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Optimization in Warehouse for Assembly and Construction Company

Abstract: Optimization of warehouse for assembly and construction company is actual in modern stage of logistics development in the cities and urban regions. One of the most important criteria during dynamical logistic development is to be guarantee of quality for company's clients. In the research, logistic complex issues on the example of the "Aria TV" company were studied. Comparative, mathematical methods and methods of spatial analysis were used to reach the purposes. The materials of specific documentation and regalements, and research works of leading specialists in the field of logistics as D. Cattaruzza, W. Yu, C. Harland and others were used in the research. There is conclusion that it is necessary to include international standards of ISO 9000 family to optimize professional activities of the company and support high level of the quality. It is offered to separate main warehouse by creating of additional warehouses in the megapolis districts actualized for the company. The research results are intended for specialists from huge logistics companies operating in the area of the cities.

Keywords: ISO 9000, warehouse, driven-data logistic, logistic process.

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Оптимизация склада для монтажно-строительной компании

Аннотация: Тема оптимизации складов монтажно-строительных компаний является актуальной на современном этапе развития логистики в крупных городах и городских агломерациях. Один из важнейших критериев во время динамического развития логистики – это оставаться гарантом качества для клиентов компании. В ходе исследования были изучены комплексные вопросы логистики на примере компании "Ария ТВ". Для достижения поставленных задач были использованы сравнительные, математические методы и методы пространственного анализа. Были использованы материалы специализированной документации и регламентов, а также исследовательских работ в области логистики, например, Д. Каттаруззы, В. Ю, К. Харланда и других. Были сделаны выводы о том, что в компании необходимо внедрить и поддерживать международный стандарт семьи ISO 9000 с целью оптимизации профессиональной деятельности компании и поддержания высокого уровня качества. Предложено произвести сепарацию основного склада путем открытия дополнительных складов в актуализированных для фирмы в районах мегаполиса. Результаты исследования предназначены для специалистов крупных логистических компаний, работающих в зоне крупных городов.

Ключевые слова: ISO 9000, склад, логистика на основе данных, логистический процесс.

Introduction

This topic has a high level of relevance to the modern stage of business development. Nowadays the warehouse becomes one of the main logistic system stages. Thousands of companies in the field of assembly and construction use a warehouse as an essential part of business processing. There are some important problems in warehouse logistics. These problems are usually decided on a local level. Therefore, the problem can have a multi-variation of solutions.

In the cities, companies may have a problem with urban traffic. It forms additional outlay in time management, managing budget and customers relationship. Moreover, these problems of enterprise management motivate customers to change a statue of a client or prefer another competitor. Therefore, this actualizes the need for a company to modernize or optimize its traffic system by using more quantities of a warehouse in the cities.

Nowadays, the streets are the venus of the city. In the level of the state, the roads also are one of the most important lines of business connection. Additionally, the roads are the ways of connection between neighbouring states in general and far states regionally. There are many challenges for the logistics industry mainly with the integration of E-commerce and new sources of data such as smartphones, sensors, GPS and other devices. Those new data sources generate a daily huge quantity of unstructured data, to deal with such complex data, the use of big data analytic tools becomes an obligation (*Ben Ayed et al., 2015*).

Vehicle routing problems define a class of combinatorial optimization problems that allow optimizing itineraries of a fleet of vehicles, when these vehicles operate round trips, that is, have multiple stops along their itinerary. This situation represents a large part of the flow of vehicles for good distribution in cities. However, route optimization in cities presents some peculiarities that should foster the development of new models (*Cattaruzza et al., 2015*). The correct construction of logistics gives to the reduction of self-cost and an increase in profit. Since universal digital programs to calculate a roadmap to the supply chain have not existed. So, it is actually necessary to create a new logistic solution in the digital sphere or create it in the manual. The variants are discussed in the paper.

The subject of the paper was warehouse optimization for assembly and construction.

The object of the paper was "Aria TV", which makes activity in the field of assembly and construction.

The main purpose was to optimize warehouse logistic system of the company.

According to the purpose, there were created tasks:

- analyze current logistic system of the company;
- actualize the problems of warehouse logistics in the field of assembly and construction on example of the company;
- develop solutions of logistic system's optimization;
- model a variant of the logistic system of the company depending on the developed solutions.

Data-driven logistics is the use of logistics and data management to create a smart and efficient way of running a business, this may include components like AI, blockchain, big data, machine learning etc.

Results

Context of the Chosen Logistics Process

The full name of the company is "Aria TV" Limited Liability Company, also has an English name "Aria TV". The company was founded by two individuals with equal shares in the company in 2004. In 2006, the Board of Shareholders doubled by exchanging equal shares in the authorized capital with the Telecommunication Company "Prometey" LLC. Later, Aria TV and Prometey were incorporated. The holding existed until 2019 when Prometey was sold to Rostelecom.

The company was established for the construction of fibre-optic communication lines (hereinafter FOCL).

Aria TV as construction and operating company is a recognized leader in the regional market for the construction and operation of overhead fibre-optic communication lines throughout St Petersburg and Leningrad region. This company is dynamically developing, increasing the area of coverage of the city with its optical fibre to supply its services to as many residential buildings as possible. The customers of the company are not only commercial enterprises or individuals but also state enterprises that need an Internet connection or recording of territories from cameras. Thanks to Aria TV, its customers can easily establish a connection to the Internet to use cloud technologies, be in direct communication with each other or with customers, as well as for personal use. In addition, video surveillance can allow securing the places needed by the customer by directly viewing the territory.

The company Aria TV has been providing its services for the construction of fibre-optic communication lines, installation and maintenance of equipment for Internet connection and video communication in the Russian market for over fifteen years. During this time, a lot of experience has been accumulated, a qualified team of specialists has been formed, and a reliable partner's reputation has been earned. Aria TV provides for its customers the installation of equipment and laying of fibre-optic cables for their subsequent use to connect to the Internet or use as a video signal transmission using video cameras.

The company also has long-term partnerships with Internet supply companies such as Rostelecom and Prometey, which provides its equipment, and in turn, Prometey helps with IT services.

The main idea is about separating the warehouse in some parts, it is actually necessary for the optimization of logistic service of the company. The company still has a main warehouse and rented small warehouses additionally. There are two variants where warehouses can be rented. The first variant is to locate warehouses in downtown or near it. The second one is to locate warehouses in Petrogradskaya district.

Due to this system of separated warehouses, the company can avoid time losses, which was a cause of traffic jams. That means the mechanics can fix outside damage for cables or cameras. Also, the product can be delivered from the main warehouse to additional ones at the "jam-free

days" like Saturday or Sunday. In St. Petersburg, Saturday evening and Sunday morning is the preferred time for cross-warehouses to deliver.

Thus, St. Petersburg is one of the old cities, so there are the usual traffic problems with this type of megapolis. The streets are very narrow, which mainly consist of only two reverse lines. In other words, this creates additional problems for oversized transport to deliver. So, the company can rent additional warehouses in the different districts of the city to escape a problem with long-time traffic.

Description and Analysis of the Chosen Process

Company has a united warehouse near its office. The warehouse stored common equipment from suppliers or a unique one from the company itself. There are four ways there, which is shown in the first figure (*Figure 1*). In the first three ways, the construction team starts from warehouses. They can go to the problem address, to the new client or to check an address. In every of three ways, the construction team should use different equipment from the warehouse.

The first way assumes to work with problem addresses. It is the rarest way because all situations with such an address are special and unique. Every time the team should use a specific way to find and fix a problem. Gradually, the company creates and updates databases for all these situations and their solutions.

The second way is about work with new customers or sometimes new addresses from old customers. In this way, the construction team uses equipment to take metric information. However, sometimes before using metric equipment, the team needs to clean up a place where they want to use it.

The third way describes the address used by the company client where some problem was detected by a monitoring programme or when the client sends or phones call to the company with the request to check. Such addresses are not problematic, and usually can be solved by basic activities, like reloading a soft with a reconnection to the power supply system or using a keyboard to reload it manually.

The fourth way is special because the construction team is already outside of the warehouse and has numerous equipment. However, sometimes it is not enough and the construction team should ignore the address or back to the warehouse to add equipment, which the team needs to complete their task.

Thus, it needs to note that in all described ways, the construction team using a different staff solves its tasks. Most of the staff are too huge to be stored in the construction team cars, so the company should change its warehouse system by renting more places to store staff.

How the Logistics Process Can Be Improved

To improve the logistic process of a company, the Standard ISO 9001–2015 Quality Management System was used. For organizations asking how to improve the quality of their products and services and consistently meet their customers' expectations, ISO has an answer. Addressing various aspects of quality management and containing some of ISO's best-known standards, there is the ISO 9000 family (ISO 9000, 2020). ISO 9001 sets out the criteria for a quality management system and is the only standard in the family that can be certified to (although this is not a requirement). It can be used by any organization, large or small, regardless

of its field of activity. In fact, there are over one million companies and organizations in over 170 countries certified to ISO 9001 (What is ISO 9001, 2013).

ISO 9001-2015 verifies five criteria:

1. Client orientation, which is the main target improved in the frame of this project. Changing warehouse logistics should decrease delay before the company starts to work with a client's problem.
2. To do easier the way of partnership in the field of construction and staff service. With this standard, the company can simply sign a contract with companies like Rostelecom to construct new points for it or add a new customer in the building with the system already done.
3. According to the Standard, it results in manufacturing development and the evolution of workers. The new experience, which is earned by the workers of the company, helps to perfect their personal skills.
4. Creation of the new logistic system or updating of existing one uses permanent analytical monitoring for modernization of manufacturing and staff policy. This solves some problems in highlight spheres.
5. New system of reaction for customer's reports is created or updated to this Standard criterion. This new system lets effectively analyze solutions and gives a company to take resultative measures to eliminate issues.

Thus, ISO quality orientation is one of the most important features to work effectively. This will allow a company to expand their influence zone by working with other companies, which have already used ISO standards, in other cities or regions. The high standards of quality provided by ISO 9000 family helps a company to improve not only business communications but work with a client base.

Description of the 'to Be' Applied Technology

According to service logistics, supply chain management is the management of the flow of products and services, involves the movement and storage of primary tools, work-in-process inventory, and finished results as well as end-to-end order fulfilment from point of generation to consumption (*Harland, 2015*). Supply chain management is a crucial process because an optimized supply chain results in lower costs and a faster production cycle (*Kenton, 2020*). Supply Chain Management (SCM) is an important part of every organization, whether small or large. SCM also deals with the movement and storing of materials needed to create a product, as well as inventory management, and keeping track of finished goods from where they were created to who they go to. Bottom line: there is no overstating the importance of Supply Chain Management (*Handfield et al., 2020*).

Many logistics sectors can profit from data-driven innovations, such as container transport, construction industry logistics, urban logistics and transport of perishable products. For example, the container transporters can have their trucks at the ready and the recipient of the shipment will know exactly when their goods will arrive. The advantages go without saying: improved efficiency and lower costs. In addition, implementing data-driven innovations can result in new earning models. It also allows companies further down the chain to structure their work more efficiently, which they will be happy to pay for. As the number of kilometres travelled

is reduced, the costs to society fall and so data-driven logistics are more sustainable too (*Data-driven logistics, 2020*).

Despite the importance and relevance of data-driven supply chains, there has been very limited empirical research that investigates how big data-driven supply chains affect supply chain capabilities. The results indicate that a data-driven supply chain has a significant positive effect on the dimensions of supply chain capabilities. Coordination and supply chain responsiveness is positively and significantly related to financial performance (*Yu et al., 2018*).

Thus, this complex of activities helps a company to improve its profit. However, it is important to remember that Supply Chain Management technology can be always re-used to rise. As this technology can be used multiple times, it is important to know when it should stop.

Implementation, Cost Benefit Analysis, and Break-Even Point

Using technology, which had been described before, it was saluted to separate the warehouse into the main one and the satellites (*Figure 2*). The main idea of this separation is about taking less cost per driving and taking more money with emergency calls. The faster a construction team comes and fixes any problem; the company will have more money. Thus, traffic jams are one of St Petersburg most problematic (*Perova, 2017*). A lot of time was spent by construction teams, which cannot reach their goal, because of jams and a lot of money was lost with it.

Satellite warehouses should be rented near an agglomeration of customers, where the way from the main warehouse is always blocked by jams, i.e., it is relevant to rent a warehouse in downtown or near it. In another way, it can be not downtown, but a hard to enter streets, like Petrogradsky district. It is the island part of the city that has four bridges to enter this district can be only used by construction teams, which is always in jams for rush hour. Therefore, if the company has the warehouse, already located in this district, jams will become a less problem. If jams have a rate of nine or ten with google rating, the construction team can go to address by their feet or use a bicycle, tool cart, etc. Construction teams' work functionally stays the same but becomes easier to complete.

To prove benefits, the table depending on the calculation of information, which company provided to use, was done. In the table, there are two ways. The first of them, the warehouse is located downtown or near it. To calculate its rental costs, a place near downtown was selected. The second one, the warehouse located in Petrogradsky district. The place must be taken near the Vasileostrovsky district. According to Table 1, rent cost depends on the place where the company rents a warehouse.

Using counting information of the company and rental cost in St Petersburg in actual districts, there were two results for every scenario. The first scenario is about a warehouse in downtown or near it, and the second scenario is about a warehouse located in Petrogradsky district. The first conclusion exists when the company rents a warehouse in the selected district. The second one is the variant when the company does not do so. In nowadays, the company works with a second variant.

According to calculation, the company will have more profit with the result, when the warehouse was rented for both scenarios. Despite the rent costs, results with renting a warehouse are more profitable. Money value is not big, but existing, that declares the effectiveness of

offering logistic improvement. In the table, there is no inflation rate, because the economical effectiveness of both variants is higher than in Russia (*Table 1*).

Conclusion

Based on the research provided in "Aria TV" company, a logistic system, which became more customer-oriented and competitive, was developed.

Aria TV was established for the construction of fibre-optic communication lines. The customers of the company are not only commercial enterprises or individuals but also state enterprises that need an Internet connection or recording of territories from cameras. The company also has long-term partnerships with Internet supply companies such as Rostelecom and Prometey, which provides its equipment. The main idea is about separating the warehouse in some parts. The company still has a main warehouse and rented small warehouses additionally. There are two variants where warehouses can be rented. The first variant is to locate warehouses in downtown or near it. The second one is to locate warehouses in Petrogradskaya district. Due to this system of separated warehouses, the company can avoid time losses, which was a cause of traffic jams.

Company has a united warehouse near its office. The warehouse stored common equipment from suppliers or a unique one from the company itself. There are four ways there. The first way assumes to work with problem addresses. The second way is about work with new customers or sometimes new addresses from old customers. The third way describes the address used by the company client where some problem was detected by a monitoring programme or when the client sends or phones call to the company with the request to check. The fourth way is special because the construction team is already outside of the warehouse and has numerous equipment. So, it needs to note that in all described ways, the construction team using a different staff solves its tasks—most of the staff are too huge to be stored in the construction team cars, so the company should change its warehouse system by renting more places to store staff.

To improve the logistic process of a company, the Standard ISO 9001-2015 Quality Management System was used. Addressing various aspects of quality management and containing some of ISO's best-known standards, there is the ISO 9000 family. ISO 9001 sets out the criteria for a quality management system and is the only standard in the family that can be certified to (although this is not a requirement). ISO 9001–2015 verifies five main criteria such as Client orientation, simplification of partnership, manufacturing development and the evolution of workers, creation of the new logistic system, and new system of reaction for customer's reports.

According to service logistics, supply chain management is the management of the flow of products and services, involves the movement and storage of primary tools, work-in-process inventory, and finished results as well as end-to-end order fulfilment from point of generation to consumption. SCM also deals with the movement and storing of materials needed to create a product, as well as inventory management, and keeping track of finished goods from where they were created to who they go to.

The main idea of this separation is about taking less cost per driving and taking more money with emergency calls. The faster a construction team comes and fixes any problem; the company will have more money. Satellite warehouses should be rented near an agglomeration of

customers, where the way from the main warehouse is always blocked by jams. In another way, it can be not downtown, but a hard to enter streets, like Petrogradsky district. Therefore, if the company has the warehouse, already located in this district, jams will become a less problem. According to calculation, the company will have more profit with the result, when the warehouse was rented for both ways.

References:

Ben Ayed, A., Ben Halima, M., & Alimi, A.M. (2015). Big data analytics for logistics and transportation. *4th International Conference on Advanced Logistics and Transport (ICALT)*, 311–312. https://doi.org/10.1109/icadlt.2015.7136630

Cattaruzza, D., Absi, N., Feillet, D., & González-Feliu, J. (2015). Vehicle routing problems for city logistics. *EURO Journal on Transportation and Logistics*, *6* (1), 51–53. https://doi.org/10.1007/s13676-014-0074-0

Data-driven logistics: the future of logistics. (2020, May 7). https://www.tno.nl/en/focus-areas/traffic-transport/roadmaps/smart-and-safe-traffic-and-transport/smart-mobility-and-logistics/data-driven-logistics/

Harland, C. (2015). Supply Chain Dynamics. *Wiley Encyclopedia of Management*, 1–2.

Handfield, R. B., Giunipero, L. C., Patterson, J., & Monczka, R. M. (2020). *Purchasing & Supply Chain Management*. South-Western, NC: Cengage Learning.

ISO 9000 Family Quality Management. (2020, November 19). *ISO*. https://www.iso.org/iso-9001-quality-management.html

Kenton, W. (2020, July 7). *Supply Chain*. Investopedia. https://www.investopedia.com/terms/s/supplychain.asp#:~:text=A%20supply%20chain%20is%20a,product%20to%20the%20final%20buyer.&text=Supply%20chain%20management%20is%20a,and%20a%20faster%20production%20cycle

Perova, A. (2017). Methods of Placement of Business Tourism Centers in Large Cities as Means Providing Traffic Safety (on the Example of St Petersburg). *Transportation Research Procedia*, *20*, 487–492. https://doi.org/10.1016/j.trpro.2017.01.079

Yu, W., Chavez, R., Jacobs, M. A., & Feng, M. (2018). Data-driven supply chain capabilities and performance: A resource-based view. *Transportation Research Part E: Logistics and Transportation Review*, *114*, 371–385. https://doi.org/10.1016/j.tre.2017.04.002

What is ISO 9001. (2013, March 2). *Rospromtest*. (In Russ.). https://www.rospromtest.ru/content.php?id=254

Appendix

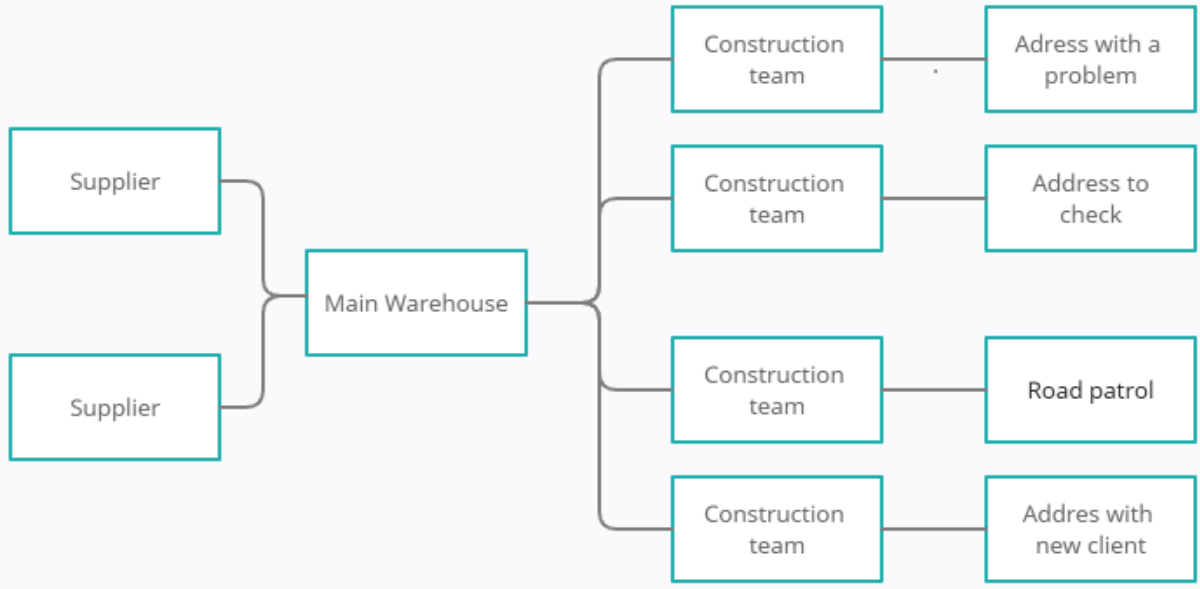

Figure 1. Scheme 'As is' of the analyzing company

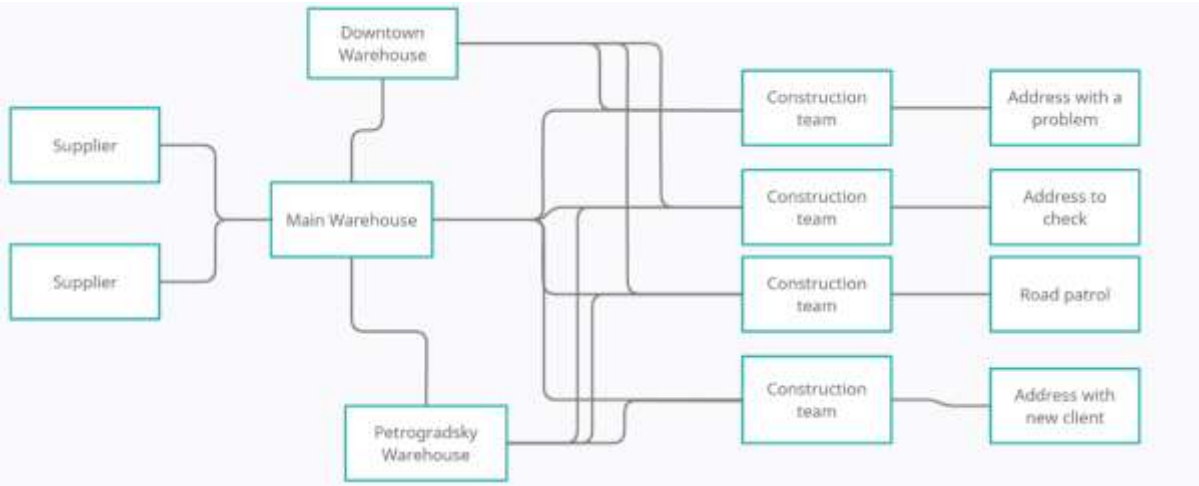

Figure 2. Scheme 'To Be' of a company after separating warehouses

Table 1. Comparing characteristics of warehouses for rent in two different districts

	Downtown or near it	Petrogradsky district
Rental costs	30 000₽	15 000₽
Service cost per kilometer	4 500₽	4 500₽
Number of kilometers	1	2
Equipment costs	0₽	0₽
Profit from installing a new cable	200 000₽	130 000₽
Number of customers near the warehouse	15,00	5,00
Average number of incidents	4,00	2,00
Average price for elimination of emergency incidents	35 000₽	17 500₽
Profit annually per year	1 574 000₽	478 000₽
Benefit without the introduction of a warehouse	1 214 000₽	454 000₽