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O.V.Malikhina, E.R. Drobot

OPTIMIZING A COMPANY'S COMPETITIVE EDGE BY MODELLING ITS SUPPLY CHAINLOGISTICS ACTIVITIES

The paper looked at the supply chain, what helps to put it together, its optimization and what it can lead to. Supply chain modelling was also considered, what problems it solves. The importance of supply chain management and what components it consists of was considered. The paper considered the system anyLogistix, which is well suited for supply chain modelling, risk tracking and change trends. Using Rostelecom as an example, the system was examined and its usability was deduced.

Keywords: supply chain, supply chain management, supply chain modelling, supply chain model.

О.В.Малихина[1], Е.Р.Дробот[2]

ОПТИМИЗАЦИЯ КОНКУРЕНТНЫХ ПРЕИМУЩЕСТВ КОМПАНИИ ПУТЁМ МОДЕЛИРОВАНИЯ ЕЁ ЛОГИСТИЧЕСКОЙ ДЕЯТЕЛЬНОСТИ В ЦЕПОЧКЕ ПОСТАВОК

В статье рассмотрена цепь поставок, что помогает её составить, её оптимизация, и к чему это может привести. Также было рассмотрено моделирование цепи поставок, какие задачи решает. Была рассмотрена важность управления цепями поставок, и из каких компонентов состоит. В работе рассмотрена система anyLogistix, которая хорошо подходит для моделирования цепи поставок, отслеживания рисков и тенденций изменения. На примере "Ростелекома" был рассмотрен принцип действия системы и выведены её удобства в эксплуатации.

Ключевые слова: цепочка поставок, управления цепями поставок, моделирование цепи поставок, модель цепи поставок.

In today's global marketplace and reality, industry success depends heavily on managing the supply chain, which is the movement of material resources from their source to the end consumer. Effective supply chain management has become a vital way to gain a competitive edge and improve business performance. The supply chain is a complex system, difficult to analyse because of its dynamics, uncertaintyand unpredictability.

There are three types of flow: material flow, information flow and cash flow. Figure 1 shows the direction of the flows.

[1] Малихина О.В., доцент кафедры бизнес-информатики, кандидат экономических наук; ФГБОУ ВО "Санкт-Петербургский государственный технологический институт (технический университет)", г. Санкт-Петербург
Malikhina O.V., Associate Professor of the Department of Business Informatics, PhD in Economics; Federal State Budgetary Educational Institution of Higher Education "Saint-Petersburg State Institute of Technology (Technical University)", Saint-Petersburg
E-mail: lesya265@gmail.com
[2] Дробот Е.Р., магистрант кафедры менеджмента и маркетинга; ФГБОУ ВО "Санкт-Петербургский государственный технологический институт (технический университет)", г. Санкт-Петербург
Drobot E.R., Undergraduate of the Department of Management and Marketing; Federal State Budgetary Educational Institution of Higher Education "Saint-Petersburg State Institute of Technology (Technical University)", Saint-Petersburg
E-mail: jane010601@gmail.com

Materials

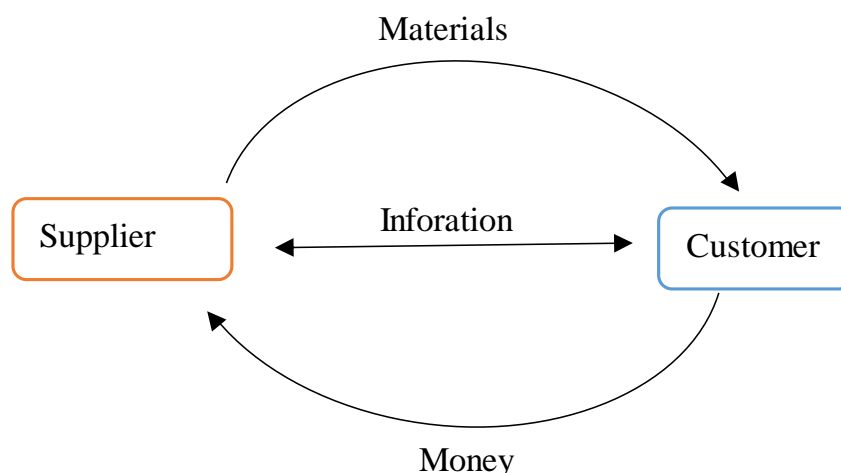Supplier ⟷ Inforation ⟷ Customer

Money

Figure 1 – Directions of flow in the supply chain

Materials are moved from the supplier to the producer, then distributed to warehouses and retailers, and finally to the end consumer. In information flow, communication is maintained on both sides. The flow includes data about changes. Cash flow is the flow of money that goes back to the supplier from customers. An efficient supply chain is essential for every company to survive in the global marketplace.

The supply chain may seem simple at first glance, but to remain effective it must be dynamic.

The supply chain is the network of people, resources, activities, organisations and technologies that are involved in and accompany a product. The supply chain encompasses all the steps a product goes through, from the supply of raw materials to production to delivery to the final consumer.

An optimised supply chain can lead to lower costs, an efficient production cycle, and continued competitiveness, which is why most companies strive to continually improve their supply chains.

Supply chains solve the basic problem of balancing supply and demand. Between supply and demand, there are other elements that make up the distribution network. These elements are warehouses, trans-shipment points, assembly plants, cross-docking and so on. The relationships between these elements are modelled to project the pathway along which goods and services will move. The supply chain network is shown in Figure 2.

Direct shop delivert

Manufacturer → Storage facility → Store

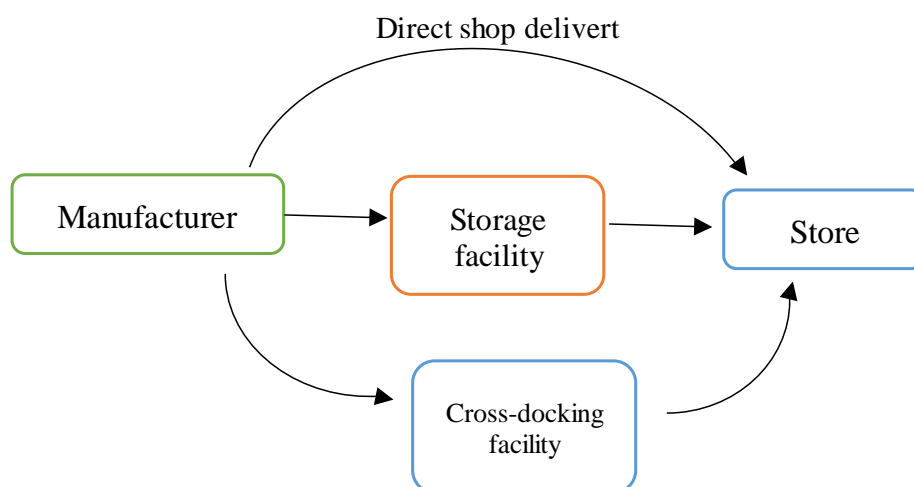Manufacturer → Cross-docking facility → Store

Figure 2 – Supply chain

Intermediate points between the producer and the shop are where the stocks, resources and everything that relates to supply chain operations are located. They add value to the prod-

uct, i.e. the supply chain is a physical movement where resources, materials, information are moved.

Many companies now do business all over the world, working with a large number of suppliers. The most common technology used to solve complex supply chain problems is modelling. Supply chain modelling is about streamlining the supply chain to achieve certain business objectives, such as low cost of supply, reduction of disruption and risk, and timeliness of delivery. Modelling helps to address the issues shown in Figure 3.

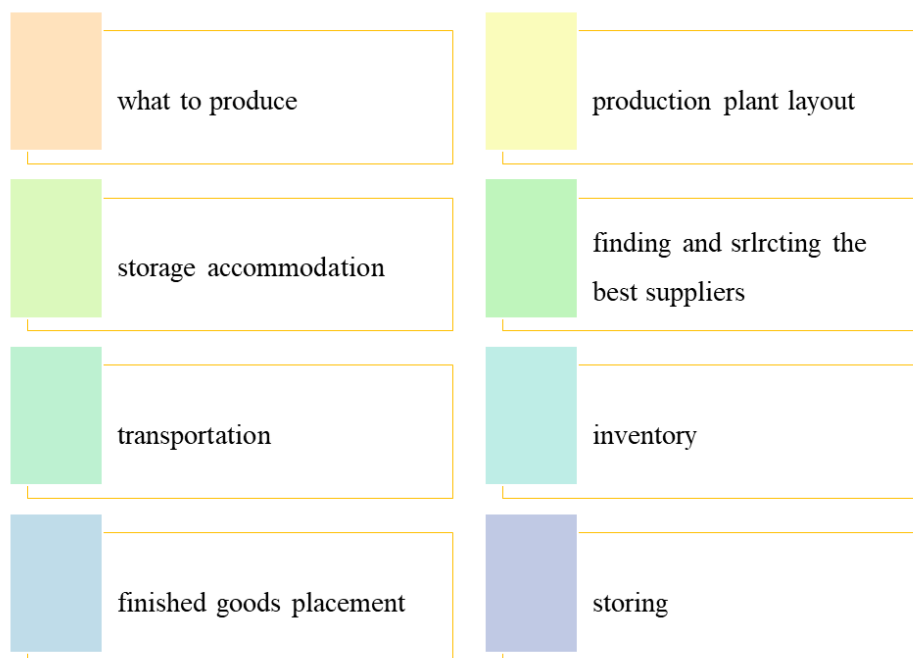|	
what to produce	production plant layout
storage accommodation	finding and srlrcting the best suppliers
transportation	inventory
finished goods placement	storing

Figure 3 – What modelling solves

Due to the volatility and uncertainty in trade relations between countries, it is now very important to pay particular attention to risk management in the global supply chain.

Supply chain management is seen as planning, designing, controlling, monitoring supply chain activities in order to create a competitive infrastructure, leverage logistics, and match demand globally. The role of supply chain management is to overcome various challenges by optimising customer service levels through rapid delivery, minimising costs and minimising product rejects.

In general, supply chain management helps to centralise control or link production, shipment, distribution of products. All of this is achieved by tight control of internal inventory, control of internal production, distribution, sales and stocks.

Although the supply chain has been around for a long time, many companies only started paying attention to it a few years ago.

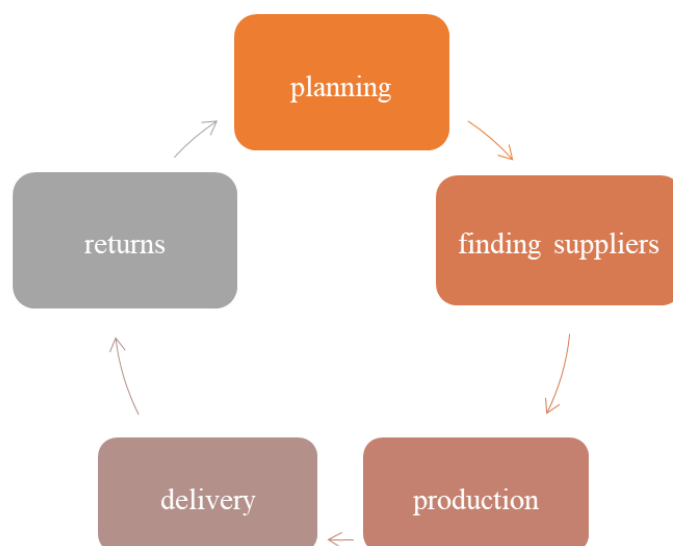Figure 4 shows the five components of traditional supply chain management systems.

Figure 4 – Components of a supply chain management system

Planning. In order to achieve the best possible results from the supply chain, it is necessary to start with planning. In this phase, deliveries are agreed according to customer and production requirements. Companies plan ahead for their future needs in terms of raw materials, production capacity, equipment limitations, staffing requirements. Large companies mainly rely on an ERP system, from which the necessary information comes and where plans are made.

Finding suppliers. Strong and trusting relationships with suppliers are essential because the quality of raw materials and the timeliness of their delivery to production depends on the choice of supplier. Different industries have different sourcing requirements, the main criteria are listed below:

- the raw materials meet the specifications required for production;
- prices are in line with market expectations;
- supplier flexibility in case of an urgent need to supply materials for production;
- the supplier has a good reputation;
- goods are delivered on time and in the appropriate quality.

It is worth bearing in mind delivery times and good quality when choosing a supplier.

Production. The transformation of raw materials into goods is an important point in the supply chain. The final product is the goal of the entire production process and during this process the company should not forget about production waste or other small nuances that may cause deviations from the plan. The company must be prepared to correct problems that may arise in production, or it will have to go back to previous stages.

Delivery. After the production phase is complete, the stage of transporting finished products to customers is reached. With well established supply chain management processes, a company has robust logistics capabilities and distribution channels that work in a timely and efficient manner, and transportation is inexpensive and safe. This is possible with redundant distribution methods if one of the existing methods fails.

Returns. Supply chain management is complete when the returns system and customer support are established. Returns are a bad enough indicator, but if it is due to a company error, the situation can have a major impact on the image. A company's reverse logistics process should be as good as all the previous steps. It is also important to keep track of the reasons for returns, which should be dealt with promptly to avoid future returns.

Supply chain alignment is a very important part of a company's life. All stages must be executed correctly and when things go wrong, you need to be able to adapt and find ways to resolve the problem. As mentioned above, supply chain modelling will help to put things in order and avoid undesirable situations.

The main aim of any company is to satisfy the end customer. If the customer is satisfied, they will come back for another purchase, this will create demand, new customers will appear. This will give the company recognition and image, which will strengthen its position on the market. According to a number of experts, customer satisfaction starts with:

- the perfect product;
- timely delivery;
- friendly service;

− effective problem-solving.

To achieve all this, you need the right supply chain model, which needs to be managed effectively. The model must be fit for purpose and reliable. The model must have internal visibility so that it can be examined to find the best solution.

Supply chain modelling and supply chain management tools:

− stock control;

− cost reduction;

− meeting customer demand;

− improving the efficiency of demand response.

As business changes, so do companies' investments in technology, chain strategies, and decision-making models. Consequently, investments in advanced analytics are a priority for these companies.

A model is seen as an abstract system, which consists of the collection of information for the purpose of research. In order to study a particular system, it is necessary to build a model that describes the system in order to conduct experiments that answer questions and suggestions that cannot be answered by applying the real system in order to avoid failures and confusions. Modelling is one of the most important methods of problem solving and is the only way to solve problems if the problems are difficult to solve using analytical or numerical methods.

There are six supply chain models, as shown in Figure 5.

The continuous flow of supplu model

The fast-chain model

The efficient chain model

Custom-configured model

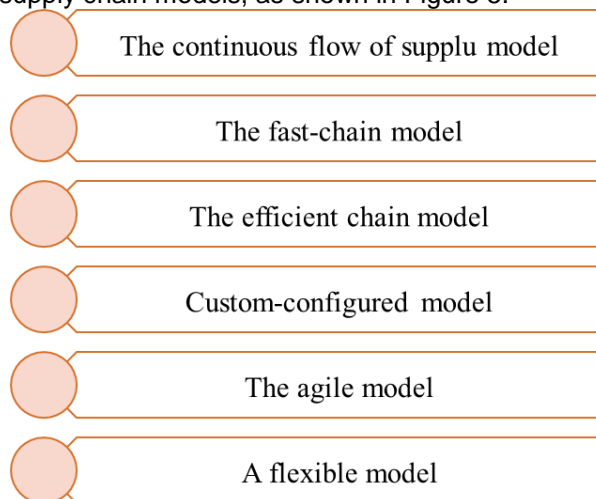The agile model

A flexible model

Figure 5 – Supply chain models

The continuous flow of supply model provides stability in an environment of high demand, which varies very little. This model would suit manufacturers who repeatedly produce the same goods with very little variation. It is ideal for commodity production and is one of the traditional supply chain models.

The fast-chain model suits manufacturers who produce fashionable products with short life cycles. Businesses change products frequently and have to release them quickly before the trend runs out.

The efficient chain model is suitable for businesses that operate in very competitive markets, where efficiency must be maintained at all times.

Custom-configured models are suitable for companies that focus on individual configurations during assembly and production.

The agile model is suitable for special orders. This model focuses on the supply chain's ability to accelerate but be sustainable when there is little movement.

A flexible model allows the company to meet high peak demand freely and manage long periods of low supply.

Supply chains vary in the complexity and size of the processes they implement. To achieve model optimisation, the following tasks can be used:

− Infrastructure solutions (opening of new warehouses);

− without infrastructure solutions (calculation of full logistics costs for specific items).

Agile and dynamic supply chains are important for companies to be competitive. The advantage of modelling gives clarity in analysing supply chain performance and forecasting to make the right decisions. The model works with specific organisational data and it is possible to calibrate the model. It is also possible to account for all constraints and create a large number of

scenarios, to anticipate and mitigate the effects of negative and uncontrollable events and to select the mostprofitable strategies.

Strategies are shaped by taking into account the company's business strategies and functional strategies to ensure competitiveness. The developed supplychain strategy translates into tactical planning, which is implemented through the company's activities.

Initially, companies large and small used Excel extensively for supply chaindesign. As the scale and complexity of the supply chain grows, Excel becomes insufficient to solve the problems that arise. Companies gradually move to R or Python, or to work with optimisation solvers.

Large-scale tasks with large amounts of data require a more complex modelling system. Large companies use specialised management tools such as anyLogistix based on CPLEX and modelling based on anyLogic. Easier to use thanExcel, with flexibility.

Supply chain managers spend an average of 40-60% of their working time fixing various supply chain irregularities. Supply chain design and optimisation canbe done with anyLogic. It is a multifunctional tool for supply chain modelling integrated with IT-based supply chain management systems in a company [3].

The software manages supply chain risks, assesses those risks, allows you tosimulate operations given real-world uncertainty, allows you to test multiple network or policy change scenarios to improve supply chain resilience and determine contingency plans. anyLogic uses tables and graphs to easily simulate thesupply chain. anyLogic enables you to make your chains more resilient, more flexible and more efficient. The figure below shows an example of the interface fromthe official anyLogic website.
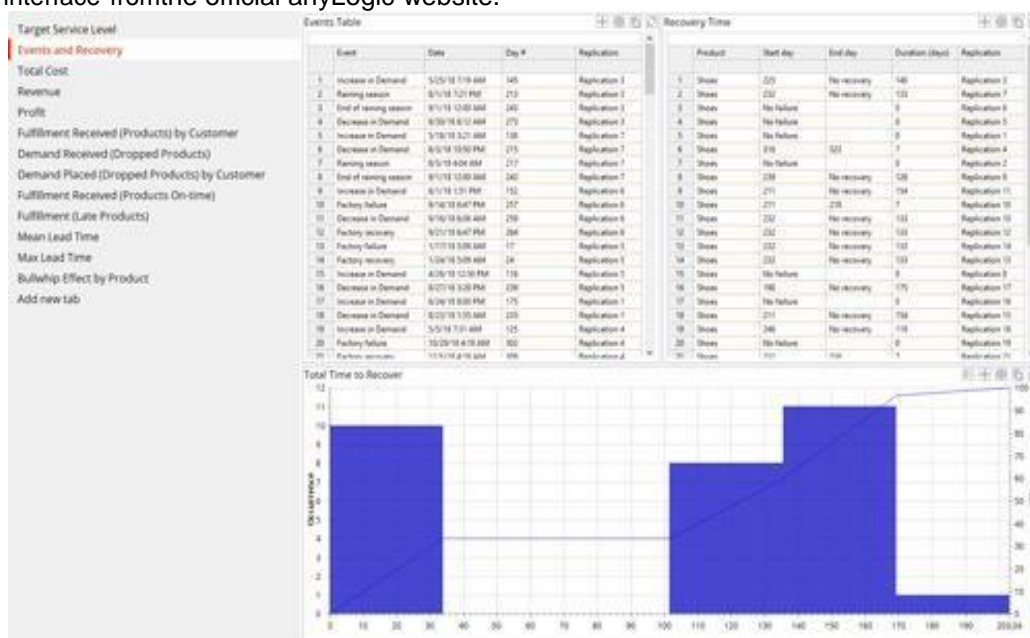

Figure 6 – Interface of anyLogic software

Data on the current state of the supply chain is entered into a simulation model, where a digital twin of the chain is created. This twin helps in making quick and informed decisions as the situation evolves. Risks are mitigated by planning and responding effectively to the situation, anyLogic deals with operational and disruptive risks.

Simulation modelling in anyLogic allows randomness to be considered in the model. The model is run several times with different parameters, and instability and its impact on supply chain performance can be seen. This allows you to assess risks, calculate the probability of an event, possible losses.

The software assesses operational risks in the supply chain:
–   fluctuations in demand, including forecasting errors;
–   risks associated with the transport of goods, loss of goods;
–   stock levels in the company's warehouses;
–   equipment breakdown in production;
–   changes in tariffs, taxes, regulations.

anyLogic enables supply chain testing with what-if scenarios. A flexible system simulates an event that negatively affects the chain, then the impact of this event on the company can be monitored.

The resilience of the supply chain can be checked against the following events:

    – supplier bankruptcy;
    – damage to transport/production infrastructure;
    – ripple effect;
    – economic and political crisis.

Quantifying risks allows you to design a network that minimises potential losses and helps you achieve your business objectives. anyLogic makes it easier to manage risk in the supply chain.

In anyLogistix, many of the supply constraints and decision variables are predefined, making them easier to create and maintain. It opens up possibilities for checking input data and tracking down errors when tasks fail. There is also map editing, which visualises problems.
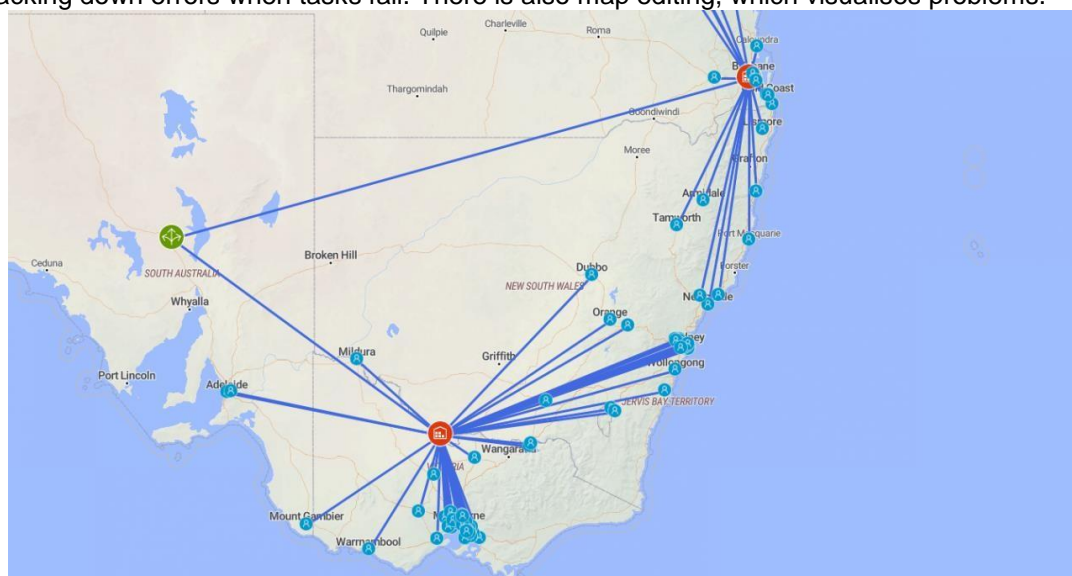

Figure 7 – Example map

Optimisation in Excel requires knowledge of linear programming, which can be problematic for all parties. In anyLogistix, products are created visually, demand for them is created, and constraints of various types (transport, storage) are set. In a few minutes, all the necessary data appears, which does not require deep technical knowledge, allowing for a special focus on logistical data.

	#	Facility	Product	Policy Type	Policy Parameters	Initial Stock, units
Inventory [19]			Filter	Filter	Filter	Filter
Locations [75]		Filter				
Paths [4]	7	DC Reno	Small appliance	Min-max policy	s=12, S=24	12
Periods [1]	8	DC Lynchburg	Small appliance	Min-max policy	s=110, S=220	110
Processing Cost [8]	9	DC Reno	Lighting	Min-max policy	s=9.6, S=19.2	9.6
Products [5]	10	DC Austin	Gardening equ.	Min-max policy	s=20, S=40	20
Shipping [8]	11	DC Lynchburg	Large home ap.	Min-max policy	s=48, S=96	48
Site States Changes [4]	12	DC Austin	Furniture	Min-max policy	s=48, S=96	48
Sourcing [103]	13	Port of New Orle.	Gardening equ.	Min-max policy	s=108, S=216	108
Suppliers [1]	14	DC Austin	Lighting	Min-max policy	s=16, S=32	16
Unit Conversions [5]						
Vehicle Types [3]						

Figure 8 – Example of tables

The software presents the constructed network on a map, making it easy to see and understand. Maps speed up work: distances are calculated automatically and displayed in the model.
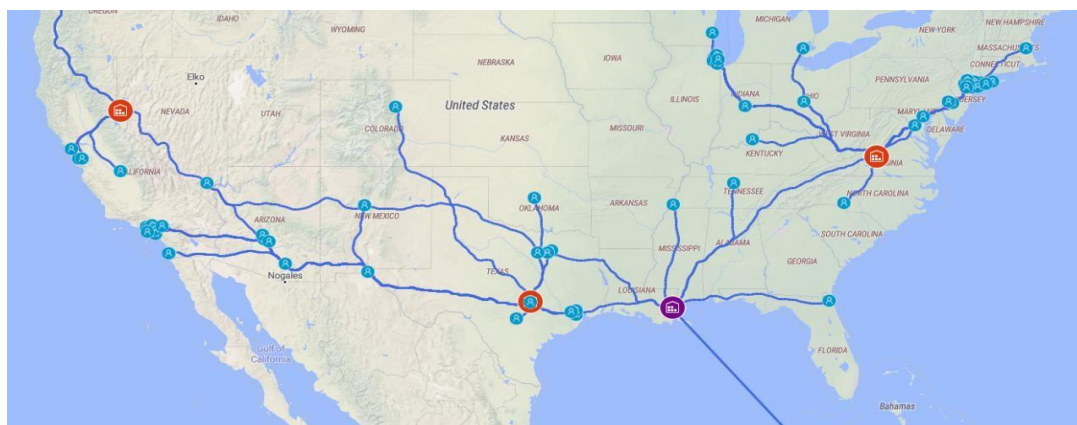
Figure 9 – Map with constructed network

There are ready-made templates of models, tables and models in the programme, and it is possible to adjust them and change them to suit the company's needs. You can add your own constraints and variables and modify the target functions.

anyLogistix provides a customisable simulation engine in which inventory and supply chain management, risk analysis and sustainability planning can be performed. By using this system, a company has a competitive advantage because by keeping track of all kinds of risks and considering different risk mitigation options, the company becomes more stable [2].

Deloitte is the world's largest professional services provider. They received a proposal from Rostelecom to develop a supply chain design solution. Rostelecom's warehouse capacity utilisation rate is only 25% due to inefficient use of space and long transport routes.

Deloitte had to design an optimal supply chain model that takes into account forecasts of demand growth, while maintaining a high level of service. Deloitte also had to select the optimum warehouse capacity and location.

The anyLogistix software was used. At the start of the project, the company's current supply chain was built and calibrated based on their data taken from the ERP system. The model was developed with 99% accuracy.

Figure 10 – Model in anyLogistix

Six scenarios were developed for different supply and inventory management options. All scenarios were optimised, which helped to identify an effective option, taking into account implementation risks, implementation costs. For each scenario there was a reporting system to investigate the options more accurately.

The work at anyLogistix developed a step-by-step map for moving from the current state of the supply chain to varied suggestions for improvement.

The results of the project satisfied Rostelecom's requests. The logistics system was significantly improved: total logistics costs were reduced by 9%, the number of company warehouses was reduced by 28%, transportation costs were reduced by 5%, and inventory turnover was increased by 26%.

More than 44,000 square metres of storage space has been freed up for sale and internal redistribution through modelling.

Rostelecom has a 35% market share. The company is the industry leader. The chart below shows the market shares of the companies by number of subscribers, according to the 3D news website.
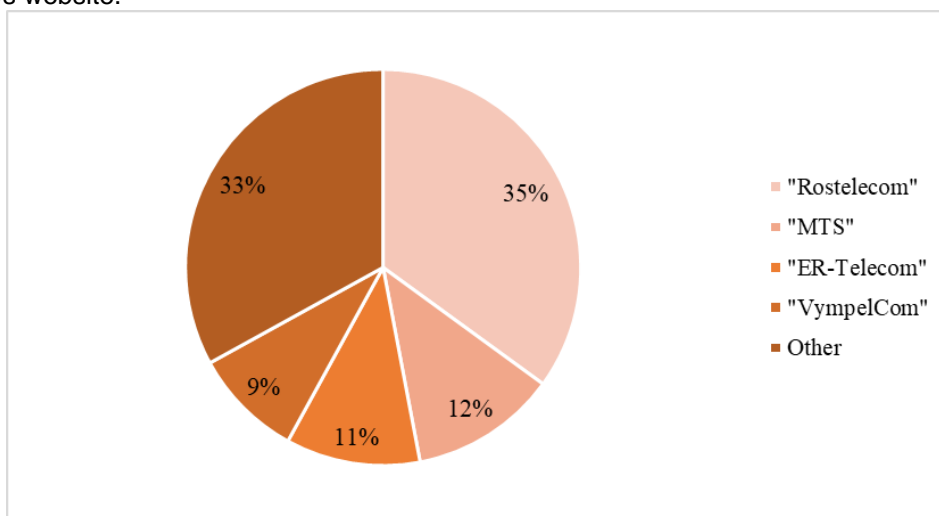

Figure 11 – Market shares

Supply chain alignment has a major impact on a company's competitive edge, as the chain simulation offers a variety of eventualities that the software predicts. While using anyLogistix, the company has reduced the logistics costs attributable to warehouses. As a result, Rostelecom has spare warehouse space that can be retrofitted for new products, or other operational options can be considered. Costs have also decreased, and consequently there are finances that can be invested in other areas, such as marketing activities.

The scenarios developed allow efficiency improvement options to be tested, performance assessed, compared against each other and the most appropriate ways of improving efficiency selected.

A well-functioning supply chain is a significant competitive advantage, as supply chain efficiency leads to cost savings. A well-functioning communication leads to simpler operations and a more accurate and timely exchange of information between supply chain entities. This is why companies need to pay particular attention to supply chain modelling, given the possibilities offered by modern systems.

Simulation, as a process, makes it easier for the entire company to focus on more important issues and be prepared for all kinds of emergencies. Having up-to-date data that is constantly updated, keeping track of that data and calculating all kinds of risks that can be prevented through modelling ensures a stable supply chain for the company. It's all about having the power to analyze, solve a wide range of supply chain management challenges, estimate the impact of change, and enable flexibility and adaptability in your supply chain. The supply chain becomes more resilient and you can react quickly to changes. The resilience and agility of the supply chain is a competitive advantage.

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