

Strategic logistics outsourcing effectiveness through the implementation of 4PL – an analysis of selected industrial applications

Eficácia da terceirização logística estratégica através da implementação do 4PL - uma análise das aplicações industriais selecionadas

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ABSTRACT

Purpose: The purpose of this paper is to investigate the effectiveness of strategic logistics outsourcing through the implementation of 4PL to support the development of competitive advantage for manufacturing firms. **Design/methodology/approach:** Applying the strategic logistics outsourcing theory along with the resource-based view of competitive advantage, the authors point out the vital role of strategic logistics outsourcing in the manufacturing firm competitiveness. The data was collected using questionnaires with 30 manufacturing firms and analysed on effectiveness statistics and t-test to determine the effect of strategic logistics outsourcing on developing the competitive advantage for manufacturing firms. **Findings:** The findings indicate that cost reduction, efficient utilization of resources in the supply chain, and ICT application in 4PL services are key drivers to the competitive advantage of manufacturing firms. **Research/practical implications:** The research proposes to use a 4th party logistics as a strategic logistics outsourcing provider for achieving the competitive advantage for manufacturing firms. **Originality/value:** This is one of the first studies that provide an empirical analysis on the effect of strategic logistics outsourcing in developing the competitive advantage for manufacturing firms.

Keywords: strategic logistics outsourcing, fourth party logistics, competitive advantage, manufacturing firms, supply chain.

RESUMO

Objetivo: O objetivo deste documento é investigar a eficácia da terceirização logística estratégica através da implementação de 4PL para apoiar o desenvolvimento da vantagem competitiva para as empresas de manufatura. **Design/metodologia/abordagem:** Aplicando a teoria da terceirização logística estratégica juntamente com a visão baseada em recursos da vantagem competitiva, os autores apontam o papel vital da terceirização logística estratégica na competitividade das empresas de manufatura. Os dados foram coletados usando questionários com 30 empresas de manufatura e analisados em estatísticas de eficácia e testes t para determinar o efeito da terceirização logística estratégica no desenvolvimento da vantagem competitiva para as empresas de manufatura. **Conclusões:** Os resultados indicam que a redução de custos, a utilização eficiente dos recursos na cadeia de fornecimento e a aplicação das TIC em serviços 4PL são os principais fatores que impulsionam a vantagem competitiva das empresas de manufatura. **Implicações práticas/de pesquisa:** A pesquisa propõe o uso de uma logística de 4ª parte como um fornecedor de terceirização logística estratégica para alcançar a vantagem competitiva para as empresas de manufatura. **Originalidade/valor:** Este é um dos primeiros estudos que fornecem uma análise empírica sobre o efeito da terceirização logística estratégica no desenvolvimento da vantagem competitiva para as empresas manufatureiras.

Palavras-chave: terceirização logística estratégica, logística de quarta parte, vantagem competitiva, empresas de manufatura, cadeia de suprimentos.

1 INTRODUCTION

Outsourcing has been considered as a successful solution for enterprises on cost savings and efficiencies while they focus on their core competences. However, new challenges and high expectations associated with outsourcing are increasing. Manufacturing firms require new approaches to gain more capabilities, flexibilities and innovation beyond cost reduction.

Logistics outsourcing has remarkably grown all over the world. The increasing application of logistics services of manufacturing firms is fostering the development of logistics service providers (LSP). The main motives for logistics outsourcing are mainly focused on cost reduction, flexibility and customer service (T. Solakivi, J. Töyli, and L. Ojala, 2013). LSPs demonstrate their important role

in quality issues in manufacturing firms (K. Gotzamani, P. Longinidis, and F. Vouzas, 2010). Enterprises coordinate with LSPs in the variety of reasons. The increasing decision to logistics outsourcing indicates that enterprises may gain value which is helpful for them in dealing with challenges in the business environment.

The strategic logistics outsourcing (4PL – fourth party logistics) involves a high integration between logistics service providers and its customers in the form of managing the whole logistics operations, therefore, it brings significant advantages to manufacturing firms. The 4PL's objective is to minimize individual inefficiencies and, at the same time, maximize the efficiency of the entire actor network by employing information technology (IT) networking and platforms (Mammitzsch and Francyk, 2012). Another study analyzed how different logistics resources such as physical resources, human resources, information resources, knowledge resources and relational resources can be bundled together to assist in achieving sustainable competitive advantage (Wong and Karia, 2010; Somsuk et al., 2012; Phusavat et al., 2013). However, there is limited empirical research that investigates which benefits of strategic logistics outsourcing positively boosting manufacturing firms in developing the competitive advantage.

The intention of this paper is to provide the investigation of the key advantages gained from strategic logistics outsourcing through the implementation of 4PL in creating the competitive advantage for manufacturing firms. The results of the research will support top management to be able to make better decisions on strategic development of logistics outsourcing within their own enterprises. Despite the persuasiveness of the competitive advantage literature, there is little empirical understanding as to how a firm sustains its competitive advantage (Pablo et al. 2007).

The paper is structured as follows: first, the theoretical support and a review of the literature on strategic logistics outsourcing and competitive advantage of manufacturing firms are presented. Second, hypotheses are presented based on the literature review. Third, this section is about

methodology. Fourth, the results are discussed with the respect of the theory and practice.

2 THEORETICAL PERSPECTIVE

2.1 LOGISTICS OUTSOURCING

Logistics concept. Logistics involves the flow of goods, services and information related to the movements of goods and services from the suppliers to satisfied customers without waste (R. C. Lieb, 1992). According to the Council Logistics Management, logistics is the process of planning, implementing, and controlling the efficient, cost effective flow and storage of raw materials, inprocess inventory, finished goods, and related information from origin to consumption for the purpose of conforming to customer wants (D. M. Lambert, J. R. Stock, and M. R. Ellram, 1998). Logistics activities are vary from purchasing, transportation, customs, insurance, warehousing, handling, order processing, information, packaging, labeling, inventory management, distribution, shipment planning to product returns (M. Tanyas and S. Serdar, 2003). Under the trends towards globalization, logistics integration along with the development of Information and Communication Technology (ICT) have created new trading models and become the core of global competitive power (UNCTAD, 2003; Ballou, R. H, 1998). The improvement of logistics has been the important resource to gain and sustain competitive advantage.

Logistics outsourcing. Outsourcing is the common answer to the question “Make-or-buy“ asked by manufacturing industry (Rothery and Robertson, 1996). According to Sink, and Langley (1997), outsourcing is the business strategy which transfers non-core functions to external suppliers so that enterprises concentrate on critical issues for the future growth. Logistics outsourcing means that a part of logistics or all activities of logistics are implemented by logistics service providers. It involves the transferring of an existing process or function to a logistics service provider to provide the service onshore or offshore (Frankfurt, 2005). Gattorna (1998) stated variations on logistics outsourcing as follows:

- Absolute independence (100% insourced): all logistics functions conducted in-house.
- Contracting of specialized functions: some logistics functions outsourced to traditional contractors.
- 3PL: management of parts of the supply chain outsourced to a 3PL provider.
- 4PL (100% outsourced): comprehensive supply chain solutions for clients through integrating 3PL providers, IT and business process management.

Enterprises have been motivated to logistics outsourcing for reaching certain objectives including cost saving (Jiang et al., 2006; Lau and Zhang, 2006; Aimi, 2007), product quality improvement (Bardhan et al., 2006), flexibility improvement (Lau and Zhang, 2006), and market share increase (Skjoett-Larsen, 2000). Logistics outsourcing is the effect of global competition on markets, high focus on core competencies, information and communication technology, and rising customer expectations (Marasco, 2008; Sheffi, 1990). The trend of logistics outsourcing is increasing in the upcoming time. Langley & Capgemini (2008) stated the rate of logistics outsourcing in regions in the world with 49% in North America, 61% in Europe, 57% in Asia Pacific, and 48% in Latin America. Another study resulted that the growth forecast for logistics outsourcing between 2009 and 2022 is 17% (Deepen, Goldsby, Knemeyer, & Wallenburg, 2008).

2.2 STRATEGIC LOGISTICS OUTSOURCING

The outsourcing of logistics activities can be defined into three levels including the transactional logistics outsourcing (2PL), the tactical logistics outsourcing (3PL) and the strategic logistics outsourcing (4PL) (Gavrielatos K.A., 2007).

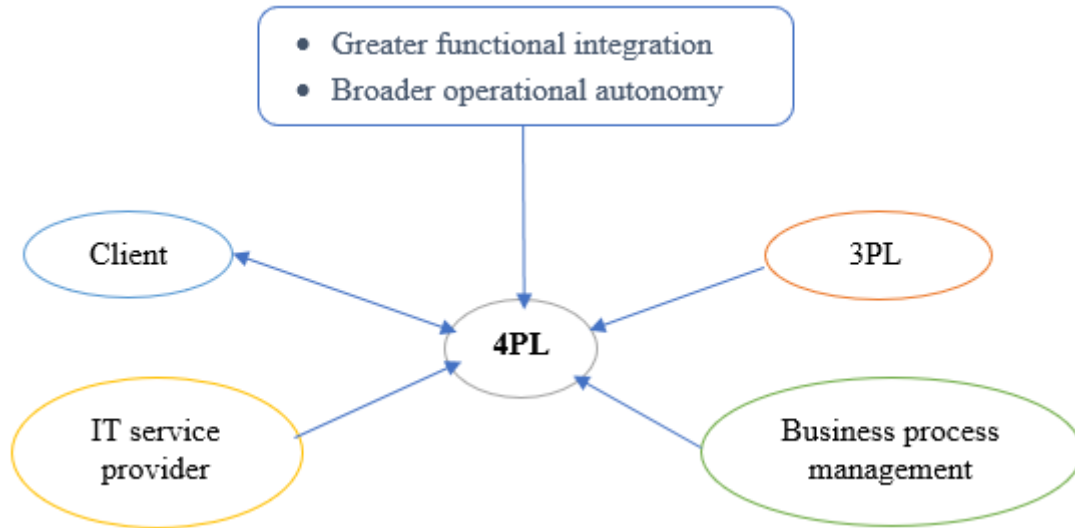
The transactional logistics outsourcing (2PL) is implemented without long-term contracts and bond between outsourcing enterprises and logistics service providers (Gavrielatos K.A., 2007). 2PL providers supply only single operation in logistics chain such as transportation, warehousing, customs formalities,

payment in order to meet shippers' demands (Frankfurt, 2005). This type hasn't combined single logistics operations into connected chain. Enterprises in this type include shipping companies, warehousing service companies, customs formalities service companies, payment service companies.

The tactical logistics outsourcing (3PL) is executed based on long-term contracts under the integration of IT system to facilitate free information flow and build transparent supply chain system (Gavrielatos K.A., 2007). Services which are outsourced to 3PLs have shifted from being a single type of service to a broader range of services, including advanced supply chain solutions (Soinio, Tanskanen and Finne, 2012). The operations of 3PL providers involve the collection of outbound shipments from manufacturers and the consolidation of shipments in their distribution centers. The consolidated shipments are then moved to the customer through alternative transportation routes (Tyan, J.C.; Wang, F.; Du, T.C., 2003).

The strategic logistics outsourcing (4PL) is the most advanced model. It leads to the breakthrough solutions to modern supply chain challenges with the purpose of providing maximum benefits to the customers (Gattorna J., 1998). Unlike 3PL, 4PL's service provision combines process, technology and management (Mukhopadhyay, 2006). In recent years, 4PL service providers contribute to the sustainable competitiveness of all the collaborating manufacturing companies (Hoffman, 2000). 4PL development highlights the ways companies initiate innovative practices in the coordination of IT management and others resources to make profound changes for the better competition. Many scholars suggested that logistics operations should be managed by 4PLs networks with strong cooperation between 3PL firms and companies which are developing the latest logistics information technology (Folinas et al., 2004; Bourlakis and Bourlakis, 2005; Krakovics et al., 2008). Fig. 1 demonstrates the cooperation between related parties in 4PL provider (Gattorna, 1998).

Fig. 1: Cooperation between related parties in 4PL



Source: Gattorna (1998)

The 4PL appropriately selects the new technological tools and combine them with conventional means for the logistics decisions based on electronic management of transactions and management systems of related parties in the supply chain (Venkatraman, N., 1989). 4PLs provide customized services, therefore, they increase independence between partners thanks to the sharing on activities of planning and coordination of information flows in the integrated processes along the supply chain.

2.3 KEY BENEFITS FROM THE APPLICATION OF STRATEGIC LOGISTICS OUTSOURCING

4PL and cost reduction. According to Supply Chain Executive Board (2005), the 4PL provides logistics services for the supply chain with ample opportunity for cost reductions. In the role of the LSP, the 4PL coordinates storage, shipment and deliveries. With distribution services, the 4PL can use the LSP's assets or its own to deliver products to the client or implement other services such as packing and assembly . In consultancy services for the supply chain, the 4PL can analyze the information flow process to redesign a more efficient chain. In general, the 4PL is responsible for ensuring the most efficient and low cost storage, shipments and delivery. Other scholars stated that 4PL is

used to reduce high transaction costs in relationships between seller and buyer. It highlights the role of IT to reduce and absorb complexity (Bourlakis and Bourlakis, 2005). The result of another study (Huiskonen and Pirtilla, 2002; Xin and Peng, 2002) also identified how logistics networks use 4PL to lower logistics costs and enhance efficiency and coordination. J. Mehmman, F. Teuteberg (2016) stated their research results that, from an economic perspective, the 4PL generates cost savings in the production and the logistics processes. Additionally, an improvement in the order cost is possible to the extent that the technology level of the sector is improved.

4PL and supply chain efficiency. In concerning the role of 4PL in the supply chain, Visser et al. (2004), Hoek (2006) stated that the 4PL develops intense knowledge and logistics competence, and provide studies for its client to improve the supply chain. Therefore, 4PL suggests, designs and implements new solutions in the supply chain. Other studies highlighted the strategic nature of 4PL and suggested that 4PL ensures the coordination, integration and competitiveness in the supply chain (Remko and Ian, 2001; Xiu et al., 2003; He et al., 2004; Christopher, 2005; Feng and Juan, 2005). Jianming (2010) concluded that the successful operation of 4PL integrates resources of a supply chain reasonably, efficiently and flexibly. Papadopoulou et al. (2013) suggested that 4PL “is constantly evolving within the complex environment of supply chain and logistics, thus denoting its innovative nature” (p. 176). In order to achieve the objective of 4PL in efficient utilities of resources in the supply chain, the application of information and communication tools (ICT) is the vital importance (Vieira et al., 2013; Piplani et al., 2004). ICT which includes mobile phone, email, radio frequency identification (RFID) and platforms of software like transportation and warehousing is applied to improve transparent communication and information exchange as well as information flow (Bourlakis and Bourlakis, 2005). Gendreau and Potvin (2004) addressed integration among ICT applications as a crucial element for greater efficiency and effectiveness in transportation processes. Indeed, a highly integrated system could manage processes faster and more efficiently, thanks to higher real-time visibility, increased real-time

information provided, and the ability to react to changes during shipment (Mason et al., 2003). Jens Mehmman, Frank Teuteberg (2016) concluded that the potential for optimization that can be generated through the involvement of 4PL is increasing with the number of orders either from within the supply chain or from outside. Brewer, Wallin & Ashenbaum (2014) suggested that firms can decide to outsource specific activities as a strategic move for establishing a competitive advantage to their rivals in the market place. These results of studies acknowledge the importance of 4PL in the achievement of main objectives in enterprises and enhance their competitive advantage.

2.4 COMPETITIVE ADVANTAGE IN MANUFACTURING FIRMS

Business market has become fiercely competitive and changed constantly. In order to be responsive to the market conditions, manufacturing firms build effective strategies based on their resources to achieve competitive advantage. The competitive advantage of a firm has traditionally been discussed by mentioning to the firm's strategies, process capabilities, and resources (Porter, 1985; Prahalad and Hamel, 1990; Barney, 1991; Persson and Virum, 2001). According to the resource-based view, the firm's superior performance is the result of efficient utilization of resources and capabilities. The resources which enable the firm to develop and sustain competitive advantage must be unique and distinct (Wernerfelt, 1984; Day, 1994; Hinterhuber, 2013). While capabilities must be valuable, rare, inimitable and non-substitutable (Rumelt, 1984; Barney, 1991).

Based on the resource-based view, activities of strategic logistics outsourcing have been studied by many scholars including warehouse management capability (Autry et al., 2005), logistics service quality performance (Richey et al., 2007), and reverse logistics performance (Daugherty et al., 2001). Therefore, the resource-based view of competitive advantage can be applied to explain the development of logistics practices and their impact on firm's competitiveness. The development of logistics practices and capabilities would be able to create competitive advantage for firms (Bowersox et al., 2000; Gligor

and Holcomb, 2012). Information technology capability is one of sources of competitiveness when firms build IT-applied supply chain. (Wu et al., 2006). Barney (2012) stated that the resource-based view significantly supports supply chain management capabilities in developing and maintaining competitive advantage.

The objective of the 4PL is to use efficiently resources within the supply chain. Benefits from the application of strategic logistics outsourcing are key drivers for the development and sustainment of competitive advantage in manufacturing firms. Based on the abovementioned literature review, the research hypotheses were developed as follows:

- Hypothesis 1: Cost effectiveness from the application of 4PL is positively related to the development of competitive advantage in manufacturing firms.
- Hypothesis 2: The efficient utilization of resources in the supply chain from the application of 4PL is positively related to the development of competitive advantage in manufacturing firms.
- Hypothesis 3: The ICT application in 4PL services is positively related to the development of competitive advantage in manufacturing firms.

4 RESEARCH METHODOLOGY

The data for this research were collected through the questionnaires which were developed mainly based on theories of Gattorna (1998), Supply Chain Executive Board (2005), Barney (2012), and Bourlakis and Bourlakis (2005). The questionnaire was designed to address the research issues in manufacturing firms which are applying 4PL services. Responses were measured via Likert's 5-point scale and given by managers. In order to assess the important role of 4PL in developing and sustaining competitive advantage in manufacturing firms, respondents in manufacturing firms were asked to point out the extent to which manufacturing firms achieve from the application of 4PL (1-not effective; 5-very effective).

Data was collected from March 2018 to May 2018. Questionnaires were distributed via email or direct mailing. All managers of surveyed manufacturing firms had been informed about the purpose of the survey to take their agreement to participate. Questionnaires were sent to 30 manufacturing firms which are applying strategic logistics outsourcing. The data was analyzed with IBM SPSS Statistics. One sample t-test analysis was applied to check whether mean values of responses are significant.

5 RESULTS AND DISCUSSION

Being the neutral providers of various services in the supply chain, the 4PLs endeavor to assist manufacturing firms to effectively utilize their resources. The results of this research are presented in three groups of benefits from the application of strategic logistics outsourcing. First, cost effectiveness is illustrated in the results of main costs in logistics including transportation costs, warehousing costs, and inventory costs. Second, the efficient utilization of resources in the supply chain is assessed through financial resource, human resource, production process, and asset resource. Third, the ICT application in 4PL services is evaluated through positive results in customer service, information flow, and communication between related parties.

Table 1 shows the results of the analysis of activities and resources which are listed in different groups. All of activities and resources receive value over 3. These results signify that activities in logistics services and resources in the supply chain which are considered as important by manufacturing firms are very diverse. Inventory and customer service are two top activities which have higher value of means than others. This would mean that manufacturing firms pay much attention to reduce this type of cost and concentrate more on delivering better services to their customers. There aren't significant differences between three groups because the key objective of strategic logistics services is to create value to the customers. As a result, main types of costs in manufacturing firms are always considered carefully.

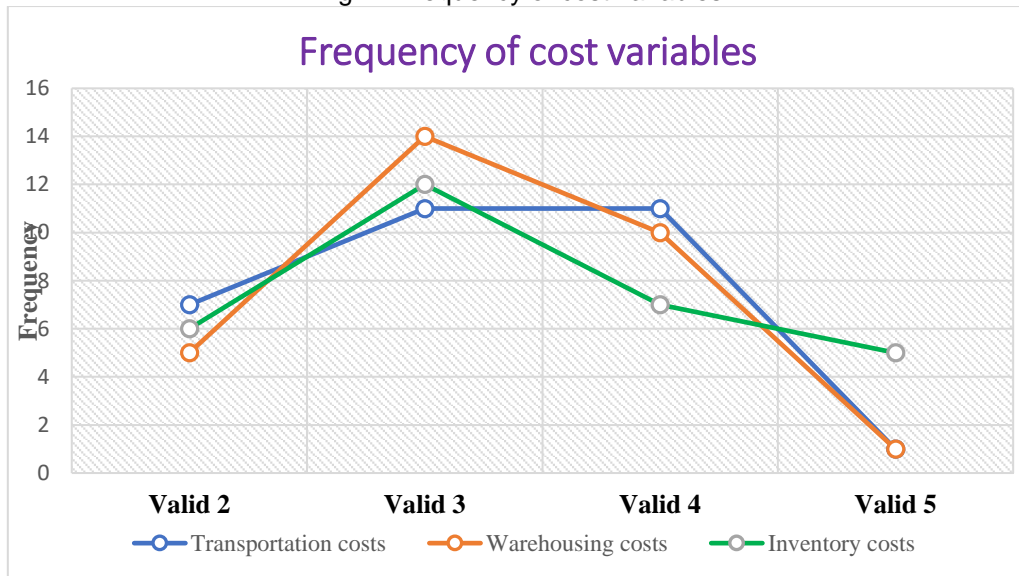
Tab. 1: Statistics of effective activities and resources from applying 4PL services

Activities and resources	N	Mean	Std. Deviation	Std. Error
Costs				
Transportation costs	30	3.20	.847	.155
Warehousing costs	30	3.23	.774	.141
Inventory costs	30	3.37	.999	.182
Resources				
Financial resource	30	3.07	.944	.172
Human resource	30	3.20	.887	.162
Production process	30	3.23	.679	.124
Asset resource	30	3.17	.791	.145
ICT application				
Customer service	30	3.27	.944	.172
Information flow	30	3.10	.845	.154
Communication between related parties	30	3.03	.765	.140

Source: Own calculations

Figure 2 presents frequency of cost variables with the validities from 2 to 5. There isn't result for valid 1 in the survey, therefore, the figure doesn't show valid 1 in the graph. Valid 3 gains the highest value and the next one is valid 4 in comparison to the remaining ones. This would mean that most manufacturing firms achieve cost reductions from the strategic logistics outsourcing through the implementation of 4PL. Variable of warehousing costs gains the considerable value with the highest frequency. For valid 4, manufacturing firms highly appreciate the role of 4PL in reducing transportation costs. This type of cost is one of the main ones that directly affect manufacturing firms' objectives in profitability and customer satisfaction. They are important constituents in developing competitive advantage for manufacturing firms. Therefore, the frequency of cost variables highly supports hypothesis 1: Cost effectiveness from the application of 4PL is positively related to the development of competitive advantage in manufacturing firms.

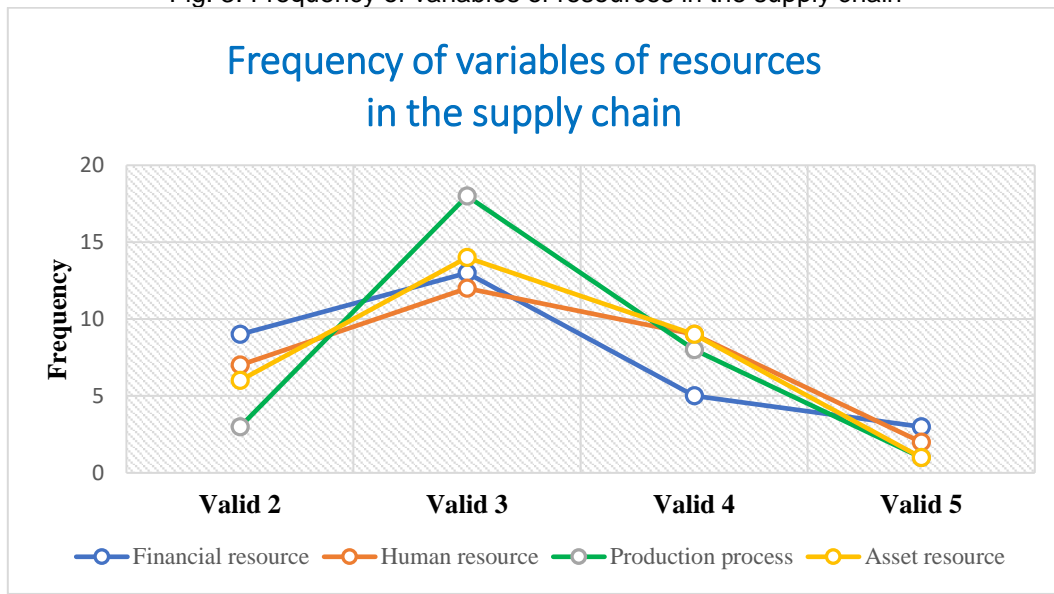
Fig. 2: Frequency of cost variables



The development of an efficient supply chain needs more than an attention in information and communication technologies. It requires process development and changing creation through the utilization of firm's resources. The increase in the flexibility of logistic activities for the reduction of resources consumption within the supply chain is one of the objectives of supply chain management (Wildemann, 2001). The mean values gained from the statistics imply that strategic logistics outsourcing creates efficiency in using key resources in business operations including financial resource, human resource, production process, and asset resource. Although the significant values aren't considerable high, they achieve enough beneficial values for proving the advantage of strategic logistics outsourcing. Figure 3 illustrates frequency of variables of resources in the supply chain shown from valid 2 to 5. Similar to frequency of cost variables, there is no result for valid 1 from the survey. Valid 3 also gains highest value for all observed resources. The results indicate the efficiency of resource utilization in the supply chain by manufacturing firms when they take advantage of the implementation of 4PL. In manufacturing firms, production process is the vital part in the strategy of making differentiated products which are superior to those of their rivals. Their decisions on outsourcing logistics activities to 4PL generate

great opportunities for them to utilize their resources in core competences. This research result implies the validity of hypothesis 2.

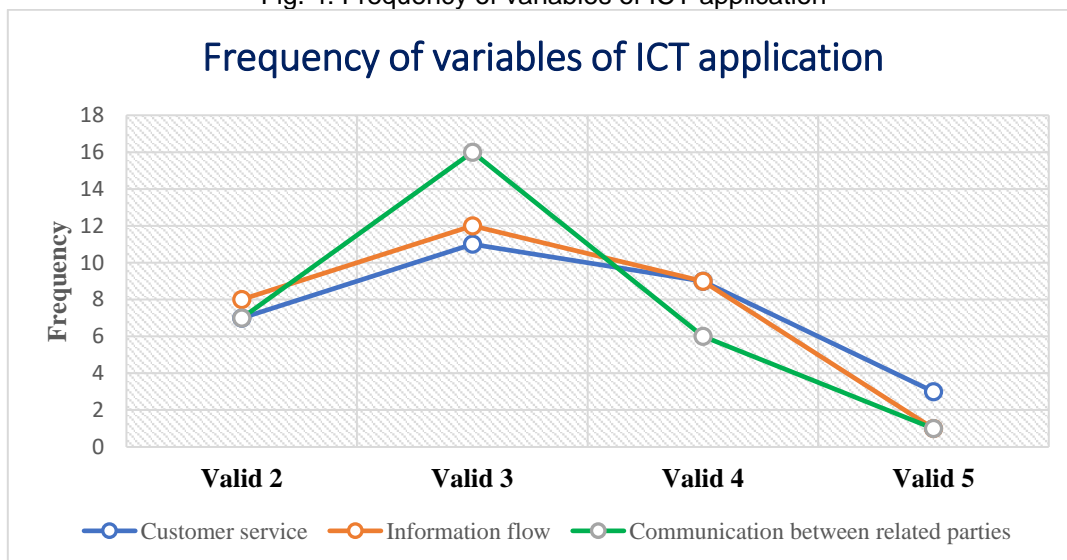
Fig. 3: Frequency of variables of resources in the supply chain



Information and communication technologies represent the technical aspects of supply chain management (Bowersox and Closs, 2011; Closs and Goldsby, 1997; Bharadwaj, 2000; Spanos et al., 2002; Giannopoulos, 2004; Golob and Regan, 2002). The results indicate that information and communication technologies play a vital role in building networks between related parties in the supply chain in manufacturing firms. All surveyed manufacturing firms appreciate the role of ICT application in enhancing the quality of customer service, information flow, and communication between related parties. From the results stated in table 1, mean value of customer service is the highest one in this group. Being one of key drivers to competitive edge, customer service is currently concentrated more and more by manufacturing firms through the application of technologies. Meanwhile manufacturing firms take advantage of ICT to enhance the quality of communication within their collaboration. It is obvious that technologies bring advanced benefits to all related parties in business operations. It is affirmed by the results of frequency of variables of ICT application demonstrated by figure 4. Nowadays, ICT have transformed communication in

the world. The collaboration between related parties in 4PL services is not performed well without the contribution of technologies. Promptness and accuracy are typical examples for enhancing trust and effective collaboration between manufacturing firms and 4PLs. It becomes the foundation for the utilization of both parties' core competences to develop competitive advantage for manufacturing firms. Hypothesis 3 is confirmed to be valid with the analyzed results.

Fig. 4: Frequency of variables of ICT application



The statistics of responses in the survey presents specifically the assessment of respondents to the application of strategic logistics outsourcing through the implementation of 4PL. According to the results stated in table 2, positive assessments from collected responses are mainly focused on valid 3, especially variables of production process and communication between related parties with the highest percentage. As shown in figures 3 and 4, frequencies of these two variables are much higher than others. Other variables such as warehousing costs and asset resource achieve remarkable rates which imply that manufacturing firms gain valuable benefits from outsourcing logistics services to 4PL.

Regarding valid 4, 30% and over give their appreciation to benefits from the implementation of 4PL including transportation costs, warehousing costs, human resource, asset resource, customer service, and information flow. Although the rate for valid 5 is not high, all of surveyed manufacturing firms have recognized high effectiveness of strategic logistics outsourcing to their business performance. There are also a small number of collected responses assessing the effective of strategic logistics outsourcing at limited level. The highest level for valid 2 is financial resource. However, the higher rate of 43.3% for this variable has supported the effectiveness at valid 3. Generally, the statistics have illustrated transparent and positive assessments from manufacturing firms to strategic logistics outsourcing through the implementation of 4PL.

Tab. 2: Percentage statistics of observed variables

Observed variables	Valid			
	2 (%)	3 (%)	4 (%)	5 (%)
Transportation costs	23.3	36.7	36.7	3.3
Warehousing costs	17.6	46.7	33.3	3.3
Inventory costs	20.0	40.0	23.3	16.7
Financial resource	30.0	43.3	16.7	10.0
Human resource	23.3	40.0	30.0	6.7
Production process	10.0	60.0	26.7	3.3
Asset resource	20.0	46.7	30.0	3.3
Customer service	23.3	36.7	30.0	10.0
Information flow	26.7	40.0	30.0	3.3
Communication between related parties	23.3	53.3	20.0	3.3

Source: Own calculations

Table 3 presents the descriptive statistics and the results of the t-test of constituents of competitive advantage in manufacturing firms. The given results indicate the statistical significance of observed variables. Although there are considerable differences in independent variables between groups and variables in the same groups, the results support the aforementioned hypotheses.

Tab. 3: Sample t-test of effective activities and resources from applying 4PL services

Activities and resources	t	df	Sig. (2-tailed)	Mean Differen ce	95% Confidence Interval of the Difference	
					Lower	Upper
Costs						
Transportation costs	1.293	29	.206	.200	-.12	.52
Warehousing costs	1.651	29	.109	.233	-.06	.52
Inventory costs	2.009	29	.054	.367	-.01	.74
Resources						
Financial resource	.387	29	.702	.067	-.29	.42
Human resource	1.235	29	.227	.200	-.13	.53
Production process	1.882	29	.070	.233	-.02	.49
Asset resource	1.153	29	.258	.167	-.13	.46
ICT application						
Customer service	1.547	29	.133	.267	-.09	.62
Information flow	.648	29	.522	.100	-.22	.42
Communication between related parties	.239	29	.813	.033	-.25	.32

The analysis of cost reduction in the application of 4PL is to investigate the level of cost effectiveness created from strategic logistics outsourcing. The 4PL can reduce the costs based on the consolidation of demands from the customers to reach economics of scale and make the optimized scheduling for all logistics activities from the perspective of the whole system. Logistics activities are executed by 3PLs in different areas including transportation, inventory, and warehousing. Warehousing management is considered as an important function in logistics. Warehousing can be a highly costly and labour-intensive function (Murphy and Poist, 1993). Private warehousing is less costly, may make greater use of human resources, and can provide tax benefits (Stock and Lambert, 2001). Thanks to the expertise of 3PLs and transparent strategies of 4PLs, manufacturing firms achieve their objectives with the most effective assumption of costs and time. Therefore, the strategic logistics outsourcing can be viewed as an alternative governance mechanism to enhance efficiency and reduce cost, allowing the firm to achieve a competitive edge through cost advantage. The results of sample t-test show that all types of observed costs are statistical significant. As a result, hypothesis 1: "Cost effectiveness from the application of

4PL is positively related to the development of competitive advantage in manufacturing firms” is confirmed with the research results.

The role of resources in the competitive advantage of manufacturing firms can be easily traced in the corporate strategies. Edith Penrose was one of the first scholars who recognised the importance of resources in achieving a firm’s competitive position (Penrose, 1959). Potential valuable services of these resources in the supply chain should be exploited in the right manner to make them available to the firms. In this research, four main resources in the supply chain are mentioned and analyzed with the statistical data. They include financial resource, human resource, production process, and asset resource. These observed variables gain statistical significant values through sample t-test. It means that manufacturing firms appreciate the role of the utilization of resources in the supply chain. One of the perspectives of effective resource utilization is the allocation strategy of firm’s resources in the supply chain focusing on core competences. The most effective solution for activities beyond core competences is logistics outsourcing. There is a large number of motives and drivers behind the logistics outsourcing. Strategic logistics outsourcing creates opportunities for positive synergy by bringing the core competences of related parties together. It has been established that strategic logistics outsourcing improves the competitiveness of manufacturing firms by rationalizing business activities and synergic effects. Although the statistical significance of these observed resources are very different, they support the hypothesis 2: The effective use of resources in the supply chain from the application of 4PL is positively related to the development of competitive advantage in manufacturing firms.

Information and communication technologies applied in logistics services are considered as real-time controlling instruments. The analysis of ICT application in 4PL reveals the positive results in the transparency of communication, information exchange, and information flow. The development and ever changing of business environment require the business approaches to be prompt and responsive. The advances in technology are taking the strategic logistics outsourcing to the new heights. New technologies, e.g. radio frequency

identification (RFID), are creating remarkable changes in logistics performance. In former studies on 4PL, scholars pointed that the 4PL is a supply chain solution which combines the capabilities of management consulting, information technology, and 3PL service providers (Gattorna, 1998); or the 4PL is a supply chain integrator that assembles and manages the resources, capabilities, and technology of its own organization with those of complementary service provider to deliver a comprehensive supply chain solution (Qiong Liu, Chaoyong Zhang, Keren Zhu, Yunqing Rao, 2013). This means that technology is an indispensable part in the 4PL services. Respondents highly appreciated the contribution of technology in achieving high quality of information flow, customer services, and communication between related parties. The statistical significances of observed variables in ICT application support hypothesis 3: The ICT application in 4PL services is positively related to the development of competitive advantage in manufacturing firms.

6 CONCLUSION

The international logistics outsourcing is still growing. Logistics service providers keep launching new services together with applying new technologies to meet their customer's demands. In the ever changing business environment, the indispensable task of manufacturing firms is to develop and sustain competitive advantage over their rivals. Manufacturing firms which focus much on cost reduction and core competences are increasing their demands in the collaboration with strategic logistics outsourcing.

The main objectives of the application of 4PL of manufacturing firms are to reduce operational costs, optimize the allocation of the firm's resources through the use of information and communication technologies. Benefits that manufacturing firms gain from 4PL services are discussed in this research with their statistical significant values. The results reveal that strategic logistics outsourcing significantly contributes to the development of competitive advantage in manufacturing firms. Specific benefits which these manufacturing firms achieve from strategic logistics outsourcing include cost reduction, efficient utilization of



resources in the supply chain, and effectiveness in information and communication. However, the research hasn't analyzed all factors in costs and resources in the supply chain of manufacturing firms as well as proposed model for the collaboration between manufacturing firms and 4PLs to achieve the optimal effectiveness in the development of competitive advantage for manufacturing firms.

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