many companies are increasingly attempting to leverage expertise, technology, and skills from the service providers (Liao et al., 2010; Rahman, 2011; Sahay and Mohan, 2006), as well as using their resources and capabilities, such as space and equipment (Liao et al., 2010; Liu et al., 2015; Yeung et al., 2012).

However, several scholars (Rajesh et al., 2013; Persson and Virum, 2001) have argued that firms can use logistics outsourcing to transfer risks that may exist in relation to their non-core activities, such as new PP development and clinical trials, which inherently

involve risks (Vogel and Getz, 1997). As a result, the user firm can focus more effectively on what it does best (Rintala et al., 2021; Sahay and Mohan, 2006), while delegating other non-core activities to trusted service providers. Bosire et al. (2013) claimed that outsourcing logistics services is likely to improve the lead time involved in operations, meaning that organisations sometimes outsource activities to expedite processes, especially in relation to the time-bounded development of new PP and clinical trials (Cockburn, 2006).

2.3. Criteria for evaluation and selection of 3PLs

As market competition becomes ever fiercer, firms are increasingly driven to leverage resources from their suppliers' network (Modi and Mabert, 2007), which entails the need for a system that can select the most appropriate logistics service providers (Chen and Hung, 2010). In this context, Modi and Mabert (2007) explained that supplier evaluation involves the process of assessing suppliers' capabilities and resources, detecting development opportunities, and benchmarking their performance. In addition, Zhang et al. (2013) suggested that an effective evaluation of the service providers' capabilities and relationships is critical, in order for the outsourcing firm to gain a sustained competitive advantage.

Yahya and Kingsman (1999) designed a vendor index system that could be used to assess the service quality, delivery performance, and provider's financial performance. Similarly, many other studies (Bagchi and Virum, 1996; Çelik, 2017; Chen and Hung, 2010; Rothaermel et al., 2006; Wu and Blackhurst, 2009) have also indicated that service quality constitutes a key criterion in the process of evaluating and selecting 3PLs.

Ordoobadi (2009) focused on the attributes of cost, service, product, quality, and delivery, and found that these attributes could help decision-makers rate and select appropriate suppliers. For example, the supplier who was able to deliver the highest quality product or service at the lowest cost would be considered the best option. Rajesh et al. (2013) developed a factor analysis model designed to identify key factors that are taken into consideration when evaluating logistics service providers. They found that the service provider's technical capability, quality, reliability and price of the service, responsiveness to unexpected events, financial strength, delivery accuracy, quick response to customer demand and market entry are among many factors that influence the selection of a service provider. Several other studies have lent support to Rajesh et al.'s (2013) findings, emphasising the importance of the service provider's technical capabilities (Yeung et al., 2012; Zhu et al., 2017), the quality of the service (Bagchi and Virum, 1996; Çelik, 2017; Chen and Hung, 2010; Rothaermel et al., 2006), the service price (Chen and Hung, 2010; Rothaermel et al., 2006; Wu and Blackhurst, 2009), the provider's ability to respond to unforeseen circumstances (Chen and Hung., 2010; Rothaermel et al., 2006), the provider's financial stability (Bagchi and Virum, 1996), the on-time service delivery (Mubarik et al., 2012; Hsiao et al., 2010; Zhu et al., 2017) and on-budget delivery (Hsiao et al., 2011; Quinn, 1999). Moreover, Ounnar et al. (2007) designed a model that can be used for supplier evaluation comprising five key criteria: lead time, cost, quality, reliability, and strategy.

Chen and Hung (2010) developed a comprehensive framework for evaluating outsourcing partners in the pharmaceutical industry, which adopted the following relevant criteria: costs, service performance, quality, compliance, and culture. Quinn (1999) argued that reliability and faster delivery service are key determinants that firms consider when partnering with logistics service providers. The study also found that logistics service providers are expected to provide quicker and more reliable services because they are more knowledgeable in this respect than the user firm. In contrast, Çelik (2017) employed an analytic hierarchy process (AHP) to study the third-party logistics selection process in the pharmaceutical industry and concluded that, among many criteria, the provider's reputation is considered particularly important within this process.

2.4. Outsourced logistics activities

When making choices about outsourcing logistics functions, elements that distinguish the firm in terms of value and quality are taken into consideration (Fill and Visser, 2000). However, it is widely believed that activities with minimal or no impact on a firm's competitive strategy may be outsourced to specialist providers (Quinn and Hilmer, 1994), while those that create a competitive advantage, and are thus essential to the business, are best kept in-house (Arif and Jawab, 2011).

The evidence from the literature generally suggests that different logistics activities are outsourced for a variety of reasons. In this regard, Azzi et al. (2013) examined the Italian health system and concluded that outsourcing to third-party logistics (3PL) providers was the most economical option, suggesting that capital costs related to materials and goods warehousing and transportation are likely to be reduced by outsourcing the warehousing and transportation functions. Many previous studies have pointed out that outsourcing warehousing (Rajesh et al., 2013; Sahay and Mohan, 2006) and transportation (Khan et al., 2017; McKinnon, 2003; Mubarik et al., 2012; Sahay and Mohan, 2006) is a commonly accepted practice. Another study conducted by Mubarik et al. (2012) examined 30 pharmaceutical companies in Pakistan and concluded that outsourcing transportation activity has had a significant influence on the effectiveness and efficiency of the supply chain within Pakistan's pharmaceutical sector. Sundaramoorthy and Karimi (2004) developed a model designed to examine production outsourcing in the pharmaceutical industry. They considered whether the manufacture of a new product should be undertaken in-house or outsourced to a contracted manufacturer. Finding a satisfactory answer to such questions can sometimes be challenging for pharmaceutical manufacturers because different organisations outsource logistics activities for different reasons (Hsiao et al., 2010).

Solakivi et al. (2011) conducted a study that investigated 223 small and medium enterprise (SME) firms operating in Finland. They concluded that activities relating to logistics information technology and order processing and management were frequently outsourced. Zhang et al. (2013) highlighted that pharmaceutical companies usually outsource to third-party logistics partners with high operational and dynamic capabilities. In addition, Hsiao et al. (2010) identified three levels of logistics activities: basic (such

as transportation, warehousing), value-added (such as inventory management); and strategic decision-making (distribution network design). Other outsourced activities include research and development (R&D) (Chambers et al., 2009), materials and product delivery (Khan et al., 2017; Sahay and Mohan, 2006), inventory management (Arif and Jawab, 2011), and reverse logistics (McKinnon, 2003).

Fadile et al. (2018) divided outsourced logistics services into three major categories: basic logistics services, such as warehousing and transportation; value-added logistics services, including, for instance, inventory management; and advanced logistics services, for example, order processing, logistics information systems, IT services, and manufacturing. Additionally, due to rising costs and the longer development time required, research and development and clinical trials have increasingly become outsourced functions (Thakur, 2010).

In summary, numerous studies within the existing literature have addressed the subject of logistics outsourcing, namely, the reasons for outsourcing activities to 3PLs (Aktas et al., 2011; Liao et al., 2010; Liu et al., 2015; Rajesh et al., 2013; Rintala et al., 2021; Zhu et al., 2017), the criteria used to evaluate and select 3PLs (Çelik, 2017; Chen and Hung, 2010; Bagchi and Virum, 1996; Hsiao et al., 2010; Mubarik et al., 2012), and frequently outsourced logistics activities (Arif and Jawab, 2011; Chambers et al., 2009; Khan et al., 2017; Sahay and Mohan, 2006; Solakivi et al., 2011; Thakur, 2010). However, none of these studies has identified the determinants of logistics outsourcing in the UK pharmaceutical manufacturing industry (PMI). For example, Aktas et al. (2011) examined logistics outsourcing in Turkish industrial companies, but did not specifically focus on the pharma industry, while Rajesh et al. (2013) investigated 3PLs in the Indian context. Other scholars have also studied logistics outsourcing but in countries other than the UK: for instance, Arif and Jawab (2011), in the Moroccan context; Baglio et al. (2017) in regard to Italy; Beaumont and Sohal (2004) in relation to Australia; Bosire et al. (2013) in the Kenyan context; Khan et al. (2017) in regard to Pakistan; Hsiao et al. (2011) in the Dutch food processing industries, and although Çelik (2017) conducted research into the pharma industry, the study was set in Turkey. This suggests that the extant literature lacks studies specifically focusing on logistics outsourcing in the context of the UK PMI. Therefore, we chose to collect and analyse data from the UK PMI in order to understand the underlying reasons for outsourcing logistics functions within this sector, hence, contributing to the literature in this research area.

3. Methodology

3.1. Research method

Web-based questionnaires and interviews are commonly used tools for collecting primary data in social science research (Bryman, 2012). Both have advantages and disadvantages, but the web-based questionnaire offers more advantages in terms of studying a population sample scattered over a wider geographical area (Kumar, 2019). Moreover, it is quicker to send out and receive responses using web-based questionnaires (Lazar and Preece, 1999), there are few costs involved and the data generated is accurate (Bryman, 2012). However, the main disadvantages of web-based questionnaires are their low response rate and reliance on the internet (Bryman, 2012). After taking both advantages and disadvantages into account, we ultimately decided that the web-based questionnaire offered the most effective way of collecting the primary data.

3.2. Sampling, questionnaire design, pilot test, and data collection

3.2.1. Sampling

The study used two sampling techniques: simple random sampling (SRS); and non-random sampling procedures. The SRS technique was used to select the samples from the UK pharmaceutical manufacturing population using the List of Pharmaceutical Companies in the UK (Pharmapproach, 2020), which is easy to use as well as being accurate, and widely accepted for many different sample sizes (Saunders et al., 2007). The SRS technique also ensures that all population members have an equal and independent chance of being selected (Kumar, 2019; Rovai et al., 2014). Therefore, the sample can be deemed representative (Kumar, 2019; Sharma, 2017). The non-random sampling procedure was then applied within the UK pharmaceutical manufacturing sector, to enable experts in the pharmaceutical supply chain to be selectively sampled (Kumar, 2019). These experts were chosen on the basis of being able to provide the most relevant, accurate, and reliable information in answer to the research questions.

3.2.2. Pilot testing and data collection

Prior to the distribution, the questionnaire was pilot tested. It is important to pilot test the research instrument to ensure that participants fully understand each question. Three randomly selected supply chain professionals from the PMI carried out the pilot test, while two academic professionals involved in supply chain management also took part. The suggestions from the pilot testing were incorporated into the revised version of the survey, thus validating the survey content. The questionnaires were then administered by sending an email containing the link to the survey questions to executives, directors, managers, and key decision-makers involved in supply chain management and logistics outsourcing.

The quantitative data collection was conducted from 27th June to 23rd July 2021. A total of 297 questionnaires were sent to potential participants: 49 valid responses were returned which represented a response rate of 16.5 %. Compared to response rates reported by other studies of logistics outsourcing, for example, 10.65% (Zhu et al., 2017) and 9.3% (Rintala et al., 2021), the response rate of 16.5% that was obtained may be considered acceptable. The Cronbach's alpha of 0.77 (which is greater than 0.70) (Bernstein and Nunnally, 1994) suggested that the constructs were reliable. To control for common method bias, the respondents' anonymity was maintained (Podsakoff et al., 2003) through informed consent. Because of the dichotomous nature of the dependent variable (Yes=1/No=0), a binary logistic regression (BLR) was used (Field, 2009) to test the statistical significance of the reasons

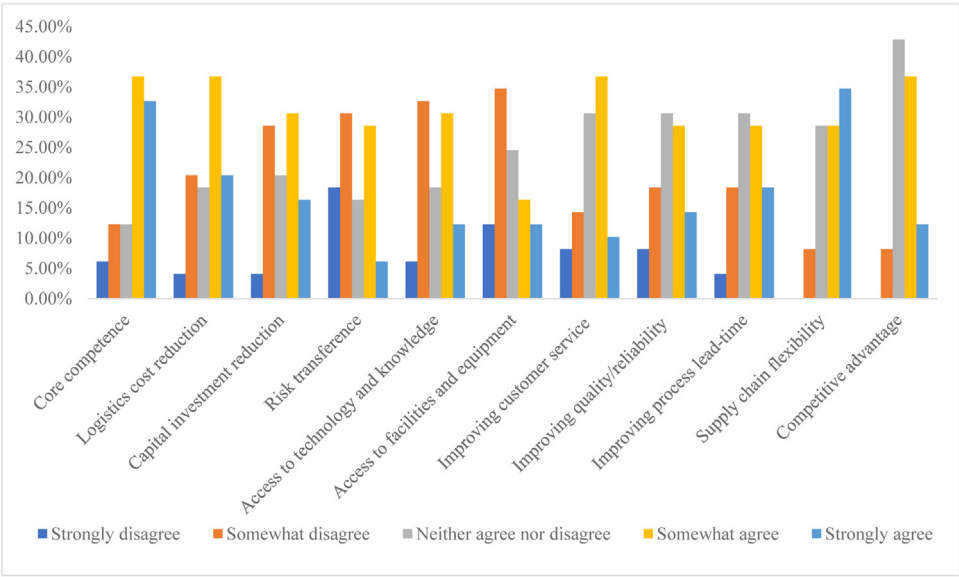

Fig. 1. Survey results showing reasons for outsourcing logistics in graphical form.

for logistics outsourcing (Table 2 and Fig 1). We used a 90% confidence interval which is common practice in the social sciences (Ganeshan et al., 2001; Lee et al., 2002; Liu et al., 2022; Sumah et al., 2020). A 90% confidence interval (i.e., p<=0.10) means that we would reject the null hypothesis for p-values of less than 0.10 (i.e., 10%) and, therefore, would find no evidence to refute the alternative hypothesis at a 90% confidence level. The Cronbach's Alpha value of 0.839, shown in Table 3, indicates that the scale meets the reliability criteria (>0.6), which was verified by the ANOVA test (df=11, F=22.129, and p-value = 0.000) (Hu and Bentler, 1999). In addition, the 0.619 value obtained for the Nagelkerke R Squared shows that the regression model is well developed. This pseudo-R Squared measure can be treated as somewhat analogous to R Squared in linear regressions (McCoach and Siegle, 2003), and therefore, it can be claimed that 61.9 % of the variance in the model is explained by the predictors. Moreover, the overall classification of 89.8% indicates that the model used is appropriate for this study.

4. Results

4.1. Respondents' socio-demographic profile

Forty-nine completed questionnaires were received and the responses are presented in Table 1. The data shows that the sample was composed of a higher proportion of males, numbering almost twice as many as females: 33 males accounted for 67% of those who completed the survey, compared to only 16 females (33%). In terms of respondents' ages, younger and older participants replied in fewer numbers: 7 (14%) responses were obtained from the 25-34 age group, 8 (16%) from the 55-64 age group, while only 2 (4%) participants were aged 65 or over. Regarding the participants' educational levels, the overwhelming majority of the sample had university degrees: 16 (33%) were postgraduates (e.g., MSc, PhD), 26 (53%) were graduates (e.g., BSc, BA), and 5 (10%) had diplomas. In terms of professional experience, 46 (94%) had at least 5 years' work experience in the UK pharmaceutical supply chain. Thus, the surveyed sample could be considered knowledgeable and experienced within their field. Regarding their job title (position), more than 85% of the sample were either managers, directors, or vice presidents (i.e., decision-makers), while specialists or team leaders accounted for 12% of those who submitted completed responses.

4.2. Reasons for outsourcing logistics services

Out of the 49 completed responses, 40 (81.63%) reported that logistics outsourcing (LO) adds value to their business. In contrast, only 9 (18.37%) claimed that it does not add value, implying that most of the surveyed UK pharmaceutical manufacturers recognise the importance of logistics outsourcing. The data also revealed that most of the surveyed sample (34, equating to 69.39%) believed ('somewhat' or 'strongly agree') that their logistics outsourcing decisions were driven by the need to focus on the core business functions. Other reasons that were given for logistics outsourcing decisions included: improving supply chain flexibility - 31 (63.27%), reducing logistics costs - 28(57.14%), reducing capital expenditure - 23 (46.94%), improving the process lead-time - 23 (47%), obtaining the best customer service - 23 (46.94%), improving quality and reliability - 21 (42.86%), and enhancing the firm's competitive advantage - 21 (42.86%). However, the following functions were not cited as reasons ('somewhat' or 'strongly disagree') for logistics outsourcing decisions: risk transference - 24 (48.98%), and access to technology, knowledge, and skills - 19 (38.78%). Table 2 and Fig. 1 summarise the survey results regarding the reasons for logistics outsourcing.

Table 1
Socio-demographic profile of the surveyed sample (n=49).

Variables	Sample	Percentage (%)
Gender		
Male	33	67
Female	16	33
Age group		
25-34	7	14
35-44	16	33
45-54	16	33
55-64	8	16
65 or over	2	4
Educational level		
Secondary school or below	2	4
Diploma	5	10
Graduate (e.g., BSc, BA)	26	53
Postgraduate and above (e.g., MSc, PhD)	16	33
Professional experience		
Less than 5	3	6
5 to 10	13	27
11 to 15	9	18
16 to 20	14	29
21 or more	10	20
Job title (Position)		
Specialist	1	2
Team Leader	5	10
Manager/Sr. Manager	22	45
Director	17	35
Vice President	4	8

Note: Age group and professional experience are shown in years.

Table 2
Survey results showing reasons for outsourcing logistics services (n=49).

Logistics Outsourcing Reason	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
Focus on core business	3 (6.12%)	6 (12.24%)	6 (12.24%)	18 (36.70%)	16 (32.70%)
Logistics cost reduction	2 (4.08%)	10 (20.41%)	9 (18.37%)	18 (36.73%)	10 (20.41%)
Capital investment reduction	2 (4.08%)	14 (28.57%)	10 (20.41%)	15 (30.61%)	8 (16.33%)
Risk transference	9 (18.37%)	15 (30.61%)	8 (16.33%)	14 (28.57%)	3 (6.12%)
Access to technology and knowledge	3 (6.12%)	16 (32.65%)	9 (18.37%)	15 (30.61%)	6 (12.24%)
Access to facilities and equipment	6 (12.24%)	17 (34.69%)	12 (24.49%)	8 (16.33%)	6 (12.24%)
Improving customer service	4 (8.16%)	7 (14.29%)	15 (30.61%)	18 (36.73%)	5 (10.20%)
Improving quality/reliability	4(8.16%)	9(18.37%)	15(30.61%)	14(28.57%)	7(14.29%)
Improving process lead-time	2(4.08%)	9(18.37%)	15(30.61%)	14(28.57%)	9(18.37%)
Supply chain flexibility	0(0%)	4(8.16%)	14(28.57%)	14(28.57%)	17(34.69%)
Competitive advantage	0(0%)	4(8.16%)	21(42.86%)	18(36.73%)	6(12.24%)

The binary regression was run in two steps. The first resulted in only four statistically significant (at a 0.10 significance level) predictors, namely logistics cost reduction (p=0.076), improving quality/reliability (p=0.064), improving supply chain flexibility (p=0.077), and enhancing a firm's competitive advantage (p=0.085). In the second stage, the predictor "customer service improvement" was eliminated by using exploratory factor analysis (EFA) which revealed insignificant correlations between the predictors "risk transference" (co-efficient= 0.038, p=0.399) and "competitive advantage"(co-efficient = 0.043, p=0.385). The results of the second regression are presented in Table 3

Table 3 shows that improving quality and reliability (Q&RI) was the most significant (p=0.038) reason for outsourcing logistics functions among the surveyed UK pharmaceutical manufacturers. Previous studies have supported this finding (Aktas et al., 2011; Ounnar et al., 2007; Zhu et al., 2017), which suggests that providing a reliable and high-quality logistics service is vital within supply chain management. The fact that the pharmaceutical supply chain (PSC) is a special type of supply chain via which the PP is produced, transported, and consumed (Xie and Breen, 2012), makes it particularly important to deliver high-quality and reliable products and services. Therefore, pharmaceutical manufacturers tend to outsource logistics functions in order to improve the quality and reliability of their products.

Reducing logistics costs (LCR) also proved to be a major reason for outsourcing logistics functions in the UK PMI. With a p value of 0.065, the data evidenced that LCR is the second most significant trigger for outsourcing logistics services in the UK pharmaceutical sector. Although it has been argued that outsourcing does not always significantly reduce costs (Aktas and Ulengin, 2005; Beaumont and Sohal, 2004), our research refutes this claim in the context of the UK PMI. The conclusion that reducing logistics costs is a significant factor in outsourcing decisions is further consolidated by Sahay and Mohan's (2006) study findings.

Table 3
Regression results showing reasons for outsourcing 3PL.

Reason for logistics outsourcing	Regression coefficient	Reason ranking	p-value
Improving quality/reliability	-2.84	1	0.038
Logistics cost reduction	-4.14	2	0.065
Improving supply chain flexibility	-2.28	3	0.082
Capital cost reduction	2.60	4	0.089
Increasing competitive advantage	1.93	5	0.089
Access to facilities and equipment	-1.90	6	0.092
Focus on core competencies	1.16	-	0.263
Risk transference	1.28	-	0.265
Access to technology, knowledge and skills	-0.85	-	0.392
Improving process lead-time	-0.22	-	0.773
Constant	19.09	-	0.036

Note: Cronbach's Alpha 0.839, Nagelkerke R Squared 0.619, Model correctness 89.80%

The data also revealed that improving supply chain flexibility was regarded as the third most significant (p=0.082) benefit to be gained from outsourcing logistics functions. Although it was not found to be a significant factor in a similar study conducted in Pakistan (Khan et al., 2017), numerous researchers (Fadile et al., 2018; Rajesh et al., 2013; Zhu et al., 2017) have recognised the importance of logistics outsourcing as a means of gaining greater flexibility in terms of operations. In addition, the data revealed that capital cost reduction (CCR) was the fourth most significant (p=0.089) benefit that UK pharmaceutical manufacturers attempt to gain through logistics outsourcing. This finding is supported by Aktas and Ulengin (2005), who pointed out that capital cost reduction constitutes an important factor in the overall efficiency of the supply chain. Recent studies have also highlighted that capital-expenditure management warrants greater attention from pharmaceutical firms (Hanafizadeh and Ravasan, 2011; McKinsey, 2019; Ravanfar, 2015). This implies that firms could reduce some of the capital costs associated with warehouses and vehicles (Rajesh et al., 2013).

Another key reason for outsourcing logistics was found to be enhancing the user firm's competitive advantage. The data suggest that this is as important as reducing the capital costs (p=0.089). Porter (1980) argued that pricing, uncertainty regarding product demand, the actions of governmental bodies and competitors, the threat of other companies developing a new PP, and the bargaining power of their suppliers and buyers all present significant challenges for pharmaceutical firms. Consequently, they are under pressure to try to operate successfully in a very dynamic and challenging environment, while remaining competitive. Thus, pharmaceutical firms may try to increase their competitiveness by outsourcing logistics services (Elmuti, 2003; Liao et al., 2010; Rajesh et al., 2013).

Out of the six statistically significant reasons, accessing partners' facilities and equipment was considered the least significant (p=0.092) in terms of influencing the outsourcing decisions in the UK PMI. It has been argued that working with a well-qualified and trained partner allows the user firm to acquire knowledge and gain access to new technologies without having to buy physical assets or employ additional staff (Zhang et al., 2013). In this way, UK pharmaceutical manufacturers can empower themselves by acquiring functions that are not available internally (Rajesh et al., 2013), or are not part of their core business (Zhu et al., 2017), such as warehousing and transportation (Liu et al., 2015). Similar studies in the literature have also indicated that leveraging competencies, facilities and equipment from 3PL providers allows firms to focus on their core competencies and decrease the proportion of their investments that are tied to assets (Rahman, 2011; Rajesh et al., 2013).

The data show that several factors are not considered significant in terms of outsourcing logistics functions in the UK PMI. Although a trend for focusing on core competencies has recently developed, according to Thakur (2010), the p value for this factor is only 0.263, while gaining access to new technologies (technology transfer) (p=0.392) was also shown to be insignificant.

This was a surprising finding, as it is widely argued that logistics outsourcing allows firms to focus on core competencies (Aktas et al., 2011; Rintala et al., 2021; Zhu et al., 2017; Yang and Zhao, 2016) by leveraging technology, knowledge and skills from service providers (Liao et al., 2010; Rahman, 2011; Ranjan and Khalil, 2008; Sahay and Mohan, 2006). This is in line with a finding obtained by a previous study which showed that core competencies and accessing emerging technologies do not usually constitute reasons for outsourcing logistics services (Khan et al., 2017).

Risk transfer is another factor that proved to be insignificant (p=0.265) as a basis for outsourcing decisions in the UK pharmaceutical industry. Although Kumar and Jha (2019) found that firms sometimes outsourced logistics functions in order to share risks, Marchet et al.'s (2018) study showed risk sharing to be of little importance in terms of logistics outsourcing. They surveyed 482 logistics managers and concluded that risk reduction had a negligible bearing on outsourcing decisions, evidenced by a p value of 0.34.

Finally, the data revealed that improving the process lead-time is the least significant reason (p=0.773) for outsourcing logistics decisions in the UK PMI. This finding is inconsistent with those of other previous studies. For instance, Bosire et al. (2013) suggested that there is a positive correlation between logistics outsourcing and the process lead time, implying that the user firm can achieve quicker and more punctual product delivery by using 3PL capabilities (Hsiao et al., 2010).

Table 4
The regression results for the logit model.

Independent Variables	Estimated Coefficients	Std. Error	z value	Pr(>|z|)
Intercept	19.06**	9.11	2.09	0.04
LCR	4.14*	2.24	1.85	0.06
CCR	2.60*	1.53	1.70	0.09
RT	1.28	1.15	1.11	0.27
AFE	1.90*	1.13	1.68	0.09
Q/RI	2.84**	1.37	2.07	0.04
SCF	2.28*	1.31	1.74	0.08
CA	1.93*	1.13	1.71	0.09

Notes:***, **, * represents p<0.01, p<0.05, p<0.1.

Table 5
Survey results showing criteria for evaluating and selecting 3PLs (n=49).

Evaluation and selection criteria	Very important	Somewhat important	Neutral	Less important	Not important
Service price	26(53.06%)	20(40.82%)	1(2.04%)	2(4.08%)	0(0.00%)
Technical capability	30(61.22%)	16(32.65%)	2(4.08%)	1(2.04%)	0(0.00%)
Financial stability	10(20.41%)	10(20.41%)	9(18.37%)	14(28.57%)	6(12.24%)
Service quality	40(81.63%)	9(18.37%)	0(0.00%)	0(0.00%)	0(0.00%)
On-time delivery	22(44.90%)	24(48.98%)	1(2.04%)	2(4.08%)	0(0.00%)
On-budget delivery	14(28.57%)	25(51.02%)	3(6.12%)	7(14.29%)	0(0.00%)
Responsiveness	12(24.49%)	6(12.24%)	18(36.73%)	7(14.29%)	6(12.24%)
Reputation	7(14.29%)	9(18.37%)	11(22.45%)	8(16.33%)	14(28.57%)
Flexibility	12(24.49%)	12(24.49%)	12(24.49%)	9(18.37%)	4(8.16%)

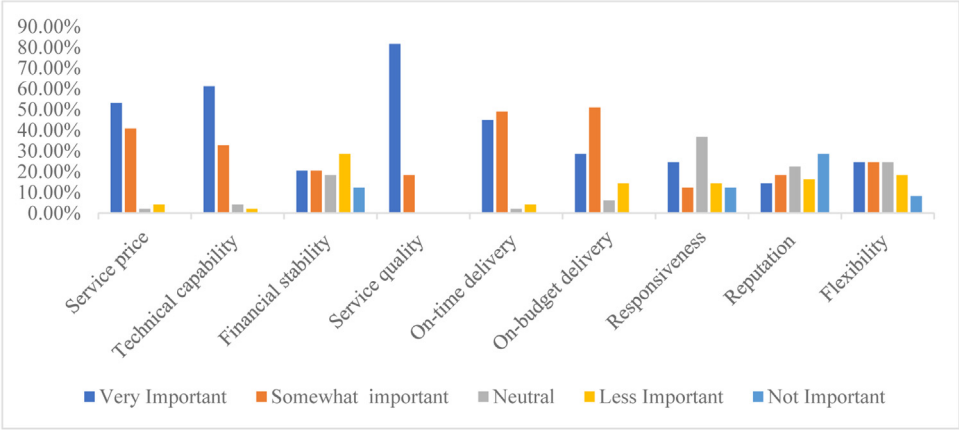

Fig. 2. Survey results showing criteria for evaluating and selecting 3PLs in graphical form.

In summary, six reasons were found to be statistically significant (at a 0.10 significance level) for outsourcing logistics services in the UK PMI. To model the relationship between the variables, the equation suggested by Domínguez-Almendros et al. (2011), namely: Logit(p) = log(p/(1-p)) = β_0 + β_1*x_1+ β_2*x_2+ β_3*x_3+…+β_n*x_n, was used, where "p" denotes the probability of outsourcing the logistics functions as a value-adding activity, "β_0" is the constant (or intercept) of the equation, β_i, i=1,2,…,n, denotes the coefficient (or slope) of the predictor variables, and x_i, i=1,2,…,n, represents the independent variables (predictors). Consequently, the regression equation used to assess the six significant reasons for logistics outsourcing is: Logit(p) = log(p/(1-p)) = 19.06 - 4.14* Logistics cost reduction (LCR)+2.60* Capital cost reduction (CCR)+1.28* Risk transference (RT) -1.90* Access to facilities and equipment (AFE) -2.84* Improving quality/reliability (Q/RI) - 2.28* Improving supply chain flexibility (SCF)+1.93* Increasing competitive advantage (CA). The regression results for the logit model are shown in Table 4.

4.3. 3PL selection and evaluation

Out of the 49 completed responses, 45 (91.84%) thought that logistics service providers should comply with pre-set evaluation and selection criteria. Using a five-point Likert scale ranging from "very important=1" through to "not important=5", the participants were asked to indicate the level of importance they would ascribe to certain evaluation criteria. Their responses were collected in tabulated form and represented graphically in Table 5 and Fig. 2, respectively. The data show that all 49 (100%) of the surveyed

Table 6
Results of the exploratory factor analysis.

	Initial Eigenvalues		Extraction Sums of Squared loadings	
Factor	Total	Percentage of Variance	Total	Percentage of variance
1	4.145	46.06	4.15	46.06
2	1.865	20.72	1.87	20.72
3	0.874	9.71	-	-
4	0.606	6.73	-	-
5	0.469	5.21	-	-
6	0.397	4.41	-	-
7	0.320	3.56	-	-
8	0.183	2.04	-	-
9	0.141	1.57	-	-
Cronbach's Alpha 0.841, KMO 0.745, χ^2= 223.8, p=0.000				

Criteria	Factor loading	
	Factor 1 Techno-commercial performance	Factor 2 Delivery performance
Service price	0.97	-
Technical capability	0.86	-
Financial stability	0.82	-
Service quality	0.73	-
On-time delivery	-	0.92
On-budget delivery	-	0.87
Responsiveness	-	0.61
Reputation	0.37	0.58
Flexibility	0.45	0.53

UK pharmaceutical manufacturers cited service quality as a prime criterion for evaluating and selecting 3PL providers. Other criteria were also revealed as significant, namely, the service provider's technical capability - 46 (93.9%), on-time delivery - 46 (93.88%), service price - 46 (93.88%), and on-budget delivery - 39 (79.59%).

Moreover, 22 (44.90%) respondents believed the provider's reputation to be a less important or unimportant criterion, while 16 (32.65%) felt it was very or somewhat important in the evaluation and selection process. The data also show that the providers' financial stability was regarded as a less important or unimportant criterion by an equal number of respondents – 20 (40.82%) – to those who viewed it as very or somewhat important.

To explore the key criteria determining the evaluation and selection of 3PLs, exploratory factor analysis (EFA) was employed. EFA is a widely used data analysis technique that is often applied when dealing with ordinal data (Basto and Pereira, 2012), using principal component analysis with oblique rotations. Table 6 summarises the results of the EFA. The Cronbach's Alpha of 0.841 indicates that the construct is reliable (Field, 2009), which was confirmed by the ANOVA test (χ^2=228.5, F=43.32, p=0.000). The KMO value of 0.745 and χ^2= 223.8, and p=0.000 indicate that the use of EFA is appropriate (Field, 2009).

Table 6 and Fig. 3 show the factor loadings for the selection criteria of logistics service providers in the surveyed sample. The data show that 66.8% of the total variance can be explained by two major factors, namely, techno-commercial (technical and commercial) performance (factor 1) and delivery performance (factor 2). Techno-commercial performance explains roughly twice as much variance as delivery performance: 46.06% and 20.72%, respectively. However, taking into consideration sub-factors that were loaded onto the main factor of techno-commercial performance, the data showed that the foremost selection criteria is the service price with a loading factor of 0.97, followed by technical capability (0.86), financial stability (0.82), and service quality (0.73), indicating that these sub-factors have a positive impact on the service provider's techno-commercial performance. This finding is in line with previous studies which have demonstrated that numerous factors could influence the assessment and selection of 3PLs, including the service price (Chen and Hung, 2010; Rothaermel et al., 2006; Wu and Blackhurst, 2009), the provider's technical capability (Yeung et al., 2012; Zhu et al., 2017), the provider's financial stability (Bagchi and Virum, 1996; Marchet et al., 2018), and the quality of the service provided (Bagchi and Virum, 1996; Çelik, 2017; Chen and Hung, 2010; Marchet et al., 2018; Rothaermel et al., 2006). Meanwhile, the following sub-factors were loaded onto delivery performance: on-time delivery (0.92), on-budget delivery (0.87), responsiveness (0.61), reputation (0.58), and the flexibility of the service provider (0.53), indicating that there is a positive relationship between these sub-factors and the service provider's delivery performance. This result is consistent with other research, which has shown on-budget delivery (Hsiao et al., 2011; Quinn, 1999), responsiveness (Chen and Hung, 2010; Rothaermel et al., 2006), reputation (Çelik, 2017; Marchet et al., 2018) and flexibility in terms of operations and delivery (Chen and Hung, 2010; Marchet et al., 2018; Rothaermel et al., 2006) to be salient.

In summary, technical know-how alongside the service price and service delivery are major determinants for selecting and evaluating the appropriate service providers, according to the surveyed UK pharmaceutical manufacturers.

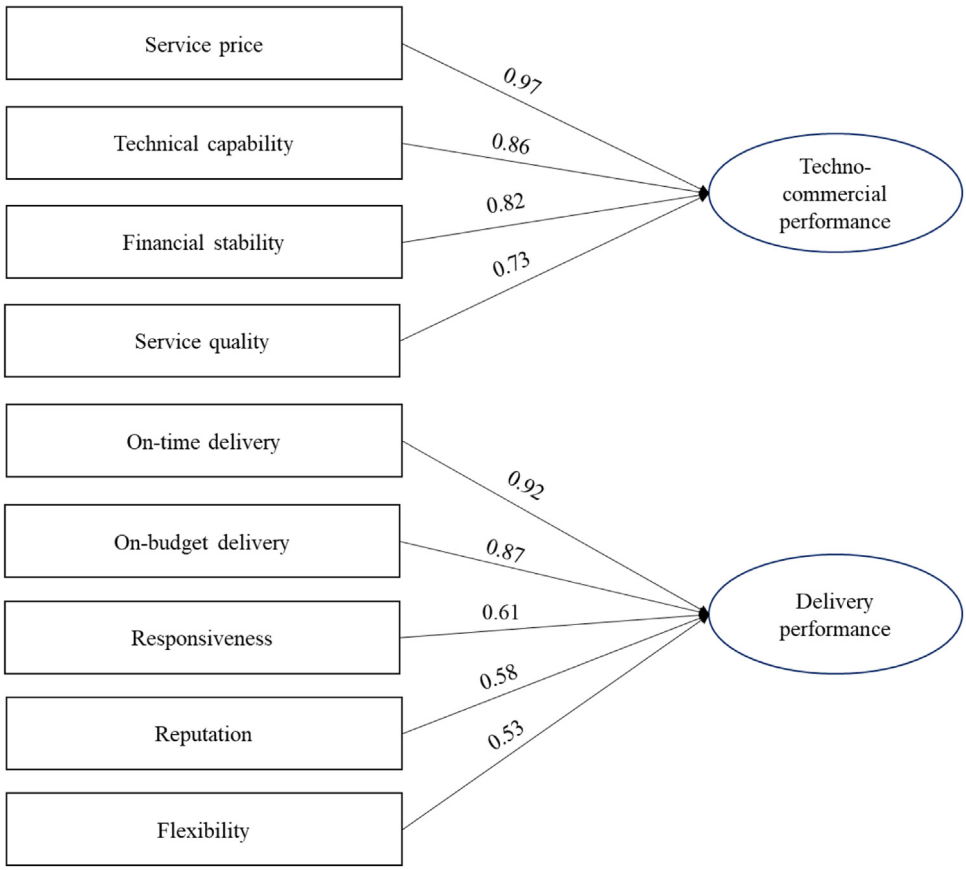

Fig. 3. Factor loadings for techno-commercial and delivery performance in diagrammatic form.

Table 7
Survey results showing frequently outsourced logistics activities (n=49).

Activity	Yes	No
Materials transportation	41(83.67%)	8(16.33%)
Finished goods delivery	38(77.55%)	11(22.45%)
Materials warehousing	28(57.14%)	21(42.86%)
Finished goods warehousing	24(48.98%)	25(51.02%)
Inventory management	19(38.78%)	30(61.22%)
Order processing	20(40.82%)	29(59.18%)
Logistics information	29(59.18%)	20(40.82%)
R&D	31(63.27%)	18(36.73%)
Manufacturing	19(38.78%)	30(61.22%)
Clinical trials	31(63.27%)	18(36.73%)
IT services	28(57.14%)	21(42.86%)

4.4. Outsourced activities

The scope of outsourced logistics activities is broad and can cover every stage of the supply chain, namely: sourcing, manufacture, delivery and return. However, in order to gain insight into the logistics functions in the UK pharmaceutical manufacturing sector that are frequently outsourced, the participants were asked whether they outsource certain activities. The results are presented in Table 7 and depicted in graphical form in Fig. 4. The data show that the overwhelming majority of the surveyed UK pharmaceutical manufacturers outsource materials transportation - 41 (83.67%). Activities such as finished goods delivery - 38 (77.55%), research and development - 31(63.27%), clinical trials - 31(63.27%), logistics information systems - 29 (59.18%), IT services - 28 (57.14%), and materials warehousing - 28 (57.14%) were also found to be frequently outsourced. However, the following activities were less frequently outsourced: finished goods warehousing - 24 (48.98%), order processing - 20 (40.82%), manufacturing and inventory management - 19 (38.78%).

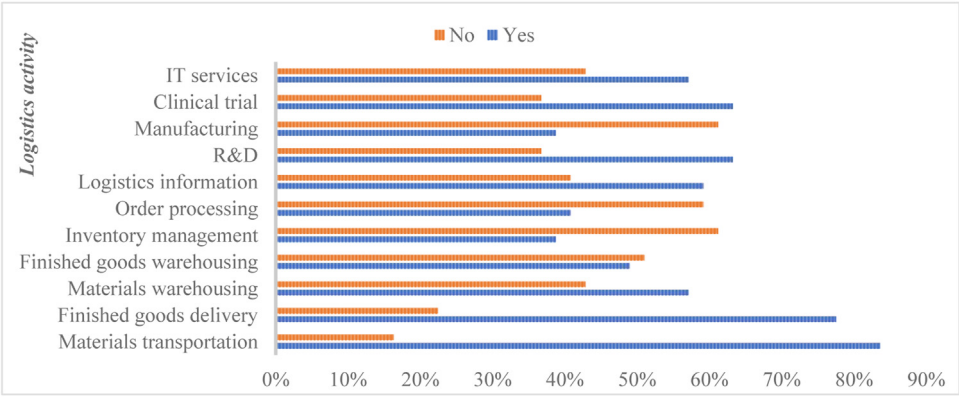

Fig. 4. Survey results showing frequently outsourced logistics activities in graphical form.

Table 8
T-test results for frequently outsourced activities.

Activity	t	df	Sig.(2-tailed)	Mean Difference	90% Confidence Interval of the Difference	
					Lower	Upper
Materials transportation	15.68	48	0	0.84	0.73	0.94
Finished goods delivery	12.88	48	0	0.78	0.65	0.9
R&D	9.51	48	0	0.65	0.51	0.79
Clinical trials	9.09	48	0	0.63	0.49	0.77
Logistics information systems	8.34	48	0	0.59	0.45	0.73
Materials warehousing	8.00	48	0	0.57	0.43	0.72
IT services	8.00	48	0	0.57	0.43	0.72
Finished goods warehousing	6.79	48	0	0.49	0.34	0.63
Inventory management	5.75	48	0	0.41	0.27	0.55
Order processing	5.75	48	0	0.41	0.27	0.55
Manufacturing	5.51	48	0	0.39	0.25	0.53

To test the statistical significance of the difference between the means of the participants who responded “Yes” and those who responded “No”, a t-test was performed. The results are presented in Table 8. The data reveal that the mean differences were statistically significant (p=0.000) for the twelve activities. However, materials transportation was found to be the most frequently outsourced activity among the surveyed UK pharmaceutical manufacturers, with a mean difference of 0.84. That was followed by finished goods delivery (0.78), then R&D (0.65), clinical trials (0.63), logistics information systems (0.59), materials warehousing (0.57), IT services (0.57), finished goods warehousing (0.49), inventory management (0.41), order processing (0.41) and manufacturing (0.39).

Consistent with Sahay and Mohan’s (2006) study, the research findings suggest that user firms prefer to outsource order processing, transportation, and distribution functions rather than carrying them out in-house. In this regard, Thakur (2010) claimed that outsourcing logistics services can ensure the efficient flow and storage of raw materials and goods.

Another functional activity that is frequently outsourced by the UK pharmaceutical manufacturers was found to be information technology (IT) and logistics information systems (LIS), which are increasingly vital in facilitating business transactions and aiding firms’ decision-making processes (Min et al., 2016). This conclusion aligns with previous studies conducted by Fadile et al. (2018) and Sahay and Mohan (2006). Moreover, information technology is recognised as playing a vital role in helping firms to process and analyse vast amounts of data and convert them into profits (Rajesh et al., 2013).

In addition, the data also demonstrated that the outsourcing of clinical trials is popular among the UK pharmaceutical manufacturers, evidenced by the fact that it was the fourth most significant outsourced activity. Thakur (2010) found that clinical trials are frequently outsourced to ensure that good clinical practices (GCP) are followed. Clinical trials are usually costly and time-consuming (Cockburn, 2006); therefore, outsourcing them to research contract organisations (RCOs) could improve a firm’s cost performance (Sahay and Mohan, 2006; Rahman, 2011) and speed up the entry of new PP into the markets (Vogel and Getz, 1997). Zhang et al. (2013) demonstrated that pharmaceutical manufacturers frequently outsource manufacturing to accelerate PP market entry and reduce the associated costs. Moreover, inventory management was also found to be frequently outsourced by the UK pharmaceutical manufacturers, which is in line with the study by Nicholson et al. (2004), in which they argued that outsourcing inventory management in the healthcare industry can generate cost savings. In other words, outsourcing inventory management can minimise the costs associated with carrying inventories.

In summary, the mean differences of all eleven activities were found to be statistically significant at a 90% confidence level, meaning the hypotheses are rejected at a 0.10 significance level. Thus, it could be inferred that all eleven activities are frequently outsourced in the UK PMI, with transportation being the most frequently outsourced function, and manufacturing the least outsourced.

5. Conclusions

Although a considerable amount is known about the drivers of logistics outsourcing in a general sense (Aktas et al., 2011; Chambers et al., 2009; Hsiao et al., 2010; Khan et al., 2017; Liao et al., 2010; Liu et al., 2015; McKinnon, 2003; Mubarik et al., 2012; Razzaque and Sheng, 1998; Zhu et al., 2017), the literature review revealed a research gap in regard to what influences decisions about logistics outsourcing in the UK pharmaceutical manufacturing sector. Therefore, our study explored the following three aspects of outsourcing: 1) the main reasons that drive UK pharmaceutical manufacturers to outsource logistics functions; 2) the criteria used by the UK pharmaceutical manufacturers in the evaluation and selection of LSPs; and 3) which logistics activities the UK pharmaceutical manufacturers frequently outsource. Using web-based questionnaires, data were collected from forty-nine pharmaceutical manufacturers located in the UK. Logistics regression analysis (LRA), exploratory factor analysis (EFA), and t-tests were used to analyse the data.

First, six reasons were found to be statistically significant with regard to outsourcing logistics activities. Improving quality and reliability was shown to constitute the most significant reason for outsourcing logistics services in the UK PMI, followed by reducing logistics costs, improving supply chain flexibility, reducing capital costs, increasing firms' competitive advantage, and accessing equipment and facilities. These findings align with those of previous studies (Aktas et al., 2011; Elmuti, 2003; Liao et al., 2010; Liu et al., 2015; Rahman, 2011; Yeung et al., 2012; Zhu et al., 2017). Our study also revealed that several factors were not statistically significant, namely, focusing on core competencies, risk sharing, accessing up-to-date technology, knowledge and skills, and improving the process lead-time.

Second, two significant factors were shown to influence the selection of vendors, namely, improving firms' techno-commercial performance and enhancing delivery performance. On the one hand, techno-commercial performance is impacted by the service price, the quality of the service, and the vendor's technical know-how and financial stability. On the other hand, the delivery performance was found to be affected by budgetary and time constraints, and the service provider's responsiveness and reputation. These findings are supported by previous studies (Bagchi and Virum,1996; Çelik, 2017; Chen and Hung, 2010; Hsiao et al., 2010; Mubarik et al., 2012; Rothaermel et al., 2006; Wu and Blackhurst, 2009; Yeung et al., 2012; Zhu et al., 2017).

Third, some basic functions, such as materials transportation and product delivery, were revealed to be the most frequently outsourced activities in the UK PMI. These basic activities are likely to be non-core functions of the business (Rajesh et al., 2013). Other highly-specialised, inherently risky functions, such as R&D and clinical trials (Vogel and Getz, 1997), were also shown to be frequently outsourced by the UK pharmaceutical manufacturers. Moreover, the pharmaceutical manufacturers frequently outsource the following functions: logistics information, materials and finished goods warehousing, IT services, inventory management, order processing, and manufacturing. These findings are also in line with those of previous studies (Adobor, 2012; Arif and Jawab, 2011; Chambers et al., 2009; Khan et al., 2017; Mubarik et al., 2012; Sahay and Mohan, 2006; Solakivi et al., 2011; Thakur, 2010).

In terms of the research significance, the study contributes to three different areas of the literature: reasons for outsourcing logistics activities; evaluation and selection criteria for 3PL providers; and frequently outsourced logistics activities. Although several previous studies have investigated these areas, none has focused on the UK PMI. Thus, this research makes a significant contribution to the literature on logistics outsourcing in the UK PMI.

The research findings may also benefit logistics outsourcing practitioners in the UK PMI, by offering user companies advice and aiding their understanding of the methods used to choose 3PLs. Additionally, the study may help LSPs to understand more about why user organisations choose to purchase services from external providers rather than undertaking them internally and which services they are most likely to purchase.

In terms of policy implications, with regards to goods transportation, the paper concludes that materials and product transportation are the most frequently outsourced activities in the UK PMI. Outsourcing transportation activities can help to transfer risks relating to GHG emissions from the outsourcer to the service providers; however, the outsourcer is still held accountable for emissions resulting from the transportation of goods when reporting Scope 3 GHG emissions. UK pharmaceutical manufacturers are therefore required to include these sustainability considerations in the 3PL selection process.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

This research is partly funded by the EPSRC (EPSRC Reference: EP/R035148/1), the NSFC (Project No. 51808392), the NSSFC (Project No. 21CSH015), and School Funding from the University of Westminster.

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