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Cost Optimization in Event Logistics

The Case of Volvo Cars Exhibitions Logistics, Volvo Ocean Race

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Abstract

International markets continue to offer expanding opportunities for global events, exhibitions and trade shows. Immense logistics efforts are required for the event to go live. The complexity of this type of logistics compared to the general supply chain is explained by high demand on flexibility, know-how and creativity from logistics service providers combined with extensive service variability and very strict timelines. Finding the ways to optimize logistics costs and achieve cost-efficiency is of primary concern for both event organizers and exhibitors.

The purpose of this study is to identify the appropriate sourcing strategy to increase cost optimization of event logistics. This study is supported by Volvo Ocean Race data as an example of a global event with extremely complicated logistics setup.

For the global event, sourcing decision is multi-objective, multi-product and multi-modal. Therefore, three types of sourcing strategies can be applied: single-, dual- or multiple-sourcing. Every of these strategies has own pros and cons. However, our thesis introduces a new solution to this problem and develops a cost weighted approach for the determination of the most cost-efficient sourcing strategy in event logistics.

Developed model and its implication to Volvo Ocean Race shows that service specialization plays a significant role in event logistics and multiple sourcing strategy proves to be the most cost beneficial. The empirical results also show that a combination of logistic providers with different portfolio and asset structure gives benefits both in the reliability of provided services and cost efficiency. We believe our findings can advance knowledge in the narrow research area of exhibitions logistics and may be applied to various types of global events.

Key words: event logistics, exhibitions logistics, Volvo Ocean Race, cost efficiency, cost optimization, sourcing strategy.

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1 INTRODUCTION

1.1 BACKGROUND DESCRIPTION

Recent surveys conducted by international exhibitions associations show that the exhibition industry geared for further growth in 2017 despite the ongoing slowdown in global economic growth and the political changes. Many companies take part in a variety of shows, trade fairs or exhibition events to promote their goods or services and develop new activities including participation in the virtual events (IELA, 2016). According to the forecast of the International Association of Exhibitions and Events, trade show and event attendance are expected to grow internationally as content and resources to foster economic development are displayed at trade events, fairs and exhibitions (IAEE, 2016). The exhibition industry provides an interactive platform for the market participants and takes over important economic functions to bring supply and demand together in one exhibition area. In a broad perspective, the exhibition industry is a political-economic instrument to stimulate the national economy development (Beier and Damböck, 2010).

A variety of definitions is used to describe the 'event'. 'A trade fair' or 'a trade show' refers to an event with a major purpose to bring buyers and sellers together to promote trade. 'A commercial exhibition' indicates the event is targeted at a specific market sector or industry and addressed to a particular group of customers. Exhibitions range from local market fairs to World Expo events with global coverage (ITC, 2012). Events are not limited only to trade fairs but include cultural, sports and political events characterized by a limited time of performance, mass appeal of spectators and international significance (Creazza, Colicchia, and Dallari, 2014). A trade fair or an exhibition is a meeting place where exhibitors have an opportunity to attract the attention of potential customers, distributors or agents and use the power of mass media to create a favorable public opinion about their products or services (Karlberg, 2008). There are a number of benefits for the companies which take part in exhibitions, including product introduction and promotion, making new connections in the industry, improving brand image, keeping an eye on the competitors and developing own competitive advantages, using the power of media to share company's profile with the wider public, learning new things and improving knowledge (Thanos, 2015). However, the risks of participating in such events are not negligible. Participation fee, travelling and exhibition costs require considerable investment and are difficult to forecast due to a complexity of a cost structure. Apart from financial investment, companies need to dedicate human resources to plan, organize, prepare and attend those events. Given the scale of associated

costs, companies expect to attract an audience to benefit from participation. Therefore, to guarantee company's successful participation in the event, the exhibitor needs to carry out a considerable amount of preparatory work to stand the fierce competition (Karlberg, 2008).

For the event to go live, immense logistics efforts are required (Minis, Paraschi, and Tzimourtas 2006) including the logistics support for pre- and post-event deliveries and venue logistics management (Agility, 2016). According to industry classification, event or exhibition logistics can be regarded from two separate angles: from exhibitors' or organizers' perspectives. Fairs organizers and exhibitors have specific logistics needs and require different supplier portfolio when it comes to sourcing logistics service providers. Event organizers focus on the effective venue logistics management (VLM) that includes the effective venue utilization, managing on-site work, handling the arriving goods, arranging storage of goods and empty packaging, waste management, introducing traffic control and management and customs / bonded facilities as well as overall logistics coordination and planning (Agility, 2016). Event exhibitors or participants usually outsource logistics services related to transportation to and from venue, temporary import and export procedures, obtaining permits and certificates, packing and labelling services, handling of cargo and packaging, storage prior to the exhibition and overall coordination and planning of logistics flows of a particular customer. The complexity of this type of logistics compared to the general logistics services is related to a combination of various types of services and very strict timelines. Transportation routing usually involves multiple stops on tight shipment schedules (Agility, 2016). For some types of shows and events, delivery precision requirements are very high and the risks of missing the deadline result in a failure of the show in general. These failures in logistics scheduling can cost the exhibitor immense amounts of lost potential contracts. Logistics providers should adhere to the show organizer's move-in and move-out dates and times, delivering to the show facility dock before the scheduled time slot results in penalties as well as a late arrival (Chapman, 2013). The additional complexity lies in the nature of the cargo itself which often happens to be either oversized or fragile, so the demand for the experienced logistics professionals increases. Exhibition logistics services require that the exhibits are delivered to the booth on time, in perfect condition and with all necessary permits and customs documents in place (Agility, 2016).

Another tricky issue with event logistics is the compliance with the customs legislation in different countries. The usual practice among exhibition logistics companies is the use of ATA carnets¹ for

¹ "The ATA Carnet is an international Customs document that a traveler may use temporarily to import certain goods into a country without having to engage in the Customs formalities usually required for the importation of goods, and without having to pay duty or value-added taxes on the goods."
Source: https://www.cbp.gov/sites/default/files/documents/ata_carnet_3.doc

temporary admission of goods (exhibits) to the shows. That means that any mistakes in customs documents at the point of entry to the country may result in the problems of taking them back, especially if the same exhibits are delivered to another show. As a result, event logistics requires not only general industry knowledge but also high flexibility, adaptability and creativity when it comes to solving the challenges and meeting the tough timing requirements (Chapman, 2013).

Venue logistics concerns managing not only materials and goods but also people and information (Ersoy, Börühan and Tek, 2012). However, for the sake of this study, we will include only cargo logistics and define event / exhibition / trade fair logistics as per the exhibitor's perspective, i.e. we deem venue logistics management to be out of scope. Terms 'event', 'exhibition' and 'trade fair' logistics will be treated as synonyms in this thesis.

Selection of right suppliers of logistics services become important decision which later will effect on the success of an event. Recently many authors have attempted to provide a framework for a more holistic view of supplier selection, their focus is on long-term relationships and procurement of goods. However, in this thesis, we have focused on defining sourcing strategies for logistics services of events, which have clearly defined time limit. One of the authors of this thesis works with a real on-going project focused on selecting suppliers for Volvo Cars Exhibitions Logistics for Volvo Ocean Race. It enables us to access to real up-to-date data from potential suppliers and to test mathematical model, that was developed after examining and studying existing literature and logistics processes and sourcing during world-wide events.

The structure of this thesis contains both theoretical and practical parts of research, it begins with problem description that emphasizes the complexity and special approach to event logistics. This part also contains an overview of Volvo Ocean Race setup, routing and major figures. We end up this part of the thesis with formulating the purpose of the study and research questions. Next chapter is dedicated to the review of existing academic studies and constitutes the theoretical background for creating an own mathematical model and further data analysis. We use a number of theories in order to formulate the hypothesis of the thesis and draw a matrix of various sourcing strategies in event logistics. The methodology part describes the adopted approach and research design as well as model development process. The next step of our research is testing the developed model on the empirical data gained from Volvo Cars sourcing process for VOR logistics services. In this part, we give a detailed observation of the available data, the model adjustment to be used for data analysis and model application results. Empirical analysis part covers the received outcome of the model application to VOR logistics data and leads to the discussion of findings and their interpretation in terms of the developed hypothesis. Finally, we answer the research questions and summarize the conclusions of the thesis.

1.2 PROBLEM DESCRIPTION AND PROBLEM ANALYSIS

Despite the growing importance of big global events and the specific role of exhibition logistics, this area is rather poorly explored and paid low attention in modern logistics research (Creazza et al., 2014). The literature review part will contain an overview of the existing scarce studies of event logistics that are mainly dedicated to the venue logistics management rather than exhibitor logistics. The focus of this study is related to the commercial efficiency of event logistics as this aspect is mentioned in several studies to be particularly important but still considered as ‘peripheral’ (Creazza et al., 2014).

A wide body of studies is devoted to the problem of selecting the most appropriate sourcing strategy in order to solve the classical trade-off between the cost benefits and level of reliability or risk management. ‘How to source’, ‘whom to source’ and ‘how many to source’ are the central questions in the problem of identifying the correct balance between insourcing or outsourcing strategies, between different types of suppliers and between the various number of suppliers in a pool. These sourcing questions are very dispersed in academic research and are somehow related to each other. The key problem we will focus on in this study is selecting the sourcing strategy to increase cost optimization of event logistics. This problem is both new and relevant as it combines a wide range of previous research and gives a new perspective that has hardly been covered before.

The literature review shows that the problem of selecting the sourcing strategy has been addressed by many researchers. The body of research includes both descriptive and analytical studies of single, dual and multiple sourcing strategies. Many studies use extensive empirical data and mathematical and program modelling. Nevertheless, the focus of these studies is dedicated to the product or material purchasing, not to sourcing of logistics services. Therefore, we assume that this thesis with developing the study on sourcing strategies of logistics service providers (LSP) and the possible benefits in achieving cost reduction in exhibitions logistics will be a solid and valuable addition to the existing research on procurement problems.

This study is supported by Volvo Ocean Race (VOR) as an example of a global event with extremely complicated logistics setup and high demand on tight lead times and high service levels. Originating from 1973, Volvo Ocean Race is one of the longest and toughest sporting events in the world attracting about 2.4 million spectators in the race villages annually. Volvo Ocean Race Logistics includes transportation and customs clearance of pavilions, hospitality infrastructure and support equipment including on-site handling on the venues (Volvo Ocean Race, 2017).

Volvo Ocean Race is a truly global sporting event - a yacht race around the world, held every three years covering the distance of 46 000 nautical miles around the world, hosting stopovers on six

continents and 12 different cities. Each team has a sailing team of 9-11 professional crew, who race day and night for more than 20 days at a time between stopovers. The map of the Volvo Ocean Race 2017-2018 shows the logistics complexities due to broad geographical coverage. The race starts on October 22nd, 2017 in Alicante (Spain) and will last until the middle of summer 2018 (Volvo Ocean Race, 2017).



Figure 1. Volvo Ocean Race 2017-2018 Route (Volvo Ocean Race, 2017)

Volvo Ocean Race CEO Knut Frostad highlights the importance of the reliable logistics partners to support the events of this size and scope: *“Logistics management is absolutely crucial to the operational delivery of the Volvo Ocean Race. The logistics challenges presented by a race visiting multiple countries are huge and to meet those challenges we need a world class partner with a proven track record.”* (GAC, 2013)

Volvo Ocean Race CEO Richard Mason emphasizes technical complexity and unpredictability of mega-events like Volvo Ocean Race: *“As a unique global event working under severe time pressures and facing unexpected obstacles, flexible logistics management is integral to operational delivery of the Volvo Ocean Race.”* (GAC, 2017)

According to internal information, Volvo Ocean Race logistics is divided into two separate setups that correspond to the general exhibitions settings described above. Volvo Ocean Race Headquarters (race organizer based in Alicante, Spain) takes care of managing the logistics flows of the main race village infrastructure. As a race organizer, they have own cargo volumes, routings and requirements to logistics service providers that are separate and not always similar to Volvo Cars pavilions dedicated to cars exhibitions and related events. Volvo Cars has a separate bidding process for the own volumes when it comes to selecting logistics providers, so we will use the empirical data available from Volvo Cars internal sourcing process for this study.

For Volvo Cars, the race is regarded not as a sporting event, but primarily as a big multi-stop exhibition, that takes place in several countries and continents over 8 months. Volvo Cars pavilions follow the routing of Volvo Ocean Race and are placed on the race village territory with an

exhibition purpose of promoting new car models. Separate Volvo Cars fair events take place during every stopover to attract public attention and potential customers in every destination city of the Volvo Ocean Race.

The map of Volvo Cars pavilions routing, presented in Figure 2, does not fully correspond to the general Volvo Ocean Race route presented in Figure 1. The only difference applies to the Melbourne stopover which is not covered by Volvo Cars. For Volvo Cars volumes, the race includes totally 11 stopovers in Alicante, Lisbon, Cape Town, Hong Kong, Guangzhou, Auckland, Itajai, Newport, Cardiff, Gothenburg and The Hague.

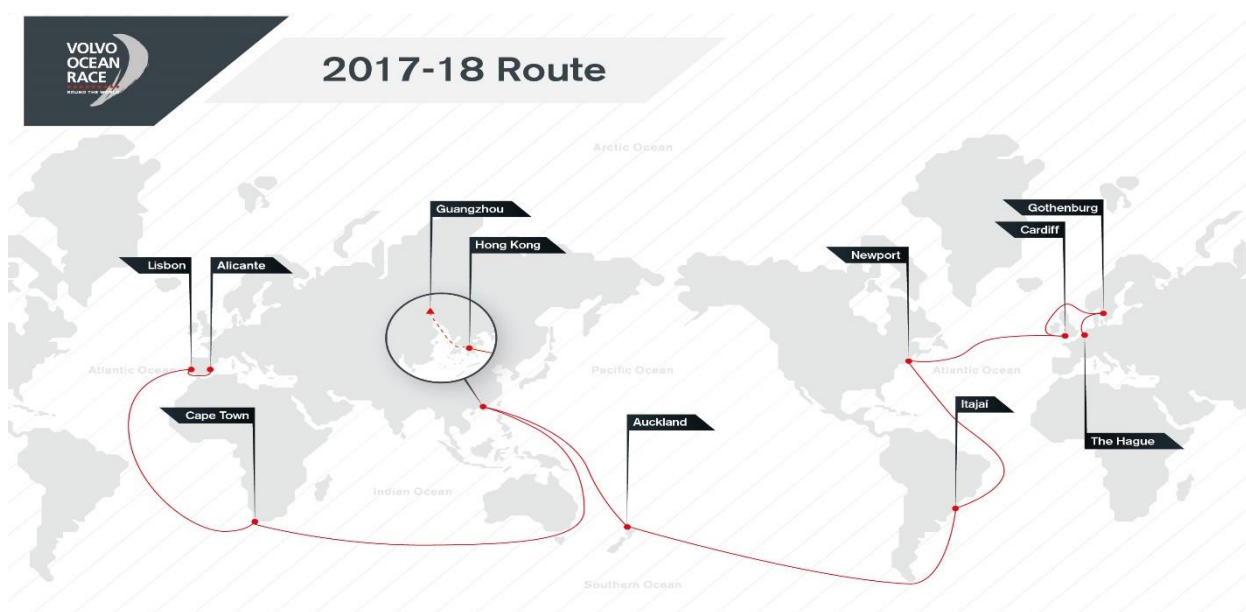


Figure 2. Volvo Cars Pavilions routing for Volvo Ocean Race 2017-2018 (Volvo Cars, 2017)

The scope of the Volvo Cars VOR is further elaborated in the later parts of our study in sections devoted to empirical data and problem description.

Volvo Ocean Race contains all typical characteristics of the event logistics that were mentioned in the introductory part of this work and will be further developed in the literature review. Dual sourcing strategy was used for previous Volvo Ocean Races with a combination of an ocean carrier and a freight forwarder in the supplier base. The sourcing strategy has been questioned this year before a new race starts in 2017-2018, about whether more service specialization and a wider supplier pool would give the commercial advantages or alternatively if the economies of scale and scope can be beneficial in single sourcing.

1.3 PURPOSE OF THE THESIS

The complexity of event logistics from the exhibitor perspective increases the requirements to freight companies sourced to perform logistics services. Those are expected to have a relevant experience and show a high level of reliability and flexibility while performing the services during the event. Exhibitors who take part in shows and events usually outsource logistics services to the experts that specialize in exhibitions logistics management and can offer not only the top level of performance but also significant cost reduction due to an efficiency of operations and economies of scope (Trade Show advisor, 2017).

One of the biggest costs associated with trade shows or events is the logistics cost including transportation, storage, material handling and installation / dismantling services. Logistics costs can become ‘a killer’ of a show if not properly planned and calculated (Keinan, 2017). In our thesis we analyze the exhibitor’s sourcing process to identify the most efficient approach to outsourcing logistics services in events and exhibitions in order to maintain the service level and enjoy cost reduction benefits.

The purpose of this study is to identify the cost structure of event logistics and investigate the influence of service specialization and sourcing strategy on cost optimization using the example of Volvo Ocean Race organized by Volvo Cars.

The research questions of the study are formulated as follows:

- 1. How do service specialization and sourcing strategy influence the cost efficiency of event logistics?*
- 2. What sourcing strategy is the most cost beneficial for the coming Volvo Ocean Race?*

1.4 DELIMITATIONS OF THE THESIS

This work has certain delimitations due to the narrow focus of the research questions and the available empirical data. As described in the background part, we sub-divide exhibitions logistics into the exhibitor and organizer logistics. For the sake of this paper, we omit venue logistics management (that includes facility planning and utilization, transportation of personnel and visitors, food supply and venue security, etc.) and regard exhibitions logistics from the participant point of view. In the cost calculation part when analyzing the empirical data, we disregard any venue management or agent fees and focus only on the costs related to logistics services directly sourced by an exhibitor. This delimitation is explained by the lack of purchasing power to influence the fixed venue management costs that are equally paid by all exhibition participants to

the event organizer or its official freight forwarder. Consequently, these costs do not influence the decision regarding the most beneficial sourcing strategy by an exhibitor and can be disregarded in the presented model.

This work is also limited by the available empirical data and is based only on a single example that is Volvo Ocean Race. We identified VOR logistics as a perfect example that contains all the features and complexities of event logistics. Nevertheless, the model presented in this study may be further applied and tested on a number of other events of various kinds.

2 THEORETICAL FRAMEWORK AND RESULTS OF LITERATURE REVIEW

The literature review part combines a number of the theories related to different aspects of logistics and not limited to event logistics. The theoretical background will be used in creating our own model of cost structure and sourcing strategies for event logistics that will be further tested on Volvo Cars empirical data. The following aspects of previous research, presented in Figure 3, will be studied to serve the purpose of this work:

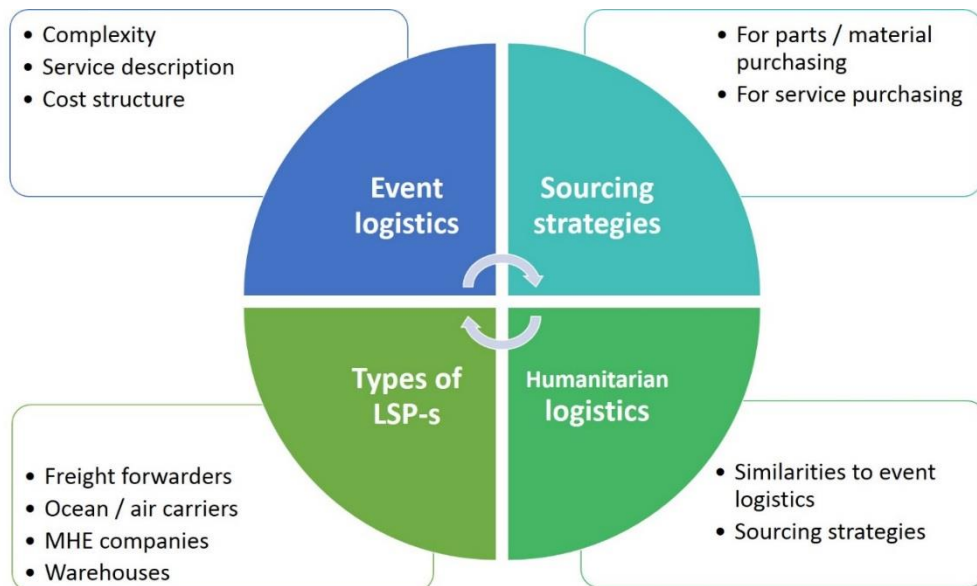


Figure 3. Literature review matrix

When describing the existing research and studies devoted to different aspects of logistics and procurement, we would like to distinguish between the references to other studies and our own thesis work. All references to ‘authors’, ‘paper’, ‘study’, ‘research’, etc. are attributed to the academic sources under revision while references to this thesis will contain word ‘we’, ‘our’ or ‘thesis’.

2.1 EVENT LOGISTICS

Following Creazza et al. (2014) we will define the events as large-scale trade shows, exhibitions, cultural and sports events, political assemblies, international festivals and similar. These different types of events have common features when coming to the logistics setup and face similar or related challenges in logistics organization (Creazza et al., 2014). Event logistics consists of pre-, on-site and post-event activities and includes a wide range of services covering almost all aspects of regular logistics, like transportation, packaging, customs, handling, warehousing, etc. (Ersoy, Börühan and Tek, 2012).

Despite the complexity of event logistics, the literature on this topic is rather scarce. One of the recent studies conducted by Creazza et al. in 2014 gives a comprehensive summary of previous researches in this area and highlights the fact that ‘very little attention has been given to the logistics challenges of organizing and staging mega-events’ (Creazza et al., 2014, p.3).

Two major works in this area cover peculiarities and list various types of logistics services of event logistics on the examples of World Expositions (Creazza et al., 2014) and Olympic Games (Minis et al., 2006). Creazza et al. focus their attention on the venue logistics management operations of food replenishment process for Milan 2015 World Exposition. The authors mention logistics challenges related to event logistics, namely planning of flows, time critical transportation, storage, tracking, installation, recovery of equipment and materials. They are the first to highlight the importance of optimization of event logistics processes in order to reduce the associated costs without sacrificing timely deliveries and reliability of service (Creazza et al., 2014). Nevertheless, their study does not cover the cost optimization topic but rather identifies the logistics setup and resource planning of the catering services.

Creazza et al. regard three distinct event stages that affect the amount and the variety of logistics work. Bump-in phase happens before the event starts and involves extensive cargo movement and handling for show preparation, the onstage phase takes place during the event and is mostly characterized by urgent changes and deliveries of materials and bump-out phase is the reverse process of the event and dismantling. Another important advantage of the research conducted by Creazza et al. (2014) is the classification of the logistics tasks and activities during the events. They define six distinct types of services including freight forwarding, customs clearance, managing of the storage, deliveries, security management and venue access checking (Creazza et al., 2014).

Creazza et al. (2014) in their research use the work of Minis et al. (2006) that presents the logistics design of Athens 2004 Olympic Games. This paper summarizes the scope of Olympic logistics

similar to the research of Creazza et al. (2014), defines the major challenges of mega-event logistics and gives a valuable overview of the aspects of the external environment that influence the event logistics. The largest portion of conclusions in the two presented researches correspond to each other, especially in the classification of logistics services. The comparison table is presented below:

Table 1. The comparison of exhibitions logistics services

Creazza et al. (2014) – World Exposition	Minis et al. (2006) – Olympic Games
Freight forwarding (inbound transportation and temporary storage)	Freight forwarding (inbound flows)
Customs clearance (brokerage)	Customs clearance
Management of the storage areas (warehousing, cross-docking, quality control, picking, etc)	Warehousing (quality control, picking, consolidation, etc.)
Deliveries (storage – venue, collection of empty packaging)	Distribution (deliveries to venue)
Security management (goods scanning, inspection)	Venue logistics (receipt, installation, maintenance of venue equipment)
Venue access checking (vehicle screening, document control)	Delivery coordination (delivery scheduling, security control)
	Asset tracking system
	Reverse logistics

Source : Creazza et al. (2014) and Minis et al. (2006)

Another important addition of Minis et al. (2006) is the analysis of external factors that influence the event logistics, namely the host country ('s) location that affects freight forwarding operations, the logistics infrastructure especially in warehousing availability, material handling equipment and IT, and the host country's logistics know-how and business environment. These factors are particularly interesting as they can have a significant influence on the whole logistics chain that is tight in its nature characterized by firm scheduling, uncertain demand, diverse operations and 'no margin for error' (Minis et al., 2006).

Besides the studies mentioned before, the valuable input into research of exhibitions logistics is made by Guo (2010) in analyzing the outsourcing trends in Chinese exhibitions logistics. The author defines exhibitions logistics in a broad and a narrow sense: the broad definition includes the delivery of exhibits before and after exhibitions as well as management of facilities and food distribution. The narrow definition involves only the movements and handling (including storage, packing and customs) of exhibits and information flows (Guo, 2010). These definitions correspond

to the organizer's and exhibitor's perspectives discussed above. The author gives a graphical presentation of the differences in the traditional supply chain logistics and exhibitions logistics that has not been done in previous studies. According to Guo (2010), exhibitions logistics operates synchronically on different levels and has shortened and poly-lined structure of the logistic chain compared to a linear traditional one. As an outcome of such a structure, exhibitions logistics is characterized by bigger complexity, limited time spans, demand on the high level of expertise and specialization from logistics providers and a smooth flow of information between all parties involved into exhibition process (Guo, 2010). Guo's study mentions another important feature of exhibitions logistics resulting in rising costs, that is the low volumes of the exhibits and relatively high price of logistics services. Outsourcing of this services to third party logistics providers helps to achieve the economy of scale, reduce the total logistics costs and improve efficiency (Guo, 2010).

These studies comprise the major body of research in event logistics. Other works are rather shallow or dedicated to small aspects of exhibitions. Ersoy et al. (2012) for example, give a very general description of the event management with a little focus on logistics while studying Izmir Expo setup. The study of Wang (2013) covers the major features of exhibitions logistics including the complexity of control and accuracy of deliveries and looks into innovation mode of the Chinese exhibitions logistics supply chain. Gruenwald (2014) focuses on a different type of event, namely geopolitical event "Bangkok Shutdown 2014", highlighting special logistics requirements compared to normal supply chain management. The complexity of geopolitical events from logistics perspective is explained by increased security requirements and managing multiple venues (Gruenwald, 2014).

2.2 EVENT LOGISTICS COST STRUCTURE

Neither of the mentioned studies raises the questions of cost structure and cost optimization in event logistics. We tried to address this question in the professional literature among the periodic magazines issued by International Exhibition Logistics Association (IELA) or booklets from the major carriers. Despite the differences in a logistic setup of various types of events and shows, we aimed at finding the common pattern or at least the applicable model that can be used in further data analysis. Nevertheless, the academic and public sources lack the cost structure data for exhibitions or event logistics. In order to create our own model and test it for Volvo Ocean Race cost structure, we used the internal Volvo reports for logistics services in a number of global motor shows.

Volvo Cars exhibition logistics statistics shows that the biggest expenses in exhibitions logistics of motor shows from the point of view of an exhibitor (or a participant) are related to on-site handling costs and inbound and outbound transportation services. We aggregated some of the Volvo Cars data in Figure 4 in accordance with the literature review part and determined that security management and venue logistics are not playing the vital role in the cost structure of the exhibitor logistics compared to an event organizer.

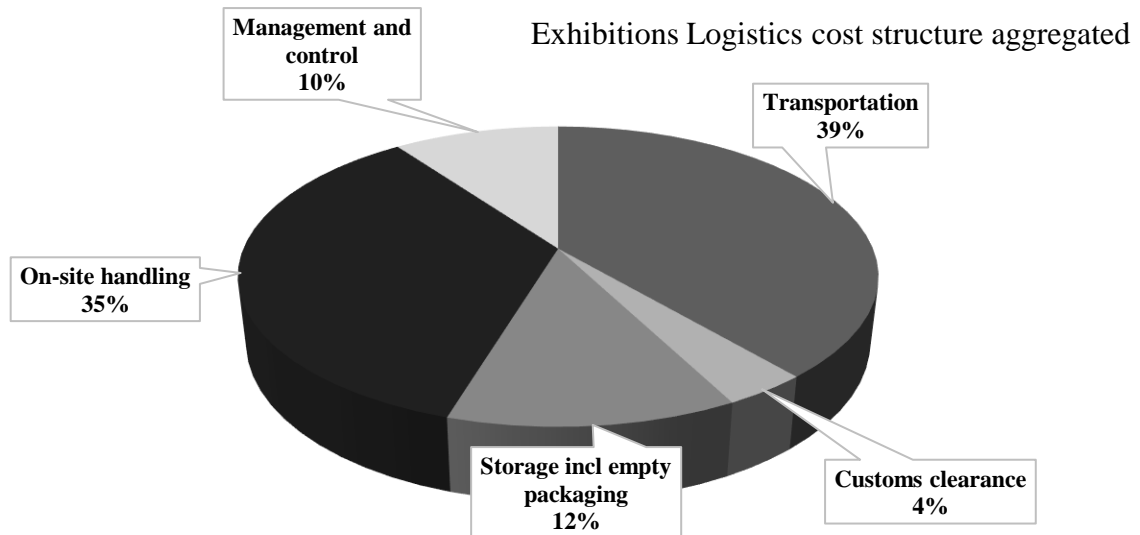


Figure 4. Exhibitions Logistics cost structure aggregated by authors (using Volvo Cars data)

This cost structure will be further described and developed in the study model and further tested using the empirical data received for Volvo Ocean Race logistics.

2.3 HUMANITARIAN LOGISTICS

The literature on humanitarian logistics emphasizes timing criticality as one of the crucial factors for successful relief operations. We consider logistics of global events being similar to humanitarian logistics, as it has fixed-limited timing, failure of the operation leads to significant losses, in addition, it has a limited budget and interest in cost optimization. Kunz and Reiner (2012) define the effectiveness of humanitarian logistics as a matching between the beneficiaries' requirements and delivery of the right relief items in time. Sheu (2007) notes that timely efficient management of flows of information, services and goods are critical elements for humanitarian logistics. While at the same time, logistics costs as the most expensive portion of any relief effort (Van Wassenhove, 2006). Therefore, humanitarian logistics plays a crucial role in organizing the delivery and warehousing of supplies during natural disasters or complex emergencies to the affected area and people. It has evident correlations with event logistics, which is focused on

organizing the delivery and warehousing of supplies during events. Both of them can have multi-objective and multi-product nature. Trestrail, Paul and Maloni (2009) summarize differences between logistics in an industry and during humanitarian relief operations: demand is extremely unpredictable and varies in volume, location and quality, while expected time-response is immediate. Concepts of lost sales in industrial logistics are translated as loss of human life and can be translated as loss of event for event logistics. One more difference is usually poor infrastructure at aid destinations, which is often not applicable to event logistics, as companies make a reasonable choice of destinations.

In contrast to event logistics, humanitarian logistics became a popular research area. Leiras, de Brito Jr, Peres, Bertazzo, and Yoshizaki (2014) carry out a literature review of humanitarian logistics and conclude that there is a significant increase in the number of publications on the subject from 2007. Authors mention that publications have focused more on strategic decision making in the last several years and emphasize a lack of applied research at the tactical and the operational decision levels. Therefore, there is still a lack of knowledge in methods in humanitarian logistics. We reviewed different logistics theories that have similarities with logistics of worldwide events, based on which, we can conclude that there is a gap in the literature that requires more attention.

Researchers distinguish three following planning stages in disaster lifecycle: (pre-disaster) preparedness phase, (post-disaster) response and recovery phases (Özdamar and Ertem, 2015). The same stages can be associated with global events: any event has these stages and logistics are involved in every step.

Unpredictability, dynamic and chaotic environment is a unique environment in which relief chains operate (Beamon and Balcik,2008). They compare strategic goals of logistics in industry: cost reduction, capital reduction, and service improvement with humanitarian operations that have goals to save lives and reduce human suffering, given financial constraints. As a result, customer service and costs are common considerations for both sectors. However, for humanitarian logistics the pressure of time is not a question of money but a risk of life losses. While talking about logistics of global events and chain of events, in particular, time pressure is motivated by the risk of money loss, but this money loss can be particularly large, as the absence or inappropriate event preparation can lead to a loss of reputation, which can lead to unaccountable financial losses and even bankruptcy. Complexity and emergency of humanitarian operations limit the time for aid agencies to select suppliers or organize efficient scheduling or road mapping, as a result management during operations focused on running operations as smoothly as possible and saving human lives. However, Rachaniotis, Dasaklis, Pappis, and Van Wassenhove (2013) emphasize that

humanitarian operations can benefit from savings achieved through better fleet management. As a solution for efficiency increase they propose theoretical optimization model in this paper, but a lack of real data do not enable it to be tested and applied in real cases. Therefore, we consider that there is a lack of sufficient methodologies within humanitarian logistics for selecting of sourcing strategies, while the importance of balanced and reasonable decisions is highlighted in many academic papers.

Researchers examine cost and time efficient ways of procurement in humanitarian logistics. However, the main focus is on the procurement of relief goods or equipment by the humanitarian organizations. There are articles about benefits of auction-based procurement in humanitarian logistics (Ertem and Buyurgan, 2013), a model that offers a competitive advantage in bid preparation that can be applied to food aid (Trestrail et al., 2009) etc. Heaslip (2013) describe that nowadays logistics services are sold as a product and even industry leaders in humanitarian logistics such as DHL, Kuehne and Nagel and UPS position themselves as providers of integrated services or solutions. We have not found any literature that provides a review of sourcing strategy in humanitarian operation. One of the reasons for this gap in the literature can be close cooperation between humanitarian organizations and logistics provider. Cozzolino (2012) mentions that logistics companies play a crucial role in humanitarian operations providing free or subsidized transportation and logistics. These leading international logistics service providers, such as Agility, DHL, FedEx, Maersk, TNT, and UPS share a lot of knowledge and experience with humanitarian organizations and enhance the speed and efficiency of relief efforts.

Schiffing and Piecyk (2014) study performance measurement in humanitarian logistics and showed that definitions of performance measurement in humanitarian logistics differ among stakeholder groups and it is very complex as many stakeholder groups are involved. Financial stability and effectiveness of a mission are two bottom lines in humanitarian logistics. Our analysis shows that these bottom lines can be applied for logistics of global events as a success of event and cost efficiency.

To sum up, our analysis of existing literature about humanitarian logistics demonstrate for us similarities between humanitarian and event logistics and emphasize the importance of logistics services in the supply chain. However, humanitarian operations have privileged status to use logistics services from global market leaders with special conditions – discounted or subsidized. Therefore, the literature does not provide sufficient information about sourcing strategies for logistics services of humanitarian operations even if these services are involved and are crucial. Event logistics within this paper are considered as a part of commercial activities, thus investigation of cost efficient sourcing strategies is needed and is not enough in existing literature.

2.4 SOURCING STRATEGIES

The area of selecting the appropriate sourcing strategy to support the well-functioning supply chain is rather well-developed in academic research. A lot of attention is paid to purchasing the products and materials while minimizing the risks of supply chain disruptions.

Procurement plays an important role in a company's value creation (Burke, Carrillo and Vakharia, 2007). Academic literature regards mainly three distinct sourcing strategies: single, dual or multiple sourcing. Following Yu, Zheng and Zhao (2009) we define single sourcing as selecting the single supplier even when other suppliers exist in the base. This sourcing strategy is opposed to sole sourcing meaning the only monopolistic supplier existing on the market. Dual sourcing is a combination of two suppliers sharing the volumes when one may have a dominant role and a major share. Multiple sourcing is characterized by the biggest purchasing power when several suppliers do business with a buyer and bid against each other providing the most advantageous conditions for the buyer.

We would like to start the literature review with the early studies on sourcing strategies. Most researches carried out in 1980-s and 1990-s are descriptive in their nature and present the general overview of risks and benefits related to various sourcing strategies. One of the earliest studies was conducted by Treleven and Schweikhart in 1988 giving a summary of risk / benefit analysis of single and multiple sourcing assessed by five distinct criteria: disruption of supply, price escalation, inventory and schedule, technology access and quality. Despite the certain level of simplification and streamlining, this study gets a valuable set of conclusions repeated and proved by later research: despite the traditional viewpoint, it is hard to identify that extremes in single or multiple sourcing are suitable for all scenarios of a supply chain. The sourcing strategy is influenced by many factors and there is no a single and unambiguous answer what strategy is the most beneficial (Treleven and Schweikhart, 1988). Nevertheless, future studies use more precise analytical methods to make approximations and find the factors influencing the appropriate sourcing strategies.

This area of research was further developed in the works of Swift and Coe (1994) and Swift (1995). The first work measures the sourcing preference scale based on the purchasing manager attitudes towards sourcing strategies. Here the biggest decision power is given to a purchasing manager while other factors including technical qualification, are disregarded. Swift's research from 1995 extends the previous research taking into account purchasing managers dissimilar preferences in regards to initial price level or a total life cost of a product.

Burke et al. (2007) investigate the appropriate sourcing strategy 'to combat uncertainties' in demand while purchasing a single product in a single period. The basic assumption of this study is that the supplier pool is already defined and technically approved and that cost is a dominant factor in the selection decision. The authors come to conclusions that single sourcing strategy strives for the strategic partnership between buyer and supplier and offers common benefits in closer cooperation. This model suits just-in-time type of supply chain with bigger coordination of product flows and information sharing (Burke et al., 2007). This advantage of single sourcing strategy is mentioned in a number of other works including Costantino and Pellegrino (2010), Yu et al. (2009), Swift (1995), Treleven et al. (1988) and others. Unlike many other researchers, Burke et al. (2007) go deeper in the analysis and consider the number of factors influencing the strategy. This analysis shows that single sourcing can be considered as the dominant strategy only when the supplier capacity considerably exceeds the buyers demand and when diversification benefits are not obtained. In other cases, multiple sourcing becomes preferable. Moreover, a trade-off between minimum order quantities, cost and reliability should be considered. Among the obvious benefits of multiple sourcing is the lower risk of supply disruption, timely delivery, supplier reliability and volume flexibility (Burke et al., 2007).

Costantino and Pellegrino (2010) continue investigating the selection of sourcing strategy in risky environments. The authors highlight the amplifying risk of supplier default leading to major supply disruptions in case of system uncertainty. Single sourcing is believed to create buyer's vulnerability and dependency on the supplier. Multiple sourcing on the other side is regarded as costlier due to managing of several suppliers and the loss of economies of scale (Costantino and Pellegrino, 2010). The benefit of this study is a detailed summary of the advantages and disadvantages of single and multiple sourcing strategies while the conclusions are rather vague and general showing the trade-off between various factors and uncertainty regarding the preferred sourcing strategy in the risky environment.

Yu et al. (2009) come to similar conclusions when studying the choice between single and dual sourcing in the presence of supply chain disruption risk. The authors are mainly summarizing the advantages and risks of both strategies and mention a number of trade-offs depending on numerous environmental factors. The major factor under study is disruption probability and the sourcing strategy is considered to depend on its magnitude (Yu et al., 2009).

The role of logistics costs in product sourcing analysis started to be addressed rather early. Hong and Hayya (1992) studied the issue of splitting the order volumes into multiple deliveries to support just-in-time product delivery. The study shows that splitting the orders will result in cost increase due to higher transportation cost, not depending what type of sourcing (single or multiple)

chosen (Hong et al., 1992). The work of Hong and Hayya (1992) was further developed by Ghodsypour and O'Brian (2001) using a non-linear programming model in multiple sourcing situation to account the total cost logistics.

Tyworth and Ruiz-Torres (2000) investigated the transportation role in the sourcing strategy decision. They emphasize that lead times can be improved by multiple sourcing due to the split of orders between several suppliers. The decision regarding sourcing strategy selection here depend on the combination of factors including, but not limited to, supplier prices, distance and reliability (Tyworth et al., 2000).

We see different approaches to cost benefits when coming to sourcing strategies. Some authors see commercial benefits in introducing several suppliers as it gives the opportunity to use bidding for a price reduction. Other researchers see the reduction of cost efficiency in multiple sourcing due to higher managing costs and loss of economies of scale. We assume that these differences depend on the nature of the purchased products and the general environment. Despite the influence of various factors, the sourcing strategies have a number of generally accepted and widely used advantages or disadvantages. Our target is to summarize the mentioned risks and benefits of different sourcing strategies into a common model. Due to only a slight difference described in the academic researchers between dual and multiple sourcing (in some works these strategies are used as synonyms), we identified similar benefits and risks in both strategies different only by the degree of influence.

Table 2. Advantages and disadvantages of different sourcing strategies based on the literature review analysis

	Single	Dual / Multiple
Advantages/ benefits	<ul style="list-style-type: none"> • Strategic partnership between buyer and supplier; • Close cooperation in JIT supply chain; • Information sharing; • Lower cost of managing a single supplier and due to economies of scale 	<ul style="list-style-type: none"> • Low risk of supply disruption; • Volumes flexibility; • Suppliers reliability in timely deliveries; • Improved lead times; • Cost benefits due to the opportunity of bidding among suppliers
Disadvantages/ risks	<ul style="list-style-type: none"> • Dependency of a buyer on a single supplier; • Buyer's vulnerability to price fluctuations; • High risk of supply disruption 	<ul style="list-style-type: none"> • Costly due to lack of economies of scale; • Lower level of cooperation between buyer and supplier resulting in lower visibility and lack of strategic relations

2.5 SERVICE PROCUREMENT & COST STRUCTURE THEORIES

Lindberg and Nordin (2008) analyze alternative views on service procurement and define several in the literature: the goods-dominant and the service-dominant logic and procurement. The First approach promotes the introduction of manufacturing principles to services such as materializing, specifying and standardizing, while the second one attempts to treat services as distinct from a product with intangible, inseparable and heterogeneous characteristics. The next approach suggests benefits of previous two practices while having a more dynamic view on services, where the importance of the process is emphasized. Services will transform during the procurement process and different approaches and models can be applied on the different stages. Moreover, the authors conducted interviews with experienced senior procurement managers and conclude that during supplier selection all respondents focus on taking advantage of market competition with help of competitive tendering using evaluation criteria for supplier selection. Most of them emphasize that costs are a central criterion for the supplier selection. However, soft measures are important for some type of services

Procurement logistics is a part of logistics that connects different business processes: goods procurement, transport of materials, receiving storage location, etc. Procurement logistics process consists of the following steps: determination of material requirements, source determination, vendor selection and comparison of quotations, order processing, purchase order monitoring, goods receipt and inventory management and last one is invoice verification (Kappauf, Lauterbach, and Koch, 2012).

There are several crucial parameters in the process of transportation: transport rates and related charges, transit time, transport visibility, on-time delivery, cost of transport management (Holter, Grant, Ritchie, and Shaw, 2008). Zeng and Rossetti (2003) suggest that the costs associated with logistics activities normally consist of the following components: transportation, warehousing, order processing/customer service, administration, and inventory holding, custom charges, risk and damage, and handling and packaging. Authors emphasize the importance of understanding and evaluating logistics cost components to assure profit margins. However, global logistics systems are complex and involve a variety of cost items. As a result, there is a lack of methodologies for evaluating the total logistics costs. Authors stratify existing methods into two groups: one focuses on the strategic aspects of global costs and another target optimized cost-effective decisions in logistics. The techniques utilized to analyze the logistics cost are categorized into 4 groups: recurrence-based, regression-based, activity-based, and optimization-based.

Research findings demonstrate that successful supply chain management requires the effective and efficient management of a portfolio of relationships. Buyer-supplier relationships can be managed with portfolio models (Gelderman and Semeijn, 2006). Gelderman and Van Weele (2005) conclude in their paper that a purchasing portfolio approach could be characteristic of a sophisticated, strategic purchasing function. Therefore, we will use it for developing our model.

One of the central studies to serve the purpose of this study the work of Holter et al. (2008) with a framework of transportation services purchasing in small and medium size enterprises. The authors focus on the question of enhancing cost efficiency and profitability by establishing the appropriate sourcing strategy and building the relationships with logistics service providers. This research is limited by studying solely transportation services and leaving other logistics related services (storage, handling, packaging, customs clearance, etc.) out of scope. Nevertheless, this paper provides valuable empirical results and model that can be further used for our research.

Holter et al. (2008) note the underdevelopment of academic research on the topic of transport purchasing. They summarize the important parameters to be considered while sourcing transportation services, namely transports rates and related charges, transit times, visibility and track and trace, on-time delivery and cost of transport management. This study raises the question that we want to further develop in our research: ‘Can transport be effectively purchased using common purchasing methods?’ (Holter et al., 2008, p. 7). The authors respond that transport purchasing follows the common purchasing strategies, but presents special challenges as transportation services are spread across several business functions. One of the arguments supporting this conclusion is that logistics costs are not limited to freight costs, but include also inventory in-transit, transport control and coordination, production planning and other costs. The results of the study show that the most optimal strategy for buying the transportation services in the case under study (small and middle size companies) is ‘cherry picking’ or selecting the best quotes for each transport route. This strategy outweighs commercially any benefits of strategic supplier relation with a single provider. Nevertheless, if we look to a longer perspective, for long-term projects multiple sourcing and order splitting becomes less attractive (Holter et al., 2008). The limitation of this work is the lack of the analysis of other factors influencing the sourcing decision, namely the risk assessment of different sourcing strategies or the factors of the environment. The authors raise a number of important questions regarding sourcing of transportation services but do not provide the detailed and well-reasoned answers. We set a target to find some of the answers in our thesis.

Danielis, Marcucci, & Rotaris (2005) study preferences of logistics managers for freight service attributes conducting interviews with managers from 65 different companies and performing an

adaptive conjoint analysis experiments with logistics managers. The results demonstrate that the main preferences of logistics managers are freight cost, transit time, risk of delay and risk of loss and damage with a strong preference for quality attributes over cost.

2.6 TYPES OF LSP-S

The theories regarded in the sections before were mainly answering the questions about how to source and how many to source, while in this part of the report we will review the literature giving the answer about whom to source. We aim at collecting the previous research dedicated to the role and types of logistics service providers especially in the context of exhibitions logistics.

Among the reviewed literature on event logistics, we could hardly find any investigation of the special traits and characteristics of the logistics service providers in this area. Only Guo (2010) briefly mentions that exhibitions industry is very expertise demanding when it comes to selecting the logistics companies. High-level specialization of event logistics providers requires qualified personnel with particular exhibitions logistics knowledge and expertise as well as the effective logistics chains, multifunctional warehouses and global presence (Guo, 2010).

We found a serious gap in academic research when it comes to the characteristics and types of logistics service providers in exhibitions industry. In order to cover this gap, we decided to study the relevant literature on the general logistics and introduce the hypothesis for exhibitions logistics to our model.

There are numerous definitions of logistics service providers (LSP) and third-party logistics (3PL) sometimes used as synonyms. It is generally noticed that there is a certain ambiguity in differentiation between several concepts: logistics service provider (LSP), third party logistics provider (3PL), freight forwarder, lead logistics provider (LLP). In many cases, these definitions are mixed and even regarded as synonyms.

A 3PL is an outsourced provider that manages all or a significant part of an organization's logistics requirements and performs transportation, locating and sometimes product consolidation activities (Logistics list, 2017). The term 3PL appeared in 1970s to identify the newly emerged intermediaries between the shippers and the carriers holding the transportation contracts (Shahraki and Yazdanpour, 2011).

Business Dictionary defines a freight forwarder as a company specialized in arranging storage and shipping of goods on behalf of the shipper. The definition of logistics service provider is a

company that provides management over the flow of goods between points of origin and destination. LSP often handles shipping, inventory, warehousing, packaging and security of shipments (Business Dictionary, 2017).

These definitions give no clarity in the differences between the concepts. Dechter (2008) differentiates 3PL and freight forwarders by defining a 3PL as a broader category that can include forwarding services. According to Dechter (2008), freight forwarders move cargo from point A to point B while 3PL move and store cargo and process inventory overlapping with traditional forwarding functions. The Law Dictionary though does not support the definition of Dechter and defines a freight forwarder as a company that handles not only actual transportation but also tracking, document preparation, warehousing, storage, space booking, consolidation, insuring and securing cargo (The Law Dictionary, 2017).

Shahraki and Yazdanpour (2011) differentiate between LSP, 3PL, LLP – lead logistics provider and 4 PL based on the criteria of relationship with a customer, service offerings and key attributes. According to the authors, LSP focuses on basic niche services with a target of cost reduction, has the least relationship with the customer and is basically the simplest form of outsourcing logistics services. 3PL occupies one step above and provides value-added services for the customer based on contractual relations with both fixed and variable pricing. 3PL offer enhanced capabilities and broader service offerings compared to LSP. LLP offers not only logistics services but also project management functions and technology integration. LLP is a single point of contact to the customer to manage other 3PL and share risks. 4PL is the most advanced type of service providers characterized by a strategic partnership with a customer, shared risks and reward, advanced technology capability and broad supply chain expertise. 4PL is actually acting on behalf of the customer in managing logistics activities (Shahraki and Yazdanpour, 2011).

As we see, there is no a clear border between different names of logistics providers and in many cases, all of those are treated as equal.

In order to improve competitiveness and meet the needs of the market, companies tend to outsource the non-core activities, like logistics services, to the third parties. Nevertheless, managing the logistics service providers is an important function due to the significant impact of logistics on the overall company efficiency and costs (Li et al., 2011). Another advantage of outsourcing logistics services to third party providers (3PL) is saving on capital investments (especially in a case of warehousing services) and reduction of financial risks (Tezuka, 2011).

Due to the high importance of logistics outsourcing, companies prefer to establish strategic partnership relations with logistics service providers or 3PL, therefore it is necessary to consider

the effective system for supplier selection based on various criteria, not limited to price (Li et al., 2011).

There is a wide bibliography of studies related to the outsourcing of logistics services and the role of third-party logistics providers in the supply chain. Marasco (2007) made an attempt at summarizing the existing valuable literature on this topic and reviewed 152 different works on 3PL. The advantage of this work is the classification of research according to the main topic and creating a catalogue of articles distribution by content.

Patterson, Ewig and Haider (2007) looked at a different perspective of 3PL activities, namely how 3PL companies select their carriers when it comes to intermodal shipping. They made a comparison with other end-shippers and found the negative bias of 3PL to intermodal transport (Zatterson et al., 2007).

Tezuka (2011) in his research provides the rationale for using 3PL services in supply chain highlighting the advantages of economies of scale and economies of scope that help to reduce total costs of logistics services. Tezuka in his work emphasizes the importance of service specialization of various logistics service providers based on the particular experience and know-how, international presence and global markets coverage. These advantages result in cost efficiency and highly skilled coordination of logistics flows and help customers to access wider geographical coverage as well as expanding to new markets (Tezuka, 2011).

Another important aspect of logistics service providers represented in a number of studies (Sehfi, 1990, Mongelluzzo et al., 2001, Du et al., 2009, Wilson, 2011, etc.) is the difference and the benefits of asset-based and non-asset LSPs. Asset-based providers are characterized by investments into own assets that they operate for the customers. Non-asset LSPs provide technology, management and resources (Wilson, 2001) and integrate into the customer's supply chain to offer a strategic approach to solving the customer's needs (Du, Jun, and Malco, 2009).

The recent study conducted by Du and Monge (2009) gives a multifaceted analysis of the advantages and limitation of different types of LSPs. According to the authors, asset-based LSPs aim at better utilization of owned assets (for example, truck or vessel fleet) and try to balance transport lanes and reduce random fluctuations to reduce the total logistics costs. The major limitation of asset-based LSPs is the lack of flexibility compared to non-asset providers especially when adjusting capacity to demand fluctuations. Non-asset LSPs offer logistics management and control services based on IT systems and personnel experience and know-how. They have more freedom to use the assets of other carriers depending on the level of demand and tend to be more integrated into customer's activities establishing the closer partnership. The answer to the question 'What type of LPS is more competitive?' depends on the market situation, LSP's competencies,

the required services and the customer's preferences (Du et al., 2009). These two types of LSPs are not always regarded as competitors (Du et al., 2009), but show a high level of collaboration and offer a combination of services when it comes to serving the complex tasks for customers' supply chains (Wilson, 2011). Mongelluzzo et al. (2001) reveal another strong tendency of asset-based companies to extend their services to carrier-neutral freight forwarding in order to gain higher margins and overcome the consequences of demand fluctuations.

A completely different approach to LSPs classification is offered by Lai (2004). The author focuses on the service capabilities of logistics service providers and uses statistical analysis to analyze the empirical data of 221 Hong Kong LSPs. The following 3 criteria were used to group the variety of services offered by 3PL companies: value-added services (assembling, packaging, cross-docking, labelling, fleet management, etc.), technology-enabled services (IT management, track-and-trace systems, etc.) and freight forwarding services. LSPs were assessed based on their capabilities in the mentioned three areas of services and the classification of LSPs was presented as an outcome of the study. Lai (2004) identifies four types of LSPs based on their service capabilities and specialization. Traditional freight forwarders have a low capability in value-add or technology-enabled services. Transformers show high performance in both freight forwarding and technology-enabled services and medium development of value-added services. Full-service providers possess a high level of capability in all three areas while niches lack the capabilities in freight forwarding and consolidation, but rather specialize in particular value-added and technology-enabled narrow areas of services like warehousing services or information management (Lai, 2004). The limitation of this paper is the absence of conclusions related to the use of the different types of LSPs for customers' needs. Nevertheless, the provided study may be useful in classifying the types of LSPs in event logistics.

Robinson (2014) suggests a classification of 3PL based on the types of provided services. The first type of LPS is a transportation based 3PL company that uses a combination of own and sub-contracted assets to offer transportation solutions. The second type of 3PL is a warehouse based one characterized by warehousing or distribution experience. The third type is called a forwarder based 3PL that is basically a middlemen between a shipper and a carrier performing mainly forwarding role, usually non-asset or with limited assets and offering a wide range of logistics services. The fourth type is a shipper / management based 3PL that focuses on the management of the shipping process, provides technology (TMS, track and trace, etc.) and information (freight data, reports) for better visibility and control of logistics chain. Financial based 3PL are limited to freight payment and auditing, cost control and monitoring as well as inventory management. The

sixth and the last type is information based 3PL mainly represented by Internet-based B2B electronic markets for transportation and logistics services (Robinson, 2014).

UN ESCAP (2013) maps logistics service providers according to the service level and identifies 6 distinctive types: carriers, warehousing providers, terminal operators, freight forwarders, non-vessel operating common carriers (NVOCC) and multimodal transport operator (MTO). Logistics service providers according to UN ESCAP mapping table is a broader definition of an operator whose services are not limited to the traditional forwarding, warehousing or transportation, but is extended further to the customer's supply chain. LSP may take over the outsourced functions of quality control and technical testing, logistics consulting and supply chain design, inventory management and project logistics, reverse logistics and even procurement (UN ESCAP, 2013).

We assume that the service specialization presented in the table below sets clear boundaries between the capabilities of various types of logistics companies. Taking into account the lack of unity in both academic and industry literature in regards to the definitions of logistics service providers as well as the presence of multiple approaches to classification of LSP-s, we decided to follow the UN ESCAP approach to defining the types of logistics providers.

Table 3. UN ESCAP Mapping of logistics services

Services	Carrier	Warehouse provider	Terminal operator	Freight forwarders	NVOCC	MTO	Logistics service providers
Carriage	x					(x)	x
Information services, including track and trace	x			x	x	x	x
Arrangement of transport operations	(x)			x	x	x	x
Warehousing (CFS)		x	x	(x)	(x)	(x)	x
Consolidation		x	x	x	x	x	x
Customs formalities and other order administration			x	x	x	x	x
Selection and integration of multiple carriers				x	x	x	x
Kitting		x		x			x
Assembly and processing of goods							x
Technical testing							x
Localization							x
Quality inspection							x
Lead logistics provision							x
Logistics consulting and supply chain design							x
Management of supply chain (including transport, warehousing and inventory)							x
Operation of supply chain							x
Project logistics							x
Procurement							x
Financial services, such as collateral management or insurance brokering							x
After market services, e.g. reverse logistics, returns and repairs							x
Outsourced call centre (e.g. technical and warranty enquiries)							x

Source: UN ESCAP, 2013

2.7 METHODS TO DEFINE A SOURCING STRATEGY

As discussed above, facing growing global competition, companies focus to take advantage of any opportunity to improve their resource utilization. Which sourcing strategy is the best for a company can be not evident. Thus, the company needs well-defined decision-making process. Researchers analyze and discuss different types of methods for supplier selection or defining sourcing strategies as vendor selection decisions are multi-objective in nature and cannot be easily solved.

Traditional approaches were based on selecting least invoice cost suppliers. However, in modern production environments other criteria become more and more important. Amongst the most significant ones are quality, electronic data interchange, delivery reliability, production capacity and geographical location (Degraeve and Roodhooft, 2000). Degraeve and Roodhooft (2000) review established methods for supplier selection. They discuss 'categorical method' when the relevant criteria for different suppliers are simply categorized in a limited number of classes (e.g. good, satisfactory and unsatisfactory), as well as 'linear weighting models', when different criteria are weighted and the supplier with the best weighted total score. 'Analytical hierarchy process model' is used as an approach that gives the opportunity to determine relative positions of the different suppliers based on pairwise comparison of weights and subscores. Another method is 'data envelopment analysis'. It is a performance evaluation tool based on the linear programming technique in which both quantitative and qualitative elements can be introduced. All these methods are focused on selecting one supplier for one order. Therefore, Degraeve and Roodhooft suggest using mathematical programming models to solve a problem with selecting the best combination of suppliers for one or more orders on the basis of the criteria defined and given different constraints.

As we mentioned above, Zeng and Rossetti (2003) define two streams in a framework for evaluating the logistics costs in global sourcing processes: one stream focuses on strategic aspects of the logistics costs, and the other deals with optimized cost-effective logistics decisions. The optimization-based method attempts to optimize the total logistics cost including transportation in conjunction with inventory and purchasing decisions. However, it has significant limitations with respect to the number of cost items, the possibility of finding the closed-form or easy solutions and the effect of international trade.

Habib, Lee and Memon (2016) emphasize that there are very few authors who suggested models that take into consideration of multiproduct, multiperiod, and multiobjective using a stochastic approach. It correlates with the problem of defining sourcing strategy for global event logistics, as sourcing is needed for different services, in different locations and in specific time-periods. While

in some cases timing and locations can be interconnected, for instance, late delivery in one location will mean late deliveries for all further-coming locations. Therefore, after reviewing the existing methods we have not found any methods developed for the needs and specifications of event logistics.

2.8 SUMMARY OF LITERATURE REVIEW

We have reviewed a number of different theories and studies that help us to understand the nature of event logistics and give the basis for analyzing the dominant sourcing strategies when selecting logistics service providers.

Summarizing the major traits of event logistics compared to the traditional supply chain, we can emphasize the following aspects:

- Complexity of event logistics due to its poly-lined structure of logistic chain
- Vast service portfolio
- Tight shipment schedules
- Complex customs legislation requirements
- High demand for particular event logistics expertise, professionalism, know-how, flexibility and creativity from logistics service providers
- Low volumes and high costs

These peculiarities of exhibition logistics make the appropriate sourcing strategy an important factor in both cost reduction and risk minimization. Outsourcing of logistics services to third party providers help to increase the level of expertise and ensure smooth operation before, during and after the event. Therefore, the answers to the questions ‘whom to source’ and ‘how many to source’ become of primary importance.

The selection of sourcing strategy between single, dual and multiple sourcing helps to identify the most beneficial number of service providers to perform logistics services of events and shows. Despite the abundance of research on this topic, very few of them are dedicated to a procurement of logistics services. Moreover, event logistics differs in its nature from the traditional supply chain in a number of factors mentioned above, so the sourcing strategy selection may be affected.

Using the conclusions of the reviewed literature we developed our own matrix of risk / benefit analysis of sourcing strategies in event logistics presented in Figure 5. This matrix is based on the Kraljic Portfolio Purchasing Model but adjusted to the purpose of this thesis to answer the research question 1.

According to the majority of sources devoted to product / material purchasing, each sourcing strategy can be characterized by a number of risks and benefits. It is generally assumed that single sourcing in product purchasing has a benefit of partnership relations between a buyer and a supplier and is more cost efficient due to economies of scale. Dual or multiple sourcing provide cost benefit due to the opportunity of bidding among several suppliers, but at the same time are usually costlier to manage. Several suppliers share the volumes and usually offer higher prices per unit if compared to single sourcing. From risk perspective, it is single sourcing that is considered as liable to supply disruptions while dual or multiple sourcing ensures back-up solutions and volumes flexibility including shorter lead times.

Description of hypothesis on sourcing strategies in event logistics

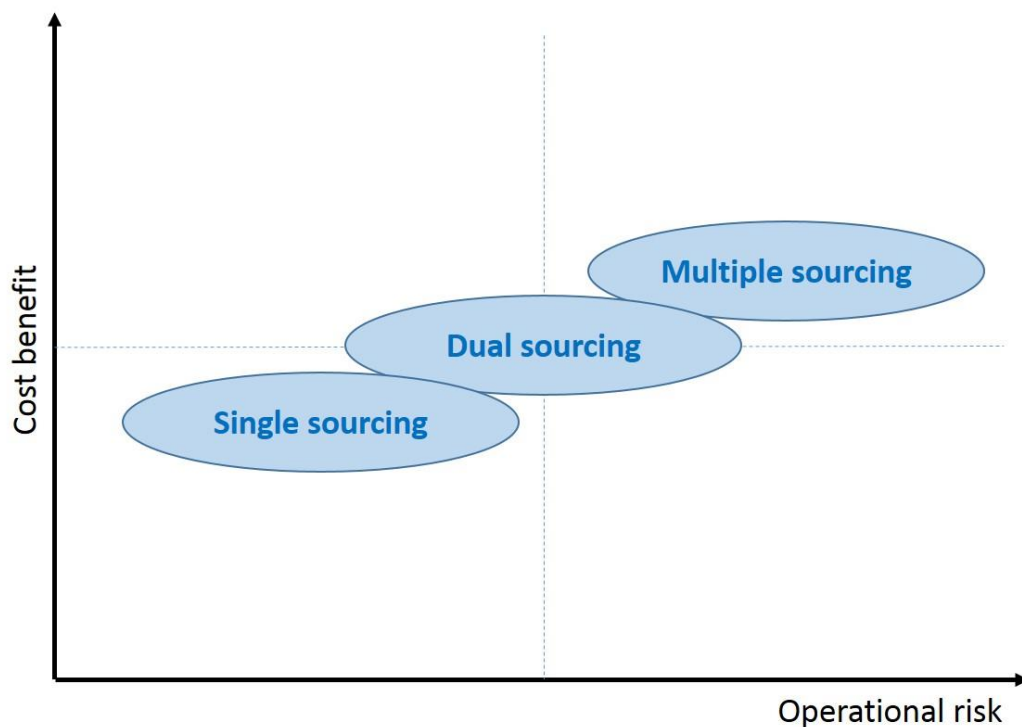


Figure 5. Matrix of risk / benefit analysis of sourcing strategies in event logistics

When applying the same type of risk / benefit analysis to event logistics, we assume that the picture changes a lot compared to product purchasing. Our approach to event logistics is presented in the matrix above. From cost-benefit perspective, we attribute lower value to single sourcing and consider that cherry picking among several providers can give more cost benefits than buying the whole pack of services from a single provider. It is partially explained by the lower volumes of event logistics compared to production supply chain where economies of scale and scope can play a more significant role. Service specialization among the logistics provider, on the contrary, can ensure lower prices and higher performance level due to expertise of each service provider in particular areas of event logistics.

From risk assessment perspective, we predict that single sourcing is less risky due to ‘umbrella coverage’ of the whole logistics chain from the pre-event to post-event phase. When splitting services to two or more providers, we face the higher risk of flow disruption due to higher complexity of managing multiple providers. At the same time, multiple sourcing gives more flexibility in case of non-performance or a lack of proper solutions by one of the providers when another one can serve as a back-up alternative. Our matrix shows the overlapping areas where different factors of environment can affect the sourcing strategy. We tried to capture the major trends and peculiarities of event logistics and present them in the matrix. We will test the validity of this hypothesis on the Volvo Ocean Race case and present the conclusions in the discussion part of this thesis.

This matrix serves as a theoretical background that will be tested later using the empirical data of Volvo Ocean Race.

Another question that we target to answer using VOR empirical data is what types of logistics service providers are most suitable to serve the purposes of event logistics. In the theoretical background part, we revised the recent studies on a comparison of asset-based (carriers) and non-asset based (forwarders) logistics service providers and the classifications of LSP-s presented by different authors and organizations. Our aim is to identify what types of LSP-s suit better the purposes of VOR from cost efficiency perspective.

3 METHODS AND METHODOLOGY

This section outlines the research design and describes the methodological approach adopted for the investigation, as well as describing the generalized developed mathematical model.

3.1 RESEARCH PARADIGM

We start this section with identifying the philosophical framework governing how our research is conducted (Collis and Hussey, 2014). This thesis is designed and performed under the positivism paradigm that is characterized by empirical research based on observation or experiment using logical or mathematical proof (Collis and Hussey, 2014). Positivism grounds on the viewpoint that trustworthy knowledge can only be gathered through measurements and observations proved by solid facts. The researcher’s role according to positivism is to gather and interpret data using objective approach and statistical analysis with observable and quantifiable findings. Moreover,

the researcher is considered to be independent of the study, so researcher's own interests and opinions should not affect the results of the study (Research Methodology, 2017).

Following Collis and Hussey (2014) we identify positivism as a paradigm where theories serve as a basis of explanation while explanation in its turn relies on establishing 'causal relationships between variables' under the deductive approach. Research under this paradigm uses mainly quantitative data and sets a target of testing a hypothesis or a model created on the basis of the existing theory. Paradigm is directly related to research design and identifies the methodology that is used to answer research questions as well as the methods of gathering and analyzing empirical data (Collis and Hussey, 2014).

3.2 RESEARCH DESIGN

Among the specific methodologies that are used under the positivism paradigm Collis and Hussey (2014) name experimental studies, surveys, cross-sectional studies and longitudinal studies. The nature of the two research questions calls for a three-stage exploratory approach. First, a review of the academic literature on event logistics and relevant areas was carried out to see how much discussion there is on event logistics and sourcing strategies for it. As a literature review is an essential part of any research, it enables authors to examine previous research done on the topic, conduct comprehensive overview, identify the relationship between concepts, identify gaps and help to work out how to answer the research questions in the best way. Next stage is determining data gathering and analysis techniques. Frankel, Naslund, & Bolumole (2005) discuss that research in logistics does not tend towards one or several research methods. Logisticians approach research from a different perspective, utilizing quantitative methods to do more positivist research, as well as qualitative methods to conduct interpretative studies. Ratliff and Nulty (1997) highlight that mathematical optimization is a powerful class of quantitative models, tools, and algorithms. It can be used to automatically generate and examine a big number of decision alternatives and select the most appropriate according to user requirements, goals and constraints.

Quantitative method will be used in this thesis to ensure precision of conclusions. It was motivated by research questions and usual data availability to respond them. A mathematical model, as a mathematical description of a real-world phenomenon, in this case, cost expectancy enables users to understand the phenomenon and to make a prediction about future behavior – which sourcing strategy will be most efficient considering costs and risks. The next stage is a development of a general mathematical model for selection of efficient selection of suppliers taking account costs and risks. This is followed by an analysis of logistics of Volvo Ocean Race, an adaptation of the general model to the case of VOR and empirical analysis of model with real data from suppliers

to define best sourcing strategy for VOR. Therefore, quantitative methods will be used to answer the research questions of interest.

3.3 MODEL DEVELOPMENT

In this section, we present a general mathematical model that can be used for the determination of an optimal sourcing strategy for the logistics of events. We assume that the company can select only one supplier for one type of services. Terms ‘supplier’, ‘carrier’, ‘service provider’ or ‘logistics service provider’ will be used as synonyms in this thesis. Nevertheless, the difference is made between the definitions of a ‘freight forwarder’ and a ‘carrier’ or an ‘ocean carrier’ that corresponds to UN ESCAP classification provided in the literature review part. Figure 6 illustrates the process of mathematical modelling. Given a real-world problem of sourcing strategy selection, the first task is to formulate a mathematical model by identifying based on what factors this decision can be made and simplifying the phenomenon enough to make it mathematically tractable. We use our knowledge of the event logistics and sourcing of services and our mathematical skills to obtain an optimization model. All these steps enable to create a general mathematical model.

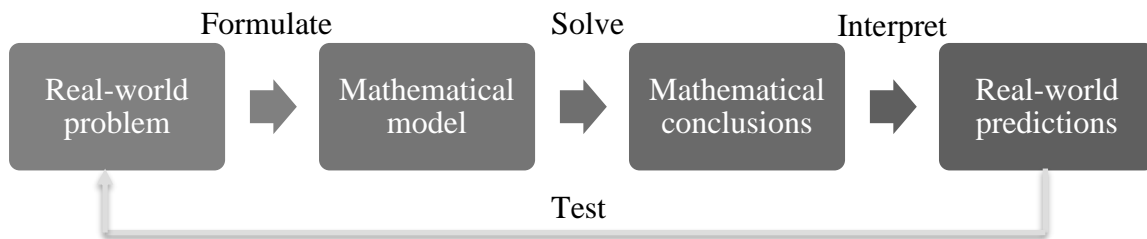


Figure 6. The modeling process

Source: Stewart, 2005

Next step is data collection and examination of data to discern patterns. These steps are considered to be different for every single case and help to answer specific questions, in the frame of this thesis it is an identification of efficient sourcing strategy for VOR.

Model description and notation

The objective of this model is to determine the optimal sourcing strategy for supplying logistics services for a worldwide event. The model minimizes the total cost of all logistics services that are needed for organization of the event and this model considers risks of late deliveries for timely-sensitive services. It enables the selection of the most efficient combination of suppliers who will

provide high-quality services while balancing costs and quality. The total cost of all services consists of a sum of costs for every needed service. Therefore, the cost for every service is presented as a mathematical expression that enables to calculate costs for individual service and as result to present a mathematical expression for the weighted expected total cost. Our target is to minimize this cost considering the probability of delayed deliveries. However, an aim of the model is to identify best sourcing strategy – the best selection of suppliers for the event logistics process based on defined cost minimization.

Before stating the model, we give a summary list of the notation and definitions which are used to formulate the proposed expected cost optimization model.

An assumption of this model is that suppliers are assigned to run a full set of one type of services. For instance, only one supplier is responsible for air freight or for container rent.

All required services for event logistics can be classified into two types: with or without a time component. This categorization is required for our model to be able to include risk of late deliveries in the model. Services without time component (n) are services that an organization buys in required quantity and with an appropriate price. These services are not dynamic. Therefore, time component is absent in it and risks of late deliveries are not applicable for these services, however, they can have many other risks, but they are out of the scope of the focus in this model. Examples of such services are rent of containers, rent of handling equipment, handling services etc.

Another group is services with the time component (z). It includes services sensitive to lead time. These types of services include, for instance, transportation between locations when late delivery is crucial for an event. If cargo arrives later than it is expected, all event planning will be threatened and can lead to considerable extra costs. Therefore, the risk of delayed deliveries ($1-\pi$), where π is a probability of successful (in time) delivery ($\pi \in (0..1)$), should be included in total cost estimation. The difference between lead time proposed by a supplier and required lead time (T_d) can define the risk of late deliveries. If a company does not find a supplier (j,l) who will provide services within required time, then this company need to use another type of services (x) that can lead to extra costs.

C	Total cost for one type of services for one supplier
n	Services without time component
z	Services with time component
i	Routes (directions) for transport services or types of needed services
Q	Quantity of different services
π	Probability of successful (in time) delivery; $\pi \in (0..1)$

P	Price for service (per unit or per route)
x	Extra service that will be used in case of high-risk of delivery
T_d	Difference between required lead time and proposed lead time (days)
T_f	Free time demurrage import (days)
P_s	Price for storage for one day per unit
j	Any supplier
l	Any supplier
s	Servive - Storage of containers
φ	Number of days when delivery success = 100%
∂	Number of days when delivery success = 0%
SS^*	Optimized Sourcing Strategy
J	Set of all possible portfolio combinations
L	Set of all possible portfolio combinations

With the assumptions given above, the mathematical model is described as following and presented as Equation (4), while calculation of sub-components presented by Equations (1),(2),(3). The calculation methods of costs for individual services are given by Equation (1) and (2).

Equation (1) is total cost (C_{nj}) for one of the suppliers (j) for one type of services without the time component (n). It is calculated as a sum of costs of all service specifications. These costs are calculated as the multiplication of price (P_{nij}) of service n for route i from supplier j and quantity (Q_{nij}) of this service n for route i . Logistics of different events can vary and can include a different number of services without the time component. However, the total cost per supplier per service without the time component should be calculated with Equation (1).

$$C_{nj} = \sum_i P_{nij} \cdot Q_{nij} \quad (1)$$

C	Total cost for one type of services for one supplier
n	Services without time component
Q	Quantity of different services
P	Price for service (per unit or per route)
j	Any supplier

Equation (2) is total cost (C_{zl}) for one of the supplier (l) for one type of services with the time component (z). The total cost of these services will be evaluated as a weighted expected cost, as risk component needs to be included. Depending on risks company will use standard service (z) or

extra service (x). Risks are expressed as a probability of not happening a successful delivery (π), which is equal to $(1 - \pi)$. Therefore, first part of equation (2) consist of two parts, first one ($\pi_{zil} \cdot P_{zil}$) present weighted price for in time deliveries (probability of successful delivery is multiplied with price for ocean freight), while second part ($(1 - \pi_{zil}) \cdot P_{xil}$) stands for late deliveries and expressed as hundred per cent probability that event will happen (=1) minus probability of happening in time (π_{zil}). This expression is multiples with a price of extra services (P_{xil}).

$$C_{zl} = \sum_i \left[\pi_{zil} \cdot P_{zil} + (1 - \pi_{zil}) \cdot P_{xil} \right] + P_{zsil} \cdot \left\{ \begin{array}{l} 0; \quad \text{if } (T_{dil} - T_{fil}) \leq 0 \\ (T_{dil} - T_{fil}); \quad \text{if } (T_{dil} - T_{fil}) > 0 \end{array} \right\} \quad (2)$$

- C Total cost for one type of services for one supplier
- z Services with time component
- i Routes (directions) for transport services or types of needed services
- Q Quantity of different services
- π Probability of successful (in time) delivery; $\pi \in (0..1)$
- P Price for service (per unit or per route)
- x Extra service that will be used in case of high-risk of delivery
- T_d Difference between required lead time and proposed lead time (days)
- T_f Number of days with free demurrage
- l Any supplier
- s Service - storage of containers

To evaluate the probability of in time deliveries difference between proposed lead time and required lead time (T_d) need to be parameterized. The probability of occurrence of different possible outcomes in any procedure that can be repeated and has a well-defined set of possible outcomes can be defined as a mathematical function -probability distribution (Freund and Williams,1972). The process of parametrization enables to decide and define the parameters necessary for a relevant specification of the probability distribution. Equation (3) present general form of parametrization for this model. Every company can define their own risk perception and select suitable function that will describe a difference between proposed lead time and required lead time (T_d) in terms of parameters (π). Days characterize high and low probability of successful deliveries can be defined using expert opinion, while probability distribution needs to be assumed.

$$\pi = \begin{cases} 0, & \text{if } T_d < \partial \\ \pi(T_d) \in (0,1), & \text{if } T_d \leq \varphi \\ 1, & \text{if } T_d > \varphi \end{cases} \quad (3)$$

- π Probability of successful (in time) delivery; $\pi \in (0..1)$
- T_d Difference between required lead time and proposed lead time (days)
- φ Number of days when delivery success = 100%
- ∂ Number of days when delivery success = 0%

The total cost of services with the time component (C_{zl}) considers as well other extra costs, for instance, this general model includes extra costs for extra storage. When services are dynamic and they cannot guarantee 100% probability of time delivery or they propose too fast delivery, which is good, that cargo is coming in time, but it means extra days it need to be saved and it will lead to extra costs for storage. Therefore, the model evaluates if extra costs should be included in every route, depending on required lead time, proposed lead time and days with free demurrage (T_f). Difference between required and lead time is compared to a number of free demurrage days. These difference (number of days) need to be paid extra. Therefore, second part² of Equation (2) define a value of extra costs, it can be 0 or if a difference is more than 0, a number of days need to be multiplied by a price per day.

The objective function (4) - is an expression of our model, which is used to define best sourcing portfolio, is an argument minimization of the total cost of all types of logistic services required for event organization. This function will calculate a price of all possible combination of sourcing combinations and define the most cheaper solution and which combination with which supplier it corresponds to.

$$SS^* = \underset{\{j \in J, l \in L\}}{\operatorname{argmin}} C_{nj} + C_{zl} \quad (4)$$

- C Total cost for one type of services for one supplier
- n Services without time component
- z Services with time component
- j Any supplier
- l Any supplier

²By the second part of the Equation (2) we mean the next part: $P_{zsil} \cdot \begin{cases} 0; & \text{if } (T_{dil} - T_{fil}) \leq 0 \\ (T_{dil} - T_{fil}); & \text{if } (T_{dil} - T_{fil}) > 0 \end{cases}$

- SS^* Optimized Sourcing Strategy
- J Set of all possible portfolio combinations
- L Set of all possible portfolio combinations

Figure 7 demonstrates general logic of the developed model and its structure.

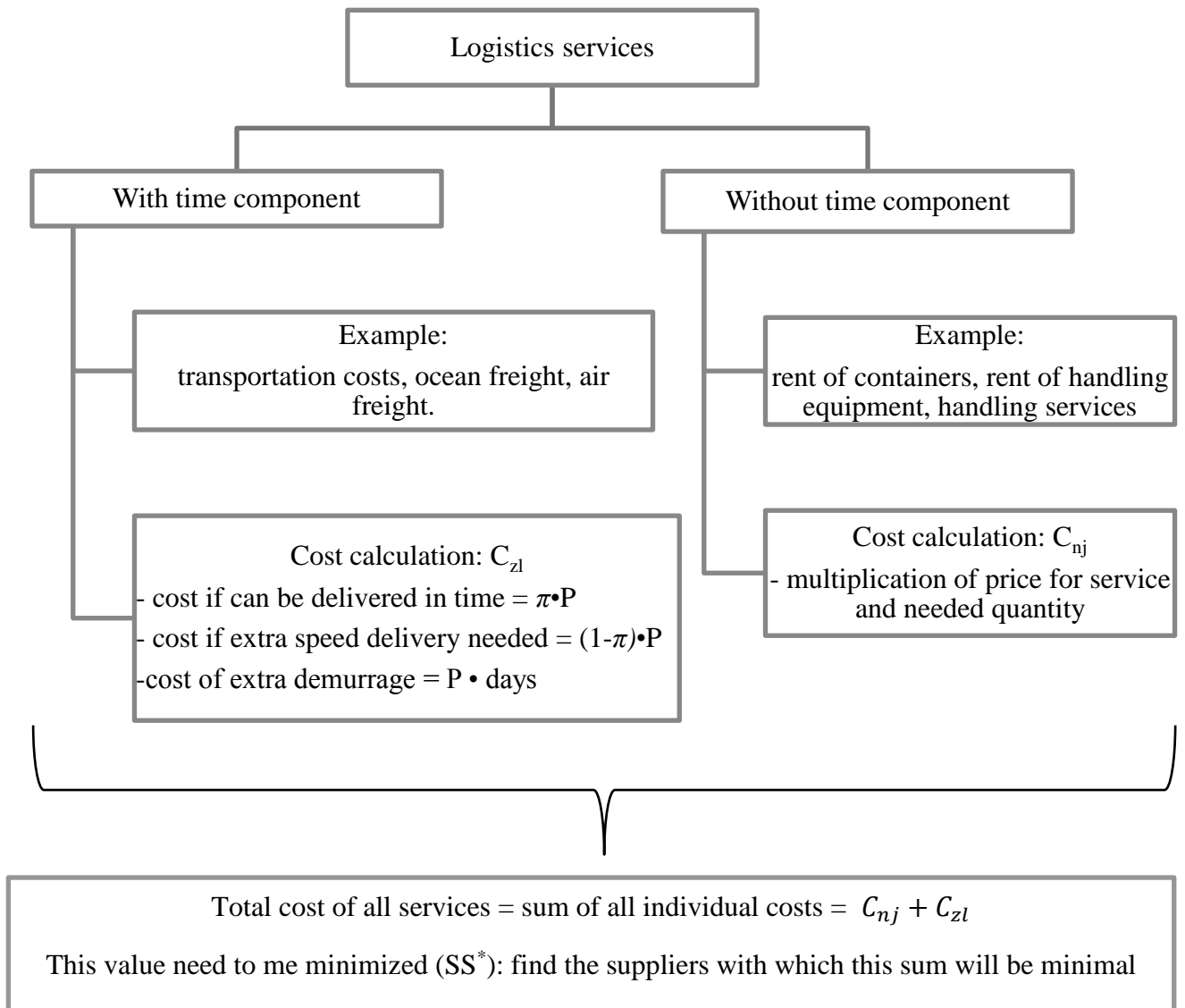


Figure 7. Structure of the general model

This model needs to be updated or adjusted for every individual case and it can be much complicated or simplified depending on the needs and processes of every event. One evident element which is needed but was not included to avoid overloading of general model is a quantity of transported elements (for instance number of containers of a specific size).

This model can be solved using standard numerical packages (Excel, Matlab, Python etc.).

4 EMPIRICAL IMPLEMENTATION: VOLVO OCEAN RACE

In this section, an empirical study is displayed to illustrate the application of the proposed model to evaluate and identify the best sourcing strategy for logistics of Volvo Ocean Race 2017-2018. Description of the sourcing strategy problem during VOR, data collection and validation as well as model adaptation and empirical analysis is conducted in this session.

4.1 BACKGROUND AND PROBLEM DESCRIPTIONS

Volvo Ocean Race data collection

General VOR logistics setup can be described as transportation, build-up and dismantling of the pavilions in each stopover on the VOR map. Materials need to be delivered to the next VOR stopover, customs cleared, delivered to the race village site, unstuffed and unpacked. After that, the pavilions are built up and prepared to accept the VOR participants during the stopover. Certain exhibitions and events take place in Volvo Cars pavilions throughout the world during each VOR stopover. After the stopover is finished and race participants leave for the next stage of their journey, pavilions are dismantled, packed, stuffed into the containers, customs cleared and sent further on to the next race stopover point.

Logistics services are required during not only the official VOR dates but also cover pre-race and post-race stages. The starting point of the VOR according to the maps presented in the introductory parts of this thesis, is Alicante (Spain), whereas the logistics routing in the RFI starts with pre-race volumes coming from the material suppliers and warehouses or factories in Germany and Sweden. This means that before the first pavilion is built in Alicante, materials should be picked-up, stuffed into the containers and delivered from the place of origin to the race village at the starting point of the race. The same applies to post-race transportation services after the last pavilion is dismantled in the race destination point The Hague, materials are brought to the warehouse in Gothenburg (Sweden).

The transportation part of VOR logistics is the biggest and most complicated; routing of the containers does not follow the race due to tight lead times needed to prepare the pavilions in each race city. Generally, there are 2 big and 1 small pavilions leap-frogging to follow the race routing.

All materials are divided into 12 kits: 11 for ocean and 1 for air transportation. Cargo for ocean freight is stuffed into containers that form 11 kits following 9 separate routings presented in Figure 7 below. Kits 1-11 consist of a combination of 40'HC (high cube), 40'OT (open top), 40' FR (flat

rack), 20' HC (high cube) and 20' RF (reefer) containers. Kits follow separate routes depending on the pavilion configuration on each stopover.

Kit 12 consists of 2 ULD (Unit Load Device) for air shipments that follow the major VOR route marked red on the map below.

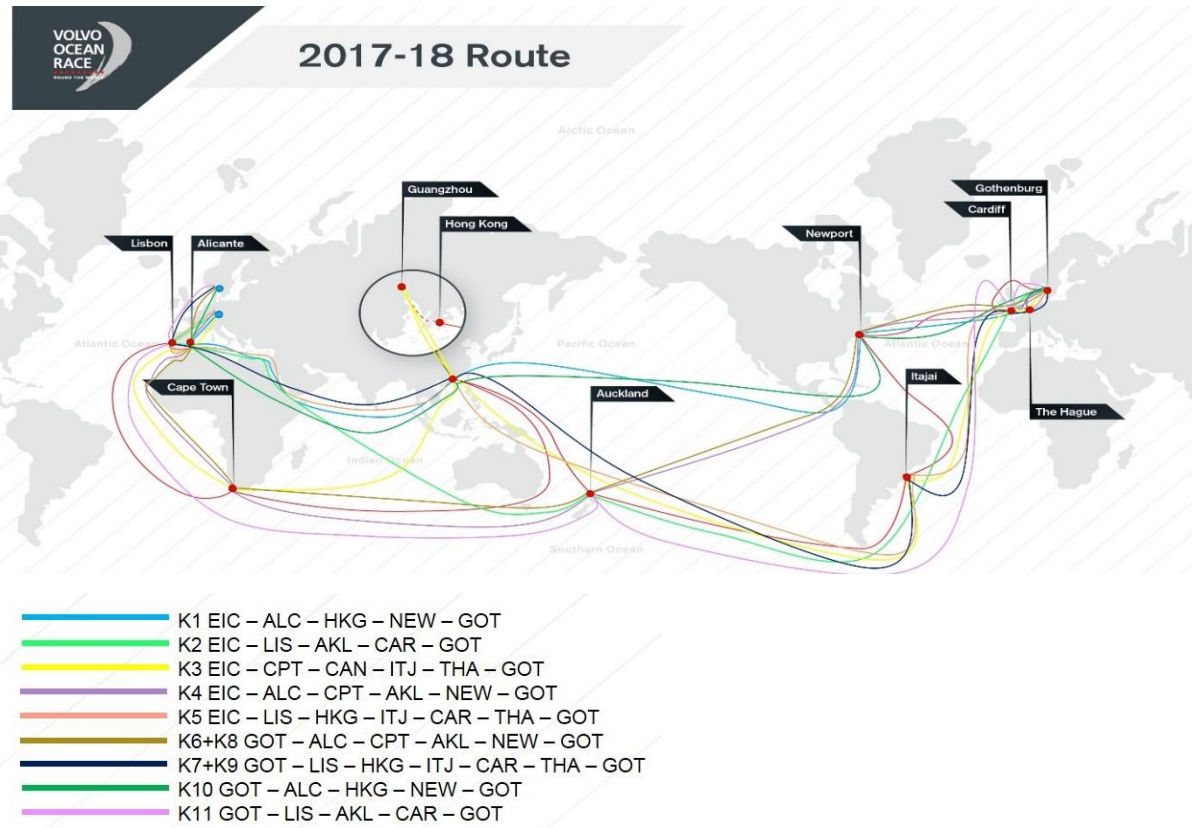


Figure 8. VOR Logistics (Volvo Cars) Routings. (EIC is Laufental-Eichenrod (Germany))

The analysis of VOR logistics is based on the commercial data gathered by Volvo Cars indirect purchasing department (further referred to as IDP). This type of data should be considered as a secondary data since the authors of this thesis have received the data from a third party, namely, Volvo Cars IDP.

Empirical data contains price lists and lead time information acquired through the standard sourcing process of Volvo Cars IDP that consists of RFI (request for information) and RFQ (request for quotation) stages. These requests communicate business needs to potential participants and asks them to propose goods or services to fulfil the business needs. The participant typically includes pricing information in the response. However, the price might not be the most important factor in the selection. As in this case lead time and thus a risk of late deliveries will be taken into account while making a decision.

IDP sourcing process may include both stages or just one of those depending on the aim of the request. RFI serves the purpose of gathering relevant market information or acquiring price

indication for project calculation and evaluation of the sourcing strategy. RFQ is a bidding process itself that has an end target of nominating the service provider or a supplier for signing the contract (Volvo Cars, 2017).

VOR sourcing process started with the RFI stage to identify the most cost efficient combination of service providers to ensure smooth operation of VOR. The expected outcome of the RFI process is to gather the market information regarding the available services, service providers, prices and lead times to meet VOR logistics specific requirements and to identify the sourcing strategy for future RFQ. RFI instructions contain the following description of the purpose: “Current RFI (request for information/rates indication) is launched by Volvo Cars to find the most optimal solution for organizing the logistics of Volvo Ocean Race that will take place in 2017-2018” (Volvo Cars, 2017). The involved parties from Volvo Cars side are Exhibitions department (VOR group) as an internal stakeholder, budget holder and technical support and IDP as a leading function for the bidding process.

RFI process is initiated at the end of February 2017 and contains two separate setups for different types of participants. The list of bidders consists of 6 freight forwarders with a relevant experience in event logistics and 2 ocean carriers (shipping lines). The names of the RFI participants will not be disclosed due to confidentiality reasons.

Table 4. Types of services of VOR RFI (based on Volvo Cars data)

No	Types of services	Freight forwarder	Ocean carrier
1	Container rent services	X	
2	Booking agent + customs + intermediate storage services	X	
3	Ocean freight services	X	X
4	Airfreight + customs + intermediate storage services	X	
5	Material handling equipment services	X	

RFI pack for ocean carriers is limited to port-port ocean freight services including origin and destination terminal handling charges (OTHC and DTHC). RFI pack for freight forwarders contain 5 major groups of services that are considered as 5 types of services for the sake of this thesis: container rent, booking agent, ocean freight, airfreight and material handling equipment (MHE) services (Volvo Cars, 2017).

3 out of 6 invited freight forwarders refused to provide the quotation and participate further in the bidding process due to several reasons including (but not limited to) complexity of VOR logistics setup, extremely tight deadlines especially for particular lanes, limitation in available resources

and others. As an outcome of the RFI 3 freight forwarding quotations and 2 ocean freight quotations were received.

4.2 DATA DESCRIPTION

This section provides empirical data description and cost structure.

Empirical data description

As the types of services are very different in their nature, the applied rate structure is developed separately for each type of service. We will give data description separately for each group of services mentioned in Table 4.

1. Container rent services

Logistics services are extended in the timeline of the VOR both for pre-race and post-race stages and take place over about 11 months. During this time Volvo Cars uses both sea and air containers for cargo movements. In order to cover the needs for containers, the strategy is selected to rent containers for the whole VOR period from a third party.

According to Volvo Cars calculation, the number of required containers is 100 sea containers of various sizes and types (40' HC, OT and FR, 20' HC and RF) and 2 ULD LD-3 XKN air containers.

The rates are requested per container per a week of rent in a common currency USD (US dollar). Besides the rent, the containers need to be delivered from the depot to the loading place before the start of the race and returned to the depot after the race finish. The pre-race loading places are Eichenrod (Germany) and Gothenburg (Sweden). Rates are quoted per roundtrip per container in a common currency USD.

2. Booking agent + customs + intermediate storage services

These types of services are related to the ocean freight, but are limited to freight forwarding and exclude port-port freight services. Rates are quoted per each ocean route (totally 102 lanes) and contain the breakdown into the following costs:

- booking agent services (including issuing a bill of lading – B/L, booking a vessel capacity with a shipping line, filling in the required documentation);
- customs services (export and import, ATA carnet);
- pre-carriage (delivery of containers from the origin site to the port of loading);
- on-carriage (delivery of containers from the port of discharge to the destination site);

- intermediate storage between the time of arrival and the time of required delivery to the race village;
- lifting services (lifts on and off the container chassis at the race village).

Some services are quoted per container (pre- and on-carriage, lifts or storage), other per shipment or consignment or document (customs services, B/L, documentation fee) in a common currency USD. All transport related services should contain the indication of the lead times.

3. *Ocean freight services*

These are port-port ocean freight services that consist of origin and destination terminal handling charges (OTHC and DTHC), ocean freight rate, bunker and other related surcharges (ISPS, CAF, GRI, VGM, AMS, etc. if applicable). Lead times for port-port delivery are indicated as a part of the rate structure.

4. *Airfreight + customs + intermediate storage services*

These services cover the full door – door services related to airfreight. Rates are quoted per each air route (totally 9 lanes) and contain the breakdown into the following costs:

- customs services (export and import, ATA carnet);
- pre-carriage (delivery of ULD from the origin site to the airport of loading);
- airfreight services;
- origin and destination terminal handling charges;
- on-carriage (delivery of ULD from the airport of destination to the venue);
- intermediate storage between the time of arrival and the time of required delivery to the race village.

Some services are quoted per ULD or kilogramme of chargeable weight (pre- and on-carriage, airfreight, storage), other per shipment or ULD (customs services, handling charges) in a common currency USD. All transport related services should contain the indication of the lead times.

5. *Material handling equipment services*

Material handling equipment (MHE) is required at each of 11 VOR stopovers in order to build up and dismantle the pavilions. MHE units are rented for a defined amount of days and include:

- cherry pickers with 18 m articulated boom,
- counterweight forklifts of 3.5, 5 and 6 tonnes with diesel engines, light towers and fork extensions,
- scissor lifts with 6 and 8 m reach, 200 and 500 kg capacity,
- flatbed trucks 6-8 m long and

- mobile cranes 60-80 tonnes.

Cherry pickers, forklifts and scissor lifts are rented without drivers and are used 24/7 including diesel / LPG or another type of fuel. Flatbed trucks and cranes are required with drivers and the working day is limited from 7 a.m. till 8 p.m.

The rate structure is created as per the venue and the type of equipment, the required number of days for rent (build-up phase and dismantle phase) are pre-set by Volvo Cars. The LSP-s are required to quote a price of MHE rent per day of work and the rate of MHE delivery to/from the venue site. For flatbed trucks and mobile cranes that are provided with drivers, the daily rent rate is divided into weekdays and weekends or holidays from 7 a.m. till 8 p.m., additional rates are quoted for an hour of overtime. Common currency USD is applicable to all venues irrespective of their actual location, currency exchange rates fluctuations are covered by the service providers.

As we see from the description above, the rate structure is very complicated and diverse depending on the type of required services. This requires a broad service scope from the potential LSP-s and a wide global network of sub-contractors with different service profiles.

Cost structure of VOR logistics (Volvo Cars)

In the theoretical framework part, we regarded the example of the cost structure of exhibitions logistics and identified that transportation costs and on-site handling (or using material handling equipment) constitute the biggest portions of the event logistics budget. We created similar cost structure using VOR logistics data to trace if VOR follows the same pattern typical for other types of events and trade shows. We used the initially received data of one freight forwarder without price adjustments according to lead time analysis (described later in the model analysis part) to create the graphical presentation of the cost structure of VOR logistics as shown in Figure 9. below.

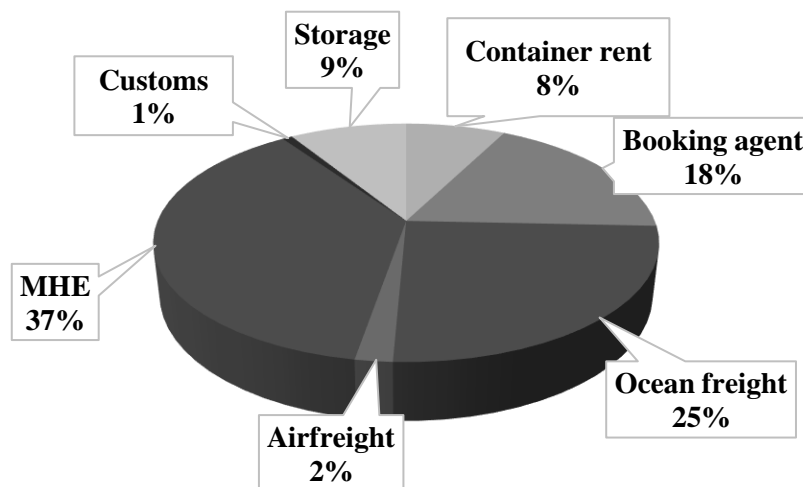


Figure 9. VOR cost structure

This cost structure corresponds to the earlier revealed trend of transportation and MHE costs being two major parts of expenses for event logistics. In this paper VOR costs are compiled into 5 types of services where customs and intermediate storage costs constitute a part of a booking agent or airfreight services respectively.

Lead time analysis and generating the adjustment factor

As stated in the literature review, lead time precision plays a crucial role in event logistics. Late delivery of materials to the venue site may lead to total failure of the exhibitor to assemble the booth or pavilion on time and be ready for the start of the exhibition. This, in its turn, means a failure to achieve the target of participation in the event and creates massive expense with no return on investment.

VOR share all the major features of event logistics and the biggest challenge to logistics service providers is to meet the required transit times to deliver the materials to race villages on the set dates. Any delays in delivery lead to shortened time for pavilion assembly and may even result in the race village being unprepared when the race boats come for the next stopover.

In order to avoid these situations, race organizers set strict requirements to match the race timelines and plan the transportation services accordingly. The major transportation mode to deliver VOR pavilions is ocean freight, which makes the reliability of ocean carriers' services of primary concern and importance. The challenge of meeting tight lead times is delegated to 3PL companies that need to find proper logistics solutions to support the race schedule.

One of the most important criteria of comparing commercial quotations offered by logistics service providers is the analysis of the ocean freight lead times. This criterion is incorporated into our mathematical model to suit Volvo Cars requirements and make the model results reliable. The first step of calculation includes the analysis of the difference between the quoted and the required lead times. The next step is to set the criteria for assessing the gaps and the final stage is to quantify the late deliveries putting certain price value to the risks of delay.

If we compare the total price of ocean freight services per all 22 lanes for approximately 100 containers, the best price is offered by ocean carriers 1 and 2. The price difference between ocean carriers and freight forwarders for ocean freight services amounts to 12%. Despite the possibility to select the cheapest and best suitable services on each lane by sub-contracting several shipping lines, freight forwarders can hardly compete in price with ocean carriers that offer discounts for the customers in case of significant volumes.

Nevertheless, ocean carriers may lack services on particular routes or offer the service with much longer lead times compared to the market. Taking into account the importance of lead times

precision in event logistics, we need to adjust ocean freight prices using the lead time analysis. Only after this adjustment is performed, we can make a proper comparison of the results to suit our model.

The results of the lead time analysis show that not a single LSP matches all required lead times. This shows that logistics was underestimated and even neglected when planning race schedule. Particular issues with lead times arise on the routes from Newport to Gothenburg, from Cape Town to Guangzhou, from Guangzhou and Hong Kong to Itajai and from Itajai to Cardiff. On the routes where no ocean services are available, the alternative solutions need to be developed, i.e. boat chartering or airfreight. These alternative solutions bear much bigger expenses and increase total logistics costs of VOR. As the sourcing process of VOR logistics is not finished yet, we lack the precise data on the costs of alternative solutions. For our model, we made an assumption that the costs of alternative modes are about 5 times more expensive than standard ocean freight solutions. For our model we used this assumption to increase ocean freight rates for the lanes where required lead times are not met. This assumption, although not precise, does not affect the model results and reliability. Actual data may be uploaded to the model when it becomes available.

Our model is based on the input that the difference in required and offered lead times of +5 days and more is considered as 'no risk' for the race logistics. When the gap is 0 or below, it is an evident delay in delivery critical for the race scheduling where alternative solutions should be applied. For the difference in lead times between +1 and +4 days, risk assessment is applied as the probability of possible delays (in a case of any disruption in ocean freight scheduling, customs clearance delays, etc.) and delay risk probability index is introduced as an opposite value to a probability of in time delivery. This index is applied as $1 - \text{probability of in time delivery}$ and correspond to of 0.2 if the gap is +4 days (low probability of delay), 0.4 for +3 days, 0.6 for +2 days (middle probability of delay) and 0.8 for +1 day (low probability of on-time delivery is equal to high probability of delay). This index is used to introduce the price increase for all cases where risk is present in the lead time analysis.

For example, if the required lead time on a route is 48 days and the offered lead time is 46 days, the difference in lead times is +2 days that equals to 0.4 probability of on-time delivery and equal to 0.6 delay risk probability index, so in 60% of cases we see a risk of actual delays in lead times and a need to evaluate alternative faster but more expensive solutions. So, the price for this lane will be calculated as 60% as the increased price (multiplied by 5) and 40% normal ocean freight price. If the difference in lead times is below 0 days, this means that we need to apply the alternative solution to 100% of volumes.

When the actual prices for alternative solutions are available, the same delay risk indexes should be applicable to calculate the final costs for ocean freight.

After applying the lead time price adjustment, we noticed that the commercial situation among the bidders has changed and ocean carrier 2 lost its leading positions due to longer lead times. Freight forwarders 1 and 3 on the contrary, improved their ranking due to the better combination of services with most optimal lead times.

Descriptive data analysis

Data for analysis, as described above, consists of the combination of price information and transportation time. All data is quantifiable, measurable and suitable for testing the described model.

Data is structured according to the type of service applied, namely grouped into 5 service levels: container rent, booking agent, ocean freight, airfreight and material handling equipment (MHE) services. Data also contains certain pre-set requirements similar to all RFI participants, i.e. the dates of stopovers or pavilion build-up/dismantling and volumes.

As soon as the results of the RFQ were obtained, we did data validation to ensure that in the conducting empirical analysis clean, correct and useful data will be used. Therefore, we did check for correctness, meaningfulness, and security of data that will be input to the model. Moreover, this analysis enables to see how to differ quotations between different suppliers and to get a general overview of RFQ results and if needed to rate the importance of questions and pricing. Figure 10 shows what services can be provided by which supplier. Due to data confidentiality, we do not announce names of the suppliers, but call them FF1, FF2, FF3, OC1, OC2, where FF stands for a freight forwarder and OC for Ocean Carrier.







Services	Suppliers		Freight Forwarders			Ocean Carriers	
			FF 1	FF 2	FF 3	OC 1	OC 2
	 Container rent services			✓	✓	✓	
 Material handling equipment services			✓	✓	✓		
 Airfreight + customs + intermediate storage services			✓	✓	✓		
 Booking agent + customs + intermediate storage services	<div style="border: 1px dashed black; padding: 5px; width: fit-content;"> <p><u>These 2 services are combined & presented as 1 service in our model</u></p> </div>		✓	✓	✓		
 Ocean freight services			✓	✓	✓	✓	✓

Figure 10. Allocation matrix of services provided by suppliers

Ocean freight services can be sourced by one of 5 different companies (3 forwarders and 2 ocean carriers), all of them provided lead-time for every requested route as well as prices. All these responses presented with positive numbers, that correspond to the logic of price and lead-time structure. Comparison of lead-times between suppliers for every route shows that there is a big distribution in proposals. For example, the largest difference in lead time is 31 days between Alicante and Cape Town, so we can predict that some lead time will be riskier than others when such big differences are presented. The total cost for this route between suppliers also differs significantly, and the highest rate is 41% higher than the lowest. Therefore, in this case 2 factors need to be considered when deciding about a supplier, as the lower price can have longer lead time and exceed the required lead time. However, the lowest difference is 1 day between Auckland and Cardiff for Kit2. Therefore, all suppliers proposed almost the same lead-time for this route. While total costs for this route differ between suppliers and difference between the lowest and highest rate is 28%. This is an example where price will be more important than lead time. The highest difference in price rate between suppliers is for the route Gothenburg – New York and account for a difference between highest and lowest in 222%, while the lowest difference is 11% for Kit11 between Auckland and Cardiff. The average difference in supplier price rates for all routes is 70%, while the highest number of routes (38%) have a difference in price rates between 11 and 46%. VOR does not make a decision of suppliers for individual routes, however, different routes will have different rates and different suppliers can win for different routes. But in this case, we need to consider total value. Therefore, it is important that developed generalized model enables us to weight every route and to make a well-considered decision with a choice of supplier.

Every requested route has required lead time needed in terms of VOR when we compare it with requested lead time we can conclude that there is no supplier who proposed lead times that will satisfy a requirement of VOR. The number of routes that will not fit in the timeline of VOR range between all suppliers from 15% to 31% out of all routes. All 5 suppliers proposed lead time higher than required for 3 routes: New York - Gothenburg (kit 1 and 10), Guangzhou – Itajai (kit 2) and Itajai - Cardiff (kit 7 and 9). Therefore, ocean freight transportation does not fit for these routes and alternative faster transportation will be used. However, all suppliers propose a satisfactory lead time for 75% of the all routes. This analysis emphasizes how important is an estimation of risks and include a weighted value for services that are affected by time-component.

Container rent services can be sourced by one of 3 freight forwarders. Results of RFQ contain cost rates for rent and delivery 6 types of containers. The lowest distribution in prices is for 40' HC OT container, while the highest for Air ULD LD-3 XKN containers.

Intermediate storage services can be served by one of 3 freight forwarders. Depending on lead time and proposed free demurrage intermediate storage will vary. As we mentioned before the company have a big range in lead-times, prices for every extra day are also different. Thus, a price for storage in the same location vary significantly between suppliers.

Material handling equipment services can be supplied as well by one of 3 freight forwarders. Prices are presented for every stopover for every supplier. A difference in the highest and lowest price is 7% in Gothenburg, while it is 184% in The Hague. 6 out of 11 locations have price rate difference varies between 7 and 50%.

Air freight services can be supplied as by one of 3 freight forwarders. Door-to-door prices were requested for 9 routes per container, where it is decided that air transportation is essential. The lowest price rate difference is for route Itajai -New York and account for only 14%. The highest difference is 230% and it corresponds to two routes: Cardiff – Gothenburg and Gothenburg - The Hague.

Results of the descriptive analysis of collected data allow us to conclude that it is accurate and thus suitable for model estimation.

4.3 MODEL APPLICATION

This section provides adaptation of described above general developed model for the case of VOR. Background and problem descriptions, as well as a description of data collection, enable us to understand what is the cost structure of logistics of VOR, how many suppliers will be involved and what data can be used to find the best cost save sourcing strategy. Description of Volvo Ocean race and its logistics presented above enable us to finalize that we will include 4 types of services in this model: container rent, material handling equipment (MHE) and ocean freight and air freight. Container rent services and material handling equipment services are two separate components without time aspect. While 2 different groups of services, such as booking agent + customs + intermediate storage services and ocean freight services will be bundled into one component in this model and will consider time-aspect. Airfreight + customs + intermediate storage services will be considered as a separate component and will not consider timing, as airfreight assumed to have very low risk of late deliveries and if it happens company need to take urgent actions which will depend on location and are very difficult predictable.

Therefore, one of this model assumptions is that airfreight deliveries will be always in time. Moreover, as well as in general model we assume that the company can select only one supplier

for one type of services. Suppliers are assigned to run the full set of one type of services. All pre-selected suppliers have enough capacity to conduct services for our volumes. One more assumption for this model, as was mentioned above, is that the costs of alternative modes are about 5 times more expensive than standard ocean freight solutions.

The notation presented below is used in the model:

$C_{container\ j}$	Total cost for container rent for one of suppliers
$C_{MHE\ k}$	Total cost for MHE for one of suppliers
$C_{oceanfreight}$	Total cost for ocean freight +booking agent
$C_{airfreight\ v}$	Total cost for air freight for one of suppliers
i	Routes (directions) for transport services or types of needed services
j,k,v	One of suppliers
l	One of combination of suppliers for ocean freight
T	Time period (weeks)
Q	Quantity of different services
π	Probability of successful (in time) delivery; $\pi \in (0..1)$
P	Price for service (per unit or per route)
x	Extra service that will be used in case of high-risk of delivery
T_d	Difference between required lead time and proposed lead time (days)
T_f	Free time demurrage import (days)
P_s	Price for storage for one day per unit
φ	Number of days when delivery success = 100%
∂	Number of days when delivery success = 0%
SS^*	Optimized Sourcing Strategy
J	Set of all possible portfolio combinations
L	Set of all possible portfolio combinations

Define the total container rent and MHE costs. The total cost of container services ($C_{container\ j}$) is presented as Equation (5). It summarizes costs for one of suppliers (j) for every type of containers (i) needed, which is calculated as quantity of needed containers ($Q_{c\ i}$) multiplied by price per this type of containers ($P_{(per\ container\ per\ week)\ ij}$)- prices are presented per 1 container per 1 week and by number of weeks. Time (T) represents a number of weeks when rent of containers is needed.

$$C_{container\ j} = \sum_i P_{(per\ container\ per\ week)\ ij} \cdot Q_{c\ i} \cdot T \quad (5)$$

The total cost of MHE ($C_{MHE k}$) is presented as Equation (6). It summarizes costs for every type of handling equipment (i) needed from every supplier (k), which is calculated as a quantity of needed equipment ($Q_{MHE i}$) multiplied by a price per this type of equipment ($P_{MHE i}$).

$$C_{MHE k} = \sum_i P_{MHE ik} \cdot Q_{MHE ik} \quad (6)$$

Ocean freight costs are the most complex component of this model, as it calculates the weighted cost, includes two types of suppliers (booking agents and provider of ocean freight services, considers risks and takes into account extra storage days.

Total ocean freight cost ($C_{oceanfreight l}$) for one of a combination of suppliers (l) is presented as a weighted expected cost depending on risks of late deliveries (Equation 7). Two services are combined inside one ocean freight cost component. As was described above booking agent + customs + intermediate storage services can be provided only by freight forwarders, and ocean freight services can be provided by freight forwarders as well as by ocean carrier. Therefore, the most efficient combination of these two services needs to be selected for successful sourcing strategy. As these two services are bundled together we need to consider all possible fixed combination of two types of suppliers.

$$C_{oceanfreight l} = \sum_i \left[[\pi_{oil} \cdot P_{oil} + (1 - \pi_{oil}) \cdot P_{ail}] + P_{oxil} \cdot \left\{ \begin{array}{l} 0; \quad \text{if } (T_{dil} - T_{fil}) \leq 0 \\ (T_{dil} - T_{fil}); \quad \text{if } (T_{dil} - T_{fil}) > 0 \end{array} \right\} \right] \quad (7)$$

Equation (8) presents our possible supplier combinations as a Cartesian product, that returns a set of products from multiple sets. That is, for sets H (all freight forwarders) and D (all ocean carriers), the Cartesian product $H \times D$ is the set of all ordered pairs (h, d) where $h \in H$ and $d \in D$. Therefore, prices included to the ocean freight cost estimation are sum of prices from combination of services and suppliers. Every P_{oil} – is a price for ocean freight services, that include booking agent + customs + intermediate storage + ocean freight services summarized for every combination of suppliers (l). Figure 11 demonstrate the logic of Equation (8) and how suppliers can be combined creating a combination. One of this combination needs to be selected in the model while minimizing total costs.

$$l = H \times D = \{(h, d) | h \in H \text{ and } d \in D\} \quad (8)$$







Suppliers									
	Freight Forwarders			Ocean Carriers					
Services	FF 1	FF 2	FF 3	OC 1	OC 2				
Booking agent + customs + intermediate storage services 	✓	✓	✓						
Ocean freight services 	✓	✓	✓	✓	✓				
 + 	Possible combinations								
	FF 1	FF 2	FF 3	FF 1	FF 1	FF 2	FF 2	FF 3	FF 3
	FF 1	FF 2	FF 3	OC 1	OC 2	OC 1	OC 2	OC 1	OC 2
Name of combination:	11	12	13	14	15	16	17	18	19

Figure 11. Combination of freight forwarders and ocean carriers for supply of ocean freight services

Every route for ocean freight transportation has information about required lead time and proposed lead time by a supplier. We calculate the difference (T_d) between these numbers and it shows how many extra days the company will have or if the number is negative we see that supplier has bigger lead time that is needed for us. Therefore, the company need to use air freight to deliver cargo in time. These number of days parameterized probability of in time deliveries π_{zil} , which is opposite value to risk of delays. The risk of delays will be presented as $(1 - \pi_{oil})$. A linear function is used in this case to parameterized T_d into π_{zil} , as we believe it represents reality on the market. To conduct parametrization number of dates when a probability of successful deliveries (π) is equal to 100%

is defined based on expert knowledge as 5 days and 0% probability of successful delivery is expected when a difference of days equal to 0. It means that if a supplier proposes lead time equal to the required lead time risk of failed delivery is 100%. Using Equation (9) $\beta = \frac{1}{5} = 0.2$.

$$\beta = \frac{1}{5} \quad (9)$$

$$\pi_{oil} = \begin{cases} 0 & , \text{if } T_d \leq 0 \\ 1 - T_d \cdot \beta & , \text{if } T_d > 0 \\ 1 & , \text{if } T_d > 5 \end{cases} \quad (10)$$

Therefore, Equation (10) represents piecewise linear function for parametrization of risks for calculation of weighted total cost for ocean freight. This function is illustrated in Figure 12.

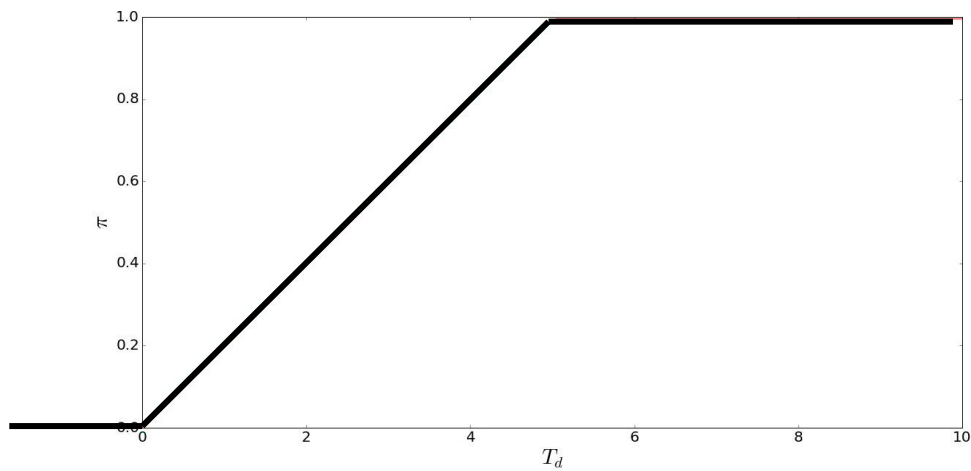


Figure 12. Function of parametrization of risks of delays

Depending on a probability of on-time deliveries and risk of delays company can evaluate weighted costs of ocean freight deliveries considering costs for ocean freight if a probability of in time deliveries is high and alternative deliveries if a risk of delays is high. The price for alternative deliveries can be presented as a separate price or it can be evaluated as an increase of standard price. Based on expert knowledge in this model alternative transportation will be handled by air transportation. However, due to the lack of time, we have not collected all alternative prices for all suppliers and all routes price. Therefore, it was decided to use standard ocean freight price increased by 5 times. This assumption was based on expert knowledge.

The second part of the total cost of ocean freight is an estimation of extra costs for storage of loaded and empty containers during the event time. This extra cost depends on the time of transportation and free demurrage days. Hence, the difference between required lead time and proposed lead time is compared with free demurrage days and the estimated value is the number of days needs to be repaid. If a difference between days in port and free time demurrage is higher than 0, extra costs need to be included, as multiplication of days and extra price per day (P_{sxil}).

All calculations described above for ocean freight cost will be calculated for every route for every combination of supplier and then summarized as a total weighted expected cost for every combination of suppliers.

Fourth service component is the total cost model is a cost for airfreight services ($C_{airfreight\ v}$), which is presented as Equation (11). It summarizes costs for every route (i) from every supplier (v), which is calculated as a quantity of containers need to be transported for this route ($Q_{airfreight\ iv}$) multiplied by a price per this type of containers for one route ($P_{airfreight\ iv}$).

$$C_{airfreight\ v} = \sum_i P_{airfreight\ iv} \cdot Q_{airfreight\ iv} \quad (11)$$

Every supplier will be presented with the total cost for every type of services it provides and between all possible combination the most cost efficient need to be selected. However, it will enable a rating to be made of all possible sourcing combination and make an analysis. If needed to make a final selection the company can include more factors for comparison of different strategies and assign the winners.

Equation (12) is an objective function which needs to be minimized and suppliers j , l , v and k with who services SS^* attains its smallest value. j , l , k and v can be different or same suppliers.

$$SS^* = \underset{\{j \in J, l \in L, k \in K, v \in V\}}{\operatorname{argmin}} [C_{container\ j} + C_{MHE\ k} + C_{oceanfreight\ l} + C_{airfreight\ v}] \quad (12)$$

It will define which sourcing strategy is beneficial for the VOR 2017-2018 as well as show if single/dual or multiple sourcing strategy is the most efficient in this case.

4.4 EMPIRICAL ANALYSIS

This section provides a description of the empirical application of data to the developed model and results of calculations.

Empirical results analysis

As a result of model application to Volvo Ocean Race logistics price data, we received the list of all possible price combinations involving 5 types of services. The outcome of the mathematical model is 243 combinations of how 5 types of services can be possibly distributed between 3 freight forwarders and 2 ocean carriers. This model takes into account that ocean carriers' offers are limited only to a single type of service, namely ocean freight, while freight forwarders quoted for all 5 types of services.

Therefore, according to our model we have the next set of suppliers for every of cost components:

Container: $J = \{FF1, FF2, FF3\}$

MHE: $K = \{FF1, FF2, FF3\}$

Air freight: $V = \{FF1, FF2, FF3\}$

Ocean freight: $L = \{FF1, FF2, FF3\} \times \{FF1, FF2, FF3, OC1, OC2\}$.

While from the set $\{1,2,3,4,5\}$ 1,2 and 3 can be bundled only with 1,2,3 from the first set, 4 and 5 is ocean carrier 1 and 2 accordingly. Therefore, ocean freight has 9 available combinations of suppliers, as was already presented above on Figure 11.

$L = \{FF1, FF1; FF2, FF2; FF3, FF3; OC1, FF1; OC2, FF1; OC1, FF2; OC2, FF2; OC1, FF3; OC2, FF3\}$.

As the developed model, can be solved using one of the standard numerical packages. Within the scope of this thesis, we have decided to use Excel, due to the lack of time to program this model, as well as Excel, will fulfil all our needs to solve this model.

We calculated the cost for every component of the model for every supplier using formulas described above. Therefore, we obtained 9 total cost for ocean freight, 3 total cost for container services, 3 total cost for MHE and 3 total cost for air freight. The objective function needs to be solved to find sourcing strategy with minimum total cost value. The number of possible sourcing strategies equal to $SS = J \cdot K \cdot V \cdot L = 3 \cdot 3 \cdot 3 \cdot 9 = 243$, as it should be all possible combinations of all suppliers from every cost component. Table 5 demonstrate 9 examples out of 243 of possible sourcing strategies and allocation of suppliers. Total cost for every combination-sourcing strategy is calculated.

Table 5. An example of possible sourcing strategies

Combination number	Suppliers Allocation			
	Ocean	Container	Air	MHE
1	l 1	FF 1	FF 1	FF 1
46	l 2	FF 3	FF 1	FF 1
67	l 3	FF 2	FF 2	FF 1
85	l 4	FF 1	FF 2	FF 1
125	l 5	FF 2	FF 3	FF 2
141	l 6	FF 1	FF 2	FF 3
164	l 7	FF 1	FF 1	FF 2
211	l 8	FF 3	FF 2	FF 1
243	l 9	FF 3	FF 3	FF 3

After getting the result of model calculation, we filtered the combinations according to the minimum total spend and applied ranking from lower to a higher amount.

As this project is real and ongoing we cannot disclose values for the results, as well as the name of suppliers we do not show and only name them correspondingly 1,2,3 for freight forwarders and 1,2 for ocean carriers. However, the gap in total pricing between the best and the worst possible combinations out of total 243, that constitute about 22% or 1.38 million US dollars. Figure 13. shows a distribution of all strategies. Percentage show comparison to the combination with the lowest total cost – as a baseline. For example, there are 18 combinations which total cost vary between lowest rate and lowest rate multiple by 1.027. The largest number of strategies is between 5.5% and 8.3% difference.

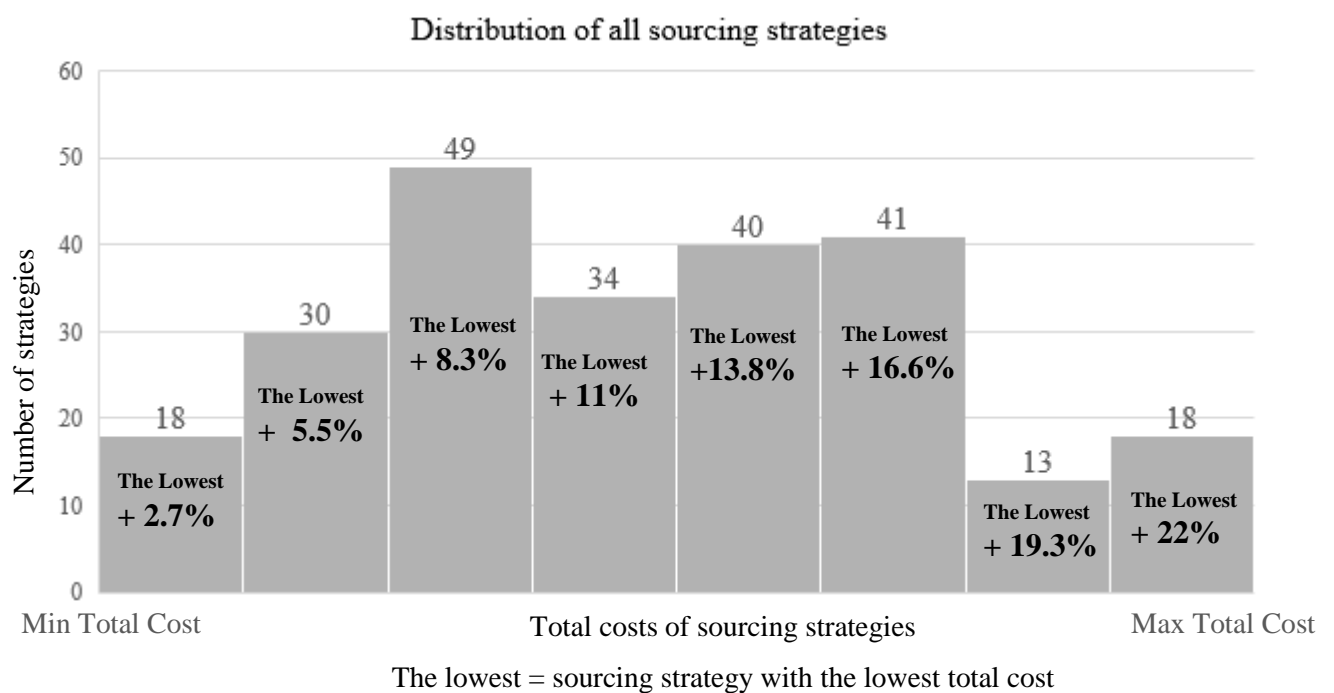


Figure 13. Distribution of all sourcing strategies according to their total cost value

We ranked all strategies and compared how total cost of every next strategy higher from the previous strategy (Figure 14.). The majority of all strategies (62%) is higher from one level best strategy in 0.01-0.09%. However, 3 strategies have increased in 1.04-1.76 %. We can conclude that majority of strategies have slightly difference in total cost between each other. However, as the total number of strategies is 243, it results in a total difference in 22%. Therefore, it is very important to evaluate all possible strategies and then make a well-defined decision. As a comparison, only of several strategies can show a tiny difference in costs.

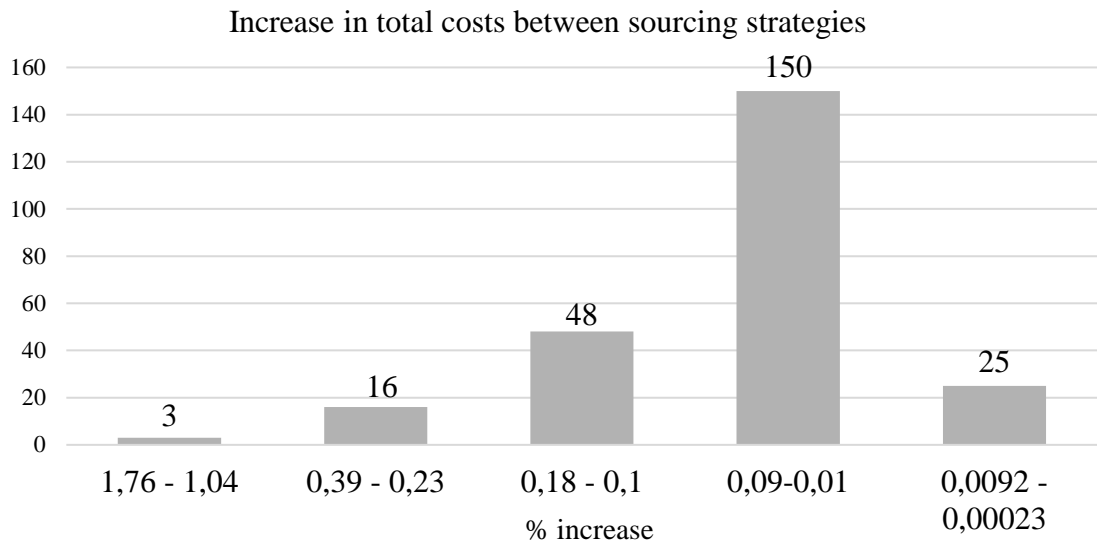


Figure 14. Distribution of all sourcing strategies comparing to each other

For the analysis and discussion part we will select three best combinations cost-wise and analyze the best single, dual and multiple sourcing scenarios according to the model outcome.

Table 6. Three best combinations of quotations by price

Rank / Result	Container rent	Booking agent	Ocean freight	Airfreight	MHE
Combination with rank 1	FF 3	FF 3	OC 1	FF 3	FF 2
Combination with rank 2	FF 3	FF 3	OC 1	FF 2	FF 2
Combination with rank 3	FF 2	FF 3	OC 1	FF 3	FF 2

FF – freight forwarder, OC – ocean carrier

As evident from the table above, two major cost elements – booking agent services + ocean freight and MHE – are similar to all three best scenarios and only airfreight (about 2% of total costs) and container rent (about 8% of total costs) vary between freight forwarders 2 and 3 in the second and third best combinations. Nevertheless, the total price difference between scenarios 1, 2 and 3 is less than 1%.

The best price combinations present the principle of ‘cherry picking’ between several service providers based on the service specialization. The biggest cost elements – ocean freight and booking agent – present a particular interest for this study. We have several scenarios of combining these services: either purchasing total door-door delivery from a freight forwarder or dividing the services into port-port ocean freight via an ocean carrier supported with a booking agent and customs services provided by a freight forwarder. If we regard all possible combinations, we identify the following 9 options:

Table 7. Possible combinations of ocean freight and booking agent services

BA				FF 1	FF 2	FF 3	FF 1	FF 2	FF 3
OF	FF 1	FF 2	FF 3	OC 1	OC 1	OC 1	OC 2	OC 2	OC 2
Rank	4	8	3	7	2	1	9	6	5

BA – booking agent services, OF – ocean freight services

The best two scenarios cost-wise are proved to be a combination of an ocean carrier and a freight forwarder. The next best option is buying a full spectrum of door-door services from a freight forwarder 3. The price difference from the best combination (freight forwarder 3 + ocean carrier 1) and the best door-door solution offered by freight forwarder 3, is about 6%.

When interpreting the received results of the model application, we should consider that in all above cases the lead time adjustment was added to the standard quoted rates, i.e. if the offered ocean freight service for a particular lane exceeded the required number of days, vessel chartering or even airfreight options were considered instead. The increased price for transportation was calculated and added to the total estimation of the ocean freight price.

This analysis shows that buying port-port freight services from an ocean carrier is not always proved to be cost efficient. If we compare pure ocean freight prices irrespective of lead time adjustments, ocean carriers 1 and 2 quoted the best rates compared to freight forwarders. Nevertheless, lead times offered by freight forwarders in some cases are much shorter as they tend to combine the services of several shipping lines based on the transit time preferences. As proved by the results presented above, even the economies of scale offered by ocean carriers do not outweigh the benefits of shortest lead times in event logistics. This is evident from the increased total price offered by the ocean carrier 2 when calculating the lead-time adjustment.

Freight forwarders' services require very careful study due to their complexity and variability. As it is evident from the results of the model calculation, freight forwarder 3 offers a balanced solution both in booking agent and ocean freight prices. Forwarder 2 is competitive in booking agent services, but rather inefficient in ocean freight due to offering longer lead times options. Forwarder 1, on the contrary, is more efficient in ocean freight part while quoting high prices for booking agent services. This difference may be explained by more costly solutions or less efficient routings offered by forwarder 1, but at the same time, it may flag that some services or expenses are underestimated or omitted in the quotations of other bidders. In this case, the applied model can reveal gaps in pricing between different service providers and highlight any inconsistency that requires further investigation and analysis.

5 DISCUSSION

5.1 INTERPRETATION OF FINDINGS

In order to answer the research question and identify how the service specialization and sourcing strategy influence cost efficiency of event logistics, we regard the example of VOR data and the empirical results received from our model application. We also attempt to prove that developed general model is applicable for this case and can be used for a wider range of applications.

As a first step, we elaborate on two variables that we identified in our research question. The level of service specialization can be described as an underlying basis for developing the sourcing strategy when purchasing logistics services. Our investigation shows that sourcing of logistics services differs from procurement of products where the product unit is usually easy to specify and it remains unchanged irrespective of the sourcing environment. When buying logistics services, the challenge occurs in setting the boundaries of a particular service that may be considered as a separate unit. In many cases, as it is shown in this thesis, some logistics services are interdependent and there exist a number of operational risks in splitting them to different service providers. In order to create the most rational split of services, logistics specialists should consider a number of factors, not limited to price, but including liability for the cargo, risks of operational non-performance, customs regimes and the level of operational complexity, etc. As an outcome of this analysis, logistics services are grouped into particular types that we define as service specialization in this thesis. In the example of VOR, the purchasing unit is a type of service that is defined as non-dividable by VOR logistics specialists at Volvo Cars. We regard 5 distinct types of services in this work considering that sourcing strategy can vary from single to multiple sourcing with maximum 5 LSPs selected to perform logistics services of VOR.

The second variable, cost efficiency, encapsulates price elements and shows the reduction of total costs for logistics services of the event.

In the theoretical framework part of this thesis, we summarized the features, risks and benefits of three sourcing strategies – single, dual and multiple sourcing. We also reviewed different types of logistics service providers that are expected to be beneficial according to their portfolio. We apply this knowledge to the VOR sourcing data and interpret the results of our empirical model.

As we already identified after empirical analysis, the most cost-efficient scenario for VOR logistics is a multiple sourcing with a combination of three service providers: an ocean carrier to perform ocean freight services, one freight forwarder to cover booking agent, container rent and airfreight services, and another freight forwarder to support with on-site handling during all VOR stopovers.

The total budget of the VOR logistics is equally distributed between these 3 providers with an ocean carrier holding about 40% of the total costs and both freight forwarders having a portion of about 30% each (Figure 15.).

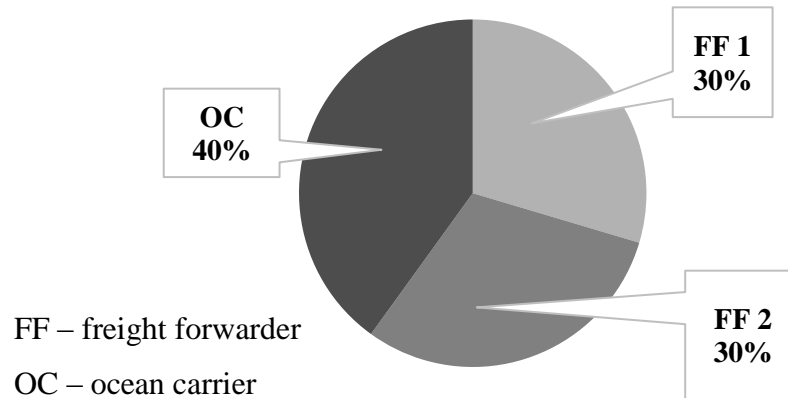


Figure 15. Share distribution between 3 service providers in the best multiple sourcing scenario

Using the developed mathematical model, we can easily identify the best single, dual and multiple sourcing scenarios out of 243 available combinations.

As the RFQ response rate was limited to 3 participants, we received only 3 possible single sourcing scenarios, namely selecting either of 3 freight forwarders to the full scope of VOR logistics. The results of the model show the following overall ranking:

Table 8. Single sourcing scenarios

Rank / Forwarder	FF 1	FF 2	FF 3
Rank out of 243	149	175	45
Difference vs best scenario (multiple)	12.2%	15%	5.4%

Dual sourcing may be a combination of services shared between a freight forwarder and an ocean carrier or a split of services between two freight forwarders. We need to emphasize that a combination of 2 shipping lines sharing the ocean freight services or a combination of two freight forwarders for booking agent and ocean freight services is not efficient from an operational perspective and was regarded as impossible in the presented model.

We got totally 48 possible combinations of dual sourcing: 6 combinations between a freight forwarder and an ocean carrier and 42 combinations of two freight forwarders.

Table 9. Three best combinations of dual sourcing scenarios

Rank / Forwarder	OC 1 + FF 3	OC 1 + FF 2	FF 3 + FF 2
Rank out of 243	9	22	36
Difference vs best scenario (multiple)	0.7%	3.4%	4.7%

The model of VOR data gives 192 combinations of multiple sourcing scenarios with the best three presented in the table below. It is interesting to notice that in the most commercially beneficial combinations ocean freight services are performed by a shipping line. The best combination of 3 freight forwarders is ranked only as number 41 with a gap to the best scenario of about 5%.

Table 10. Three best combinations of multiple sourcing scenarios

Rank / Forwarder	OC 1 + FF 3 + FF 2	OC 1 + FF 3 + FF 2	OC 1 + FF 3 + FF 2
Rank out of 243	1	2	3
Difference vs best scenario (multiple)	0%	0.03%	0.04%

As discussed above, all best scenarios of multiple sourcing involve the same 3 LSPs: an ocean carrier 1 and freight forwarders 2 and 3. The difference is explained by switching the air freight and container rent scope (the lowest types of services budget-wise) between freight forwarders. These changes give a very insignificant price difference of 0.03 – 0.04% or just 1 600 – 2 500 USD.

Table 11. Best scenarios single, dual and multiple sourcing

	<i>Single sourcing</i>	<i>Dual sourcing</i>	<i>Multiple sourcing</i>
Rank out of 243	45	9	1
Difference vs best scenario (multiple)	5.4%	0.7%	0%

The comparison table shows that the difference between the best multiple sourcing option and the best dual sourcing scenario constitute less than 1%. This means that when taking the final decision regarding the sourcing strategy selection (multiple or dual), a purchaser needs to consider other operational and financial factors. Single sourcing though proves to be commercially inefficient,

the best single-sourcing solution is ranked only as number 45 in the list of scenarios and shows price difference of 5.4% (or about 0.34 million USD).

Another important conclusion is that buying ocean freight services from an ocean carrier instead of a freight forwarder leads to a commercial efficiency of 4.7% (presented in 35 best scenarios).

The described results of our model can be applied to the matrix of risk/benefit analysis of sourcing strategies proposed as a hypothesis after literature review part. We assumed that cost efficiency of event logistics should rise from single to dual and multiple sourcing strategy. This study and the analysis of empirical data of Volvo Ocean Race support the hypothesis showing that service specialization of event logistics and splitting volumes to different service providers with various portfolio and expertise, give the general reduction in the price level. This specialization should also contribute to higher service level and performance excellence.

Another aspect of the risk/benefit matrix, namely risk scale, according to our hypothesis, should show the opposite tendency with the highest level of risk attributed to multiple sourcing scenario and single sourcing being the most reliable operationally. Due to the limitation of this thesis, we have not regarded performance risk factors except for lead time risks, so this paper can hardly provide a well-developed answer. From a lead time perspective, we noticed completely different tendency when single sourcing scenarios were less favorable. We consider these results as contradictory to the usual industry practice where freight forwarders offer more flexible solutions combining the services of several sub-contractors according to the best possible alternatives. At this stage of the sourcing process, we can explain the discrepancy between the developed matrix and the received results by the limited amount of available data. This study needs a bigger sample to make the reliable conclusions and generalization of the results. Moreover, a number of other operational factors should be taken into consideration to support or reject the hypothesis presented in a risk/benefit matrix.

Our study confirms that the complexity of event logistics sets a specifically high demand on the professionalism and expertise of logistics service providers in particular branch of industry. Reliability of service level is an essential requirement that qualifies LSP-s to be a part of the event logistics sourcing process. The empirical results also prove that service specialization plays a crucial role in event logistics and that cost benefit is achieved not due to economies of scale or scope as in a traditional supply chain, but rather due to extensive knowledge, know-how and flexibility of LSP-s. A combination of asset and non-asset based LSP-s (ocean carriers and freight forwarders specializing in event logistics) and using the benefits of both, gives the most efficient outcome of the sourcing process and ensures the required service level.

5.2 ADDRESSING RESEARCH QUESTIONS

Analysis of existing literature, developing the model, applying data from VOR and empirical analysis enables us to answer our research questions.

1. How do service specialization and sourcing strategy influence the cost efficiency of event logistics?

Based on existing findings of other researchers as well as analysis of sourcing strategies for VOR we can finalize that service specialization and sourcing strategy play the significant role in cost efficiency. Current market conditions are very competitive even for big companies, as Volvo Cars and others. Even under the best economic conditions, smart companies constantly look for cost-saving opportunities. Volvo Ocean Race is a very costly event, while benefits of it can be hardly quantified. Company gains reputation promotes itself and products around the world but does not have direct profit from it. Therefore, cost efficiency of this type of events is crucial, as the company cannot allow spent any spare money. It is relevant to many of global events, as many of them focus on promotion and rating increase, for example, trade exhibitions etc. Detailed analysis of cost structure of event and factors that influence it, is important and enable to find strengths, drawbacks and bottle-necks. The company can understand which cost components are crucial and which can be not so streaked or can be substituted. The case of VOR shows that ocean freight is one of the most important transport links and it accounts for 25% of all costs. This cost component is affected by several factors, and especially lead-time. Therefore, risk evaluation of in time deliveries is essential for selecting the most cost-efficient strategy. Developed model empowers to compare all possible sourcing strategies considering risks and prices. Correlation between theories and empirical analysis shows that service specialization in multiple sourcing strategy can significantly reduce costs. The difference between various sourcing specification accounts for 5.4% and 0.7%, that can be assumed as not a big difference, however in the scope of big events such as VOR, 5.4% save 0.34 MUSD, which is a big amount of money.

2. What sourcing strategy is the most cost beneficial for the coming Volvo Ocean Race?

Developed model and collected price rates and additional information from suppliers helped us to find the most cost-efficient sourcing strategy. The winning strategy is multiple sourcing with container rent services, airfreight + customs + intermediate storage services and booking agent + customs + intermediate storage services run by one freight forwarder #3, material handling equipment services sourced by freight forwarder #2 and ocean freight services will be operated by ocean carrier #1.

CONCLUSION

International markets continue to offer expanding opportunities for global events, thus understanding the cost-effectiveness of its sourcing strategy has drawn a great deal of interest. Analysis of literature review shows a scarcity of research regarding event logistics and especially its sourcing efficiency.

Event logistics plays not only an important role in cost efficiency of global events but also determines whether the event will take place at all. Analysis of the literature shows that the most efforts of researchers have been focused on sourcing strategy for materials and within defined supply chains. The model developed in this thesis considers specific characteristics of event logistics operations which are significant in decision-making process while organizing worldwide events.

Supplier selection decisions are often multi-objective and sometimes conflicting criteria have to be considered. For the global event this decision is multi-objective, multi-period, multi-product and multi-modal. Therefore, three types of sourcing strategies can be applied: single-sourcing, dual- or multiple-sourcing. Every of these strategies had own pros and cons. However, our thesis introduces a new solution to this problem and develops a cost weighted approach for the determination of sourcing strategies.

The general mathematical model allows to include risk analysis and costs to simplify strategic decision making. This model can be applied to the needs of different global events. The real ongoing project - The Volvo Ocean Race was used to test developed approach for sourcing strategy selection based on cost structure, price and lead-time information.

Developed model and its implication to VOR shows that multiple sourcing strategies are most cost-efficient. Service specialization plays a significant role in event logistics, as it is very complex and highly demanding process. The best cost efficiency within global events and VOR especially should be achieved not due economies of scale, but due to extensive knowledge, know-how and flexibility of LSP-s. That will result in a distribution of services between the several suppliers, whose service proposition meet all these characteristics. The empirical results also show that a combination of LSP-s with different portfolio and asset structure (forwarders, MHE providers, ocean carriers, etc.) gives benefits both in the reliability of provided services and in cost efficiency.

The results of the empirical analysis enable us to answer research questions and discuss practical implication in regard to the literature review, as well as decision making. Our results are aligned

with existing research findings. Therefore, we believe our findings can advance knowledge in the narrow research area of event logistics, be applied to another real-world problem.

It is necessary to mention that the newly developed framework relies on a few assumptions and has a number of limitations. We made several assumptions for the general model, such as suppliers are assigned to run a full set of one type of services. As well as we made more assumptions for applied model to VOR. One of the basic assumptions of this study is that the supplier pool is already defined and technically approved and that cost is a dominant factor in the selection decision. We assumed input parameters such as a price for an alternative of ocean freight transportation. One more assumption is a type of mathematical distribution for parametrization of risks. We assumed to have a piecewise linear function and did assumptions for values of key points used for extra- or interpolation. Therefore, the general and applied models have some limitations due to time limit and scope of the VOR. However, the limitations discussed above indicate the directions for possible future research.

A particular contribution of the model developed is that it also considers risks of late deliveries and forthcoming excessive costs for risk elimination. The model includes analysis of an optimal solution of sourcing strategy under a multicriteria analysis, which provides valuable insights for decision-makers such as enabling cost reduction and guarantying deliveries on schedule. This lead time adjustment of the model makes it possible to regard its usage in humanitarian logistics. Despite obvious differences in the importance of cost factor in event logistics compared to humanitarian logistics, 'value for money' is still a matter of concern. The less you spend for transportation, the more you can save for purchasing other products and necessary medication in humanitarian activities, so the best ratio of price and urgency of deliveries should be found. We assume that presented model can be adjusted and further developed for humanitarian logistics area by adding other important variables that affect the sourcing decisions especially in a case of preventative actions. Another financial aspect of humanitarian logistics that can be incorporated into the existing model is value in kind or sponsorship funding offered by carriers and freight forwarders as their contribution to humanitarian operations.

The practical implication of the developed model and matrix of risk/benefit analysis of sourcing strategies in event logistics is allowing managers to understand what sourcing strategies to follow to maximize cost efficiency as well as reach the highest level of services and as result successful event holding. Therefore, this study has a number of implications for strategy makers at the level of the company and within supply.

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