St. Petersburg University
Graduate School of Management
Master in Management Program

METHOD DEVELOPMENT OF LOGISTICS SERVICE QUALITY EVALUATION

Master's Thesis by the 2nd year student
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St. Petersburg
2017

ЗАЯВЛЕНИЕ О САМОСТОЯТЕЛЬНОМ ХАРАКТЕРЕ ВЫПОЛНЕНИЯ ВЫПУСКНОЙ КВАЛИФИКАЦИОННОЙ РАБОТЫ

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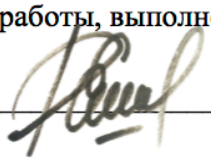

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Аннотация

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Научный руководитель	Андрей Васильевич Зятчин, к. ф.-м. н.
Описание цели, задач и основных результатов	**Цель работы**: совершенствование метода оценки качества логистического сервиса и его применение для кейс-компании. **Задачи работы**: – На основе обзора литературы определить наиболее соответствующий метод оценки качества логистического сервиса; – Специфицировать и усовершенствовать выбранный метод оценки качества логистического сервиса; – Реализовать применение усовершенствованного метода на примере кейс-компании. **Основные результаты работы**: – Модель SERVQUAL была выбрана в качестве наиболее подходящей для оценки качества логистического сервиса на основе обзора литературы; – Необходимость решения задачи многокритериальной оптимизации и ранжирования атрибутов качества логистического сервиса была специфицирована; – Метод APIS был выбран и использован в качестве инструмента совершенствования метода оценки качества логистического сервиса; – Усовершенствованный метод был применен для оценки качества логистического сервиса компании РЖД Логистика.
Ключевые слова	Логистика, Качество Логистического Сервиса, Модель SERVQUAL, APIS Метод, Многокритериальная Оптимизация.

Abstract

Master Student's Name	Elizaveta Shakhanova
Master Thesis Title	Method development of logistics service quality evaluation
Main field of study	Master in Management
Year	2017
Academic Advisor's Name	Andrey V. Zyatchin, Senior Lecturer
Description of the goal, tasks and main results	**Research goal:** method development of logistics service quality evaluation and its application to case company. **Research tasks:** – On the basis of academic literature review define the most appropriate method of logistic service quality evaluation; – Specify and improve the chosen method of logistic service quality evaluation; – Apply the modified method of logistic service quality evaluation to the case company. **Research results:** – SERVQUAL model was chosen as the most appropriate for logistics service quality evaluation on the basis of conducted literature review; – The necessity of multi-criteria optimization problem solution and ranking of logistics service quality attributes was specified; – APIS Method was chosen and used as the instrument for logistics service quality evaluation method development; – The developed method was applied for the evaluation of logistics service quality of RZD Logistics company.
Keywords	Logistics, Logistics Service Quality, SERVQUAL Model, APIS Method, Multi-criteria Optimization.

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Introduction

Forced by the process of globalization, supply chain nowadays is constantly transforming from fragmentation stage to total integration and even collaboration. Thus, various separate functions, such as purchasing, sourcing, transportation, warehousing etc., are not performed consequently, but are united in an integrated system of business activities of a specially created type of company – logistics provider, an enterprise, rendering complex logistics services.

The level of competition in services sector in general and logistics service in particular is constantly increasing, and the ability of companies to understand their customers and ensure their satisfaction with the services received has become fundamental for organization's competitive advantage formation. Thus, the evaluation of logistics service quality with a reliable instrument on a periodic basis is transforming into obligatory process for successful development of logistics service provider business.

The subject of this study is represented by the peculiarities of logistics service quality evaluation and assessment of its potential for improvement on the basis of the chosen method. Logistics service quality of RZD Logistics company, in turn, is considered as the object of the research, in particular – the empirical study conducted. The choice of the case company is determined by its successful business performance: the organization has become the largest multimodal logistics operator in the Commonwealth of Independent States (CIS) and Baltic countries and is rapidly growing in line with the concept of logistics business segment development of JSC Russian Railways Holding, the biggest transportation company in Russian Federation.

The main goal of current research addresses the actuality of chosen topic described above, and is formulated as method development of logistics service quality evaluation. In order to achieve the formulated goal, the following range of tasks should be successfully completed:

- On the basis of academic literature review define the most appropriate method of logistic service quality evaluation;
- Specify and improve the chosen method of logistic service quality evaluation;
- Apply the modified method of logistic service quality evaluation to the case company.

The above mentioned research tasks are formulating the basic structure of current master thesis. The paper includes introduction, three chapters, each unfolding one of the research tasks, conclusion, list of references and appendices. The first chapter is devoted to the justification of the theoretical relevance of the chosen research topic, identification of the research gap and formulation of research objective basing on the conducted analysis of academic literature about existing methods of logistics service quality evaluation. Firstly, various interpretations of logistics service concept formation are described. Secondly, the term «logistics service quality» is defined.

Thirdly, the existing models of logistics service quality evaluation are outlined and the potential for the improvement of chosen SERVQUAL model is determined.

The second chapter describes the methodology used for sequential mixed method research. Methods were chosen in accordance with the specifics of the investigated subject, their reasonability and relevance is explained and justified. In particular, the research design is introduced in this part of the paper and the process of logistics service quality attributes' selection is explained; various methods of multiple criteria decision making are considered and the choice of aggregated preference index method is justified; the process of survey creation is described.

The third chapter demonstrates the results of conducted empirical study aiming to provide a comprehensive description of developed logistics service quality evaluation method. The chapter is structured in the following way: the data collection for a chosen case company is firstly described; logistics service quality of the company is secondly evaluated with application of proposed methods; thirdly, the results are interpreted, providing with the possibility to formulate theoretical contribution and practical implications of developed method.

Current research incorporates the use of both primary and secondary data. Primary data is represented by collected scores of service quality gaps and relative weights for 22 chosen logistics service quality attributes. Secondary data is derived from academic literature analysis with the purpose of most appropriate quality evaluation model and attributes identification. Periodic scientific and practical publications, cited in this paper, are accessible in EBSCO, Emerald, Elsevier, ScienceDirect, JSTOR databases. In addition, semi-structured expert interview was conducted within the current research with acting head manager of St. Petersburg branch of RZD Logistics company, subsidiary of JSC Russian Railways.

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CHAPTER 1. STATE OF THE ART OF LOGISTICS SERVICE QUALITY CONCEPT

This chapter is devoted to the justification of the theoretical relevance of the chosen research topic, identification of the research gap and formulation of research objective basing on the conducted analysis of academic literature about existing methods of logistics service quality evaluation. The chapter follows the proposed structure: firstly, the concept of logistics service is reviewed; secondly, the logistics service quality as the set of quality attributes is defined; thirdly, the existing methods and techniques of logistics service evaluation are analyzed and the opportunities for their potential improvements are distinguished, formulating the research gap.

1.1 Logistics service: definition and key stages of concept development

The concept of logistics service, rapidly developing since 1990s in tight connection with supply chain management, nowadays is gaining attention from the industrial and logistic enterprises. The current pace of changes is determined by growing uncertainty and complexity of business processes and the integration of all involved players into value creation. Thus, supply chain management as the discipline combines the tasks of operational management – effective management of production and inventories, logistics – minimization of costs in a logistic chain, and marketing, oriented to value creation for the client and establishment of long-term, reliable relations with suppliers and partners (Stock and Boyer, 2009).

Despite the increasing popularity of supply chain management (further referred as SCM) concept, universally accepted definition of the SCM term still does not exist (Fedotov and Krotov, 2011). Some researches define SCM as an evolving management philosophy, aimed to ensure the proper alignment of firms in order to maintain the material flow of resources and goods from supplier to ultimate customer (Cooper and Ellram, 1993; Lambert, 2014). The alternative view on SCM definition is based on the idea of described management philosophy implementation trough business processes: SCM is understood as «the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate consumer» (Christopher, 2005).

The definition, which will be used as the basis for current thesis, is proposed by Council of Supply Chain Management Professionals (CSCMP) and aims to incorporate both described views: «SCM encompasses the planning and management of all activities involved in sourcing and procurement, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners – suppliers, intermediaries, third party service providers, and customers. In essence, SCM integrates supply and demand management within and across companies» (CSCMP.org, 2016). The following interpretation of SCM finds reflection in published earlier Mentzer Model, which is represented in Figure 1.1 (Mentzer, 2001). The model emphasizes the importance of both inter-functional coordination inside the organization

and inter-corporate relationships between companies in the supply chain, which result in customer satisfaction and creation of value and competitive advantage.

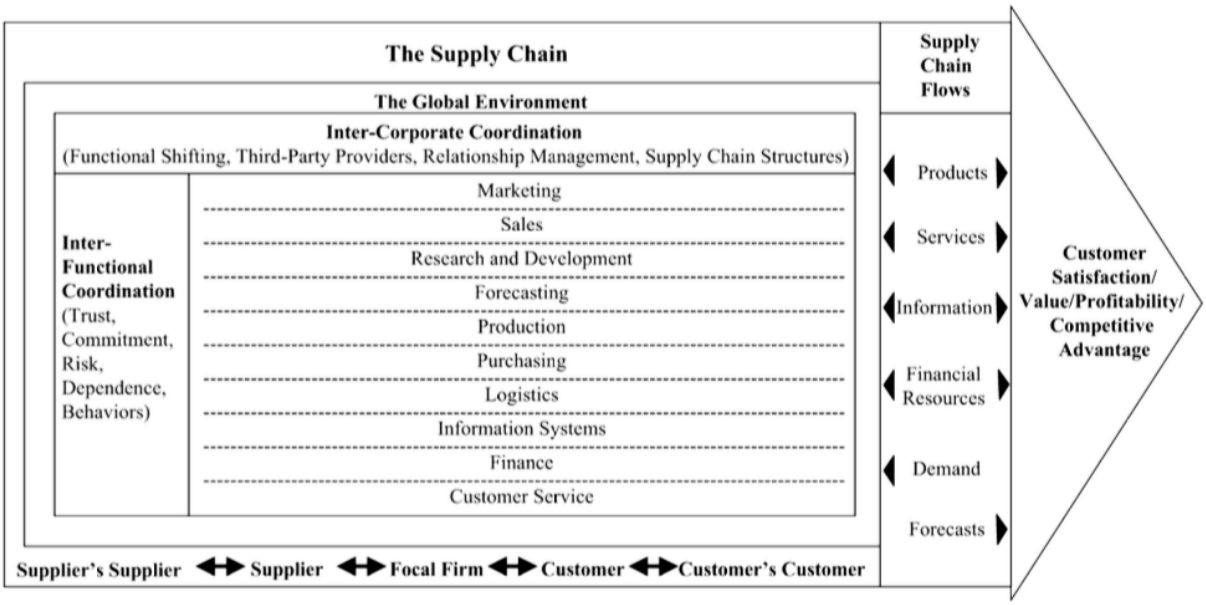

Figure 1.1 A model of supply chain management

Source: Mentzer et al., 2001

Both proposed definition by CSCMP and framework by Mentzer include logistics management activities in SCM. However, the interrelation of logistics and SCM is not yet clearly defined and generates a lot of contradiction among researchers and practitioners. According to Larson and Halldorsson, it is possible to divide all existing approaches into four perspectives: traditionalist, re-labelling, unionist and intersectionist (Larson and Halldorsson, 2004). Graphically this division is represented in Figure 1.2.

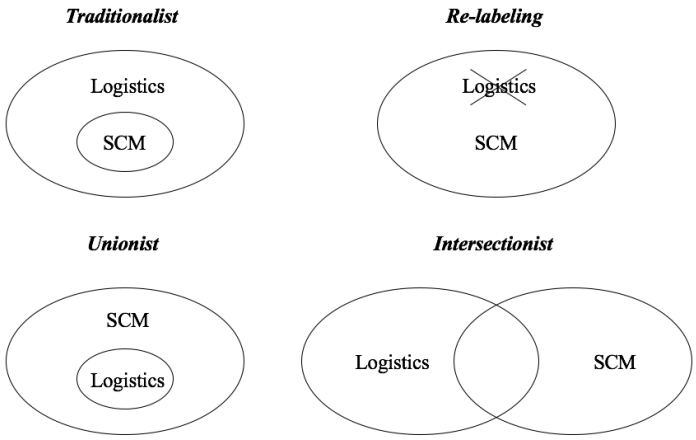

Figure 1.2 Four perspectives of SCM and logistics interrelation

Source: Larson and Halldorsson, 2004

According to the proposed classification, traditionalists' perspective supposes, that SCM forms a minor part, special type of external or inter-organizational logistics; intersectionist's view

is based on the idea of SCM and logistics being distinguished basing on the level of decision making – strategic and tactic respectively; relabelling suggests the use of supply chain management term as a synonym or substitution for logistics; and the last type – unionist perspective, defines logistics as a particular sphere, part of SCM. The latter will be further used in current research, as it correlates with the definition formulated by CSCMP and already mentioned Mentzer Model. In addition, the choice of this interpretation is justified by the stages of logistics service concept evolvement, described in this paper further.

From the beginning of concept development and up until now, SCM is constantly transforming from fragmentation stage to total integration and even collaboration. Thus, various separate functions, such as purchasing, sourcing, transportation, warehousing etc., are nowadays not performed consequently, but are united in an integrated system of business activities. The timeline of activities' integration is presented in Figure 1.3.

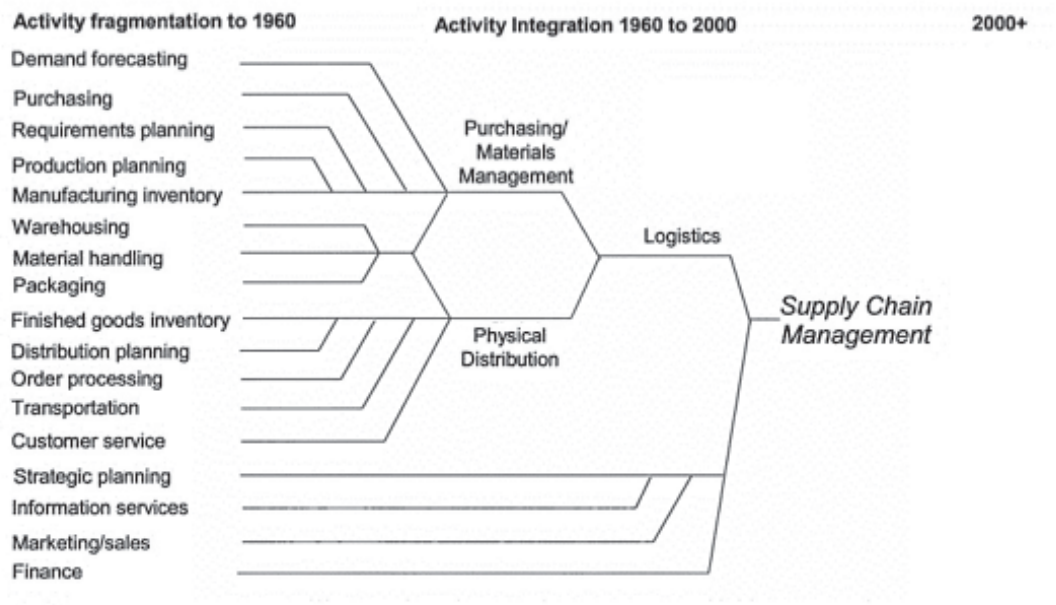

Figure 1.3 Evolution of SCM concept towards activities' integration

Source: Ballou, 2007

As it is evident from the classification above, the formation of logistics concept has become an illustrative example of such integration into unite business activity, incorporating inbound and outbound transportation, fleet management, warehousing and inventory management, demand forecasting and supply planning, order fulfilment and customer service. Thus, logistics management, can be defined as «part of SCM that plans, implements, and controls the efficient forward and reverse flow and storage of goods, services, and related information between the point of origin and point of consumption in order to meet customer requirements» (CSCMP.org, 2016).

In turn, the definition of logistics service is tightly connected with the notion of customer satisfaction. Logistics service is usually referred as the set of the logistics operations aimed to

provide maximum level of consumers' satisfaction in process of material, financial and information flows management. Thus, the level of logistics service directly influences company's successful performance in the market, transaction and operational costs and, as a result, profitability of the organization in the whole, defining not only the level of existing customers' loyalty, but also the percentage of potential clients willing to pay for company's services. As a result, logistics service capabilities can be leveraged to create customer and supplier value through service performance, increase market share, enable mass customization, create effective customer response-based systems and provide a competitive advantage (Mentzer et al., 2001, Wang et al., 2016).

The elaboration of logistics service concept is inseparably connected with the emergence and constant development of logistics providers' business. Such tendency is determined by the willingness of production organizations to transfer or outsource logistics functions to professionals, experts in their field, in order to decrease the level of internal operations complexity and obtain accurate, advanced logistics service.

Logistics providers are the organizations which are engaged in rendering services, carrying out both separate operations and integrated logistics functions, such as transportation, warehousing, customs clearance etc. The commonly accepted classification of logistics providers was firstly introduced by Accenture consulting company in 1996 starting from «4PL» term and being decomposed further to 1, 2 and 3PL providers. It is important to note, that the number of distinguished levels increases with technological progress: nowadays, for example, the concept of 5PL, which is based on fundamental implementation of information technologies into logistics service, is being already widely discussed.

The levels of classification are distinguished in accordance with the degree of integration of provider's activity with the business of the customer, and the number of performed logistics functions. The comparative description of functions' delegation level among logistics providers is present in Table1.1

Table 1.1 Classification of logistics providers according to functions' delegation

Type of provider	**Degree of functions' delegation**
1PL	No delegation of operations
2PL	Delegation directly to the performer of services
3PL	Delegation to the intermediary, performing functions of contractors' coordination
4PL	Delegation to the intermediary uniting performance of internal and external performers of logistic functions

As it is evident from Table 1.1, 1PL forms the basic level of service providers, being represented by autonomous logistics and the performance of all involved operations by the company – cargo owner, without any involvement of external agents. Second party logistics, in turn, is usually associated with basic logistics services such as transportation and warehousing, performed by specialized organizations separately; 3PL or third party logistics provider is responsible for complex logistics service and focused on integrated operations' performance, transforming the outsourcing of activities from the point of view of the client into value adding decision (Hertz and Alfredsson, 2003). The last type, 4PL today is referred as the advanced level of integration among supply chain players. Fourth-party logistics involves various processes of planning, execution and control of all logistics operations and management of flows of information, raw materials, products and capital in alignment with long-term strategic objectives of all companies inside the supply chain.

Taking into consideration the increasing complexity of business processes' integration among involved parties of the supply chain and rapid development of technologies, the focus of the majority of organizations is being moved nowadays towards the increase of customers' satisfaction and value creation (Meidutė-Kavaliauskienė, 2014). This fact connects the concept of logistics service with the concept of logistics service quality, perceived from the client's side, which will be discussed in this chapter further.

1.2 Logistics service quality: evolution of definition

Various disciplines, such as industrial economics, production management, supply chain management, marketing, etc., operate with diverse terminology and scientific frameworks, which result in differences and even the conflicts in paradigms of quality management and a variety of existing definitions. Thus, the concept of total quality management (TQM) quality has evolved as the attempt to reach consensus. The fundamental idea concept is based on the fact, that the maintenance of a certain level of products' and processes' quality is a direct responsibility of all parties involved into production process. Hence, TQM involves management, workforce, suppliers, distributors and even consumers, aiming to meet or exceed customer expectations. The common TQM practices include cross-functional product design, strategic planning, supplier quality management and development, committed leadership, cross-functional training and employee involvement (Aized, 2012). TQM nowadays is considered as a source of competitive advantage, the basis of which is formed by the principle of definition of quality indicators or attributes from the point of view of the consumer.

Further, on the basis of TQM concept, International Organization for Standardization has developed a universally accepted set of principles – ISO 9000, which addresses various aspects of quality management, describing requirements to corporate quality management systems of

enterprises and specifies corresponding terms and definitions. The latest version of ISO 9000 series of standards, which has been revised in 2015, includes, for example, ISO 9000 – fundamentals and vocabulary of quality management systems, ISO 9001 – a set of requirements to quality management systems implemented in organizations, ISO 9004 – a guide for managing sustainable success of an organization through the quality management system implementation and total quality management approach etc. (Iso.org, 2017).

It is important to note, that the evaluation of quality of a provided service considerably differs from the assessment of product's quality and is usually perceived as more complicated. This fact is explained by the range of differences of material products from services. In case of services, for example, production, distribution and consumption are simultaneous processes, the customer value forms during the interaction of client with the company (Ovsyanko, 2011). Based on the distinctive characteristics of service, the definition of its quality was formulated in academic literature with the focus on the necessity of customer's needs, expectations and perception evaluation (Xie et al., 2013). Thus, service quality nowadays is being widely interpreted as «the difference of terms of service provision and customers' expectations of perceived service». (Meidutė-Kavaliauskienė, 2014). Basing on the previously discussed interpretation of service quality, it, in turn, becomes possible to formulate the definition of logistics service quality.

Logistics service quality nowadays is usually referred as «actually perceived performance on customer expectations through all logistics activities, such as procurement, production, sales, returns, retrieval, and disposal, from a customer perspective» (Jang et al., 2014). A literature review conducted on the subject of service quality in general and logistics service quality (further also referred as LSQ) in particular has revealed that evolution of the definitions and conceptualization of the topic is based on two distinct approaches, which are often being termed objective and subjective quality (Thai, 2013). Such bi-dimensional model has found reflection in a large number of academic papers, basing on the concept of technical and functional quality, firstly introduced by Grönross in 1984. According to the study, technical quality represents the outcomes of a rendered service, and functional quality – the process of service delivery (Grönross, 1984). Such interpretation further transformed into the identification of operational LSQ and relational LSQ, with the former dimension referring to physical distribution activities and the latter involving activities of marketing customer service.

The first perspective emphasizes the importance of service adaptation to specifications, developed by service providers, and defines LSQ as the fulfillment of operational, technical requirements for cargo transportation. Such approach has also been referred in literature as physical distribution service quality. Hence, such interpretation of logistics service quality focuses on service providers as the major party, not taking into consideration the understanding of quality

from customers' side. In other words, this school tries to indicate the methods of service value quantification from logistics executives' point of view, not evaluating customers' perceptions of the value created by logistics services (Rafiq and Jaafar, 2007).

The second approach to LSQ definition, widely contributed by Millen and Maggard (1997), Sohal et al. (1999), and Mentzer, Flint, and Hult (2001), aims to distinguish attributes of logistics service quality, which further evaluate the discrepancy of customers' expectations and perception of LSQ. Thus, the alternative approach supplements objective operational physical distribution quality dimensions with subjective, descriptive attributes, formulated by customers. It is possible to identify various types of classifications developed for the above mentioned groups of quality attributes. Lehtinen, for example, proposed to group the characteristics in either service process or service result, defining process as a consequence of the customers' experience of contacting with the company and linking result to core or technical capability of providers (Lehtinen, 1999). Further in studies, McDougall and Levesque (2000) and Brady, Robertson, and Cronin (2001) similarly suggested to describe service quality the combination of technical ability and service perceived value dimensions.

Despite the fact, that two polar interpretations of logistics service quality have been widely discussed among both academics and practitioners, subsequent studies have transferred the focus towards the necessity of integration of marketing and logistics activities. Hence, two separate classifications of LSQ definitions evolved to become complementary elements. Conducted analysis of various academic papers (Novack et al., 1994; Rutner and Langley 2000; Stank et al. 2003; Kim and Choi, 2008; Kang et al., 2008; Esmaeili and Kahnali, 2015 and other) has revealed, that a new approach to LSQ definition is based on the formulation of logistics service quality indicators or attributes, further distributed among LSQ dimensions. These dimensions or groups reflect certain perceived characteristics of logistics service and usually include tangibles, timeliness, responsiveness, assurance, communication, order accuracy, customer service etc. It is necessary to note, however, that the commonly accepted range of such dimensions does not exist and vary among publications, being supported by different service quality frameworks, expert interviews and surveys.

The interrelationship of price-related attributes with logistics service quality dimensions is also being discussed in literature. The price of logistics services sometimes is included in the list of LSQ indicators (Chen et al., 2009), yet the majority of studies do not consider price-related elements to be the measurable service quality attributes (Parasuraman et al., 1994; Cronin et al., 2000; Palseon et al., 2014). The latter point of view is supported by the specifics of price formation in logistics service market, where the main role is played by tariffs and specifications of cargo and means of transport used. Thus, the average price for logistics service in terms of same route, type

of goods and transportation methods, does not vary significantly, and the only possibility for a provider to increase price is tightly connected with the implementation of value-adding services.

As it has been discussed earlier, logistics service quality attributes are very often distinguished in accordance with existing service quality evaluation models, aiming to provide a decision maker – company's executive, with a range of distinct, precise service quality measurement variables. The above mentioned evaluation models, their advantages and potential for improvement will be de described in this paper further.

1.3 Conceptual models of service quality evaluation

Recognition of clients' needs and requirements and measurement of their satisfaction are fundamental for successful business development of any service provider, including players of logistics services market. Hence, measurement of the service performance in terms of customers' expectations and their perception is favorable for organization's processes improvement, identification of service strengths and weaknesses and formulation of an appropriate strategy (Stasiak-Betlejewska et al., 2014). Quality profiles, formulated as a result of LSQ evaluation, allow to cluster groups of customers with similar needs, thus enabling the company to customize its service delivery. In addition, since service quality is a vital element in creating and maintaining of a particular level of customer satisfaction, LSQ also plays a significant role in sustaining desirable profit of providers. As a result, measurement of service quality deserves special attention, and due to intangible nature of services sector, the evaluation of service quality involves complex processes (Baki et al., 2009).

The existing LSQ measurement tools, according to conducted analysis of academic literature, have not been developed from scratch and are rather adapted to the specificity of logistics sector from the research output in field of service quality in general. Moreover, the majority of existing frameworks are based on the modification of three fundamental models – Customer Journey Analysis framework, the Kano model and SERVQUAL, realized by adding quality attributes and customers; touchpoints, specific for a particular sector, group of operations and even mode of transportation. The models and their modified versions are described further.

1.3.1 Customer Journey Analysis

Customer Journey Analysis (further also referred as CJA) framework has emerged from business process mapping practice, usually described as a visual representation of a sequence of observable service dimensions from both company's and clients' side. In particular, customer journey mapping aims to provide a decision maker with a visual modeling of service delivery processes from two perspectives: as it is planned by service providers and as it is actually performed in real-life conditions.

A customer journey is always described and mapped as a sequence of consecutive touchpoints – the stages of client's interactions with the service providers necessary to achieve a specific goal (Halvorsrud et al., 2016). However, during the execution of the service, various deviations from the developed journey may appear. Graphically the examples of planned and actual customer journeys are represented in Figure 1.4.

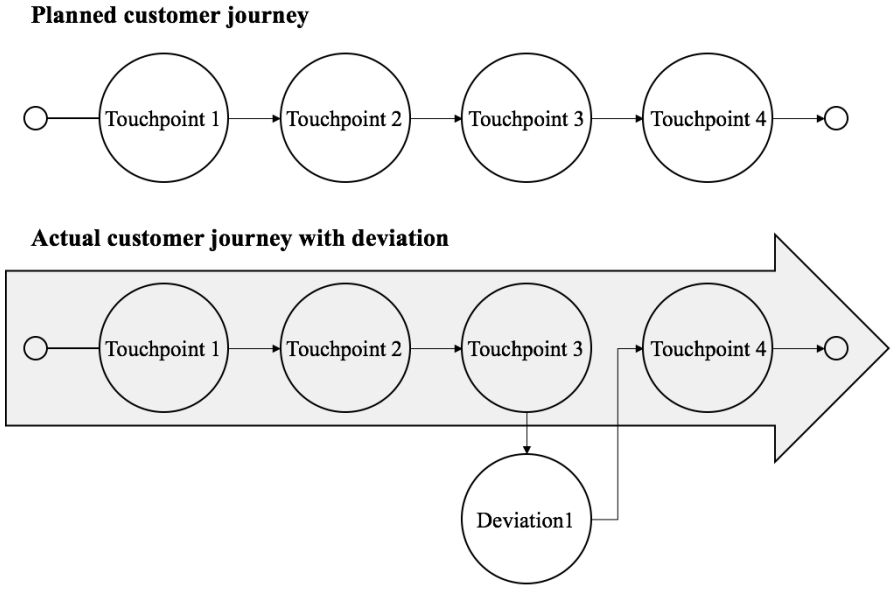

Figure 1.4 Examples of planned and actual customer journeys

Source: adapted from Halvorsrud et al., 2016

Two main types of deviations are being usually distinguished: touchpoint with an unwanted outcome is called a «failing touchpoint», and an absent stage in the journey is referred to as «missing touchpoint». Customer Journey Analysis technique has been developed addressing the need for empirical investigation of service delivery processes and appearing deviations from the client's perspective and evaluation of service quality.

CJA involves the examination of customers' experiences using multiple data sources and emphasizing the role of qualitative data analysis. The procedure of service quality evaluation with the application of CJA is performed through the realization of five consecutive stages.

Stage 1 aims to investigate the circumstances, in which the necessity for Customer Journey Analysis evolved. This step is performed by the involvement of different players – representatives of a service provider: employees and operative units' managers, responsible for particular stages of service rendering. During the first stage the scope of the analysis is formed, and start and endpoint of the ideal, planned journey are defined.

Stage 2 is proceeded with the purpose of identification, modeling, and verification of service delivery process in terms of developed customer journey. This stage of analysis is based on the application of an outside-in perspective and incorporates interviews with customer

relationship management team, screening of customer-facing materials, such as corporate website and e-mails. In addition, a structural review of the back-end procedures is performed with the involvement of experts on system architecture and business processes' management. As a result of the second phase, appropriate routines are established for further monitoring of the actual customer journey.

The objective of Stage 3 is formulated as respondents' sampling and data collection. CJA approach introduces case study as the key method of data collection, hence clients satisfying case-specific selection criteria are offered to participate in the service evaluation procedure shortly after the completion of the journey's initial touchpoint. Data collection is usually performed via distribution of diaries among case study participants. Clients are asked to report on «any sort of events or communication with the company» (Halvorsrud et al., 2016), filling in separate input fields for chosen touchpoints' attributes, such as date, time, description of the event, relative rating of each event, and any suggestions for process stages' improvement. As a final step of this stage, the actual journey is reviewed through a debriefing interview with each client, enabling a comparison of immediate assessments from the diary with the retrospect assessment.

Stage 4 is devoted to the analysis of collected qualitative data and mapping of each actual customer journey, for further comparison with the ideal picture. Gathered information transforms into a detailed model of actual journey, identifying the existing deviations. Visualization of a developed actual process of service rendering may be also advantageous on this phase of analysis.

The final step, Stage 5 of CJA, is based on further examination of potential gaps between the planned and actual journeys, and development of the strategy for deviations' elimination. Prioritizing among identified deviations is done basing on the frequency and assumed severity of the distinguished mismatches, as well as feasibility of their mitigation. In addition, follow-up procedures are established with the purpose of implemented changes' success tracking.

The main advantage of the described approach is its universality: CJA is applicable in any business sector, including logistics services. However, the procedure of customer journey analysis is rather complicated and time consuming due to the necessity of qualitative data collection and processing: it is vital to select appropriate pool of respondents and monitor their involvement in service quality evaluation on all stages of service rendering. In addition, the prioritization of identified deviations is performed subjectively basing only on the results of conducted case study and interviews. Thus, it becomes reasonable to consider various other models, aiming to transform qualitative data to quantitative outcomes, supporting decision making.

1.3.2 The Kano's model

The Kano model, named after its author – Noriaki Kano, Professor of Tokyo Rika University, was developed in late 1970s with the aim of defining service quality attributes in context of customer needs. It is widely considered, that the model originates in psychological field of studies and partly refers to «Motivator-Hygiene Theory» of Frederick Hertzberg (Witell and Lofgren, 2007). However, the key finding of Kano (Kano et al., 1984), which underlies the development of the model, is based on the contradiction of traditional view of linear nature of quality definition and proposal of non-linear, two-dimensional interpretation of quality attributes. In particular, the authors suggested that in various cases service quality indicators may exhibit a non-linear pattern and thus may not always create the expected satisfaction from customers' side.

The authors of the model distinguish three types of service requirements which differently influence customer satisfaction level in accordance with the degree of achievement. These types include «must be», «one-dimensional» and «attractive» quality requirements and are graphically represented in Figure 1.5.

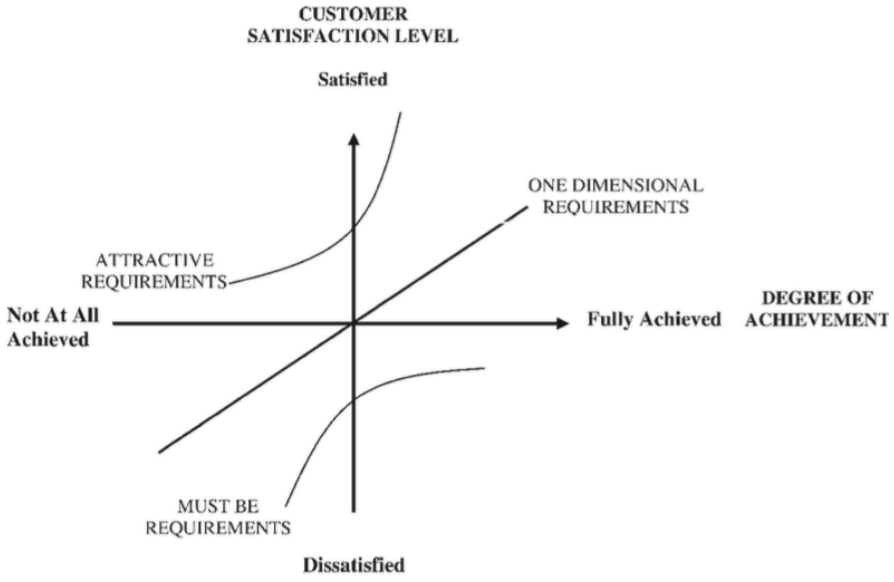

Figure 1.5 Types of service requirements according to Kano's model

Source: Baki et al., 2009

Analyzing each group of requirements in particular, it can be concluded, that «Must be» requirements should be defined as mandatory in terms of customer satisfaction: the fulfilment of this class of requirements is necessary but not sufficient condition for achieving customer satisfaction (Busacca and Padula, 2005). In turn, «one-dimensional» requirements demonstrate linear pattern: satisfaction of a customer increase in accordance with the extension of service attributes' degree of achievements. The two classes described are vitally important in terms of creating competitive advantage of a firm. The last, but not the least group – «attractive» requirements, can be described as sufficient, but not necessary condition for satisfaction. Customer

does not expect such attributes of service to be present, but if they are introduced and properly delivered, they generate higher level of client's satisfaction as a result. Attractive attributes can be used as an element of an aggressive marketing strategy to attract competitors' customers.

The measurement of service quality basing on Kano's model is done with the implementation of a special instrument – Kano evaluation table, example of which is present in Table 1.2. The table consists of two dimensions, determined as functional and dysfunctional questions. The questions represent the same chosen attributes or factors of service quality, suitable for a chosen industry; however, functional questions stand for client's feelings regarding the situation, when the attribute exists, and dysfunctional – the perception of quality, if this attribute is not provided.

Table 1.2 Example of Kano evaluation table (Sohn et al., 2017)

Quality attribute		**Dysfunctional question**				
		Like	**Must-be**	**Neutral**	**Live with**	**Dislike**
Functional question	Like	Q	A	A	A	O
	Must-be	R	I	I	I	M
	Neutral	R	I	I	I	M
	Live with	R	I	I	I	M
	Dislike	R	R	R	R	Q

Notes: A – Attractive Quality; O – One-dimensional Quality; M – Must-be Quality; I – Indifferent Quality; R – Reverse Quality; Q – Questionable Quality; Like – I like it that way; Must-be – It must be that way; Neutral – I am neutral; Live with – I can live with it that way; Dislike – I dislike it that way.

The evaluation of LSQ, in particular, is done in various studies with the assessment of such quality characteristics of logistics service, as reliability of delivery, lead time, accident management, IT capability, organizational expertize, transaction keeping practices etc. (Baki et al., 2009; Sohn et al., 2017). For each logistics service quality attribute, a pair of described questions is asked with five answer boxes, respectively, and the combination of answers for each evaluated attribute determines, to which out of six distinguished groups of quality the attribute refers: attractive, one-dimensional, must-be, indifferent, revers and questionable quality.

The developed classification is further used for the prioritizing of LSQ attributes from the point of view of customers' satisfaction level, previously described with regards to Figure 1.5., and such possibility of ranking forms an advantage of Kano's model. In particular, the most frequent type for each attribute becomes its determinant, and further quality attributes are arranged according to the general rule: must-be have to be improved first, then one-dimensional attributes are corrected, and the attractive group is advanced the last.

However, it is necessary to note, that the model does not provide a decision maker with a possibility to actually measure the existing level of LSQ among dimensions. In addition, identified reverse and questionable groups of quality attributes may not be prioritized, thus Kano's model is usually applicable in combination with other evaluation models, such as SERVQUAL.

1.3.3 SERVQUAL model

Despite the fact, that SERVQUAL model was firstly introduced by Parasuraman in the end of 20th century (Parasuraman et al., 1985, 1988), it is still widely used by researches as one of the richest and most accurate survey instruments for evaluating service quality, applicable for the majority of industries and sectors.

The model defined service quality as a function of the differences between customers' expectation of the service and its actual performance along the range of quality dimensions. In other words, service quality may be evaluated via comparison of desired and actually performed quality (Baki et al., 2009). Such interpretation of service quality is based on the identification of five various gaps, which are graphically represented in Figure 1.6. The gaps characterize the discrepancy from both management and consumer side and include (Seth and Deshmaukh, 2005):

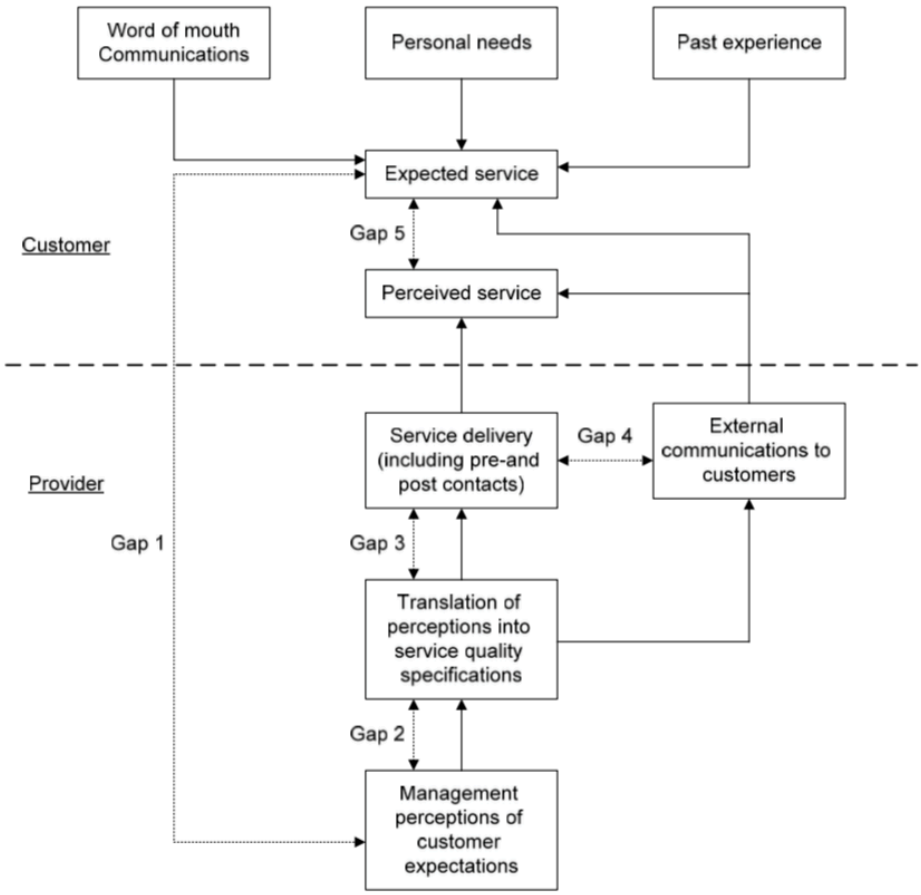

Figure 1.6 Model of service quality gaps

Source: Parasuraman et al., 1985

- Gap 1: the difference between customers' expectations and management's perceptions of rendered service quality. The possible reasons for this gap occurrence are lack of demand forecasting, wrong interpretation of customers' expectations and inadequate communication of the nature of interaction with consumers to management.
- Gap 2: the mismatch between management's perceptions of customer's expectations and service quality specifications and developed standards, usually evolving as a result of insufficient support of planning activities from top-management.
- Gap 3: addresses the difference between service quality specifications, developed by management, and actually delivered service.
- Gap 4: discrepancy of actual service delivery and the communication of it to customers, usually because of inappropriate coordination of marketing initiatives and operations.
- Gap 5: depends on size and direction (either positive or negative) of the four gaps and describes the mismatch of expected and perceived service quality from customer's point of view.

The last gap, usually described as the most significant, has become the basis for SERVQUAL model creation. Using factor analysis, Parasuraman et al. have determined five dimensions of service quality namely tangibles, reliability, responsiveness, assurance and empathy. According to the research of authors, it is possible to identify service quality attributes, specific for any industry and then to classify them in the five groups mentioned above.

Considering each group in particular, «tangibles» element represents the characteristics of the service, which are evident or visible for clients: the appearance of company's staff, physical facilities, equipment and integrated information and communication technologies; «reliability» stands for provider's abilities to perform the service accurately and dependably; «responsiveness» group characterizes prompt service and the willingness of company's staff and management to help clients; «assurance» typifies the knowledge and courtesy of service providers and their ability to show trust and confidence; the last group «empathy» represents the care and individual attention to each customer form company's side (Shahin and Samea, 2010; Roslan et al., 2015).

SERVQUAL model has found reflection in wide range of studies (Davis and Mentzer, 2006; Nadiri and Hussain, 2005; Peiro et al., 2005), becoming a fundamental framework for service quality evaluation in various business areas and industries, including supply chain management and logistics. Banomyong, for example, has identified significant service quality attributes that could influence the process of third party logistics provider selection (Banomyong et al., 2005), and numerous articles (i.e. Thantongpaiboon et al., 2008; Goh et al., 2011) utilized SERVQUAL model for the evaluation of maritime shipping services. In addition, Pakdil and Aydin, in turn, have supplemented the classical model with additional service

dimensions, such as «employees», «availability» and «image». (Pakdil and Aydin, 2007). The authors of the study have also suggested that the gap scores are obviously differed by the respondents' (clients) profile. In the described case of airline service quality evaluation, it was revealed, that frequency and direction of flights affect their expectations and perceptions. Hence, the authors have developed the idea of necessity of clients' segmentation and prioritizing in case of service quality assessment.

As it has been previously discussed, the range of commonly accepted service quality attributes does not exist, as it is important to specify quality indicators for an industry of company's operations. In addition to this fact, the significance of each of five quality dimensions is considered to be different according to clients' requirements in particular service sector. In case of logistics service provider selection from consumers' point of view, «reliability» group of factors is mentioned as critical, including, for example, adherence to scheduled time of shipping, compensation guarantee in case of a delay and an opportunity for the client to contact the expert company's representative in case of questions (Czajkowska, 2015). Despite the fact that SERVQUAL model is used for service quality assessment most frequently in relevant contemporary academic literature (Gulc, 2017), it still has several limitations, which have become the basis for research gap formulation, described in details further.

1.4 Research gap

As it has been previously discussed, SERVQUAL model is developed with the purpose of evaluation of the gap between customer's expectations and actual perceived level of service quality. Yet, the majority of assessments of this gap are done nowadays via only statistical analysis instruments and tests, such as Wilcoxon test, Mann-Whitney U test (Esmaeili and Kahnali, 2015), ANOVA, Chi-square test, Tukey's test (Tansakul et al., 2013) and others. The listed methods only determine the significance of «Expected – Perceived service quality» gaps, but do not take into account the importance of each evaluated attribute and five quality dimensions from customers' point of view, specific for the industry.

The necessity of considering relative weights of quality attributes, on the other hand, is supported by the existence of both budget and time constraints, which do not allow a decision maker – company's executive, to improve all imperfect quality factors simultaneously and reconsider the strategies of the organization. Further researches are needed in service industry in general and logistics in particular «to prioritize service quality dimensions using decision making methods» (Esmaeili and Kahnali, 2015).

In addition, the necessity to classify clients and their influence on the reliability of data collected should be also addressed in alignment with developing practice of customer focus.

However, any of the previous studies aimed to propose a method of logistics service quality evaluation, have not addressed the following idea.

Therefore, a new approach towards data processing in terms of SERVQUAL model is reasonable and aims towards multi-criteria optimization, where the range of criteria include «Expected – Perceived service quality» gap significance, attributes' importance and reliability of customer's answers.

CHAPTER 2. METHOD OF LOGISTICS SERVICE QUALITY EVALUATION

This chapter is devoted to the description of the methodology used for sequential mixed method research in current master thesis. Methods were chosen in accordance with the specifics of the investigated subject, their reasonability and relevance is explained and justified. Firstly, the research design is introduced and the process of logistics service quality attributes' selection is explained. Secondly, various methods of multiple criteria decision making are considered and the choice of aggregated preference index method is justified. Thirdly, the process of survey creation and is described.

2.1 Research design

Basing on the identified research gap in scientific field of service quality evaluation in general and LSQ assessment in particular, the goal of current research was formulated as method development of logistics service quality evaluation and its application to chosen case company. The goal is achieved through consecutive completion of three tasks, which are:

- On the basis of academic literature review define the most appropriate method of logistics service quality evaluation;
- Specify and improve the chosen method of logistic service quality evaluation;
- Apply the modified method of logistic service quality evaluation to the case company.

Sequential mixed method research was used in current master thesis. Such research method involves the collection and analysis of both quantitative and qualitative data in a single study, and «sequential» characteristic stands for the fact, that one type of data provides a basis for collection of another type (Cameron, 2009). Due to the fact, that it is possible to decompose the research design of current paper into two major steps – qualitative, followed by quantitative, the research design is classified as two-phase exploratory. This design is particularly useful when there is a need to develop and test an instrument or identify important variables to study them quantitatively when the set of variables is unknown (Creswell, 2013). Both of these reasons find reflection in present master thesis.

The qualitative phase of current research includes the formulation of logistics service quality attributes' range via literature review and its justification based on conducted expert interview. Quantitative stage, in turn, follows qualitative part with further developed method application: collection of data via created survey for the case company and data analysis using chosen aggregated preference index method. Each of the stages of the research are explicitly described in this paper further with the example of developed method application for chosen case company in Chapter 3.

2.2 Selection of logistics service quality attributes

As it has been previously discussed, SERVQUAL model of service quality evaluation determined five dimensions of attributes, classified in tangibles, reliability, responsiveness, assurance and empathy groups. It is suggested, that practitioners and researchers working in a particular industry should confirm the dimensions' structure and determine the number of attributes relative to specific business sector. Taking this fact into account, the selection of logistics service quality attributes was performed basing on the following reviewed studies: Baki et al., 2009; Chen et al., 2009; Tansakul et al., 2013; Zhang and Hou, 2013; Thai, 2013; Esmaeili and Kahnali, 2015; Czajkowska, 2015; Limbourga et al., 2016; Kilibarda et al., 2016. The analysis of academic literature resulted in determination of usage frequency of each quality factor, and the most periodically repeated ones were included into preliminary table (Table 2.1).

Table 2.1 Chosen LSQ attributes

Quality attributes	**Reviewed academic papers**									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Σ**
Modern, appealing physical facilities	x	x	x	x	x	x		x	x	8
Staff expert for their positions	x	x	x		x	x	x	x	x	8
Providing service at a promised time	x	x		x	x	x		x	x	7
Problems solved as soon as possible	x	x	x	x	x			x	x	7
Customers feeling received personalized	x	x	x	x		x	x	x		7
Utilizing ITs	x		x		x	x	x	x		6
Accurate transaction records	x	x	x		x		x	x		6
Employees are willing to help	x	x		x	x	x		x		6
Good looking staff	x	x		x		x		x	x	6
Staff understand clients' specific needs		x	x			x	x	x	x	6
Providing fast service	x		x	x			x	x		5
Clients' requests and complaints met in satisfactory way	x			x	x	x		x		5
Tolerant, respectful and patient staff	x	x			x			x	x	5
Delivering free of problems and damage	x		x		x	x		x		5
Clients feel secured about the service		x	x			x		x	x	5
Correctly informing about delivery status	x	x						x	x	4
Client feels trust in staff and confident in service performed	x		x		x			x		4
Convenient opening hours to all clients		x		x		x			x	4
Providing accurate service in the first place		x		x				x	x	4
Wide branch of suitably located offices	x			x	x			x		4

Table 2.1 (continued)

Quality attributes	Reviewed academic papers									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Σ**
Staff communicating in a proper manner			x			x		x		3
Effective office design	x			x					x	3
Enough staff to provide service on time	x		x					x		3
Available service time fits to customers' needs		x						x		2
Enough convenient space inside the organization to rest						x				1
Notes: 1 – Baki et al., 2009; 2 – Chen et al.,2009; 3 – Tansakul et al., 2013; 4 – Zhang and Hou, 2013; 5 – Thai, 2013; 6 – Esmaeili and Kahnali, 2015; 7 – Czajkowska, 2015, 8 – Limbourga et al., 2016; 9 – Kilibarda et al., 2016.										

As it can be seen from Table 2.1, four attributes, including effective office design, enough company's staff to provide service on time, available service time fits to customers' needs, enough convenient space inside the organization to rest and staff communicating in a proper manner have been utilized in literature less frequently. Thus, their inclusion in any of five fundamental LSQ dimensions is questionable and is not performed in terms of current paper.

The second stage of logistics service quality attributes determination was based on the justification of chosen group of criteria via conducted expert interview. Taking into account the fact, that the preliminary list of attributes was formed as a result of academic literature analysis, it was decided to involve a business professional into finalization of attributes' list. Acting head manager of St. Petersburg branch of RZD Logistics, Larionov F.F., was chosen for expert position. Semi-structured interview approach has been followed as the most appropriate for current study. On the one hand, the depth and breadth of the conversation is determined by the necessity of critical evaluation of preliminary chosen LSQ attributes. However, on the other hand, the method of semi-structured interview provides with a possibility to reveal important practical insights that cannot be anticipated in advance and included into the set of questions.

As a result of expert interview, it has been concluded, that all LSQ attributes, represented in Table 2.1 with the total sum of 4 and above are suitable for evaluation process. Moreover, it has been suggested by the expert, that "staff communicating in a proper manner" quality factor is also illustrative, despite the lower developed sum score, and hence should be included into the range of quality criteria.

In addition, according to expert's opinion, the inclusion of an additional quality attribute – «convenient, accessible and informative website» is obligatory. This necessity is determined by the fact, that nowadays in the business-to-business segment the corporate website is becoming an

effective platform for communicating corporate brand features and distinguishing among competitors (Simões et al., 2015). Thus, it becomes possible to include the following logistics service quality attribute in tangible dimension, as usually organization's website is the first asset of the company, which a client faces and evaluates, even before choosing a particular logistics service provider.

As a result, 22 chosen attributes have been distributed among five fundamental dimensions of SERVQUAL model, forming the hierarchy further used as the basis for survey creation and data collection. The hierarchy of LSQ attributes is graphically represented in Figure 2.1.

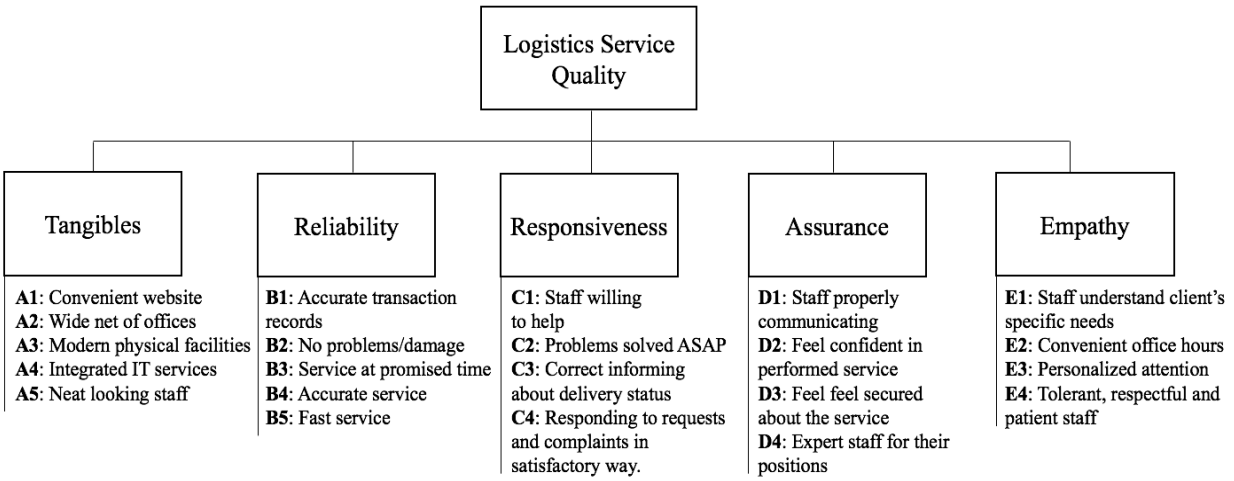

Figure 2.1 Developed hierarchy of logistics service quality attributes

It is crucial to specify, that the following set of logistics service quality attributes, present in Figure 2.1, is not compulsory and common for each organization: any decision maker may adjust the list of chosen criteria basing on the areas of company's performance, which have to be evaluated from customers' side.

2.3 Methods of multiple criteria decision making and ranking

The next stage of qualitative part of current research involved the choice of most appropriate method of multiple criteria decision making, which addresses the identified research gaps of SERVQUAL application for logistics service quality evaluation.

Multiple criteria decision making (MCDM), often also referred as a synonym for multi-criteria optimization, is a complicated procedure of identifying the best alternative or decision based on the analysis of range of criteria valuations. In case of logistics service quality evaluation via SERVQUAL model, the two ranges of assessed criteria include the size of «Expected – Performed quality of service» gap and the importance of each quality attribute expressed in weight coefficients. Thus, it becomes necessary for a decision maker to prioritize quality factors taking both ranges of criteria into consideration. The following section of master thesis examines currently used multiple criteria decision making methods in the area of service quality evaluation,

and justifies the applicability of newly proposed aggregated preference index method, not used for service quality evaluation previously.

2.3.1. Weighted Point Method

Weighted Point method is usually referred as the least complicated approach to multiple criteria decision making and is based on the calculation of weighted average of scores. In particular, in accordance with the method, the relevant attributes are chosen and each is assigned with a weight coefficient depending on its importance to the overall analyzed subject. Weighted Point method is used by researchers in combination with SERVQUAL model for both service quality evaluation in general (Brochado, A., 2009; Ulewicz R., 2014) and LSQ assessment in particular (Czajkowska, 2015; Limbourga et al., 2016).

Despite the key advantage of described method, which is the simplicity of required calculations, Weighted Point approach is also described as not literally reliable due to the necessity of converting qualitative judgment about the importance of attributes to quantitative form. From evaluators' side, the identification of exact numeric score is perceived as difficult and subjective task. Thus, various complex approaches addressing the necessity for weights approximation are developed and described further.

2.3.3 Fuzzy approach

Service quality evaluation requires a careful assessment of various attributes from client's side, and creation of survey is usually implemented in researches as the key instrument of necessary quantitative data collection. Traditional survey method for quality assessment requires the evaluators to make choices among «very low», «low», «medium», «high» and «very high» description of both expected and performed level of service quality of quality based on a 5-point Likert scale. However, such type of survey scale formulation does not account for different perception and ambiguity among evaluators (Karami and Guo, 2012). Thus, a fuzzy theory was developed in order to allow uncertainty associated with an individual's subjective judgment to be incorporated with Likert scale dimensions.

Fuzzy numbers represent decision maker's subjective judgment, forming the linguistic variable measured by categorical evaluation. The idea of fuzzy numbers' use is based on the possibility for a decision maker to subjectively assume the personal range of the linguistic variables by assigning a real number for the lower bound, upper bound and mean value from a triangle distribution. Graphically the approach is represented in Figure 2.2.

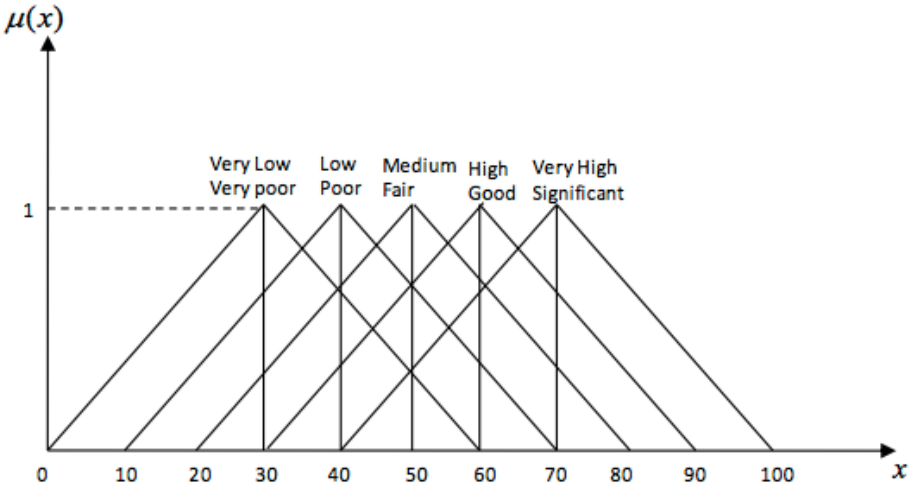

Figure 2.2 Triangle Membership Function of Fuzzy Numbers Set

Source: Karami and Guo, 2012

Aggregation operations in this method aim to create a single fuzzy number from several fuzzy numbers, which can be further compared. In order to obtain an aggregated number, the gravity center method has been used to defuzzy the fuzzy member.

The advantages of current method application to data collection and analysis include the description of system in terms of combination of numerical and linguistic data and possibility to acquire approximate evaluations, which are more relevant to customers' opinions. These positive characteristics of method form the basis for fuzzy wide use for service quality evaluation in general, and in combination with SERVQUAL model in particular, calculating fuzzy perception, expectation and gap scores (Charles et al., 2013; Behdioğlu et al., 2017).

However, the method described still has several considerable disadvantages. Firstly, service quality assessment using fuzzy approach does not illustrate precise evaluations of client's perception of expected and really performed service level, as the used 5-point Likert scale reduces the variance of evaluators' scores. Secondly, fuzzy number approach does not take into consideration different significance of quality attributes, hence it may be applied only jointly with other multiple criteria decision making methods. In addition, such approach towards service quality evaluation is complicated and time consuming in terms of calculations.

2.3.2 Analytical Hierarchy Process

The Analytical Hierarchy Process (further also referred as AHP), developed by Thomas L. Saaty (1990), is one of the best known and frequently used multi-criteria analysis techniques. The approach allows users to assess the relative weight of multiple criteria in an intuitive manner via pairwise comparisons. Thus, AHP may be interpreted as a consistent way of converting such pairwise comparisons into a set of numbers representing the relative priority of each of criteria.

The process of multiple criteria decision making using AHP approach begins with the decomposition of the goal into a hierarchical structure of various alternatives, range of criteria and other factors, influencing final decision making. Each of the elements included into the hierarchy stands for distinctive aspects of analyzed problem. Hence, the chosen components may represent tangible and intangible factors, measured by both quantitative scores and qualitative attributes, unbiased data and subjective experts' evaluations. Such arrangement of components in a hierarchy provides a decision maker with an overall view of the complex relationships and helps to confirm, that chosen factors have the same magnitude to be compared accurately. In addition, it is essential to consider the environment surrounding the problem and to identify all participants associated with it in order to obtain most relevant results.

The next stage of AHP method is the definition of importance of each attribute using relative weights in pairwise comparison. Rating the relative priority of the factors is done by assigning a weight between 1 (the two factors have equal importance) and 9 (second factor has extreme importance in comparison with the first factor) to the more important criterion, and the reciprocal of this value is defined for the other factor in analyzed pair. The given weights are then normalized and averaged for each considered attribute.

At the final stage of the analysis using Analytical Hierarchy Process, the synthesis or linear convolution is accomplished for the developed hierarchy of priorities. As a result, the priorities of chosen alternatives are calculated, and the best alternative is considered to be characterized with the maximum priority value.

To conclude, the range of advantages of described approach include intuitive appeal to the decision makers and its ability to use the pairwise comparison form of data input, which is usually perceived as straightforward and convenient (Lamaakchaoui et al., 2015). In addition, decomposition of decision problem helps to clearly identify the importance of each element and to capture both subjective and objective evaluation measures. However, several disadvantages of the approach are also identified in academic literature and include the fact, that the number of pairwise comparisons to be made may become very large. Moreover, the artificial limitation of the use of 9−point scale creates the difficulty for a decision maker in determination of suitable weight and reduction of answer's variance.

2.3.4 Technique for order preference by similarity to an ideal solution

The technique for order preference by similarity to an ideal solution (TOPSIS) is known as one of the most widely used multiple criteria decision-making (MCDM) method on an equal basis with AHP approach. TOPSIS was proposed by Hwang and Yoon in 1981 and stands for the principle that best chosen alternative should have the shortest distance from the positive ideal solution and the farthest distance from the negative ideal solution.

According to TOPSIS approach, a series of comparisons of relative distances between ideal, negative ideal and real situations (scores) provides the decision maker with the preference order of the analyzed alternatives. TOPSIS algorithm is realized via five steps: firstly, normalized decision matrix is constructed to transform the various factors' dimensions into non-dimensional attributes; secondly, weighted normalized decision matrix is developed; thirdly, ideal and negative ideal solutions are determined; fourthly, the Separation Measure and the gaps between idea, negative ideal and real scores are calculated; lastly, the alternatives are ranked in preference order.

The main advantage of TOPSIS in comparison with previously discussed methods is the absence of limitations for a number of alternatives and criteria in the decision making process. However, the implementation of the approach requires the exact numeric scores of attributes' weights, and this fact leads to ambiguity and subjectivity, as has been previously discussed. Addressing this problem, numerous studies have attempted to apply fuzzy set theory, using linguistic variables in accordance with fuzzy numbers approach.

2.3.5 Aggregated Preference Indices Method

Aggregated Preference Indices method (further also referred as APIS) is a multiple criteria decision-making approach, relatively similar to previously discussed TOPSIS technique. The realization of the method is done by comparison of numeric values developed via synthesized single preference indices function and calculation of weights coefficients. Interactive decision support system (DSS) APIS – a specially created computer software for decision-making under uncertainty, was introduced by Hovanov with the purpose to simplify necessary calculations.

The existing opportunities of DSS APIS utilization are broad enough, forming the main advantage of the approach over other well-known multiple criteria decision-making methods. Distinctive feature of APIS is based on its possibility to find computed solution under uncertainty even in cases of analyzing nonnumeric, inexact and incomplete data (Hovanov, 2008). The list of such cases usually includes the following characteristics of a problem:

- Shortage of numeric information is evident for the chosen problem and the evaluations are subjected to uncertainty due to non-precise data;
- The object for estimation is represented by a sophisticated system, thus it becomes complicated to define indices of efficiency for comparison;
- Solution for the problem contains alternatives that are hard to compare due to lack of unified criteria;
- Calculation of different alternatives' probabilities is based on information from sources with diverse level of reliability, and it is necessary to make estimations based on experts' opinion.

Method of aggregates is fundamental for the development of APIS approach. Its main objective is determined as the synthesis of various evaluations of a complex object into a single computation. The evaluations mentioned, in turn, represent individual indicators or attributes, which characterize the preference, quality, efficiency, reliability, utility, etc. of a chosen multiparameter object, organizational system, managerial or investment decision, strategic choice.

A simplified algorithm of composite indicator construction using APIS may be represented as the following range of consequents stages, sufficient for a complete, comprehensive evaluation or multiple criteria decision-making realization. The steps are described further:

1. A certain vector $q = (q_1, \dots, q_m)$ of individual indicators is formed, using m various criteria or attributes;
2. A function for estimation of individual preference indices is constructed and synthesizing single preference indices function $Q(q;w)$ is selected;
3. The value of a parameter vector $w = (w_1, \dots, w_m)$ is defined. These parameters of attributes may be interpreted as weight coefficients, defining the influence degree of individual indicators $q_1, \dots, q_m$ on the complex synthesized evaluation Q. The identification of weight coefficients is usually perceived as the most complicated step of composite indicator construction. As it has been previously discussed during the description of other multiple criteria decision-making methods, the evaluator usually does cannot define the exact numeric value of the weight, and it is easier for him to express his opinion in comparative, linguistic form. However, APIS approach copes with such difficulty and allows to proceed non-numeric, inexact and incomplete weight information. It is also necessary to note, that ordinal, interval weight information used for APIS method should not obligatory refer to all aggregates or weights, as the decision supporting system may proceed incomplete information, available for the researcher (Hovanov, 2005).
4. The output of DSS APIS application is represented by the calculated estimates $\overline{w_i}(I)$, their accuracy $s_i(I)$ and reliability $p(i,j;I)$ of the pairwise dominance. These results are also illustrated by the so-called APIS charts of weighting factors. In addition, the values $\overline{Q_i}(\mathrm{I})$ of aggregates, their accuracy $S_i(I)$, $j = 1,..,k$ and reliability $P(j,l;I)$, $j, l = 1,...,k$ are formed, providing a decision maker with a possibility to choose the best alternative.

Taking all characteristics of described method into consideration, it becomes possible to conclude, that the main advantage of DSS APIS over other well-known decision support systems consists in its complexity. Firstly, its ability to take into account different types of uncertain information on weight-coefficients simplifies the evaluation process from the point of view of

respondents or decision maker. Secondly, method's possibility of fast customization of attributes' preferences and simultaneous ranking of alternatives' significance without unified criteria characterizes it as the most functional among all previously described approaches. Thirdly, specially developed software or decision supporting system contributes to ease of calculations and may be implemented for a wide range of problems.

All described advantages of aggregated preference indices method form the basis for the decision to use APIS as an instrument for logistics service quality evaluation method development. In addition, the use of APIS is justified by the fact, that all the cases of various types of uncertainty described previously are relevant for logistics service quality evaluation. In particular, clients' evaluations of expected and perceived levels of service quality are non-precise and highly subjective; the respondents are characterized with diverse level of reliability, as the frequency of their use of providers' services varies; the object for estimation – logistics service quality, is a sophisticated system represented by the hierarchy of attributes.

The adaptation of DSS APIS for a particular problem of LSQ evaluation is described and justified in current master thesis further.

2.4 Survey creation and description of developed method for data analysis

The stage of quantitative research in current master thesis was performed by the creation of survey, which addresses the evaluation of customers' expected and perceived levels of provided logistics service. Basing on the fact, that aggregated preference index method was chosen as the most appropriate for this particular data type analysis, the following requirements for the choice of the scale had to be met:

- The scale should enable to capture the difference in respondents' feelings during the comparison of expected and performed level of service to maximum possible extend;
- The examiner has to be assured in all the gradations of evaluators' judgments at the same time.

In order to meet the requirements stated, the survey included continuous Likert scale as an instrument of quantitative data collection. The advantage of the chosen scale is determined by larger variance of quantitative scores, which results in possibility for customers to assess service quality attributes more accurately. The only difficulty of utilization of chosen scale is the time consuming process of answers' translation in numerical values.

The developed survey, example of which is present in Appendix 1, is logically divided into six steps of clients' scores gaining. Firstly, customers are asked to evaluate the expected and performed level of LSQ and relative importance for each of five quality dimensions and 22 quality attributes, described in this paper earlier. Secondly, respondents are asked to identify the importance of each quality dimension via allocating 100 points among them.

The final stage of collected quantitative data analysis incorporates the application of aggregated preference index method, not used for service quality evaluation previously. The calculations are proceeded in DSS APIS software – a computer program, specially created by Hovanov, the computation algorithm of which has been described in the previous section of the following chapter.

The input data for APIS software is represented by a range of numeric scores of attributes for several alternatives. In particular case of LSQ evaluation using SERVQUAL model approach, the input variables – x_{ij}, are the results of subtraction of perceived level of LSQ from the expected level, calculated for each of 22 quality attributes from each customer respond.

On the first step of data analysis each of five quality dimensions – tangibles, reliability, responsiveness, assurance and empathy, are processed as separate groups of logistics service quality attributes, and the input table takes the following form (Table 2.2) with N number of clients and M number of quality attributes $(i \in (1, 2, ..., N);\ j \in (1, 2, ..., M))$ analyzed. Each of five quality dimensions, in turn, get the for of such input table.

Table 2.2 Input data for further analysis using APIS

Attributes / Alternatives	Attribute 1	Attribute 2	…	Attribute j
Client 1	x_{11}	x_{12}	...	x_{1j}
Client 2	x_{21}	x_{22}	...	x_{2j}
…	...	...	...	...
Client i	x_{i1}	x_{i2}	...	x_{ij}

Relative significance of each LSQ attribute is used on the next stage of data analysis. Average score of attribute's importance, calculated as the sum of points provided to an attribute by each evaluator and divided on the number of respondents, is transformed from numeric estimations to comparative statements, such as «Attribute №1 = Attribute №2», «Attribute №1 > > Attribute №2» or «Attribute №1 < Attribute №2».

In addition, it is also possible to prioritize clients – respondents of the survey, via the same comparative statements, as used for quality attributes, in accordance with chosen characteristic. This idea is correlated with the evolving practice of customers' segmentation and idea of customer focus. In particular, the implementation of customer focused strategy does not necessarily mean satisfaction of all clients' requirements. On the contrary, «the strategic choice of primary customer – with special emphasis on «primary» – defines the business» (Simons, 2014). Hence, in terms of service quality evaluation, the prioritization could be done with the purpose of ranking the reliability of respondents' answers, following the assumption, that the more often customer addresses to company's services, the wider experience he has, thus the more reliable are his answers. The list of examples of characteristics used for clients' classification may include

frequency of use of evaluated logistics provider services, the volume and value of cargo transported, the amount of profit generated per customer etc.

As a result of the following stage, the weight-coefficients estimations are calculated for each LSQ attributes and aggregated preference indices are determined for each client. The latter obtained data is further reused as input variables for the second cycle of calculations using APIS software. The repeated run is necessary for the calculation of weight-coefficients estimations for each of five LSQ dimensions.

The final step of the analysis incorporates simple multiplication of weight-coefficients estimations of each logistics service quality attribute and coefficients of service quality dimensions. As a result, a final index is formed for each LSQ factor, taking into consideration the size of the gap between expected and performed level of quality and the importance of each attribute and group. The developed indexes are used for quality attributes' ranking and comparison, and the factor with the biggest score may be interpreted as the quality attribute, which need to be reconsidered and improved by company's representatives.

To conclude, the proposed method of LSQ evaluation basing on SERVQUAL model and aggregated preference indices method has been developed addressing the identified areas of possible improvement from the research gap. First of all, it allows to process non-numeric, non-exact and non-complete information about attributes' weights simultaneously with the data on quality gap size. Secondly, the information regarding weights is represented in comparative statements form, instead of the use of approximate numeric estimations. Thirdly, an instrument of ranking the significance of clients' answers is introduced, providing a decision maker – company's representative, with a possibility to assess their reliability basing on chosen criteria (i.e. frequency of provider's service use). The last, but not the least advantage of developed method is formed by the existence of specially developed software, which simplifies the process of calculations and creates an opportunity of fast customization of attributes' preferences. The practical application of developed method to chosen company case will specify the steps of proposed data analysis algorithm and output and is present in Chapter 3.

CHAPTER 3. APPLICATION OF DEVELOPED LOGISTICS SERVICE QUALITY EVALUATION METHOD TO RZD LOGISTICS COMPANY CASE

The following chapter aims to demonstrate the results of conducted empirical study aiming to provide a comprehensive description of developed logistics service quality evaluation method. The chapter is structured in the following way: the data collection for a chosen case company is firstly described; logistics service quality of the company is secondly evaluated with application of proposed methods; thirdly, the results are interpreted, providing with the possibility to formulate theoretical contribution and practical implications of developed method.

3.1 Company case data collection

Russian third-party logistics provider, RZD Logistics, has been chosen as a case company for current master thesis. RZD Logistics was established in 2010 in line with the logistics business segment development of JSC Russian Railways Holding, the biggest transportation company in Russian Federation. The subsidiary company is constantly improving operational results and increasing the volume of container traffic, becoming the largest multimodal logistics operator in the Commonwealth of Independent States (CIS) and Baltic countries. In addition, in March 2017 company's CEO, Vyacheslav Valentik, has stated in the interview, that in 2016 the organization «… has focused on deeper immersion in the transportation infrastructure of our clients» and «has optimized the system of supply chain management for them and improved logistics services» (Rzdlog.om, 2017). Thus, the necessity of logistics service quality evaluation from customers' side becomes well-supported by company's business development focus.

The questioner, the example of which is present in Appendix 1, was developed for RZD Logistics company clients in both Russian and English language and was further distributed among evaluators via email or transferred personally.

The sample of respondents included logistics managers of companies from different business sectors, who are responsible for the organization of B2B logistics processes and have at least once chosen RZD Logistics as logistics provider during the last two years. The survey lasted for one month, during which 30 responses were collected. Considering the fact, that proposed aggregated preference index method is fundamentally developed for the evaluation of experts' opinion, such number of filled questioners is sufficient for subsequent data proceeding.

After the finalization of data collection stage of research, the analysis was performed in accordance with previously described developed method of LSQ evaluation based on SERVQUAL model. The detailed description of data proceeding and results interpretation is present in this chapter further.

3.2 Evaluation of logistics service quality of RZD Logistics with the implementation of developed method

The analysis of quantitative collected data was performed following the algorithm of developed method of logistics service quality evaluation based on SERVQUAL model, described in Section 2.4. The calculations were proceeded using APIS – software, specially developed for aggregated preference indices method (Hovanov, 2005).

In accordance with the proposed developed method, clients' evaluations represent the alternatives, which provide each of 22 logistics service quality attributes with numeric score of the difference between expected and performed level of service quality. The input tables, divided according to five quality dimensions – tangibles, reliability, responsiveness, assurance and empathy, is present in Appendix 2.

The objective of first step of data analysis is the calculation of the weight-coefficients' estimations for each LSQ attribute and aggregated preference indices for each client. The stage included the formulation of comparative statements about weights, derived from the average sum of allocated points to each of logistics service quality attributes. The results of weight estimations for all LSQ dimensions is present in Table 3.1.

Table 3.1 Comparative statements characterizing the weights of LSQ attributes

LQS dimension	**Comparative weight statements**
(A) Tangibles	(A3) Modern physical facilities > (A4) Integrated IT services (A2) Wide net of suitably located offices > (A5) Neat looking staff (A4) Integrated IT services > (A2) Wide net of suitably located offices (A1) Convenient website > (A2) Wide net of suitably located offices
(B) Reliability	(B2) No problems/damage > (B3) Service at a promised time (B3) Service at a promised time > (B5) Fast service (B4) Accurate service > (B5) Fast service (B5) Fast service > (B1) Accurate transactions records
(C) Responsiveness	(C2) Problems solved ASAP > (C4) Satisfactory responding to requests (C1) Staff willing to help > (C3) Correctly informed about delivery status (C4) Satisfactory responding to requests >(C1) Staff willing to help
(D) Assurance	(D2) Confident in service performed > (D3) Feel secured about the service (D4) Expert staff > (D1) Staff properly communicating (D3) Feel secured about the service > (D4) Expert staff
(E) Empathy	(E1) Staff understanding specific needs > (E3) Personalized attention (E3) Personalized attention > (E4) Tolerant, respectful and patient staff (E4) Tolerant, respectful and patient staff > (E2) Convenient office hours

The attributes' aggregated weight coefficients are developed as a result of multi-criteria optimization between «Expected – Performed level of service quality» gap size and relative importance of each LSQ attribute.

Also, an assumption on customers' answers reliability is made in order to provide the full picture of the developed method application. The proposed comparative statement used further is «Client 3 > Client 5», meaning, that the answers of Client 3 are perceived as more reliable. However, such assumption is not supported with any information from company's side, as it may be characterized as restricted. The decisions on prioritizing clients, in fact, has to done by company's representative.

The results of calculation of the weight-coefficients estimations, proceeded with DSS APIS, are present in Table 3.2. In addition, graphical representation of the output per each service quality dimension is present in Appendix 3.

Table 3.2 Attributes' weight-coefficients estimations

Attribute		Weight coefficient
(A) Tangibles	(A1) Convenient website	0,291
	(A2) Wide net of suitably located offices	0,088
	(A3) Modern physical facilities	0,397
	(A4) Integrated IT services	0,195
	(A5) Neat looking staff	0,029
(B) Reliability	(B1) Accurate transaction records	0,029
	(B2) No problems/damage	0,397
	(B3) Service at promised time	0,195
	(B4) Accurate service in first place	0,291
	(B5) Fast service	0,088
(C) Responsiv.	(C1) Staff is willing to help	0,143
	(C2) Problems solved ASAP	0,530
	(C3) Correctly informed about delivery status	0,052
	(C4) Satisfactory responding to requests	0,276
(D) Assurance	(D1) Staff properly communicating	0,052
	(D2) Confident in service performed	0,530
	(D3) Feel secured about the service	0,276
	(D4) Expert staff	0,143

Table 3.2 (continued)

Attribute		Weight coefficient
(E) Empathy	(E1) Staff understand specific needs	0,530
	(E2) Convenient office hours	0,052
	(E3) Personalized attention	0,276
	(E4) Tolerant, respectful and patient staff	0,143

The second stage of quantitative data analysis involved the calculation of the same weight-coefficients estimations, but for five dimensions of logistics service quality. This step is extremely important, as the pairwise multiplication of the two weight-coefficients estimations (of attributes and dimensions) will allow to compare and range LSQ factors, rank them and draw managerial conclusions, forming the distinctive advantage of proposed developed method.

The following step is performed with the use of aggregated preference indices of each quality dimension from each client, which have also been included in APIS software output during the realization of the first run of computations. The pivot table of input data used for the second run of calculations is present in Appendix 4. Similar to the first round of calculations, comparative weight statements were distinguished for logistics service quality dimensions via the comparison of average sum of allocated points. In particular, Reliability LSQ group was perceived by respondents as the most important one, followed by Responsiveness dimension. Other three quality dimensions, in turn, have taken the following form of comparative statements: «Assurance > Tangibles» and «Tangibles > Empathy».

As a result of current step completion, five weight-coefficients estimations for each logistics service quality dimension were calculated. Graphic interpretation of DSS APIS output is represented in Figure 3.1.

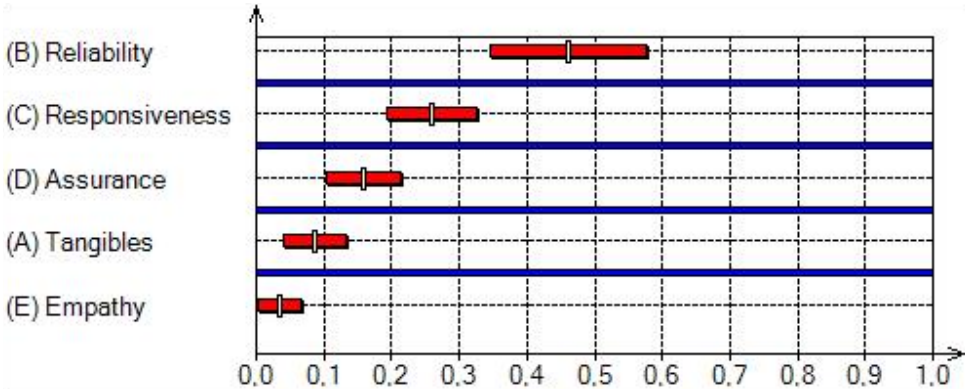

Figure 3.1 Representation of weight-coefficients estimation for quality dimensions

The diagram – DSS APIS output, demonstrates red and blue intercepts of a straight line. Each abscissa of middle points of red intervals stands for the average value of a correspondent weight- coefficient, while red interval's length represents the doubled standard deviation of the

weight- coefficient. An abscissa of a blue line's end on the right side shows, in turn, the reliability for dominance relation between neighboring weight-coefficients.

It can be seen from Figure 3.1, that the biggest weight-coefficients estimation belongs to Reliability LSQ dimension, with the numeric value of 0.4602. Responsiveness, Assurance, Tangibles and Empathy dimensions are characterized by 0.2607, 0.158, 0.0887 and 0.0334 values correspondingly. The dominance relation is maximum for each pair.

As it has been previously discussed, the last, third stage of collected data analysis incorporates simple multiplication of weight-coefficients estimations of each logistics service quality attribute and same coefficients of service quality dimensions. Such action provides with a possibility to transform all values to identical type and further to compare and arrange it, drawing managerial conclusion. The multiplication of logistics service quality attributes' scores from Table 3.2 with weight-coefficients estimations of dimensions mentioned above resulted in the final scores of LSQ attributes being included in Table 3.3, sorted in decreasing order and ranked.

Table 3.3 Final indices of logistics service quality attributes

Attribute	Final index	Dimension	Rank
(B2) No problems/damage	0,18288	Reliability	1
(C2) Problems solved ASAP	0,13807	Responsiveness	2
(B4) Accurate service in first place	0,13383	Reliability	3
(B3) Service at promised time	0,08955	Reliability	4
(D2) Confident in service performed	0,08368	Assurance	5
(C4) Satisfactory responding to requests	0,07187	Responsiveness	6
(D3) Feel secured about the service	0,04356	Assurance	7
(B5) Fast service	0,04050	Reliability	8
(C1) Staff is willing to help	0,03731	Responsiveness	9
(A3) Modern physical facilities	0,03525	Tangibles	10
(A1) Convenient website	0,02579	Tangibles	11
(D4) Expert staff	0,02261	Assurance	12
(E1) Staff understand specific needs	0,01769	Empathy	13
(A4) Integrated IT services	0,01726	Tangibles	14
(C3) Correctly informed about delivery status	0,01345	Responsiveness	15
(B1) Accurate transaction records	0,01344	Reliability	16
(E3) Personalized attention	0,00921	Empathy	17
(D1) Staff properly communicating	0,00815	Assurance	18
(A2) Wide net of suitably located offices	0,00781	Tangibles	19

Table 3.3 (continued)

Attribute	Final index	Dimension	Rank
(E4) Tolerant, respectful and patient staff	0,00478	Empathy	20
(A5) Neat looking staff	0,00259	Tangibles	21
(E2) Convenient office hours	0,00172	Empathy	22

The calculated quantitative results, present in Table 3.3, will be further interpreted both in terms of drawn managerial conclusion and practical implications, and theoretical contribution of developed method.

3.3 Empirical research results interpretation and discussion

Current section is devoted to the description of managerial conclusion, drawn from quantitative results of analyzed case, and the discussion regarding theoretical contribution, practical implications of developed method, existing limitations and opportunities for further research.

3.3.1 Managerial conclusion for RZD Logistics company case

As it is evident from Table 3.3, RZD Logistics company's performance is perceived the best from the point of view of its clients, talking about the characteristics of the service, which are evident, visible or associated with the emotional side of service quality. In particular, clients appreciate convenient opening hours of suitably located offices, personality trait of employed staff and the paid personalized attention.

However, «No problems/damage» is the quality attribute, which has the biggest score of calculated aggregated indices in analyzed RZD Logistics company case. The obtained quantitative score provides with a possibility to conclude, that this particular quality attribute demonstrates the biggest gap between expected and performed level of service, being at the same time critically important from the point of view of RZD Logistics company clients.

In addition, it can be noticed from Table 3.3, that three out of five quality attributes, associated with Reliability LSQ dimension, are located in the top rows and are ranked first, third and fourth respectively. However, as it has been previously specified, Reliability dimension is regarded as the most important according to customers' perception.

Taking the obtained results into consideration, it becomes possible to formulate the following recommendation: the efforts of RZD Logistics management have to be directed towards elimination of any problems associated and cargo damages occurring during the performed logistics services. Fulfilling the services free of damages and unexpected problems will allow the company to increase the level of customers' satisfaction, strengthening the competitive position of the organization in the market.

3.3.2 Theoretical contribution and practical implication of conducted research

The main theoretical contribution of current paper is based on the development of a complex method for logistics service quality evaluation, which addresses the necessity of ranking LSQ attributes in accordance with their weights.

Basing on the fundamental SERVQUAL model, a new algorithm for logistics service quality evaluation was proposed, incorporating the advantages of DSS APIS utilization. The list of improvements includes:

- Possibility to use continuous Likert scale during the stage of data collection: such instrument provides with larger variance of quantitative scores, which results in possibility for customers to assess service quality attributes more accurately;
- Simultaneous taking into account the relative significance (weights) of LSQ criteria and respondents' answers, allowing to prioritize both chosen quality attributes and reliability of client' answers during the same computation;
- Opportunity to proceed non-numeric, inexact and incomplete information regarding weight coefficients in comparative statements form, reflecting the real-life type of data to the greatest extend;
- Simplified process of calculations, performed with the use of mostly suitable software (DSS APIS).

In addition to the above mentioned improvements, it is also possible to conclude, that the proposed method is not specific for supply chain management and logistics field of study. On the contrary, the developed approach may be implemented for service quality evaluation in the majority of business sectors, and the only adjustment necessary is the identification of relevant service quality attributes.

Describing the practical implication of the research conducted, it may be suggested, that the developed method aims to support the decision making on prioritizing LSQ attributes' improvement in accordance with their relative importance. Due to the fact, that all necessary calculations are performed via the decision supporting system, the process of quality attributes' ranking is simplified, transforming the developed method into a useful instrument for logistics service quality evaluation, which can be easily implemented in real business cases.

3.3.3 Limitations and opportunities for further research

Several limitations associated with the conducted empirical research are necessary to be discussed. Firstly, the results obtained from the application of developed method for LSQ evaluation of RZD Logistics company case may be questioned due to small sample size, which consisted of respondents from various regions of company's operations.

In addition, the comparative statement used for customers' answers prioritization («Client 3 > Client 5») was an assumption due to the non-disclosed format of such information. However, the empirical part of current research is still appropriate even taking the described limitations into account, as the main objective of it was the justification of the overall applicability of developed method.

The list of described limitations provides the researchers with opportunities for further method development. Future research is suggested to enhance the understanding of possible criteria for clients' responses reliability prioritization. In addition, the investigation of peculiarities of large logistics service providers' quality assessment may be beneficial, aiming to classify respondents in accordance with their geographical location.

Conclusion

The constantly increasing level of competition in logistics service business sector has transformed the evaluation of rendered service quality into obligatory procedure. Such process allows organizations to identify the existing quality gaps, take necessary actions and contribute to increasing customer satisfaction, forming a competitive advantage in the market.

However, the majority of methods, used for LSQ evaluation nowadays, only determine the significance of «Expected – Perceived service quality level» gaps, but do not take into account the importance of each evaluated attribute from customers' side. The necessity of considering relative weights of quality attributes, on the other hand, is supported by the existence of both budget and time constraints, which do not allow a decision maker – company's responsible manager, to improve all imperfect quality factors simultaneously.

The goal of current research was formulated as the development of logistics service quality evaluation method, which addresses the idea of relative weights considering. The goal was achieved by the implementation of APIS approach for service quality evaluation method basing on fundamental SERVQUAL model, and further approbation of the developed method on RZD Logistics case company.

The proposed improvements of SERVQUAL model application for logistics service quality evaluation included the analysis of collected data via DSS APIS, treating logistics service quality criteria as attributes and clients – respondents of the survey, as alternatives in terms of chosen decision supporting system. The application of developed method included three sequential rounds of calculations. The first round aimed to determine 22 attributes' weight-coefficients estimations, which are developed as a result of aggregation of their «Expected – Performed quality» gap and their relative importance. The second round's objective was to distinguish the five weight-coefficients estimations for each logistics service quality dimension. The final stage – pair multiplication of calculated weight coefficients, allowed to arrange all analyzed quality attributes in in decreasing order, providing the decision maker with a possibility to identify the attribute with the biggest gap score and highest relative importance. This gap, in accordance with the research, has to be eliminated first, negatively impacting on customers' satisfaction level.

The list of advantages of developed method, which form theoretical contribution of current research, include:

- Possibility to use continuous Likert scale during the stage of data collection, increasing the variance of possible answers from clients' side;
- Simultaneous taking into account the relative significance (weights) of LSQ criteria and respondents' answers;

- Opportunity to proceed non-numeric, inexact and incomplete information regarding weight coefficients in comparative statements form;
- Simplified process of calculations, performed with the use of DSS APIS.

The proposed method also has a potential for application in real-life business cases due to the simplicity of performed calculations and possibility to adjust the list of assessed quality attributes to the necessity and strategic focus of a particular organization. In addition, the prioritization of clients' responses will allow to receive more accurate results, which, in turn, will justify the decision on budget and time allocation for service quality gaps elimination.

List of references

1. Aized, T. (2012) *Total Quality Management and Six Sigma.* 1st ed. Rijeka: InTech, 296 p.
2. Baki, B., Basfirinci, C., Cilingir, Z. (2009). An application of integrating SERVQUAL and Kano's model into QFD for logistics services: A case study from Turkey. *Asia Pacific Journal of Marketing and Logistics*, 21(1), pp. 106-126
3. Ballou, R. (2007). The evolution and future of logistics and supply chain management. *European Business Review*, 19(4), pp. 332-348.
4. Banomyong, R., Ritthironk, N., and Varadejsatitwong, P. (2005). Selecting logistics providers in Thailand: A shippers' perspective. *Proceeding of the 10th International Symposium on Logistics 3-5 July 2005*, pp. 568-573.
5. Behdioğlu, S., Acar, E. and Burhan, H. (2017) Evaluating service quality by fuzzy SERVQUAL: a case study in a physiotherapy and rehabilitation hospital. *Total Quality Management and Business Excellence*, 28(5-6), pp. 633-662.
6. Brady, M., Robertson C., Cronin J. (2001). Managing Behavioural Intentions in Diverse Cultural Environments: An Investigation of Service Quality, Service Value, and Satisfaction for American and Education Fast-food Customers. *Journal of International Management,* 36(3), pp. 192-209.
7. Brochado, A. (2009). Comparing Alternative Instruments to Measure Service Quality in Higher Education. *Quality Assurance in Education: An International Perspective*, 17(2), pp. 174-190.
8. Busacca, B. and Padula, G. (2005). Understanding the relationship between attribute performance and overall satisfaction: theory, measurement and implications. *Marketing Intelligence and Planning*, 23(6), pp. 543-61.
9. Cameron, R. (2009) A sequential mixed model research design: Design, analytical and display issues. *International Journal of Multiple Research Approaches*, 3(1), pp. 140-152.
10. Charles V., Kumar, V. and Suggu, S. (2013). Adapting Fuzzy Linguistic Servqual Model: A Comparative Analysis of Bank Services. *Middle-East Journal of Scientific Research*, 18(8), pp. 1119-1132.
11. Chen, K., Chang, C., Lai, C. (2009) Service quality gaps of business customers in the shipping industry. *Transportation Research Part E*, 45(1), pp. 222-237.
12. Christopher, M. (2005). *Logistics and supply chain management*. Pearson Education, 305 p.
13. Cooper, M. and Ellram, L. (1993). Characteristics of Supply Chain Management and the Implications for Purchasing and Logistics Strategy. *The International Journal of Logistics Management*, 4(2), pp. 13-24.

14. Creswell, J. (2013). *Research design: Qualitative, Quantitative, and Mixed Methods Approaches*. 4th ed. SAGE Publications, 273 p.
15. Cronin Jr., J., Brady, M., Hult, G. (2000). Assessing the effects of quality, value, and customer satisfaction on customer behavioral intentions in service environments. *Journal of Retailing,* 76(2), pp. 193-218.
16. CSCMP.org. (2016). *SCM Definitions and Glossary of Terms*. [online] Available at: https://cscmp.org/imis0/CSCMP/Educate/SCM_Definitions_and_Glossary_of_Terms/CSCMP/Educate/SCM_Definitions_and_Glossary_of_Terms.aspx?hkey=60879588-f65f-4ab5-8c4b-6878815ef921 [Accessed 16 Nov. 2016].
17. Czajkowska, A. and Stasiak-Betlejewska, R. (2015) Quality Management Tools applying in the Strategy of Logistics Services Quality Improvement. *Serbian Journal of Management*, 10(2), pp. 225-234.
18. Davis, B., Mentzer, J. (2006). Logistics service-driven loyalty: an exploratory study. *Journal of Business Logistics,* 27(2), pp. 53-74.
19. Esmaeili, A. and Kahnali, R. (2015). An integration of SERVQUAL dimensions and logistics service quality indicators (A case study). *International Journal of Services and Operations Management*, 21(3), pp. 289-309.
20. Fedotov V. and Krotov K. (2011). Supply Chain Management: In Search for Definition of the Concept and Research Domain. *Russian Management Journal*, 9(2), pp. 49–58.
21. Goh, M., Desouza, R. and Garg, M. (2011). Assessing trade friendliness of logistics services in ASEAN. *Asia Pacific Journal of Marketing and Logistics*, 23(1), pp. 773-792.
22. Grönross C. (1984). A service quality model and its marketing implications. *European Journal of Marketing,* 18(4), pp. 36-44.
23. Gulc, A. (2017) Models and Methods of Measuring the Quality of Logistic Service. *Procedia Engineering*, 182(1), pp. 255-264.
24. Halvorsrud, R., Kvale, K., Følstad, A. (2016). Improving Service Quality through Customer Journey Analysis. *Journal of Service Theory and Practice*, 26(6), pp. 840-867.
25. Hertz, S. and Alfredsson M. (2003) Strategic Development of Third Party Logistics Providers. *Industrial Marketing Management*, 32(2), pp. 139-149
26. Hovanov, N. (2005). Decision Support System APIS: Advanced user guide. *Polyidea Limited 2005-2007,* 66 p.
27. Iso.org. (2015). *ISO 9000:2015*. [online] Available at: https://www.iso.org/obp/ui/#iso:std:iso:9001:ed-5:v1:en [Accessed 15 Feb. 2017].

28. Jang, P., Kwon O., Kim, M. (2014). The Role of Logistics Service Quality in Long-Term Partnership Development with Shippers. *Supply Chain Forum: An International Journal*, 15(2), pp. 82-108
29. Kang, K., Ahn, S. and Chai, M. (2008). Development of the scale to measure the logistics service quality. *The Korean Society for Quality Management*, 36(1), pp. 45-58.
30. Kano, N. Seraku, K., Takahaski, F. and Tsuji, S. (1984). Attractive quality and must-be quality. *The Journal of The Japanese Society for Quality Control*, 14(2), pp. 39-48.
31. Karami, A. and Guo, Z. (2012). A Fuzzy Logic Multi-Criteria Decision Framework for Selecting IT Service Providers. *Proceedings of the 45th Annual Hawaii International Conference on System Sciences HICSS 2012*, pp. 1118-1127.
32. Kilibarda, M., Nikolicic, S., Andrejic, M. (2016) Measurement of logistics service quality in freight forwarding companies: A case study of the Serbian market. *The International Journal of Logistics Management*, 27(3), pp. 770-794.
33. Kim, J. and Choi, S. (2008). The influence of the logistics service quality on logistics value, customer satisfaction, and long-term orientation: Focused on the convenience store of Seoul and Incheon area. *Korea Logistics Review*, 18(4), pp. 35-64.
34. Lamaakchaoui, C., Azmani, A., El Jarroudi, M. (2015). An AHP-based Model for Selecting Complementary Products. *International Journal of Computer Applications*, 120(22), pp. 1-6.
35. Lambert, D. (2014). *Supply Chain Management: Processes, Partnerships, Performance*. 4th ed. Supply Chain Management Institute, 431 p.
36. Larson, P. and Halldorsson, A. (2004). Logistics versus supply chain management: An international survey. *International Journal of Logistics Research and Applications*, 7(1), pp. 17-31.
37. Lehtinen, U., and Lehtinen, J. (1999). Two Approaches to Service Quality Dimensions. *The Services Industries Journal*, 11(3), pp. 287-303.
38. Limbourga, S., Giangb, H., Coolsc, M. (2016). Logistics Service Quality: The Case of Da Nang City. *Procedia Engineering*, 142(1), pp. 124-130.
39. McDougall, G., and Levesque, T. (2000). Customer Satisfaction with Services: Putting Perceived Value into the Equation. *Journal of Services Marketing,* 14(5), pp. 392-410.
40. Meidutė-Kavaliauskienė, I., Aranskis, A., Litvinenko, M. (2014). Consumer satisfaction with the quality of logistics services. *Procedia – Social and Behavioral Sciences,* 110 (1), pp. 330-340.
41. Mentzer, J. , Flint, D., and Hult, T. (2001). Logistics Service Quality as a Segment-Customized Process. *Journal of Marketing,* 65(4), pp. 82–104.

42. Mentzer, J., DeWitt, W., Keebler, J., Min, S., Nix, N., Smith, C. and Zacharia, Z. (2001). Defining supply chain management. *Journal of Business Logistics*, 22(2), pp. 1-25.
43. Mentzer, J., Flint D., Hult, T. (2001), Logistics Service Quality as a Segment-Customized Process. *Journal of Marketing,* 65(4), pp. 82-104.
44. Millen, R., and Maggard, M. (1997). The Change in Quality Practices in Logistics: 1995 Versus 1991. *Total Quality Management,* 8(4), pp. 173–179.
45. Nadiri, H., Hussain, K. (2005). Diagnosing the zone of tolerance for hotel services. *Managing Service Quality*, 15(3), pp. 259-277.
46. Novack, R., Rinehart, L., Langley, C. (1994). An Internal Assessment of Logistics Value. *Journal of Business Logistics,* 15(1): pp. 113-152.
47. Ovsyanko D. (2011) *Quality Management.* 1st ed. Graduate school of management SPbU, 204 p.
48. Pakdil, F., and Aydin, O. (2007). Expectations and perceptions in airline services: An analysis using weighted SERVQUAL scores. *Journal of Air Transport Management*, 13(1), pp. 229-237.
49. Palseon J., Kwon O., Kim M. (2014) The Role of Logistics Service Quality in Long-Term Partnership Development with Shippers. *Supply Chain Forum: An International Journal*, 15(2), pp. 82-108.
50. Parasuraman, A., Zeithaml, V., Berry, L. (1994). Reassessment of expectations as a comparison standard in measuring service quality: implications for future research. *Journal of Marketing*, 58(1), pp. 111-124.
51. Parasuraman, A., Zeithaml, V.A., Berry, L.L. (1985). A conceptual model of service quality and its implications for future research. *Journal of Marketing*, 49(4), pp. 41-50.
52. Parasuraman, A., Zeithaml, V.A., Berry, L.L. (1988). SERVQUAL: a multi-item scale for measuring customer perceptions of service quality. *Journal of Retailing*, 64(1), pp. 12-40.
53. Peiro, J., Vicente, M., Ramos, J. (2005). Employees' overestimation of functional and relational service quality: a gap analysis. *The Service Industries Journal*, 25(1), pp. 773-788.
54. Rafiq, M., and Jaafar, H. (2007). Measuring Customers' Perceptions of Logistics Service Quality of 3PL Service Providers. *Journal of Business Logistics,* 28(2), pp. 159–175.
55. Roslan A., Wahab, E., Nor, A. (2015). Service Quality: A Case Study of Logistics Sector in Iskandar Malaysia Using SERVQUAL Model. *Procedia – Social and Behavioral Sciences*, 172, pp. 457-462.
56. Rutner, S. and Langley C. (2000). Logistics Value: Definition, Process, and Measurement. *International Journal of Logistics Management*, 1(2), pp. 73-82.

57. Rzdlog.com. (2017). *RZD Logistics JSC increased its volume of processed cargoes in 2016 by 5%, to 56 million tons*. [online] Available at: http://www.rzdlog.com/press/377/ [Accessed 16 Mar. 2017].
58. Saaty, T. (1990). How to make a decision: The Analytic Hierarchy Process. *European Journal of Operational Research*, 48(1), pp. 9-26.
59. Seth, N., Deshmukh, S.G. (2005). Service quality models: a review. *International Journal of Quality & Reliability Management*, 22(9), pp. 913-949.
60. Shahin, A. and Samea, M. (2010). Developing the Models of Service Quality Gaps: A Critical Discussion. *Business Management and Strategy*, 1(1), pp. 1-11.
61. Simões, C., Singhc, J., Perind, M. (2015). Corporate brand expressions in business-to-business companies' websites: Evidence from Brazil and India. *Industrial Marketing Management,* 51(1), pp. 59-68.
62. Simons, R. (2014). Choosing the Right Customer. *Harvard Business Review*, 92(3), pp. 48-55.
63. Sohal, A. , Millen R., Maggard, M., and Moss, S. (1999). Quality in Logistics: A Comparison of Practices between Australian and North American/European Firms. *International Journal of Physical Distribution & Logistics Management,* 29(4), pp. 267–274.
64. Sohn, J., Woo, S., Kim T. (2017) Assessment of logistics service quality using the Kano model in a logistics-triadic relationship. *The International Journal of Logistics Management*, 28(2), pp. 680-698.
65. Stank, T. , Goldsby, T., Vickery, S. and Savitskie, K. (2003). Logistics Service Performance: Estimating its Influence on Market Share. *Journal of Business Logistics,* 24(1), pp. 27-55.
66. Stasiak-Betlejewska, R., Kaye, M., Dyason, M., Stachová, K., Urbancová, H. (2014). The services quality level assessment at the technical university using the Servqual method. *Journal on Efficiency and Responsibility in Education and Science*, 7 (3-4), pp. 53-58.
67. Stock, J. and Boyer, S. (2009). Developing a consensus definition of supply chain management: A qualitative study. *International Journal of Physical Distribution & Logistics Management,* 39(8), pp. 690-711.
68. Tansakul C., Buddhakulsomsiri J., Wasusri T., Chaiwat P., Kritjaroen T. (2013). A gap analysis in service quality of Thai logistics service providers. *Proceedings of the 4th International Conference on Engineering, Project, and Production Management EPPM*, pp. 537-550.
69. Thai, V. (2013). Logistics service quality: conceptual model and empirical evidence. *International Journal of Logistics Research and Applications*, 16(2), pp. 114-131.

70. Thantongpaiboon, C. and Wassusri, T. (2008). Ocean Transport service quality assessment. *Proceedings of the 13th International Symposium on Logistics*, pp. 473-489.
71. Timmerman, E. (1986). An approach to vendor performance evaluation. *Journal of Purchasing and Materials Management*, 22(4), pp. 1-7.
72. Ulewicz R. (2014). Application of servqual method for evaluation of quality of educational services at the university of higher education. *Polish Journal of Management Studies*, 9(1), pp. 254-264.
73. Wang, X., Persson, G., Huemer, L. (2016). Logistics Service Providers and Value Creation Through Collaboration: A Case Study. *Long Range Planning*, 49(1), pp. 117-128.
74. Witell, L. and Lofgren, M. (2007). Classification of quality attributes. *Managing Service Quality*, 17(1), pp. 54-73.
75. Xie, G., Wang, S., Lai, K. (2013). Quality improvement in competing supply chains. *International Journal of Production Economics*, 134 (1), pp. 262-270.
76. Zhang, S. and Hou, Y. (2013). A SERVQUAL Model for Assessment of Service Quality in Supply Chain. *Information Technology Journal*, 12(15), pp. 3472-3475.

Appendices

Appendix 1 – Survey for logistics service quality evaluation

The survey of client opinion regarding logistics services
performed by XYZ company
with the aim of logistics service quality evaluation

This questionnaire is devoted to the collection of client opinion regarding logistics services performed by XYZ company. The evaluations of expected and performed level of service quality from customer's point of view will be further compared.

The survey is conducted as part of research for the Master in Management Program Thesis in Graduate School of Management, Saint-Petersburg State University.

The organizer of the study ensures not to disclose any personal information. The collected information will be processed using DSS APIS and will reflect a generic character. Your answers are very important to obtain high quality results.

If You have questions, please, contact the organizer of the research directly.

Contact information:
Elizaveta Shakhanova
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E-mail: st014644@student.spbu.ru

The survey is divided into 5 groups of questions, in which You need to state Your opinion regarding the expected and actually perceived level of quality performed by XYZ company. Each group represents one of five service quality dimensions: tangibles, reliability, responsiveness, assurance and empathy.

It is necessary to mark the degree to which You agree with the statements characterizing each of five groups for XYZ company with a vertical line (where 0 – totally disagree with the statement, 10 – totally agree with the statement). In addition, You are kindly ask to state the relative importance of each quality attribute by distributing 100 points among each list.

Quality dimension #1: Tangibles

Attribute		**Expected level of service quality per attribute**	**Perceived level of service quality per attribute**	**Relative importance (allocate 100 points)**
A1	Company's website is convenient, accessible and informative.			
A2	Company has a wide net of suitably located offices.			
A3	Company is equipped with modern physical facilities.			
A4	Company is integrating IT services (ex. ability to track the delivery online etc.)			
A5	Company staff is looking presentably (neat).			

Quality dimension #2: Reliability

Attribute		Expected level of service quality per attribute	Perceived level of service quality per attribute	Relative importance (allocate 100 points)
B1	Company is keeping transaction records accurately.			
B2	Company performs services without problems and damage from the first time.			
B3	Company provides services at the time they promised.			
B4	Company provides accurate service in the first place.			
B5	Company provides fast service.			

Quality dimension #3: Responsiveness

Attribute		Expected level of service quality per attribute	Perceived level of service quality per attribute	Relative importance (allocate 100 points)
C1	Company's employees are willing to help You.			
C2	The problems appearing are solved as soon as possible.			
C3	Information about delivery status is communicated correctly to customers.			
C4	Company is responding to Your requests and complaints in a satisfactory way.			

Quality dimension #4: Assurance

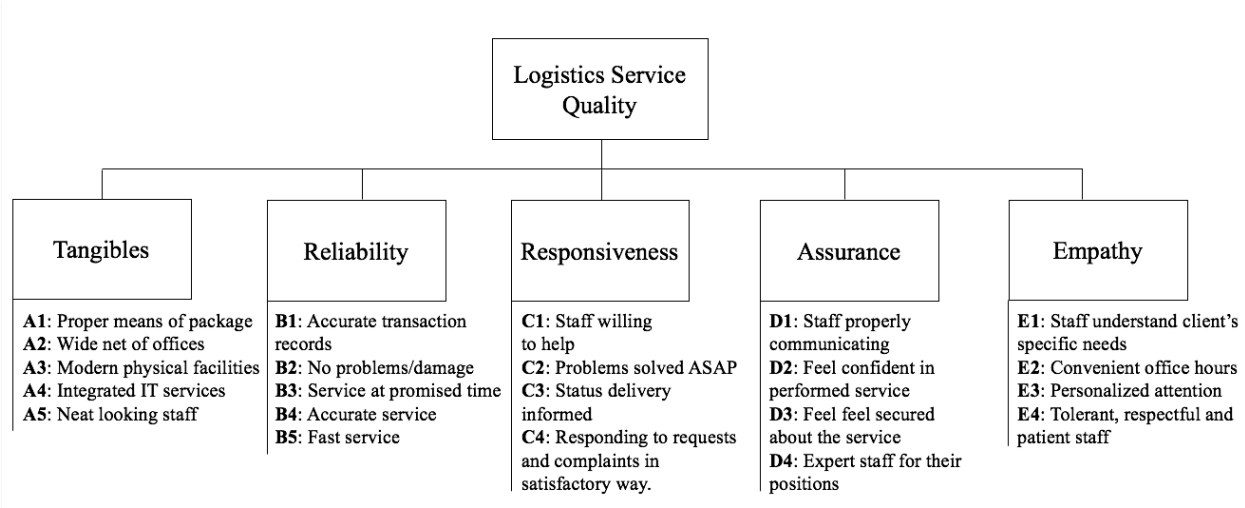
Attribute		Expected level of service quality per attribute	Perceived level of service quality per attribute	Relative importance (allocate 100 points)
D1	Staff is communicating in a proper manner			
D2	Company is making You feel trust in staff and confident in service performed			
D3	Company is making You feel secured about the service.			
D4	Company employs staff expert for their positions			

Quality dimension #5: Empathy

Attribute		Expected level of service quality per attribute	Perceived level of service quality per attribute	Relative importance (allocate 100 points)
E1	Employees of the company understand Your specific needs			
E2	Office hours are convenient			
E3	Company is making You feel received personalized attention to			
E4	Company' staff is tolerant, respectful and patient			

The las stage of survey completion: please, estimate the importance/significance of each quality dimension for the process of logistics service quality evaluation:

Quality dimension		Relative importance (allocate 100 points):
A	Tangibles	
B	Reliability	
C	Responsiveness	
D	Assurance	
E	Empathy	



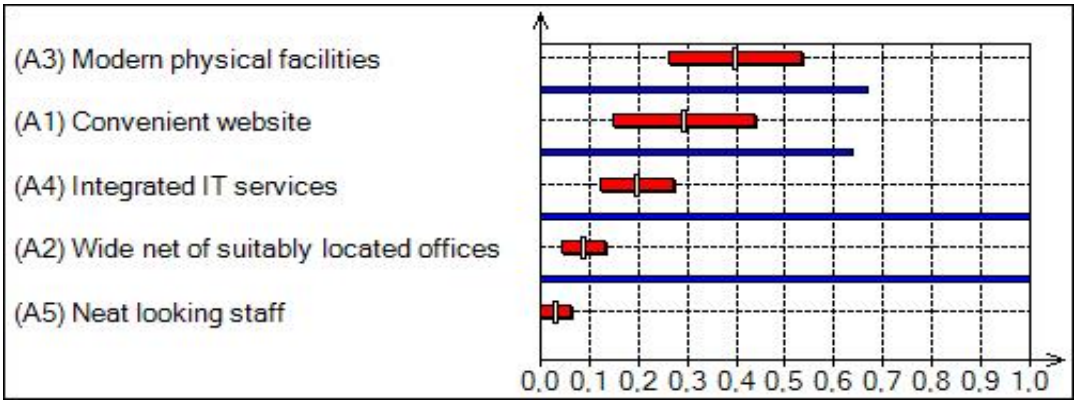
Thank You!

Appendix 2 – Input data for the first run of RZD Logistics LSQ evaluation

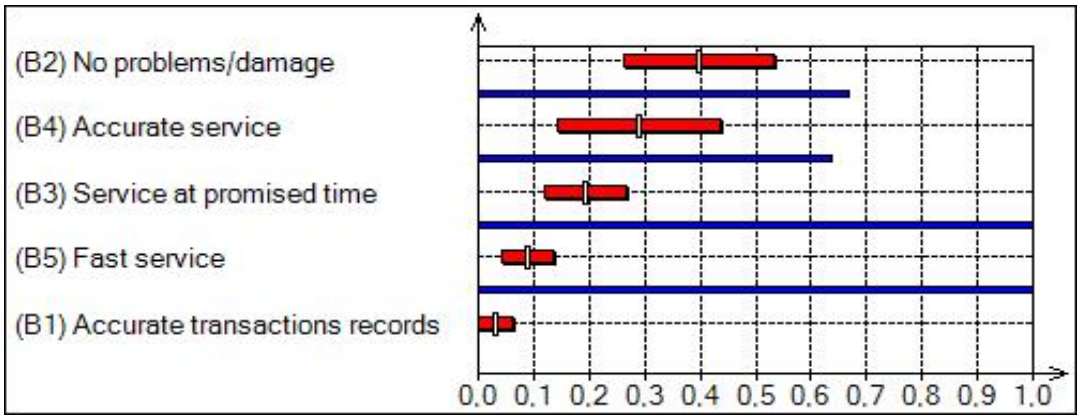
Alternative	Tangibles					Reliability					Responsiveness				Assurance				Empathy			
	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	D1	D2	D3	D4	E1	E2	E3	E4
Client 1	3,92	0,48	1,00	2,86	2,17	2,33	5,23	3,32	4,40	2,17	3,82	4,10	1,00	1,99	4,21	1,65	3,33	3,37	3,45	0,84	2,23	0,76
Client 2	3,21	2,29	3,73	2,53	0,20	4,31	4,82	2,80	5,76	0,87	3,11	2,29	0,56	2,01	3,11	2,05	3,21	3,24	2,11	1,30	2,53	1,00
Client 3	1,41	0,10	2,02	4,77	0,25	2,87	3,11	3,04	4,21	1,55	2,20	2,50	1,30	4,77	3,87	1,88	2,00	1,85	1,87	2,00	1,95	1,21
Client 4	1,07	1,32	1,45	1,34	0,50	3,84	4,04	1,23	1,09	2,58	1,23	5,05	0,78	3,84	2,46	1,45	1,46	2,10	2,84	0,74	1,45	0,76
Client 5	1,49	0,71	1,92	2,59	1,24	4,00	2,66	1,76	0,89	1,44	3,54	2,53	2,20	3,20	3,54	1,40	3,80	1,78	3,05	0,60	3,00	0,66
Client 6	1,91	1,37	2,51	2,69	2,56	3,56	3,56	2,43	3,65	2,56	2,88	1,98	1,35	0,95	2,85	0,90	1,35	3,56	2,85	0,98	0,99	1,39
Client 7	2,01	1,90	1,01	3,65	1,61	1,78	4,33	1,01	2,88	1,61	2,01	2,44	1,01	2,47	1,99	2,18	1,55	0,44	2,74	1,11	0,89	2,30
Client 8	0,79	0,78	1,64	2,88	0,51	0,79	2,79	3,43	2,00	2,88	1,42	4,68	2,07	3,30	0,70	3,75	2,20	0,50	1,93	1,73	1,47	1,42
Client 9	2,19	0,86	1,75	2,32	0,37	2,45	3,40	1,75	6,20	1,56	2,74	3,56	1,82	1,33	2,64	3,01	0,78	1,50	2,55	0,40	1,94	0,80
Client 10	3,56	0,11	1,08	1,32	0,04	4,65	4,12	1,77	5,30	1,45	3,78	2,95	0,84	1,00	4,01	2,95	0,94	0,87	3,89	2,40	2,05	1,33
Client 11	2,46	0,63	2,03	3,30	1,05	2,23	2,90	2,37	4,00	2,05	2,15	4,50	1,11	2,20	3,21	1,74	3,14	1,00	2,64	1,69	1,36	0,53
Client 12	3,01	0,92	1,92	4,20	0,30	1,42	3,31	1,05	3,78	1,45	0,78	3,75	2,09	2,74	3,98	2,11	2,64	1,53	1,11	1,84	2,84	2,20
Client 13	1,97	0,71	1,06	2,53	0,65	3,23	3,54	0,96	4,24	3,21	1,10	4,12	0,76	1,10	4,00	1,57	1,73	1,48	2,00	0,34	3,00	0,74
Client 14	1,59	1,20	0,80	3,10	1,43	1,22	2,46	2,44	3,15	1,67	2,54	2,86	0,89	0,98	2,15	1,89	1,95	0,94	2,34	0,77	2,56	1,11
Client 15	2,43	0,67	1,21	1,36	0,93	4,40	2,95	2,12	2,11	2,34	3,12	5,11	0,60	0,75	2,36	2,45	2,05	2,74	0,67	1,00	1,84	1,35
Client 16	2,66	1,28	0,48	2,50	0,11	3,12	4,58	1,83	1,57	1,90	0,88	4,00	1,35	1,62	1,65	2,10	3,11	3,11	0,96	2,00	0,97	0,89
Client 17	2,31	2,04	1,23	1,72	1,23	2,50	5,00	2,00	2,43	0,98	1,75	3,74	2,01	1,44	1,34	3,05	0,97	1,95	1,10	1,42	1,45	1,43
Client 18	1,05	1,35	2,11	4,00	2,04	2,11	3,26	3,40	5,55	1,00	1,10	4,73	2,00	2,63	0,80	1,11	4,00	0,66	2,49	0,80	2,40	2,00
Client 19	0,82	0,90	1,79	3,32	1,00	1,84	2,20	1,99	4,11	2,00	2,20	2,90	1,34	3,00	2,00	0,43	3,74	2,89	3,00	2,30	3,00	0,67
Client 20	3,11	0,78	1,74	2,89	0,47	0,99	2,80	0,85	2,43	0,74	3,00	1,85	1,46	0,90	1,37	0,97	2,10	3,00	2,18	0,99	1,74	0,89
Client 21	2,54	0,70	0,94	2,45	0,84	2,25	3,51	3,00	2,11	3,11	1,62	3,78	0,89	4,33	2,53	1,68	1,00	3,12	1,85	1,50	2,20	1,32
Client 22	3,04	1,25	3,51	2,01	0,70	2,56	4,75	2,48	1,76	2,42	1,07	4,15	0,73	1,75	1,84	2,43	0,73	2,66	0,94	1,34	1,48	1,84
Client 23	1,22	1,37	2,22	1,30	0,33	1,78	4,99	1,43	3,50	0,90	0,90	3,66	0,82	2,45	0,87	1,97	0,64	1,34	0,88	2,50	2,00	1,10
Client 24	1,30	1,22	3,05	0,88	1,26	1,01	3,00	3,33	4,32	1,54	2,24	2,60	1,31	2,11	2,15	3,52	2,56	3,03	2,73	1,10	1,74	0,74
Client 24	0,86	0,76	2,00	1,94	0,54	3,34	2,11	3,50	1,15	2,43	1,37	5,32	1,03	3,02	1,48	2,10	1,73	2,45	1,47	0,75	0,59	2,40
Client 26	1,42	0,30	1,95	2,30	1,21	2,00	1,59	2,60	3,23	2,60	0,65	4,50	2,10	1,11	0,75	1,00	1,22	2,11	1,50	0,50	0,90	2,00
Client 27	0,84	0,94	1,44	4,20	1,11	2,55	2,75	3,02	2,67	1,78	1,94	3,75	0,99	1,67	1,96	0,85	0,97	1,85	2,30	0,66	2,54	1,73
Client 28	0,92	0,37	1,30	3,17	2,30	3,11	4,00	1,75	1,05	0,68	2,00	2,68	1,00	2,00	2,45	1,63	2,00	0,94	1,84	0,36	2,00	1,00
Client 29	1,73	1,10	2,15	3,84	0,99	1,54	1,34	1,44	3,69	2,30	2,69	1,95	0,46	3,96	3,00	1,15	1,53	0,55	0,37	1,30	1,84	0,58
Client 30	2,15	0,54	1,10	1,11	1,00	2,73	2,59	1,99	3,00	1,30	3,11	3,11	0,79	2,00	3,10	1,32	3,00	2,00	1,00	1,75	3,00	0,44

Appendix 3 – Weight-coefficients estimations for LSQ attributes

(A) Tangibles dimension

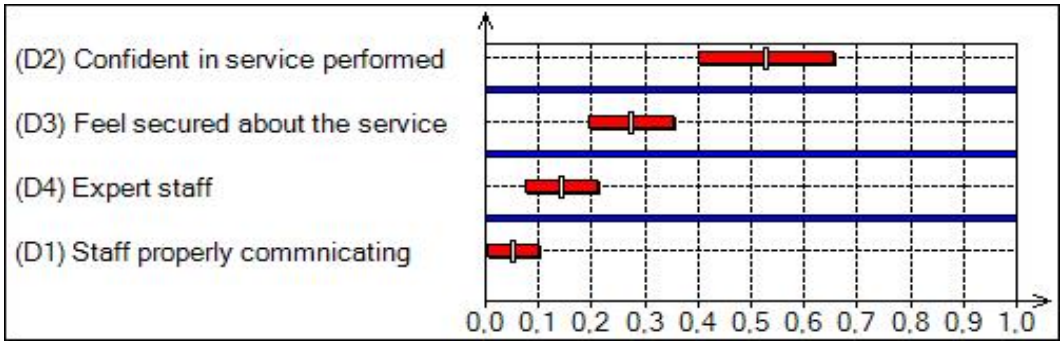


(B) Reliability dimension

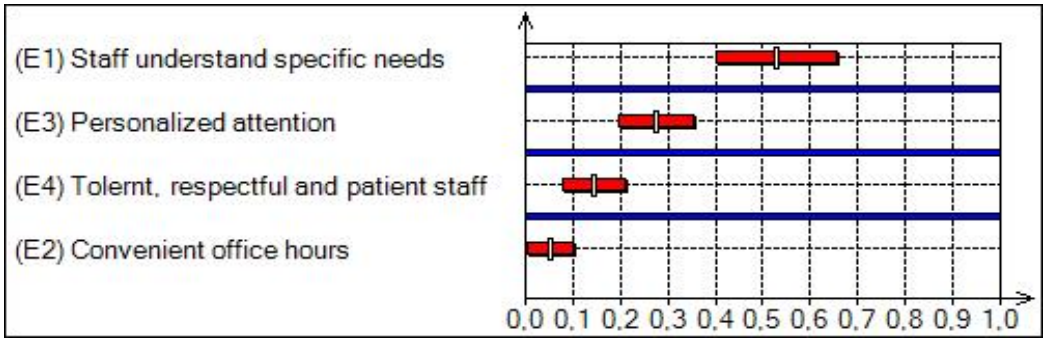


(C) Responsiveness dimension

(D) Assurance dimension



(E) Empathy dimension



Appendix 4 – Input data for the second run of calculations: LSQ dimensions' weight-coefficients estimations

Client	Quality dimension				
	Tangibles	**Reliability**	**Responsiveness**	**Assurance**	**Empathy**
Client 1	0,507	0,166	0,412	0,399	0,314
Client 2	0,205	0,201	0,732	0,367	0,453
Client 3	0,557	0,431	0,530	0,546	0,523
Client 4	0,778	0,596	0,264	0,668	0,497
Client 5	0,635	0,748	0,546	0,483	0,299
Client 6	0,477	0,420	0,839	0,692	0,497
Client 7	0,593	0,534	0,714	0,627	0,455
Client 8	0,725	0,525	0,311	0,340	0,560
Client 9	0,608	0,390	0,565	0,500	0,490
Client 10	0,647	0,351	0,662	0,505	0,189
Client 11	0,501	0,500	0,409	0,523	0,532
Client 12	0,415	0,594	0,519	0,470	0,467
Client 13	0,705	0,477	0,600	0,633	0,457
Client 14	0,715	0,607	0,732	0,615	0,419
Client 15	0,701	0,590	0,387	0,432	0,730
Client 16	0,697	0,500	0,575	0,395	0,795
Client 17	0,633	0,434	0,569	0,476	0,694
Client 18	0,547	0,340	0,366	0,604	0,349
Client 19	0,672	0,598	0,589	0,614	0,265
Client 20	0,498	0,763	0,854	0,667	0,548
Client 21	0,669	0,458	0,403	0,621	0,501
Client 22	0,310	0,410	0,553	0,555	0,686
Client 23	0,672	0,426	0,585	0,711	0,662
Client 24	0,579	0,429	0,695	0,209	0,473
Client 25	0,722	0,632	0,265	0,541	0,682
Client 26	0,669	0,642	0,522	0,784	0,677
Client 27	0,666	0,548	0,573	0,823	0,385
Client 28	0,736	0,636	0,711	0,648	0,576
Client 29	0,509	0,741	0,673	0,773	0,824
Client 30	0,758	0,637	0,601	0,558	0,596