KAUNAS UNIVERSITY OF TECHNOLOGY

MECHANICAL ENGINEERING AND DESIGN FACULTY

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DEVELOPMENT AND INTEGRATION OF THE NEW LOGISTICS MANAGEMENT SOFTWARE AND SYSTEM IN A TRANSPORTATION COMPANY

Final project for Master degree

Supervisor
Assoc. Prof. Dr. Kazimieras Juzėnas

KAUNAS, 2015

KAUNAS UNIVERSITY OF TECHNOLOGY
MECHANICAL ENGINEERING AND DESIGN FACULTY
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Industrial engineering and management (code 621H77003)

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KAUNAS, 2015

KAUNAS UNIVERSITY OF TECHNOLOGY

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DEVELOPMENT AND INTEGRATION OF THE NEW LOGISTICS MANAGEMENT SOFTWARE AND SYSTEM IN A TRANSPORTATION COMPANY

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2015 June 11
Kaunas

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Jasinskaitė, E. Naujos programinės įrangos ir inžinerinės sistemos skirtos logistikos valdymui kūrimas ir integracija transporto įmonėje. *Pramonės inžinerijos magistro* baigiamasis projektas / vadovas doc. dr. Kazimieras Juzėnas; Kauno technologijos universitetas, Mechanikos inžinerijos ir dizaino fakultetas, Gamybos inžinerijos katedra.

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SANTRAUKA

Šiame bagiamajame magistro darbe yra pateikiama naujos kompiuterinės logistikos valdymo sistemos projektavimas, svarbiausių jos funkcijų analizė, svarstomos pritaikymo ir integracijos galimybės Lietuvos pramonėje logistikos procesų tobulinimui. Ši sistema yra skirta kontroliuoti ir užtikrinti stabilų bei kokybišką prekių pervežimą vilkikais, pradedant nuo gautų klientų užsakymų sisteminimo, automatizuoto prekių skaičiavimo ir paskirstymo sandėliuose, iki vairuotojų kontroliavimo, tikslių krovimo vietų nustatymo ir galutinių vartotojų poreikių analizės. Pagrindiniai logistikos valdymo sistemos uždaviniai yra laiko ir kaštų sumažinimas, krovimo vietų tikslumo padidinimas, vairuotojų profesionalumo užtikrinimas, padidintos komunikacijos galimybės, duomenų bazės ir reikiamų dokumentų gavimo pasiekiamumas laiku, vilkikų darbo ir poilsio rėžimų maksimalaus kontroliavimas, tiklsus prekių kiekių skaičiavimas, padidintas produktyvumas ir efektingumas bei padidintas klientų pasitenkinimo rodiklis. Šios sitemos kūrimą įtakojo dvi Lietuvos įmonės, Pimoji UAB “Adampolis”, kurioje logistikos sektoriuje atsirasdavo netikslumai sandėliuose dėl žmonių klaidų ir netikslių kiekų skaičiavimo bei netinkamo paskirtymo sadėliuose. Antroji UAB “KM Logistics” įmonėje, kurioje logistikai valdyti yra naudojamos kelios skirtingos sistemos, kurios nepakankamai užtikrina vairuotojų kontrolę, neparenka tikslaus prekių gabenimo maršruto, neužtikrina reikiamų dokumentų gavimo laiku ir negali užtikrinti kokybiškos logistikos grandinės kontrolės. Ši logistikos valdymo sistema gali būti pritaikyta abiejoms skirtingų pobūdžių įmonėms, tuo pačiu įrodant jos įdiegimo galimybes kitose Lietuvos transporto įmonėse. Šią Logistikos valdymo sistemą sudaro integruotos ir sujungtos kelios sistemos vienoje programoje, tokios kaip: duomenų bazė, kurioje fiksuojami gaunami užsakymai ir atliekami reisai; savaime atsinaujinanti GPS sistema, užtikrinanti tikslią vietų paiešką ir vairutojų vietos nustaymą, jutiklių ir barkodų skaityvumų įdiegimas, kuris užtikrina automatizuotą prekių kiekio skaičiavimą ir specifikacijas bei komunikavimo sistema, leidžianti bendrauti su vairutojais bei klientais bet kuriuo metu. Ši logistikos valdymo programa, kartu su pritaikytais automatizavimo sprendimais gali tapti viena svarbiausių kompiuterizuotų inžinerinių sistemų Lietuvos pramonėje, kuri kontroliuodama kokybišką ir tikslų prekių gabenimą, gali užtikrinti Lietuvos logistikos sektoriaus plėtrą ir pranašumą visoje Europoje.

Reikšminiai žodžiai

Logistikos valdymo sistema; logistikos procesų tobulinimas, automatizavio sprendimai logistikos sektoriuje; kompiuterizuotas logistikos gradinės valdymas.

Jasinskaitė, E. Development and integration of the new logistics management software and system in a transportation company. *Master of industrial engineering* final project / supervisor Assoc. Prof. Dr. Kazimieras Juzėnas; Kaunas University of Technology, Mechanical Engineering and Design faculty, Production Engineering department.

Kaunas, 2015. 98 pages.

SUMMARY

In this final Master degree thesis there is presented the design of the new computer aided engineering logistics management software, there is given analysis of it‘s main functions and considerations of this system integration and development in Lithuanian industry. This system is intended to control and provide stable and high qualified cargo transportation by trucks, starting with systematization of orders received by customers and automated calculation and distribution of goods in warehouses till control of drivers, online communication, precise deterrmination of routes and analysis of end-user needs. The main tasks of the logistics management system is reduction of time and costs, increasing of accurate determination of loading places addresses, drivers professionalism ensuring, increased opportunities for communication, availability of necessary documents gathering, maximum control of drivers work and rest regimes, accurate calculation of the quantity and specifications of goods and increasing customer satisfaction rate. The design of this system was influenced by two Lithanian companies. The first one was JSC „Adampolis“, there in it‘s logistics sector occurred inaccuracies due to human errors and not adequate distribution in warehouses. The second one is JSC„ KM Logistics“, which uses several different programs to control logistics, but still can not ensure appropriate drivers control, the precise movements of goods, accurate routing, the necessary documents gathering in time and can not guarantee the quality of logistics chain management. This logistics management system can be adapted for both different companies for controling logistics, therefore is such way demonstrating its development and adaptation opportunities in other Lithuanian industrial enterprises. The logistics management system consists of several interconnected and integrated systems, such as: database, which records orders received and routes accomplished; self-regenerating GPS system that ensures accurate addresses search and online driver destination determination; sensors and barcode scanners installation, which provides an automated calculation of the quantity and specifications of products and integrated communication system, that enables online communication with drivers and customers. The main indicators, which shows this logistics management system‘s advantages and competitiveness is reduced costs, saved time, ensured the efficiency and productivity and also increased customer satisfaction rate. This new logistics management program could become one of the most important computerized engineering systems in Lithuanian industry, which by ensuring the highest quality of cargo transportation, can provide logistics sector development in Lithuania and esure competitiveness across all Europe.

Key words

Logistics management system; optimization of logistics processes, automatization solutions in logistics sector; computerized logistics chain management.

KAUNAS UN IVERSITY OF TECHNOLOGY
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Head of _____ *(Signature, date)*

Production engineering Department Assoc. Prof. Dr. Kazimieras Juzėnas *(Name, Surname)*

MASTER STUDIES FINAL PROJECT TASK ASSIGNMENT
Study programme INDUSTRIAL ENGINEERING AND MANAGEMENT

The final project of Master studies to gain the master qualification degree, is research or applied type project, for completion and defence of which 30 credits are assigned. The final project of the student must demonstrate the deepened and enlarged knowledge acquired in the main studies, also gained skills to formulate and solve an actual problem having limited and (or) contradictory information, independently conduct scientific or applied analysis and properly interpret data. By completing and defending the final project Master studies student must demonstrate the creativity, ability to apply fundamental knowledge, understanding of social and commercial environment, Legal Acts and financial possibilities, show the information search skills, ability to carry out the qualified analysis, use numerical methods, applied software, common information technologies and correct language, ability to formulate proper conclusions.

1. Title of the Project

Development and integration of the new logistics management software and system in a transportation company

Approved by the Dean 2015 y. Gegužės m. 11 d. Order No. ST17-E-11-2

2. Aim of the project

To develop and integrate of the new logistics management software and system in a transportation company for logistics processes improvement and optimization by applying the newest technological solutions.

3. Structure of the project

1. Problem analysis - analysis of logistics sector and it's processes in Lithuania by determining problems occurring and possible improvement spheres.
2. Researching part- selection of technological processes, automation solutions and necessary functions for logistics management improvement.
3. Project part – developing the algorithms and models for logistics management software, by providing technical alternative solutions and required functions for a program.
4. Economic part – given SWOT analysis and forecasts for this new program to be developed in Lithuania.

4. Requirements and conditions

5. This task assignment is an integral part of the final project

6. Project submission deadline: 2015 June 1st.

Given to the student _____Ernesta Jasinskaitė_____

Task Assignment received ____Ernesta Jasinskaitė_____ _____
(*Name, Surname of the Student*) (*Signature, date*)

Supervisor _Assoc, Prof.. Dr. Kazimieras Juzėnas _ _____
(*Position, Name, Surname)* (*Signature, date*)

CONTENTS

INTRODUCTION

There are various computer aided softwares, which assists to all steps from design, process planning, management of resources, production planning, controlling of manufacturing operations and etc. The purpose of such computerized systems is to create a faster and more effective production process; to develop the highest quality, the most precise dimensions; to plan accurate material usage and to gain the largest profit and customers satisfaction.

Unfortunately there is a lack of such systems investigated for management directly the logistics chain in Lithuanian enterprises. There are a lot of computerized engineering systems adopted to design and manufacturing, but there is a lack of such computer aided softwares with data bases, which would be adapted for automated warehousing management and transportation control, which would facilitate the work, save time, plan and be able to accomplish various logistics steps in Lithuanian enterprises.

There were two reasons for this work to born. The culprits are two Lithuanian enterprises UAB "Adampolis" and JSC "KM Logistics". In the first one, JSC "Adampolis" appeared problem then on 2013.12.31 during inventorization of products in the storage there were a lot of uncertainties and it was not possible to determine them. A large minus of earnings were lost, because of manual calculation in warehousing and not accurate numbers of transported, imported and supplied goods. By this new installed software connection with automated and retrieval systems, it will be able to see all uncertainties, surplus of products and necessary information about the deliveries. The next reason for this software to be installed in reality was initiated in the other company JSC "KM Logistics", because there were appeared problems associated with transportation accuracy, like problems of route planning, lack of necessary delivering information and not appropriate driver's control. These both Lithuanian different enterprises gave the inspiration of the new computerized and automated software development, which could be useful for both enterprises.

The objective of this work: is to design and integrate of the new computer aided logistics management software for controlling, planning and management of logistics in Lithuanian industry. It will be a new program, which would help for Lithuanian enterprises to accomplish various complicated tasks, which are associated with logistics, like gathering accurate information from automated warehouses and trailers, communication with drivers and clients online, observation of travelling, planning delivering of goods at the fastest way and etc.. This system, automatically with sensors, which will be held in warehouse's shells and in trailers, also with barcode readers, integrated in individual tabs, will help to accurately and automatically calculate inventory in any storages or loaded trailers. Also all transportation, with the help of integrated navigation systems

and data base will let us to view and regulate all transportation steps from gathering and distribution of orders till delivering of the product from one point till another. All necessary data, like products, travelling routes, roads, taxes, licenses, customers, suppliers, drivers, delivering information, even information about employees will be held in one data base. This system will have an opportunity to be integrated into computers, tabs and smart phones. This system will be used by clients, managers, the drivers and the owners of trucks.

The main aim of this work: is to develop and optimize logistics processes by using automation, IT technologies and engineering solutions. In this work there will be analyzed the main possible functions of this system and compared two possible transport situations in the enterprise – the logistic chain in the enterprise in usual way by planning all transportation and warehousing steps manually, and the other way by planning and controlling it automatically with integration of logistics management system. The main parameters which could show as the effectiveness of this program are shortened time, reduced expenditures, provided quality and increased rate of satisfaction level of customers.

The main tasks in this work:

1. To analyze Lithuanian logistics sector and indicate problematic aspects in logistics processes.
2. To provide technological solutions for controlling logistics in warehouses and distribution centers as well as loading/unloading of trailer.
3. To develop the necessary functions for program to ensure the logistics management processes improvement.
4. To develop necessary templates, models and algorithms of the designed software.
5. Provide economic analysis, forecasts and benefits of this program.

In this work there will be designed the new computerized logistics management software and provided engineering and automated solutions for development of logistics processes in Lithuanian enterprises. There will be shown the main modules and algorithms for this program overlook. To understand the desirable options of this new system creation, at first we need to overview the existing engineering computerized systems in Lithuanian industry and to understand the importance and desirable benefits of it.

1. INTRODUCING TO THE ENGINEERING COMPUTERIZED SOFTWARES AND LITHUANIAN LOGISTICS SECTOR

Before investigation of the new software to control logistics and warehousing in enterprises, we need at first to get acquainted and overview the evolution of other usual computerized systems – to understand how they are involved, developed and adapted in Lithuanian industry.

The main tasks in theoretical part of this work:

1. To get knowledge about the basic engineering computerized programs used in Lithuanian industry.
2. To estimate basic computerized logistics management steps.
3. To introduce with automatic storage and retrieval systems AS/RS.
4. To analyze possible storage and transportation management systems - sensors types and navigation systems for the new programs application.
5. To analyze Lithuanian industry approach about computer aided systems and their possible perspectives in the future.
6. To analyze existing softwares, used to control logistics in Lithuania

The objectives of the first part of this research project is to introduce to the existing situation about the computerized engineering systems used in Lithuanian industry and their inter-comparison; also to present forecasts about the demand and possibilities of computer aided manufacturing engineering software's installation for management of logistics in Lithuanian industry.

1.1. THE OVERVIEW OF EXISTING COMPUTERIZED SYSTEMS IN LITHUANIAN INDUSTRY

Earlier the application of computers in science was called the factory of the future, but from about 1960's it came to the reality and now by alternative adjustment this automatic technology in industry can help to gain the best profitable outputs in any Lithuanian enterprise, which is associated with production, manufacturing and logistics processes. Every developed company must use the application of computer aided softwares, because sophisticated computing capabilities can solve complex problems, manage the data and plan every step, associated with the design, manufacturing and sales of their production.

Global market changes very quickly, and any company, which cannot adapt to it and can appear itself behind competitors. One of opportunity to adapt is to apply automated solutions and to

use modern computerized systems, which allows to control existing production and to continue innovations. For more developed and modernized industry to become in Lithuania, the usage of computers in planning and accomplishing process is very important area, because it can provide qualitative variety of products, to expand the export, to improve the economical situation and to reach the highest level of modernization, as like in the other more developed countries like Germany, Japanese, USA, Scandinavian countries and etc.

1.1.1. The automotive logistics integration capabilities to be adapted in Lithuanian industry

At first to be capable to apply the automated solutions in Lithuanian enterprises we need to get knowledge about the approach to the logistics and computerized technologies from Lithuanian point of view.

Only at the end of 1950's Lithuanian engineers were introduced with the science of computers. The first engineering projects there associated with computer-aided modelling and statistical analysis of automation control systems. In 1970 there were 16 centres with 21 computers in Lithuania. The first program in computer engineering started to exist during the 1958-1959 in Kaunas University of Technology and this new science was called the engineering of computing devices and equipment [2]. During those year were also appeared the first automated storage and retrieval systems (AS/RS) for heavy loads materials handling [3]. The industry in Lithuania from those time started to grow rapidly and we must to kept up with new technologies and to expand the technological, economical, business and logistics sectors.

Lithuanian's integrated into the global economy, as it became a member of EU and it affected the country's necessity to develope and compete with neighboring countries, in such way agility of manufacturing and logistics acquired great importance [4].

Introduction of such advanced technologies like computerized systems to any enterprise's system is a huge challenge for it's development, modernization and possible innovations. Introduction of a new technology to the enterprise's operational systems makes changes not only in its organizational structure but also for its processes, facilities, time savings, safety ensuring and larger profits. Computerized engineering systems implementation can reduce material costs, work force, inventory, idle facilities or machine time, and improve material handling and manufacturing processes. Flexible management systems affects the overall cost, and are at first focused on quality and customer needs.

For Lithuania it is difficult to be in front of competitors. Lithuanian manufacturing companies cannot buy all necessary equipment and provide the best opportunities for experienced employees, for this reason, to minimize cost the companies have to search for partners, especially

for logistics handling. Cooperation with partners creates favorable conditions for agility, but proper cooperation requires appropriate tools and techniques, as computerized and automated systems to ensure proper quality [6]. Lithuanian manufacturing enterprises should invest in their flexible equipment implementation and installations. The installed new software for logistics management can increase enterprise effectiveness, services quality, and make the enterprise more popular and desirable between new and existing customers.

1.1.2. Relation between existing engineering computerized softwares used in Lithuania

The goal and purpose of any computer aided management is to create more faster and accurate production processes and to reach the highest quality and with appropriate material usage to gain the larger quantity and profit with lowest expenditures. In the figure below (Fig.1.1.) we can see the basic computerized numerical control aided systems and their relation with each other.

To understand what it means computerized control in industry, we can take an example of computerized machinery, like for example CNC machines. CNC is a process, based for automatically operating a manufacturing machine by giving the commands of letters, numbers or special instructions. A complete set of these coded characters for executing an operation is called a program. The program is translated into corresponding electrical signals, which are send as the inputs to motors that run the machine in this case. If a computer is used to create a program, the process is known as computer-aided programming [1]. For the new computerized logistics management program, the idea is very similar – to use computer for creating the program, which would obtain or send necessary information and would be able to analyze it and represent the best management solutions associated with logistics processes.

One of modernized computer aided systems example is CAME. It gives a widely usage of computer software aid to analyze and solve various complicated tasks in manufacturing engineering. The basic branches of CAME system includes CAD/CAM softwares, which together are used for computer systems to assist in the creation, modification, analysis, control or optimization of a design or manufacturing processes.

CAME concerns not only about the planning of operations, which are performed in the workshop, but it also involves all steps for producing a product – from materials gathering, dimensions calculation, designing, evaluating, manufacturing and even till packing, warehousing and distribution. It can help to any enterprise to design or find the best technological solutions and to provide the highest quality at the right time to existing or to the new products development. For a proper planning of operations is responsible computer-aided process planning (CAPP), which can refer to all steps of planning the design, production and manufacturing operations at the right time and in the right place. With MRP records we can calculate and plan necessary materials

consumption and supply at the right time. CAQ with data bases and held standards can ensure that all requirements in production will be fulfilled. These and other computerized softwares concerns not only about the planning of operations, which are performed in the workshop, but it also involves all steps for management of processes – from materials, geometry and shapes selection, designing, evaluating, calculating, ensuring manufacturing operations performance, distribution and etc.

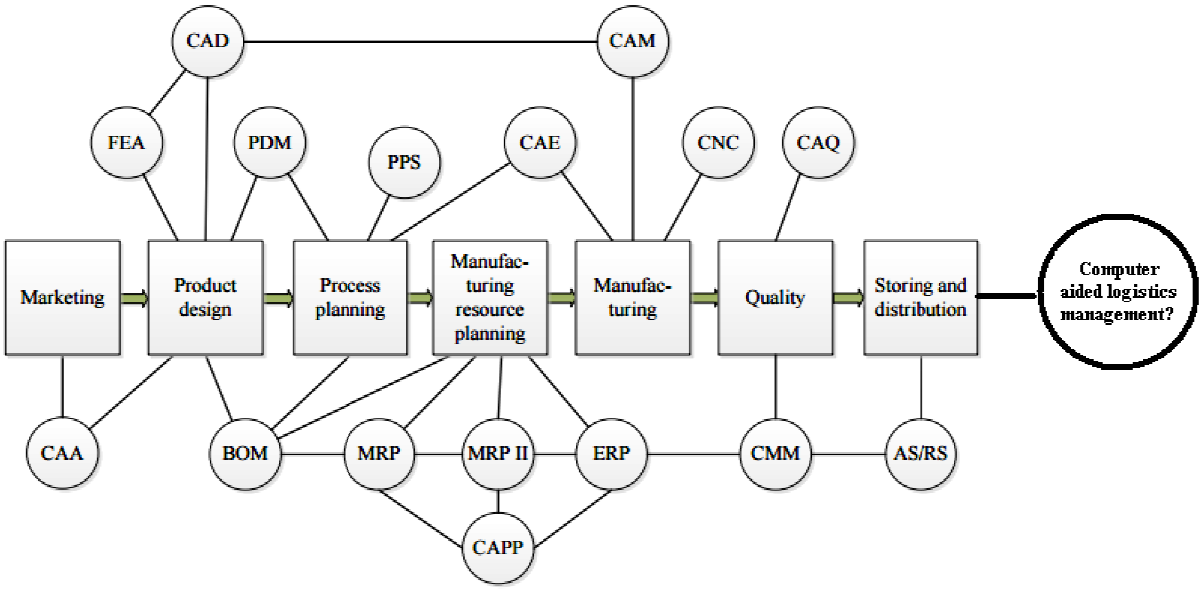

Fig. 1.1. Integrated approach for software application [2]

Here we can see abbreviations of computer-aided techniques, which are shown in the figure above (Fig. 1.1.):

CAD - computer-aided design
CAE - computer-aided engineering
CNC - computer numerical control
CAQ - computer-aided quality assurance
CAM - computer-aided manufacturing
CAPP - computer-aided process planning
CAQ - computer-aided quality assurance
CMM - coordinate measuring machines
PPC - production planning and control
ERP - enterprise resource planning
FEA - finite element analysis
BOM - bill of materials
MRP - materials requirements planning
AS/RS - automated storage/retrieval system

The last circle contributes to the logistics control. The question is left why there was no such circle before – why there was no computerized logistics controlling software application. The answer is that logistics management covers different braches, as for example it could connect CAE, CAPP, CAQ, AS/RS and to work as the whole. In simply words there are a lot of separate programs, navigation systems, provided maps, data bases and programs, which could plan transport routes, would

automatically could calculate goods or plan driver's schedule, but there is no one such system, which would hold on all these programs and would work together as the whole automatically. To understand the importance of logistics processes development with computerized automated solutios, we need at first to analyze the Lithuanian logistics sector.

1.2. LOGISTICS SECTOR EXISTENCE IN LITHUANIAN INDUSTRY

The logistics sector in Lithuania was developed from 1991 year, because of economical, political, social changes and increased competitiveness between neighboring countries.

The main branches of logistics in Lithuania was developed [4-7]:

- Customs Services;
- Railway, sea, river transport Services;
- Port Services, Ship Supply;
- Road Transport Services.

The main Logistics Services in Lithuania includes:

- Transportation and transport/drivers offers;
- Provision of logistics solutions and logistics managers offers;
- Warehousing and open cargo storage yards;
- Customs brokerage.

In these days there are approximately 4,500 companies and 72,000 employees working in the sector of logistics in Lithuania [5]. The most known companies in the transport and logistics sector in the country includes: Lithuanian Railways JSC, Girteka Logistics JSC, Vlantana JSC, KLASCO SC, Transekspedicija JSC, Limarko group, and JSC Transtira [6]. Lithuania is committed to investing 100 million EUR into four main logistics branches: seaport at Klaipėda, Trans-European roads network, airports and warehousing [4-7]. The main directions of Lithuanian production transportation and export is shown in figure below (Fig. 1.2):

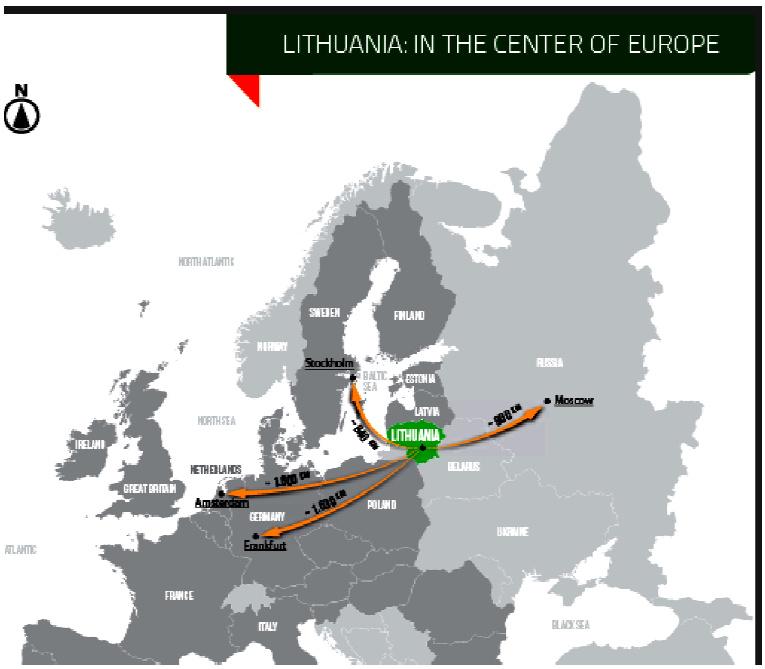

Fig. 1.2. Lithuanian possibilities for export [6]

Lithuania has a very relevant geographical location near the Baltic Sea, and is close to major developed countries. Lithuania provides an advanced logistics sector, which accounts for 10.6% of GDP in the country and offers an access to over 750 million consumers in and around the EU [5]. The other facts and advantages of the country location [6]:

- Provide opportunity to deliver just-in-time production by air, sea, rail and road.
- Two major trans-European corridors connect Lithuania's market to the rest of the EU.
- The Port of Klaipeda is one of the northernmost ice-free ports in the world.
- Lithuania has a modern truck fleet of 25,000 units;
- From any of Lithuania's four airports we can reach any major European city in less then 3 hours.
- Lithuania is centrally located between four sizeable markets: West Europe, the North (Scandinavian) countries, and the Eastern markets of Russia and the Commonwealth of Independent States [7].
- Lithuania holds approximately about 700,000 m^2 of warehousing facilities (the main are in Vilnius about 335,000 m^2, while in Kaunas - 184,000 m^2, and Klaipeda - 124,000 m^2 [5].

From listed advantages about Lithuanian geographical location, that can make conclusions that we have all opportunities for logistics sector development and successful expansion.

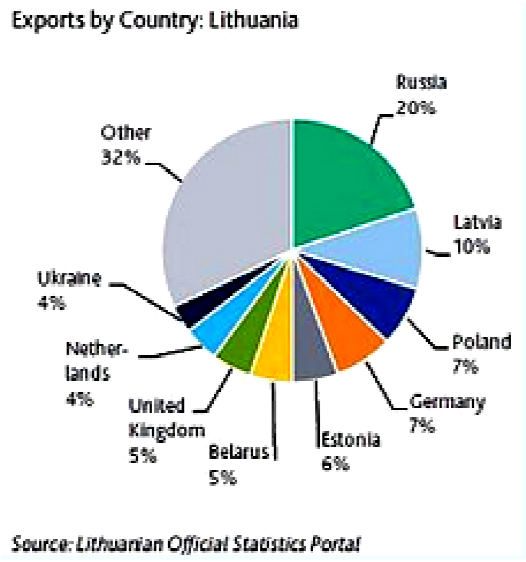

Fig. 1.3. Lithuanian basic exports by country in 2014 [6]

As we can see from figure above (Fig. 1.3.), the largest part of cargo in 2014 from Lithuania was exported to Russian, after that to Poland, Latvia and Germany. The "Other" countries includes the most of west Europe like Belarus, France and Spain. However, because of the ongoing political tensions between Ukraine and Russia, the Baltic countries, as well as Lithuania are unlikely to have an impact of exports decreasing to these countries for a while. However, exports to Russia worked only as transit route for re-exports, which there originated from other countries and now Lithuania can increase exports to west Europe [6].

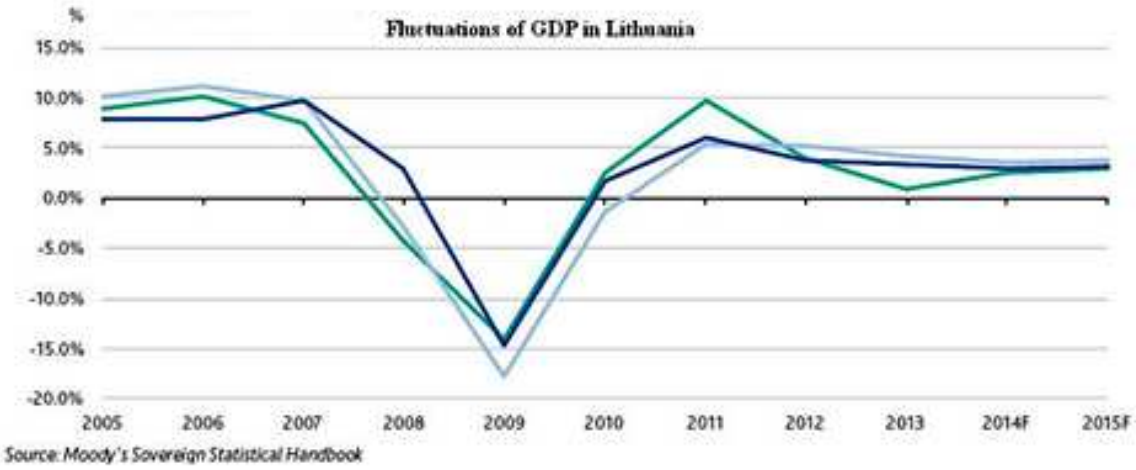

Fig. 1.4. Lithuanian GDP fluctuations by the year [6]

In figure above (Fig. 1.4.) we can see Lithuanian GDP variations by the year. In 2009 we can see the clear downfall of GDP, but from 2014 we are forecasted to remain permanent for over then 5

years. [6]. From diagram below (Fig. 1.5.) we can see that GDP is highly dependent on logistics sector growing in Lithuania. We can see the forecasts that from 2015 till 2030 freight transport activity increase, as well as with GDP will grow with 1.7% per year, by improving the economical level of Lithuanian country and developing the logistics sector.

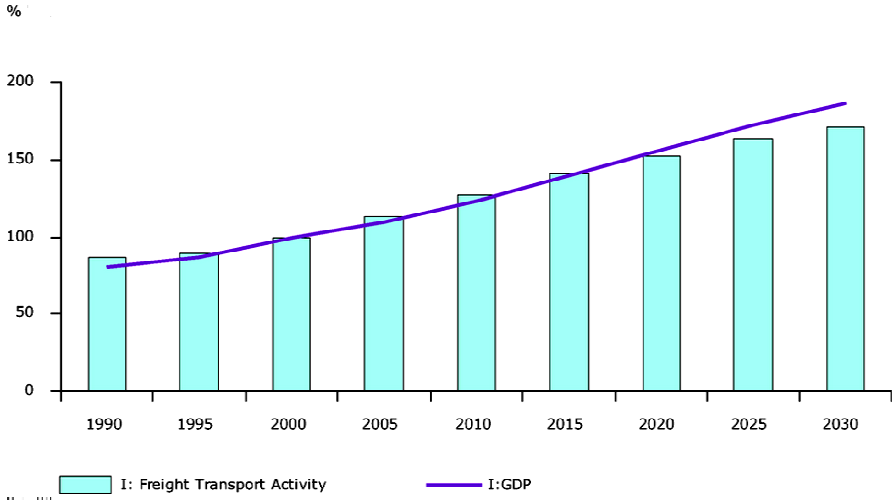

Fig. 1.5. Lithuanian GDP dependence on freight transport activity [7]

We can see above details about transportation between EU Members, which also shows transportation activity dependence from GDP variation. This long term tendency is a combined result from productive and effective transportation development. Lithuania has also become one of the EU's primary transport hubs. Lithuania by participating in the Europe union develops new ideas and establishes new programs for engineering and logistics sectors development in the country [7].

High technology development program

There was established the High-technology development program for the year of 2007-2015, which goal was to develop and expand already existing fields with long-term global perspective to become competitive in the world market. This program's objectives are to encourage researches and development in these science areas: biotechnology, mechatronics, laser technology, information technology, nanotechnology, electronics and also increasing production, manufacturing and transport spheres. In other words this programs encourages the installation of new computerized software and application of automation solutions into industry for improving production, manufacturing and ensure the proper management of it [7].

Lithuanian Innovation Strategy

Lithuanian Innovation Strategy is the long-term development planning document, which sets strategies, visions, objectives, forecasts, determines goals and results to be achieved with innovations from 2010 up to 2020. The main purpose of this Strategy is based to develop competitive knowledge economy in the country, by using the newest technologies, equipment, automation, IT solutions and qualified human resources to mobilize and effectively manage state resources and distribution [6]. The

vision of this strategy is based on the Lithuanian economy to provide of high added value products and services as well as increase competitiveness in the global market. The goals are to create favorable environment and successful business. The developed technologies, together with proper management of business will help to create high level innovations in Lithuanian industry [7].

The Lithuanian Transport and Transit Development Strategy

This strategy in Lithuanian was created from 2005 till 2025 to give the priority to the development of logistics sector - to develop international transport corridors, multimodal cargo transportation and to provide high quality logistics services. The main aim of this strategy is concerned to freight transport, attention would be paid to the intermodal transportation establishment, management of processes and innovative technologies. The road, railway, seaport and airport infrastructure have to be modernised with the adaptation of the newest effective transportation technologies and appropriate processes management [8-9].

These strategies for promotion of innovations, technology development and proper transport management shows great importance for engineering and logistics sectors necessity to be increased, because these fields are the main braches in Lithuania, which can ensure competitiveness in the global market.

1.2.1. Advantages of computer aided automatization application in Lithuanian industry

The main reasons for companies to investigate into new computerized and automated technologies, while being in Lithuania [1-3]:

- Well educated workforce;
- Enough well promoted logistics services;
- High-quality manufacturing;
- Given attention to technological sciences, as engineering, mechanics, medicine, etc.;
- Growing number of successful global companies;
- Good location near the Baltic sea, almost in the middle of Europe.

These and other reasons and advantages guarantees of successful investment in to new technologies, such like CAME or logistics management software integration in Lithuania.

The following benefits of investment to integration of automated and computerized systems in the enterprise:

- Savings in labor force and material planned consumptions;
- Savings in time, due to proper planning and management of all work;
- Savings in space and power consumption;
- Savings in expenditures (for example by avoiding of taxed roads);
- Savings in documentation – all data is located in the program;

- Reached the highest accuracy and largest quantity of designed or produced products.
- Improved quality, profitability, productivity, effectiveness and efficiency in business.

The biggest advantages for enterprises to invest into computer integrated systems are that Lithuanian historical manufacturing strengths include: machinery, electrical equipment, metal processing and construction. Lithuanian is in thankful geographical zone, with expanded logistics abilities – the export is growing, as well as technical education. These are the main reasons for developing logistics sphere with new technologies.

By using various engineering computerized software's abilities, all processes from gathering of order, producing the product or transportation of it can be more effectively maintained, organized, operations accurately performed and the better outcome reached in larger earnings and customer's satisfaction gained about the quality.

Now we can overview and analyze the work principles of existing computerized systems used in Lithuanian industry.

1.2.2. Integrated logistics support

The computerized integrated logistics management refers to the integrated logistics support (ILS). It and integrated strategy for developing the processes for automated material handling, optimization of logistics functions, manage existing resources, and guide the engineering processes for decreasing expenditures and making the system easier to manage [21].

The main activities of ILS include [21-24]:

- Maintainability engineering (preventive, predictive and corrective plans);
- Supply management (of raw materials, necessary part or other resources);
- Support plans of equipment and machines (inventory distribution, equipment installation);
- Organization of personnel (training; knowledge and information sharing);
- Technical data and design interface (specif. regulations and documents sharing);
- Necessary packaging, handling, storage, and transportation management.

The main goal in logistics is to deliver a demanded product for customer at the right time and place at the fastest way, by providing the highest quality at lowest expenditures. Appropriate logistics strategy concerns listed areas above, in respect to ensure that all equipment and support items are preserved, packaged, marked, handled, transported, and stored properly for short or long term requirements. ILS is necessary, because to do all logistics chain manually is too complicated work, which requires a lot of time and money expenditures, qualified personnel and inventory.

1.3. THE MAIN LOGISTICS PROCESSES AND OCCURRING PROBLEMS

The sector of logistics could be called one of the most complicated sectors in industry. This is because all activities are made on just in time and can not always be forecasted and planned. This is the reason why we need to design an appropriate computerized management of logistics processes that it could help us to avoid or solve appeared problems.

The logistics processes from outside view looks like a simply actions:

1. The Logistics manager receives the orders from customers about the delivery. The order is sent to the driver (the driver starts driving to designated region).
2. The manager calculates the rest driving time, which is left for the driver for that day; verify traffic conditions and plan the travelling routes till the destinations; calculates driver's ETA (Estimated Time of Arrival).
3. The manager informs the client about possibilities to come for instructed destinations at the right time in the right place.
4. For the driver the logistics manager gives the coordinates of address and roads for loading place; gives the information about quantity of goods and times of arrivals.
5. The client sends for a manager the reference numbers, which are also given for the driver, which will be necessary to register in the loading and unloading places. Also the client gives instructions for extra information, for example like to use the special additional equipment in loading place, like helmet or anti-slip-mates.
6. The driver comes for load, register for loading with the reference number and prepare trailer for loading.
7. After loaded, the CMR (Contract for the International Carriage of Goods by Road) is given to the driver. The driver manually measures the left free space and parameters of loaded cargo; tells about the loaded quantity, specifications of goods and weight of cargo, which is written to CMR. The written and measured parameters are compared.
8. The driver informs manager about made loading and manager tells all information to the client. After that manager and driver is waiting for permission from the client to go for unload.
9. The cargo is supported by driver and the seal is putted on trailers doors.
10. When the manager receives permission to go, he calculates again the resting time of driver for that day and send such report (Fig. 1.6.) to the client. In this given example, the managers should tell to the driver to go for parking and to inform the client that driver's driving time is finished for this day.

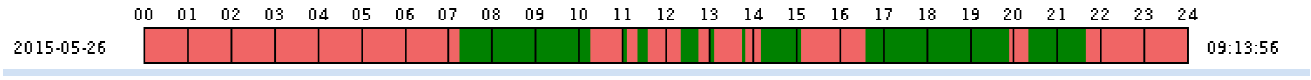

Fig. 1.6. Calculating the driver's working regime

12. The manager is searching the coordinates for unloading address and plans the route for driving till the destination. The instructions are sent to the driver.

13. As the driver comes to the unloading place, he registers for unloading, gives the ref. number and CMR, received from the loading place and prepares the trailer near the ramp for unloading.

14. When the driver is unloaded, he receives the signed and fulfilled CMR and additional papers, like delivery or weight notes.

15. After the truck is empty, the client is informed about it and the manager receives the new order.

16. The route is entered to the data base manually by the manager; the invoice is written by the entered data and sent together with CMR to the client.

17. The client calculates driven kilometres individually and the payment of the route is paid by the client, as he receives the right documents as the evidence of completed order.

These logistics steps should look very easily accomplished, but taking in account that manager has from 10 till 25 drivers at one time, it becomes more complicated then some problems appear.

The main common problems, appearing during logistics processes from the logistics manager point of view:

– The lack of information about the order. Not accurate given ref. numbers or changed addresses of loading or unloading destinations were not told.

– Not accurate calculation of working, driving and rest regimes of driver or not appropriate planning of his working hours, which costs delays of deliveries.

– Shortage of driver's language and communication skills, which costs misunderstandings in the loading or unloading places. Also shortage of necessary documents, or the documents there not completely fulfilled or lost.

– Not accurate addresses there found, or not appropriate routes there planned for transportation and l arge expenditures for roads there spent, because of lack of information about taxed roads.

– Not accurate quantities of goods there loaded, or the cargo was damaged during loading or unloading, because of lack of necessary equipment in warehouses.

– Too much time is wasting in loading or unloading places, then there are not appropriate automated equipment installed and the loadings are maid manually.

– The large occurrence of human errors by using data base or writing invoices.

– Customer dissatisfaction level growth, in respect to not completed instructions, delays, provided not qualitative service or lack of provided information or documents during the delivery.

There are also a variety of other problems and unpredictable factors like traffic jams, truck's break ups, the drivers psychological and physiological problems, inaccessibility to client or driver, the lack of information about tech. specifications or regulations, misunderstandings and etc.

In this master thesis there will be given solutions, how the appropriate automated and computerized management steps could facilitate and improve the logistics chain and the efficiency, save time and expenditures; provide the larger quality of service and higher customer satisfaction, by designing and developing the appropriate functions for the logistic's management software.

The main goal of this work is to facilitate the work for 4 sides, evolved in logistics by giving one solution, by adapting necessary functions to logistic's management software in respect:

1) to facilitate the work for employees in warehouses in the loading or unloading places – to find appropriate automated solutions, which could be integrated in warehouses and trailers and would be able to send the right signals to program automatically and to ensure calculations of the right quantity of cargo or it's parameters.

2) to facilitate the work for logistics managers. To provide appropriate planning of routes, calculation of working times, automated routes rewritings into data base, together with sent photos of CMRs and other documents saving; to provide communication capabilities with drivers and clients online and opportunity of tracking vehicles online.

3) to facilitate the work for drivers, that they would have appropriate communication tool online, would have renewable GPS system with ability to view the streets online, would have the special digital dictionary and opportunity to make and send photos of documents or damaged cargo online.

4) to facilitate the work for clients, with opportunity to send the new orders directly to the program, which would automatically recognize the addresses and reference numbers. Also to give the opportunity for clients to observe the trucks and see their uploaded files with the provided communication tool.

To concern with the automation of warehousing, we will take this logistic's management software capability to be integrated in JSC "Adampolis" because of errors in calculations of inventory, appearing shortages of goods and not appropriate planning for distribution in warehouses and to concern about the appropriate management of transport we will adapt this software for JSC "KM Logistics".

2. DEVELOPING AUTOMATION SOLUTIONS FOR LOGISTICS MANAGEMENT INTO JSC “ADAMPOLIS”

In this chapter there will be explained the main principles how the automated solutions could be adapted in this enterprise of JSC “Adampolis” for management of warehousing. There will be analyzed the work principle of automated and retrieval systems (AS/RS) integration. Also estimated how the signals of tracing the products from shells or trailers are gathered into the computerized logistics management system and how the program would transfer this information and present it as useful data.

The automated warehousing solutions could be usefully used to facilitate the processes of logistics, and we will present what benefits it could give for Lithuanian industry.

2.1. THE GENERAL INFORMATION ABOUT JSC “ADAMPOLIS”

JSC “Adampolis” (Fig. 2.1.) is a representative partner of MAN - the Germany manufacturer of trucks - in Lithuania successfully continues its specialization and expands its activity in the fields of heavy vehicles sales and repairs. It also has over fields of activity – from sales of trucks, buses and their original or spare parts till rental and financial services. The company has 4 services and 6 spare parts shops, with located warehouses with it in Lithuania [22]. JSC “Adampolis” seeks to reach the highest flexibility, to satisfy its clients by fulfilling their individual needs on an operational basis as well as to handle the arisen problems qualitatively and in due time.

Fig. 2.1. The outside look of the enterprise JSC “Adampolis” [22]

The principle of logistics sector work:

1) The orders for purchase the original or spare parts for vehicle are sent to the reception of shop as well as the order about registered new repair of truck is sent to the service;

2) The information about required parts is passed to the warehouse;

3) The storekeepers are searching for ordered goods or missing parts, which are necessary for repair in local warehouse, if something is missing, the goods are ordered to come from other

warehouse located in other city (Kaunas, Vilnius, Klaipėda, Marijampolė), or if it is still misisng the parts are ordered from Germany;

4) The company uses their own transport for delivery or hire the carriers to deliver final products to customers or to make transport between their distribution centres.

Problems occurring in logistics processes:

- The orders are written to the data base manually – human errors appears,
- There are no responsible persons like logistics managers or professional drivers, who would be responsible for transportation of goods, usually the storekeepers or other employers, who has heavy vehicles licenses are delivering the goods among warehouses or till the final customer. This costs time loses and delays of deliveries.
- The warehousing does not have any automated equipment for heavy loads, everything is done manually. It is not safe, takes a lot of time and costs human errors and uncertainties, shortages or surplus of products.

The company needed a system and automotive solutions, which would help to manage the future growth, reduce freight and double handling costs, minimize transportation expenses, optimise the distribution centres of spare and original parts and to manage the operations, concerning warehousing and logistics.

Computerized logistics management system in this enterprise could accomplish various logistics processes from customer's orders gathering, automatically writing them to the data base, planning transportation of goods between shops or till delivering it to the final consumer. It must be able to automatically register newly gathered orders and to have a user interface for collecting input information from a user about a desired operation and for providing output information about performed actions. The computer software for logistics management must generate a plan for resources and spare parts management, navigate transportation and distribute parts in storage correctly. The main goal of automated logistics management is to satisfy a customer and ensure that his order would be fulfilled and completed at the right time. Now company uses only a data base, called "Būtenta", there the orders are written manually and the loadings in warehouses are also made by human hands. The best solution for this enterprise is to integrate automated machines in the warehouses and install a software for logistic's proper management, which would be able to get, read and analyze the signals from installed sensors from warehouses and present the necessary plans or actions.

2.1.1. Analysis of the data base used in the enterprise

As it was mentioned before, JSC "Adampolis" uses only one program, a data base, which is called "Būtenta". It is an accounting system used for recording sales profit, and hold all necessary information, as served customers number, repaired vehicles number or received revenues. It is a data

base, holding information about clients, vehicles types, employees and other information in one software. However this software is not capable for any automatic application or necessary calculations without manual interruption.

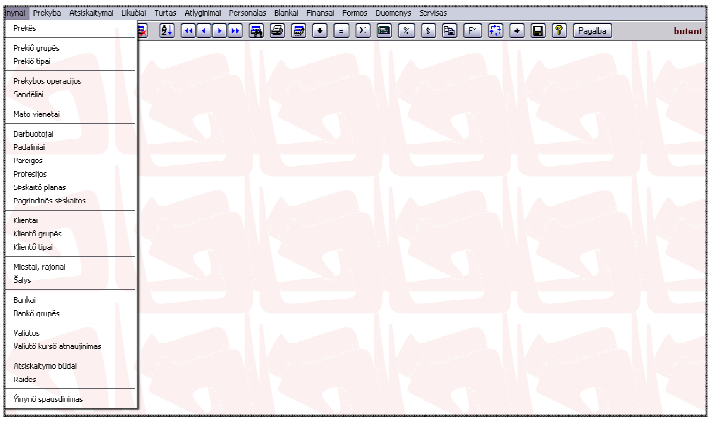

Fig. 2.3. The initial “Būtenta” data base window

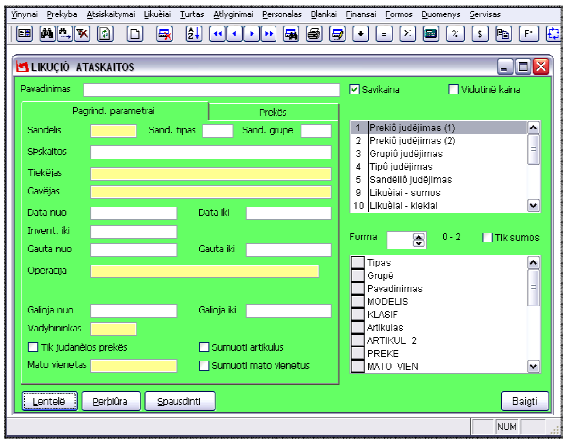

Fig. 2.4. The initial menu window

We can see that in the initial data base window, we can choose what we want to look for, for example items, their types, groups or even clients and information about them. In Fig. 2.4. we can see the basic menu for necessary data findings or reports preparation. For example we can filter gained profit by dates, clients or by separate workshop. By account’s generator we can generate any report what we want by using imputed data in the software, for example we can generate an account about serviced vehicles by the year of registration in Lithuania. By usage of this data base the contracts for clients are generated and the bills by managers are invoiced to clients. However, this program is just a data base and it can not provide any plans or solutions concerning warehousing or transportation.

2.1.2. Automatic orders gathering

Now in JSC “Adampolis” all orders are received by communicating face to face with client, by calls or by emails. These orders manually are written into “Būtenta” data base. In automatic way orders could be fulfilled by clients online (Fig. 2.5.), by giving simple electronic table about the order. Also by using various inventory management systems, like barcode readers and tablets (shown in Annex 4) the necessary data about cargo could be automatically entered into the order’s information.

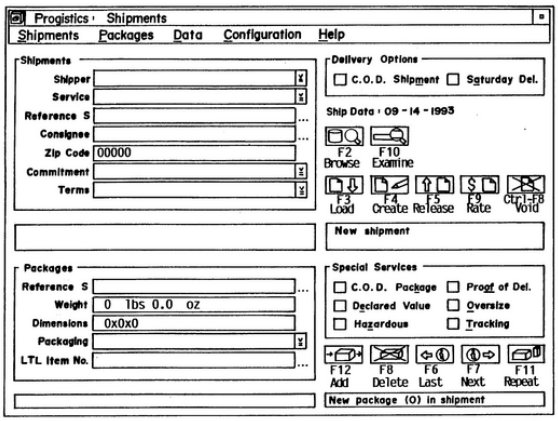

Fig. 2.5. Filling table for order [19]

The fulfilled order would automatically be entered into the data base, and reminder about new order automatically would be send to responsible persons, like storekeepers. The primal order may also be automatically assigned to a carrier, based on the information from the rate subsystem. The program automatically in a few minutes would check about existing and missing goods in the warehouse and would generate a plan for further steps, like for example would verify and plan schedule of service free time and send answer to client, or to verify spare or original parts in the stores, if it is lack of them, the program would automatically book the new ones from the nearest available suppliers. In response, a transportation subsystem may automatically be caused to transport items for the particular order to one or more distribution stations. The system must be flexible and adaptable. Such automated logistics management system would serve as a tool for the automated order processing, packaging, sand transportation of goods.

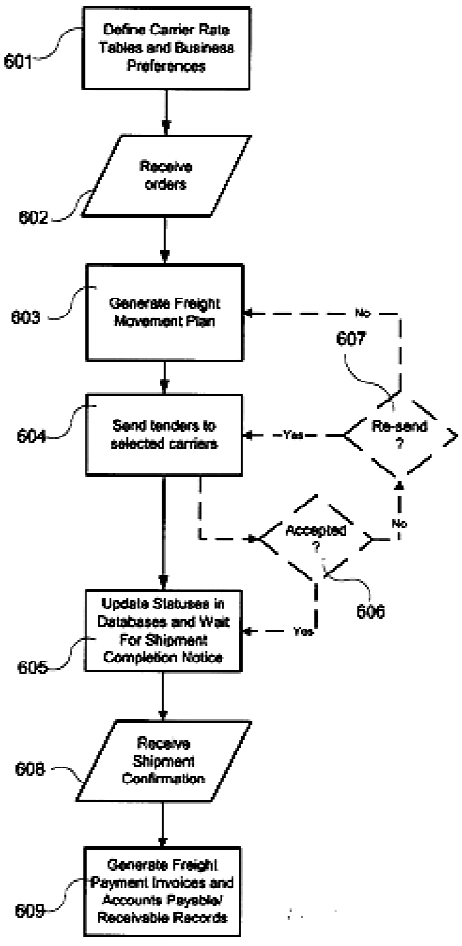

Fig. 2.6. The algorithm for transportation management [24]

In the figure at the left side (Fig. 2.6) we can see the example of algorithm for transportation management in JSC "Adampolis". Before orders are collected the necessary information about available drivers is prepared (step 601), orders are received and systematized in the existing database in "Būtenta" (block 602). The rules and plan for transport is prepared (block 603) and are sent to the drivers (on step 604). The legislations and regulations for operation are taken in to account already (in the

step 605), carriers or the drivers can accept (step 606) or decline it at, as shown in the step at (607), the programmable logic sequence decides whether to send the order back to 607 for re-routing or to try re-sending the tender to the other drivers. Once received shipment confirmation to be accepted, transportation is done. After this, there is received confirmation that a freight movement has been completed (at step 608) there is received freight payment invoices and received records into that same database in “Būtenta” (at step 609). [24]

The main functions of a data processing system, is to verify existing and necessary resources; and to give instructions, necessary to perform the order [19-24]:

-to receive necessary data about orders from an order management subsystem;

-receive from an automated transportation subsystem information from monitoring and detection, that the warehouse has received or is missing of some necessary item;

-in response to received data which tells that the distribution centre has received an item, automatically determining whether the order is available by comparing the descriptions from the order-management subsystem with information about available products to determine with a help of the data reading management subsystem whether all products required for the particular order are in the storage at the right time;

-if no order is currently available, automatically causing the automated transportation subsystem to give a signal and divert the item to a storage area;

-automatically calculating necessary loading capacity in trailer and other necessary parameters like number for pallets or packages required to complete the order.

-if order can be accomplished, automatically selecting a driver for the order and automatically determining whether the selected driver has an available truck at the right time and place;

-if determining that the selected carrier does not have available truck at the right place, the program automatically would send the reminders and book the truck as soon as possible.

-if determining that the selected carrier has an available truck at the distribution facility with sufficient capacity in trailer to perform the order, automatically causing the automated transportation subsystem to give permission to transport products [19].

These subsystems like order-management subsystem, data reading management subsystem and automated transportation subsystem could be used together in one automated logistics management system to accomplish these all necessary above listed functions by automatically receiving and sending necessary information. For automatically gathering necessary information about distribution centres, trailers and warehouses we need to integrate automated solutions in these facilities.

2.2. INTRODUCTION INTO AS/RS SYSTEMS

The storing and distribution in warehouses can be facilitated with usage of automated storage and retrieval systems (AS/RS), which are responsible for warehousing control. In the development of the new logistics control software, which will be able recognize scanned barcodes online and to receive and read electrical signals gathered from sensors it is necessary at first to get knowledge about work principle of AS/RS systems.

Automated storage and retrieval systems (AS/RS) are responsible for appropriate automated inventory control and management. They are applied in storages, warehouses, distribution centers or in workshops. They gave industry the benefits of much faster retrieval, loading actions and safety environment ensuring; increased productivity, as well as the capability to be integrated in warehouses with inventory control and material requirements planning systems [10]. These systems consist of computerized systems, working together with machines or robots, which can automatically move and place loads or products into the right places. By increasing flexibility they controls inventory, tracking materials, minimize manual labor, increase safety at work, minimize time for shipping of goods and by the most important advantage these systems helps to increase utilization and space in storage and provide accurate measurement and weight of loads.

The work principle by simplified explanation: retrieval of items is accomplished by specifying the item type and quantity to be retrieved, while the computer determines where in the storage area or in the trailer the item can be stored and plans the movement, the shuttle machines moves the item to the right place and after every movement is finished the computer updates the received information [10]. In such way the logistic's management software will gather necessary information about the cargo distribution in warehouses and trailers.

AS/RS technology is usually integrated with various types of pick to light systems and microprocessor controller [11]. Automated storage and retrieval systems are integrated, in respect to effectively manage various operations in distribution centres with various types of loads. In a shuttle system, there are held two separate transport devices, which are able to do vertical and horizontal movements. A lift, like an elevator, by movement of up and down, handles various weight loads. Simulators are used in automated storages to monitor how the process works [12]. In picture below (Fig. 2.6.) we can see example, how integrated automatic storage and retrieval system looks in the warehouse.

[Fig.2.6.] Automatic storage and retrieval system AS/RS [13]

The connections between shuttle machine and computer is shown below, in [Fig. 2.7.], there we can see how these machines could work together with computerized program, like our new logistics management software. On a retrieval machine there are integrated light sensitive sensors which send inputted signals to the installed program, and computer simulation by calculating automatically necessary parameters, like movement, or shifts of machine sends output signals to actuators and gives instruction what to do. Also the cargo with 3D view and dimensions would appear on the screen and all necessary dimensions, geometry and volume will be calculated immediately by this program.

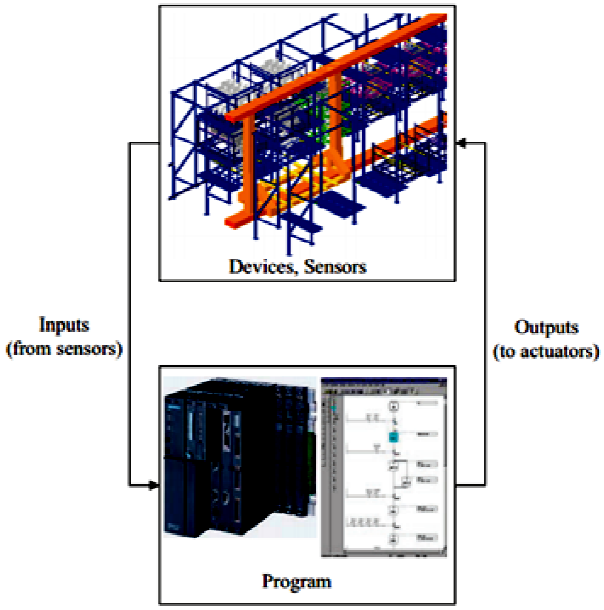

Fig. 2.7. Connection between shuttle machine with computer simulation [14]

The major benefit of the proposed automated machines is the reduction of time to find necessary cargo in warehouses, reduction of the loading or unloading time and indication of potential

errors that can be detected and fixed before actual implementation. In the next subchapter we will analyze example and work principle of AS/RS systems by loading and preparing a pallet before transportation.

2.2.1. Algorithm for loading a pallet automatically

Unfortunately now the company loads the trucks with pallets with items, like spare parts manually. It takes a lot of time and sometimes cost employees health deterioration. Now we will analyze how the pallets can be loaded automatically in JSC “Adampolis”.

Then the order is gathered and analyzed now from (Fig 2.8.) we can see the algorithm of general automated path for the right products to be loaded on the right pallets before shipping [20]. For the loading, raising, holding, moving and transferring the pallet, there are used AS/RS systems.

The algorithm of process begins at the fist block (block 01) then the order is gathered, it is analyzed, as shown at (block 02), logistic’s management control system then assigns the item to appropriate pallet-build station. The employer may then scan a barcode on the cargo label (block 03), and computerized control system may respond to this information by giving an advice to the employer about the proper possible pallet-build (block 04) [20]. The automated machines may then place the item on the indicated pallet (block 05). Preferably, the operator then scans a barcode on a pallet (block 06). The automated control system responds by updating pallet and order status data (block 07) and giving the confirmation, that the item was added to the proper pallet (block 08). As indicated at (block 09), computer system may then determine whether the load is completely loaded on pallets. If the load is not complete, the preceding steps may be repeated again. If the load is complete, manufacturing control system may update information to so indicate (block 010). The operator may then receive eject signal (block 011) to cause manufacturing control system to update status data (block 012) and convey the loaded pallet with automated machine (block 013). Management control system checks the pallet status data to verify that the load is complete with scanning the data (block 015). After being ejected the loaded pallet may then be wrapped by a forklift (block 016). By scanning a shipping label of the pallet (block 014) manufacturing control system may update data and gives instructions to load the pallet in trailer (block 017). The process of loading the particular pallet is finished and the pallet is ready to be transported by truck (block 017) [20].

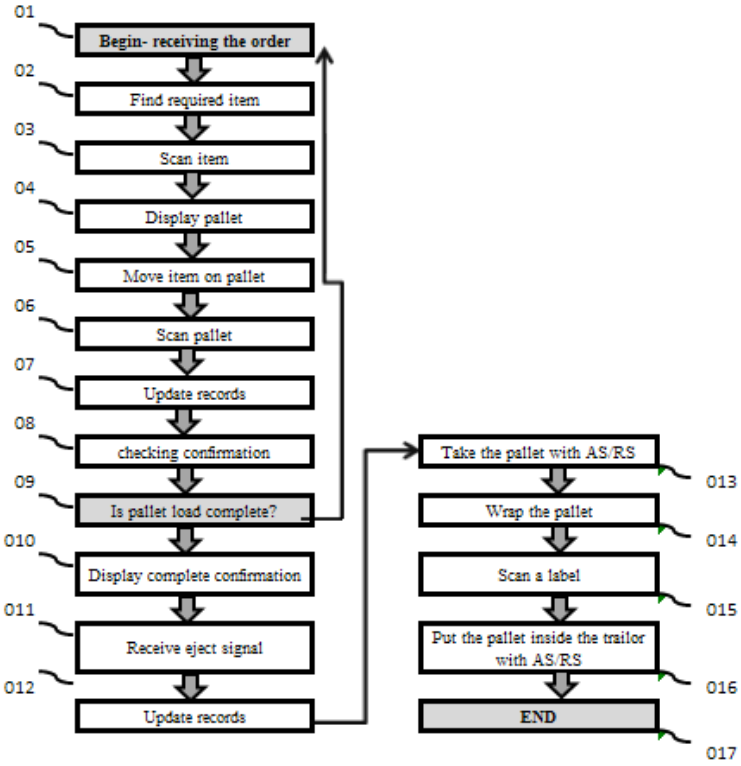

Fig. 2.8. Exemplary process for loading goods onto pallets automatically [19-20]

A typical manually operated equipment to handle pallets is able to handle an average of 15 pallets per hour, while the installed AS/RS systems are able to handle of 186 Euro standard pallets per hour [20].

In (Fig. 2.9.) we can see the example of simulation how there was replaced an empty pallet with a full one graphically by using automated storage and retrieval systems.

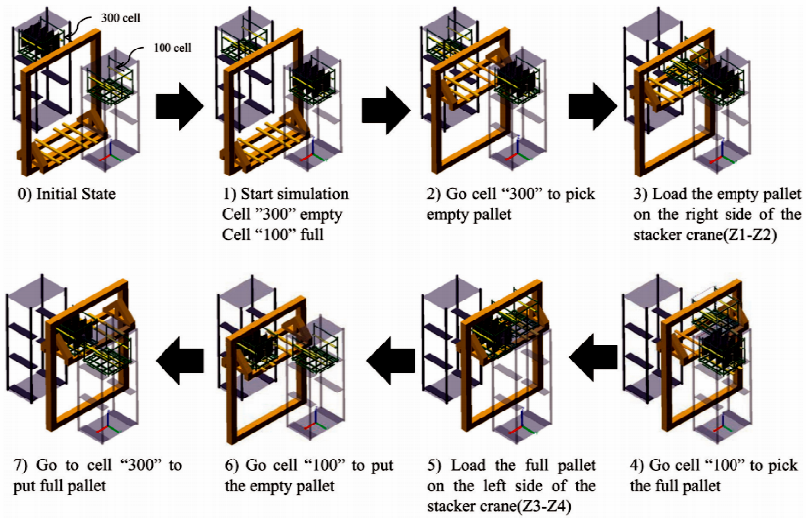

Fig. 2.9. Changes in AS/RS graphic model while replacing an empty pallet with a full one [14]

Automated storage/retrieval systems (AS/RS) capabilities at the basics include consulting, file conversion, recording of movements, planning and implementation of various loadings management. The main idea of automatically loading the pallet is to reduce manual work, to save time and to determine whether the shipment is appropriate and sufficient for the particular order to be completed and if it is so, automatically release the order and identify the free space available; if not in response to provide the necessary information about the shortage of goods [14].

2.2.2. Reliability and advantages of AS/RS

There are definite advantages of developed of AS/RS in today's Lean and JIT oriented methods in Lithuanian industry. The list of AS/RS advantages [15-20]:

- Increased accuracy and customer services;
- Inventory control and maximized space;
- Logistics efficiency;
- Reduced labour, material, equipment costs and costs for damaged goods;
- Ensured safety in warehouses;
- Space efficiency and energy savings;
- Increased speed and lowered time to handle the cargo.

Such parameters like saved space, time, efficiency, accuracy, and other benefits inherent in AS/RS machines, combined with the flexibility, made them a powerful automated tool for management of logistics in any technical enterprise. As the AS/RS is a technique, which covers various constructions of machine, electrical parameters, installation of sensors and actuators, it must compile with specified standards (which are listen in Annex 3).

2.2.3. Storage automatization - AS/RS installation in the enterprise

Storage or warehouse automatization can be achieved with integration of AS/RS system. AS/RS installation includes planning of mechanical assembly, mechanical setting of assembly line and the electrical installation of various interconnected supporting components, such as bus bars, barcode readers, various sensors, control wiring, control enclosures and various of other devices [18-21]. All appropriate installation would build an optimal storage and transportation system for efficient material handling from the shells of warehouse till the truck’s trailer inside (Fig. 2.8). We must concern not only on the automation solutions and handling equipment, but also to ensure proper transportation. In shipment of products we must analyze the size and weight of load, the type and quantity of products (materials), which will be shipped and time of required delivery.

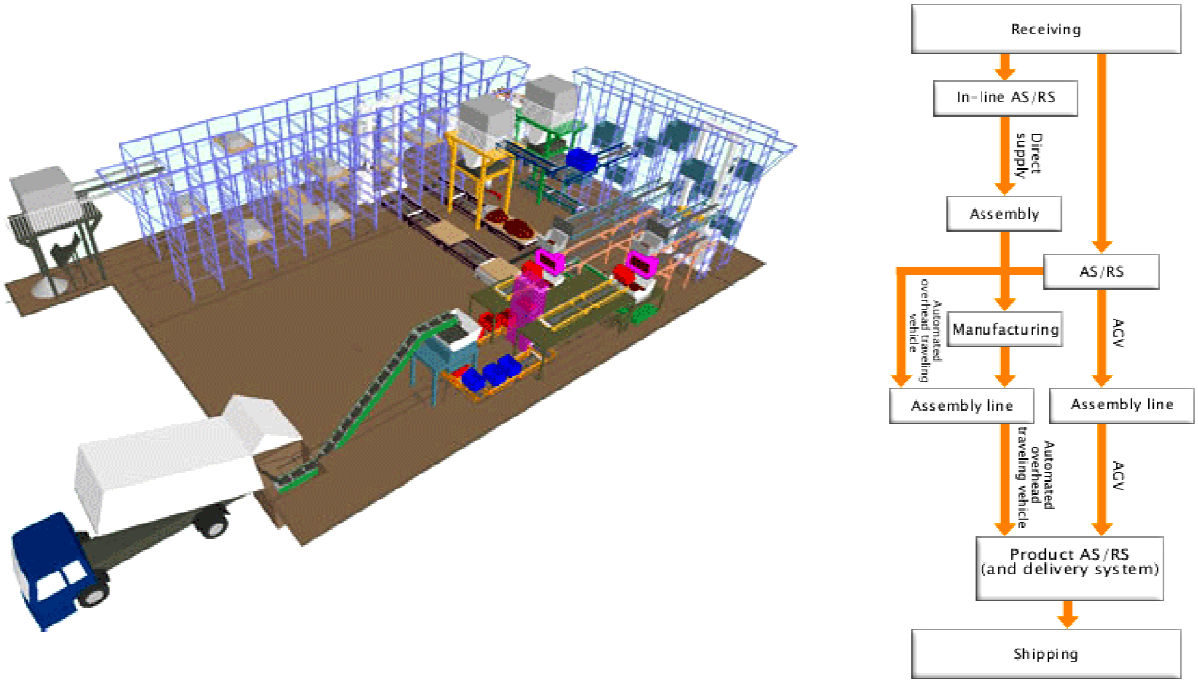

Fig. 2.8. The application of automated storage [18]

By transporting goods such considerations must be taken into account:

- System constraints (necessary equipment and devices);
- Special security regulations (standards, safety, privacy, legalization);
- Environmental impacts and restrictions;

An automated transport management is related on method for determining an optimal, cost-minimizing set of planned processes. Additionally it is a related method for tracking and controlling the delivery of products according to the optimal transportation plan to ensure the best outcomes, profit and quality. Managing network of transportation operations compromises 3 basic models:

- Planning module for planning transportation route from initial loading place till the final unloading destination at the right time and the fastest way;
- Management module to manage and execute the planned movement with driving companies or own drivers by ensuring their professional maximum hours driving and provide communication.
- Data accounting and expenditures module, for accounting payments, record accomplished transports, register necessary documents, calculating road taxes and etc.

An appropriate automated warehouse and transportation management allows organizations to fully optimize transportation operations by facilitating the modelling and management of extremely detailed order requirements and business rules and to identify the lowest-cost transportation solutions.

2.3. AUTOMATED SOLUTIONS APPLICABLE FOR TRAILERS

Automated truck loading systems (ATLS)

For automatization and management of warehouses material handling systems AS/RS there applied. For loading and unloading the trucks, the similar automated machines can be adapted, which are called automated truck loading systems (ATLS) or automatic guided vehicle (AGL).

The work principle of ATLS (Fig. 2.9.): the Loading Module (LM) is a robotized lift-truck, integrated on a special transfer platform that enables travels sideways, allowing it to transfer cargo from one dock till another. When the platform select the appropriate door, it detects the presence of a trailer and measures its free space to optimize the load pattern. The loads are brought to this loading module by an overhead feed conveyor that runs above the dock doors, keeping docks available for lift-truck and load it [27].

The advantages of ATLS:

- Increased trailer capacity;
- 2-3 times faster trailer loading/ unloading time;
- Reduced manual work and errors, eliminated product damage;
- Provider more safety environment (no forklifts needed,).

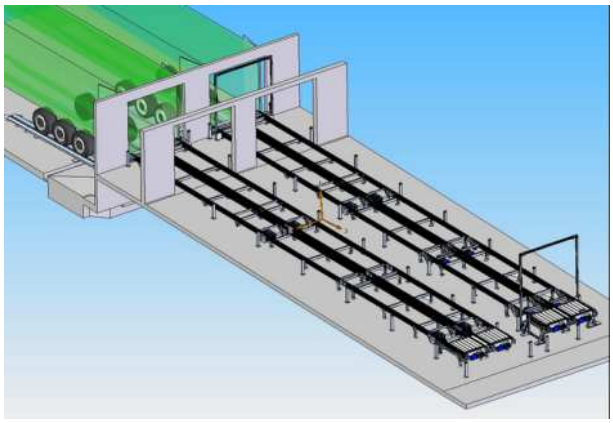

Fig. 2.9. Automated truck loading systems (ATLS) [27]

Cargo Sensor

The cargo sensor with proper tracking solution could be integrated directly to the trailer for tracking the existing loaded cargo, by providing visibility and security of it. By using ultrasonic technology, the cargo full length light sensor monitors the trailer online and can immediately send an alert if there is any change in load status, for example variation of weights and their parameters [55]. The sensor provides accurate, reliable updates and historical data about trailer's arrival and loaded

condition (loading starting-finishing). This information would be sent directly to logistic's management software and provided for managers and customers to observe near every entered transport order [56]. The tech. specifications of this sensor is given in the catalogue (in Annex 5) and the work principle is give in (Annex 6).

In the figure below (Fig. 2.10) we can see there the sensors could be installed in the truck and trailer. Various sensors could be used: for tracking the vehicle, for measuring pressure between tires, temperature and light sensors. The antennas installed in truck and trailer receives data wirelessly from sensors and trailer transceiver then transmits into the logistic's management software necessary information via the CanBus [55-57].

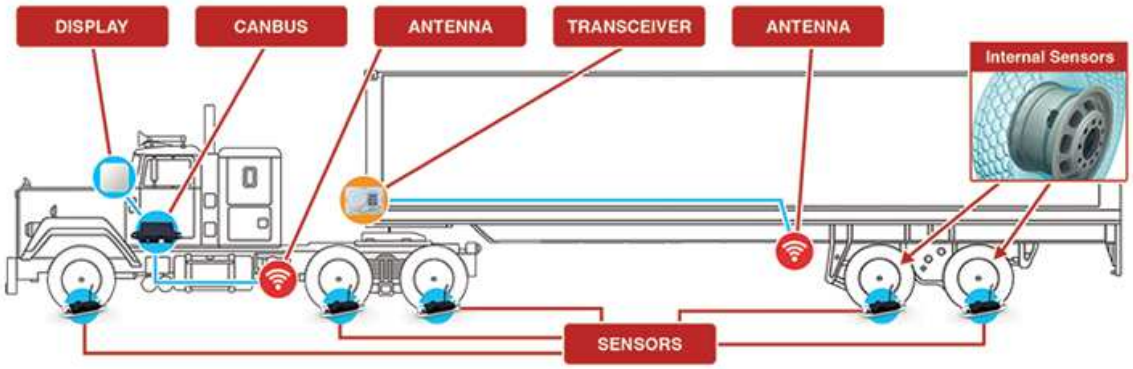

Fig. 2.10. Sensors integrated in the truck [57]

Planning of load distribution

The load planning can be accomplished by integrating the function to logistic's management software of automatically calculating the load ad it's proper distribution in trailer. The example of such features can be provided by Load Xpert Software (given in Annex 7), there all suggested load plans comply with industry best practices for cargo securement, which reduces transportation costs with cargo load planning optimization, minimize labour time and cargo damages; avoid overweight and provides the best plan for loading [57].

Calculating the weight of loaded trailer

In this way high precision pressure sensor installed in trailers, measures the loaded weight. The calculated trailer weight automatically is shown on the in-cab display and the information is sent to logistics management software. The alarm of exceeded weight is given immediately. In the figure below we can see example of such sensors overlook.

Fig. 2.11. Air-weight Scales Sensors for weight calculation [58]

The aim of the automated solutions application together with logistic's management systems installation is to immediately get necessary information, automatically calculate and prepare the ordered cargo in warehouses, to load or unload the truck as soon as possible and ensure safety in work zone by decreasing the manual work and possible human errors. The designed logistics management software, connected with storage distribution management, AS/RS and ATLS systems can enlarge the productivity in logistics sectors, reduce time and cost consumtions in any enterprise and provide accurate calculations in stockages in, as well as in JSC "Adampolis" logistics sector.

In this chapter we focused attention to the automated managing of warehousing and loading of trucks in JSC "Adampolis" and how the invented logistics management software could work in it. In the next chapter we will focus exactly on transportation management, routes planning, organization and control of driver's work in JSC "KM Logistics".

3. INTEGRATION OF LOGISTICS MANAGEMENT SOFTWARE

3.1. THE GENERAL INFORMATION ABOUT JSC "KM LOGISTICS"

The JSC "KM Logistics" is the transport carriage enterprise, which works as expeditors with clients from West Europe countries. The enterprise owns 70 mega and standard trucks (Fig. 3.1.) and rent more than 70 trucks at the same time. The company is certified by DNV on ISO 9001, ISO 14001 and Ohsas 18001 standards [Given in chapter 3.1.1.]. Every employer here is qualified and trained to work. Everyone in this company very well know and understand AETR convention, ADR treats and TIR convention [Given in chapter 3.1.2.]. The main purpose of enterprise is to ensure the quality by delivering the cargo at the right time in the right place and in such way to satisfy the client.

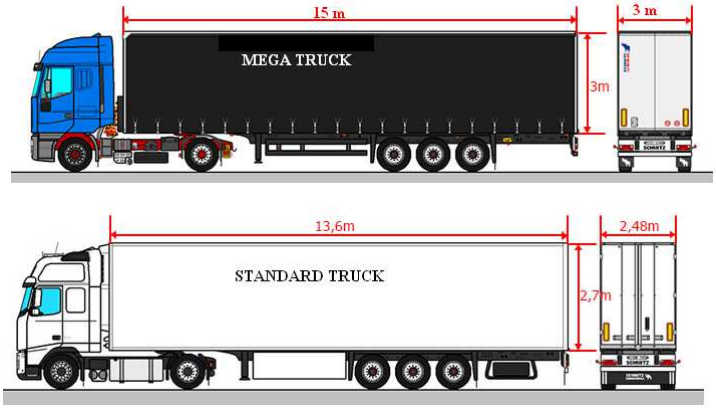

Fig. 3.1. Mega and Standard trucks, in JSC "KM Logistics" [29]

The main purpose of integration of computerized logistics management system in this enterprise is to allow seeing location of the truck and other parameters online, planning routes, constantly to keep in touch with drivers, convey to tasks planned by the customer, supervising the course of the process, finding solutions to any issues and appearing delivering problems.

The software should conduct track and trace systems, navigation system, provide 4D views of road watching online, barcode readers, necessary data bases. This system should be integrated and available in every truck, to the drivers work computer and transport manager's tabs or smart phones.

3.1.1. Certification of company JSC "KM Logistics"

The basic standards, which should be met in every professional logistics company, as like in the JSC "KM Logistics" are:

ISO 9001:2008 - sets out the requirements of a quality management system. This standard is based on a number of quality management rules including a strong customer focus, the motivation and implication of top management, the process approach and continual improvement [30].

ISO 14001:2004 - sets out the criteria for an environmental management system, which shows that organization can follow to set up an effective environmental management system [30].

Ohsas 18001 standard sets out the minimum requirements for occupational health and safety management and is a framework for an occupational health and safety management system. It can help to organize the policies, procedures and controls needed for your organization to achieve the best possible working conditions [31]. More information about standards are given in (Annex 3).

These complied standards ensures professional work environment with customers with trained working personnel; safety environment by using the largest part of Euro 5 and Euro 6 trucks; and by well knowing and managing AETR, ADR and TIR conventions provide the healthy, safety and qualified work for drivers in the road and surroundings.

3.1.2. Legislations and conventions concerning the company

To guarantee the quality not just for customers, but also to ensure good working conditions for drivers the AETR convention must be well known and controlled in the enterprise. To provide safety environment ADR regulations must be completed and by knowledge of TIR regulations we can provide successful transport from one country to another.

AETR (European agreement about international road transport) - agreement concerns the work of crews of vehicles engaged in international road transport. The agreement covers 49 contracting countries. Its provisions are aligned with the current EU legislation on driving times, breaks and rest periods [30-33].

ADR (The European Agreement concerning the International Carriage of Dangerous Goods by Road) – gives regulations and conditions, concerning transported hazardous cargo for packaging and labelling; regards the construction, equipment and operation of the vehicle carrying the goods [30-33].

TIR (International Road Transports) - establishes an international customs transit system with maximum facility for transportation of cargo (is operational at these days in 57 countries). It allows to carry out goods, mange transport operations in road transport for vehicles between customers without customs inspections at the borders without the need to deposit financial customs guarantees at each of the borders in every country as entered [33].

These regulations give the basic knowledge in logistics sector by road transport. The management and planning of logistics processes strongly depends on these regulations and legislations. However it is not enough just to have knowledge, we need to have appropriate tools, equipments, to gain availability and communication opportunity for successful management and control of transport.

3.2. THE SYSTEMS USED TO MANAGE TRANSPORTATION IN JSC "KM LOGISTICS"

The JSC "KM Logistics" as well as any other transport enterprises in Lithuania do not have any unique solo logistics management system. They just use various programs at one time, (like data base and "Google Maps") for finding the necessary addresses, driver uses different, and their own old navigation systems. The enterprise need to buy provided services and information from other enterprises like from JSC "Apsaugos cetras" or PTV "MAPadGide"; usually use telephones and emails for communication with drives or customers, and one manually rerecording data base, called "Transportas". Also, the basic information and documents, like CMRs are fulfilled manually and put into archives. When the client asks to find one or another shipment document, CMR or invoice, it is very difficult and takes a lot of time to find it.

The JSC "KM Logistics" use such main systems for logistics management at one time:

1. The usage of data registration and collection base, called "Transportas". It is similar program, as "Būtenta", which is used in JSC "Adampolis". In this program all routs are entered manually. This program holds the basic information about clients, drivers, trucks, codes of cities, driven kilometres and basic specifications. The program is used by managers, accountants and all other employees in the enterprise. The similar data registration programs, used in Lithuania are: "2it LMS", "Operatus Mobilis", "Car Manager", "Info Tran" and etc..

The main existing functions of data base "Transportas":

- Transportation contracts registration (manually);
- Rout prices registration and calculation (not accurate, only by manually entered equations);
- Not comprehensive order and trip accounting;
- Registration of users/departments and rights administration (entered manually);
- Customer database (also entered manually);
- Not flexible and versatile search and filter;
- Registration of incoming invoices;
- Not possible automatically to generate contracts with carriers and customers'
- Provision of reports (only a couple of types).

The disadvantages of this data base is that every record is made manually, so there appears a lot of human errors, mistakes and not always correct information is held. Also the old and unnecessary information is kept. In consequence, because the invoices are written from entered data, it sometimes can cost discrepancies for book keepers. The provided reports has only 4 primary types (incomes by

client, by driving company, by truck or by date), which usually can not provide necessary additional information.

2. The main program used in JSC„KM Logistics“ is bought every month from JSC „Apsagos centras“ .“Apsaugos Centras” usage – provides e-Transport real time fleet management and vehicle security service. “Apsaugos Centras” has developed this system for tracking vehicles in 2005. ETransport services concerns to improve the result - the highest reliability of service, which ensures the reliability of 24 hours/day working in Central Monitoring Panel (CSP). ETransportservice is provided through a web browser, on the eTransport service is accessible from any computer with internet connection. Management of company’s vehicle fleet helps to reduce expenditure on fleet’s control and optimize labour productivity by enabling remote monitoring and control of vehicle’s real-time position and performance parameters. “E-Transport“ provides users with tools for real-time vehicle tracking through web-based application using internet browser. Vehicle tracking includes parameters such asvehicle’s location, route, speed, fuel consumption, temperature in cargo space, operation time of hydraulic devices and other measurable parameters of vehicle performance [34]. The JSC „KM Logistics“ uses the page [www.apsaugoscentras.lt], by paying them for service every month. This webside and their provide services are enought sufficient to manage general transportation steps, but there can also be some connection losts or loading the webpage problems almost every day. The other disadvantage is that it is enought expensive and every month it together with provided webfleet messanger displays, which is clled simply „Garmin“ costs taxes of 1000-2000 Eur, depending of the trucks numbers working and connected that month.

3. „Webfleet messanger displays“ (Fig. 3.2.) are used for communication between drivers and expeditors, to watch the location of driver and to acces the newest information about roads, tech. specifications or traffic. By Webfleet with handy fleet management app on the smartphone, notepad or tablet we can view and control dispersed operation, With Webfleet we can receive an automatic notification of significant changes across the fleet. [36]. This program is integrated in all computers, phones and tablets. This is a significance program to be connected all the time for drivers, while beeing in the road. The Webfleet function was also provided and bought from „Apsaugos centras“. The logins and passwords are also given to clients for watching trucks destinatio, but this program is provided only in Lithuanian language and it is not possible to communicate or share documents with customers by it.

Fig. 3.2. Examples of displays of Webfleet messenger [36]

4. Route planning via system "Maps&Guides" online on their website: [http://www.mapandguide.com/]. PTV Map&Guide is reliable transport management software to calculate the optimal truck route. The transport management software takes into account all relevant data: truck and hazardous goods restrictions, individual vehicle profiles as well as transport costs and toll costs in the roads. Besides that, the transport manager optimises the sequence of stop points and could provide the optimal routes planning [37]. This system is available only on a awebsite online and takes taxes for it's usage – 500 Eur/month cost.

The main function and advantages of this system:

- Saving cost and mounts for roads taxes with efficient truck route planning;
- Save time by optimising the sequence of trucks location (stop) point (Fig.3.3.);
- Profit from official enought accurate maps, data and cost profiles;
- Secure competitive advantages for environment with precise CO_2 reports.
- Saving driving time by enoght accurate kilometers calculation and route planning.
- The routes and reports can be exported to excel.

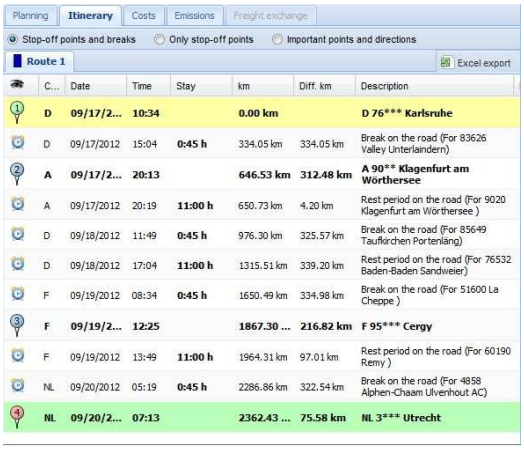

Fig. 3.3. Map&Guide route optimisation software display [37]

4. Traffic changes are available at [http://routes.tomtom.com/]. The copany also pay the monthly taxes for the access to this page. We can watch here the traffic changes, traffic jams or accidents online any time. The figure below (Fig. 3.4.) we can see the traffic jam in Spain, there red line shows the raw of vehicles standing in the street. For this acces to the webpage JSC “KM Logistics“ pay monthly ferry of 50 Eur/mont.

Fig. 3.4. Traffic jam showed online via program „Tom Tom“ online [38]

5. Documentation. Necessary and sufficient documents, such like CMRs (example is given in Annex 1) are filled manually on simple papers. This is a big disadvantage, because they easily can be lost or sometimes be unreadable. It is very difficult to archive such documentation and find the right document, then client asks for it. It takes too much time to fill them, register and manage these papers by hand and also it takes a lot of space in the enterprise to keep it in archives. Also all information about road, legislations, regulations, info about standards and other documents are held in books, papers or just published via internet. All these documents should be held in the database of logistic‘s management software, which will be desiged during this research project.

After analysis of systems, (their advantages and disadvantages) used in JSC “KM Logistics” we could now try to organize development, analyze the main necessary functions for the new Logistic’s management software, but at first we should analyze the existing other such softwares in Lithuania.

3.3. THE OVERVIEW OF EXITING TRANSPORTATION MANAGEMENT SYSTEMS

There is no such unique system in Lithuania, which would connect all necessary functions for logistics management (which are given in Chapter 3.2.) and automated warehouse control solutions (given in Chapter 2.6) in to one. However there are some similar programs used in the other developed countries like Germany, USA, Scandinavian countries and etc. Some examples are given below.

Siemens Transportation & Route Management system (Fig. 3.4)

Siemens has an offer how to manage the transportation with their cost-efficient navigation system. Siemens supports the optimization of the operational route planning process. The software automatically calculates the cheapest, fastest and most efficient route. Incoming new orders can be coped with automatically through reassignments and rerouting during delivery. The expandable and modular software can easily be adapted to customer requirements [25].

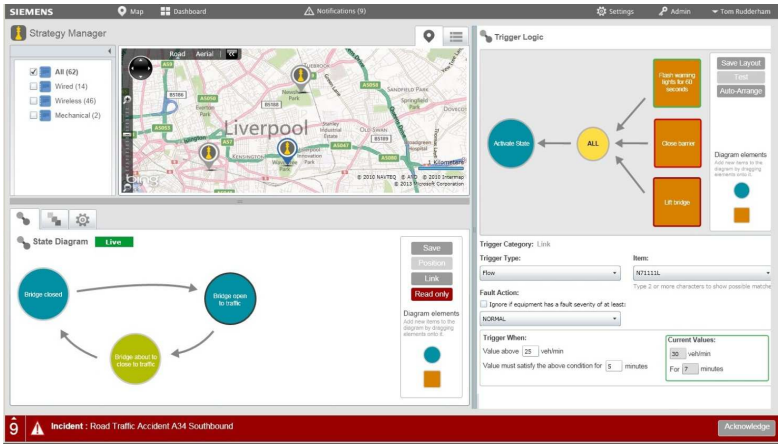

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Fig. 3.5. The Siemens installed software for management of transportation [25]

Siemens “Transportation & Route Management” combines interactive planning concepts and mobile technologies into a modular integrated planning and monitoring system. It enables customers to reach streamlined and efficient processes for planning, execution and control of all transport activities in a single system. [25]

Such softwares, like Siemens software (Fig.3.5.) presents route calculation with consideration of [38]:

- Vehicle utilization times;
- Time windows for orders;
- Regulations of driving times;
- Optimization of routes based on historical data from Web portals;

• Support of Navigation systems;

• Vehicle location via GPS and forecasted arrival times;

• Subsequent route evaluations;

• Reports to support further planning actions [38].

"Operatus mobilis" [39] - objectively assess the client's fleet of the current situation analysis to help determine the company needs to find savings opportunities and also take over the administration of the car park's accounting and administration system. This system is working only as database.

"2it LMS" transportation management system [40]. – logistics management system, which includes transport, cargo and voyage management, settlements with customers and suppliers, management of customer information. The system allows you to manage the high level of complexity of freight. Logistics systems are widely used in logistics, shipping companies as well as companies which carry large quantities of cargo.

The main functions of this software include [40]:

- Drivers management.
- Sales Management.
- Financial Management.
- Document Management.
- Staff management.
- Freight, transport, distance control.
- Reports availability.

This software works as data base and provides online information gathering and map views on their site, but this program does not allows to communicate with drivers and can not ensure the most accurate route planning.

RTA Fleet Maintenance & Management for Trucking Fleets is robust and flexible, offering inventory management and customization option for every industry. The main functions:

– vehicle/ equipment/parts/inventory management;
– work order management;
– driver reporting; fuel management;
– database support [41].

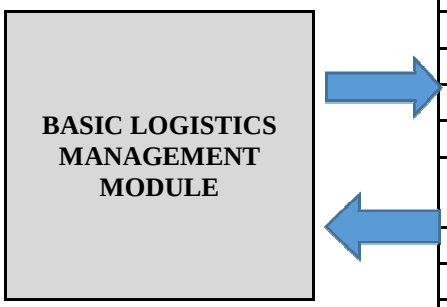
All these examples of inventory and transportation management softwares could be validate to manage some of logistics processes in Lithuanian industry, but there is one difference from all of them – that these all programs accomplish different tasks and can not ensure all steps management together. This is the aim of the designing of the new logisctic's management software, which would provide all necessary functions in one program and would ensure successful optimized logistics processes.

4. ORGANIZING THE DEVELOPMENT OF LOGISTIC'S MANAGEMENT SOFTWARE

4.1. THE MAIN FUNCTIONS FOR LOGISTIC'S MANAGEMENT SOFTWARE

In this chapter there will be analyzed the main functions ant purposes, which should be accomplished by developed logistics management software to control warehousing, transportation, routes planning, organization of drivers work and so on. The goal of this system to connect all necessary systems, database, navigations, maps, communication tools into one, which would help to optimize logistics management and reach the best outcomes, profitability and the largest customer satisfaction.

The basic module functions should include (Table 4.1.):



Available automated planning of drivers regimes schedule
Actual cost and journey cost planning
Automated orders gathering and transportation schedule planning
Routes planning
Various reports validation for transport activity analysis
Available and renewable data base and provision of information
Provision of fast communication with drivers and clients. Translation function.
Online observation of transportation and tracking of trucks.
Automated calculations of cargo with installed sensors
Automated reading and generating information from bar code readers
Other technique successful usage opportunities, like for computers, notepads, Smart Phones, Tabs
Opportunity to make and share photos of documents.

4.1. Table of the main functions for Logistic's management software

The logistic's organizing and planning software should perform various tasks and provide other various functions, like [40-42]:

- Reports preparation and printing,
- Automatic trip routes planning and preparation of route schedule,
- Complete accounting of fuel - calculation of actual fuel expenditure pro rate or by kilometres, different fuel expense reports,
- Calculation of road payments and expenditures,
- Trucks and drivers availability calendar (changing of drivers),
- Technical inspections and specifications,
- Truck repairs history, information about available services,

- Lists of accidents, dangerous weather conditions and traffic jams,
- Various reports for own vehicle accounting,
- Accounting of insurance policies and custom services; various documents, CEMT, TIR and other permits,
- History of work with permits and fuel cards (fuel card, fuel discounts),,
- Accounting of inventory in trailer or in warehouse,
- Automated input of supplier's invoices (for fuel, roads, etc.),
- Information reception from tracking systems,
- Automated loading/unloading registration, reference numbers preparation,
- Interactive and available maps,
- Direct reminder about new information registration and situation to the user, i.e. for manager, client or driver [42].

In this chapter there also will be given primary templates for the basic software's windows in the system by their developed modules, which will be used by transport managers, clients and drivers, then the program will be integrated.

4.2. DEVELOPING THE MAIN MODULES AND FUNCTIONS

The main modules selection should be shown for as like a first window on logistic's management software, see figure below (Fig.4.2.)

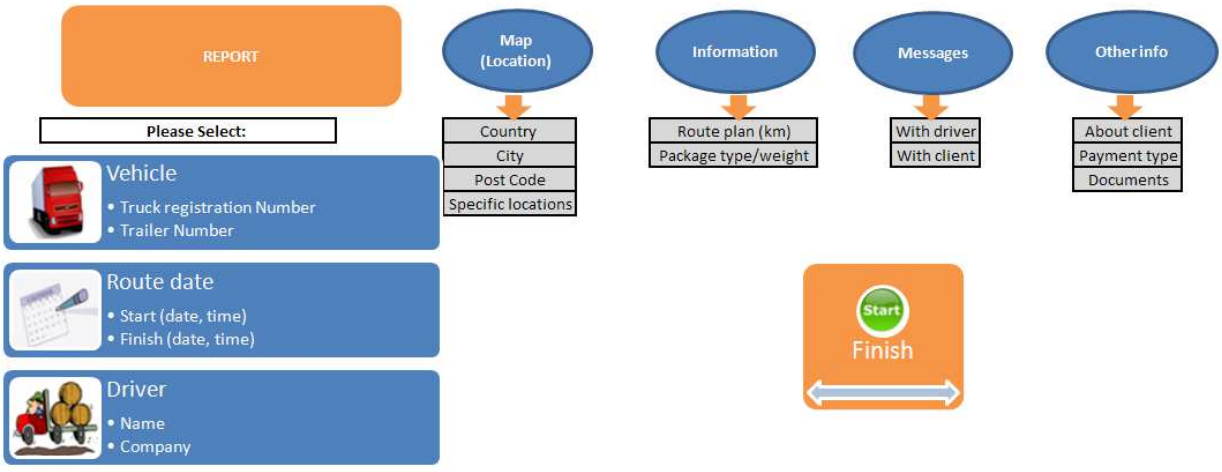


Fig.4.2. Template for the first page of the logistic's management software

In the basic window we could choose, which information is required for us. By selecting "Maps" we should receive information about desirable address – country, city, region, street or industrial zone. The main industrial enterprises, and points there were accomplished the delivery is

marked in the map and provided the online view of desirable destination. The main information about delivery must hold automated route planning, by the optimal calculation of ratio between as possible less kilometres/less expenditures for roads. Of course the other main information should hold the information about types of goods, the type of package, quantity and volume of it. By choosing the "Messages" button, we can write the message to the client or driver online, upload the file or to see the history of messages before. Now about the most important logistics management software's modules, their functions and sub functions will be given below:

Database

The database should be not only the simple program with larger memory to keep information, but it should automatically generate, manage, calculate necessary parameters and provide required reports. The main goal of this module is to gain as possible detailed on-line information as fast as possible.

The main goals:

- Accurate and controllable order gathering and fulfilment process;
- To provide time and expenditures information;
- Simple and flexible to use;
- Hold and provide sharing of necessary documents of accomplished transport (like CMR or delivery notes).
- The loaded files, like CMRs would be saved in the system automatically near every route respectively.

The shipment's registration into the system should be easily understandable and hold the main parameters, like in the template of new orders registration in the picture below (Fig. 4.3.):

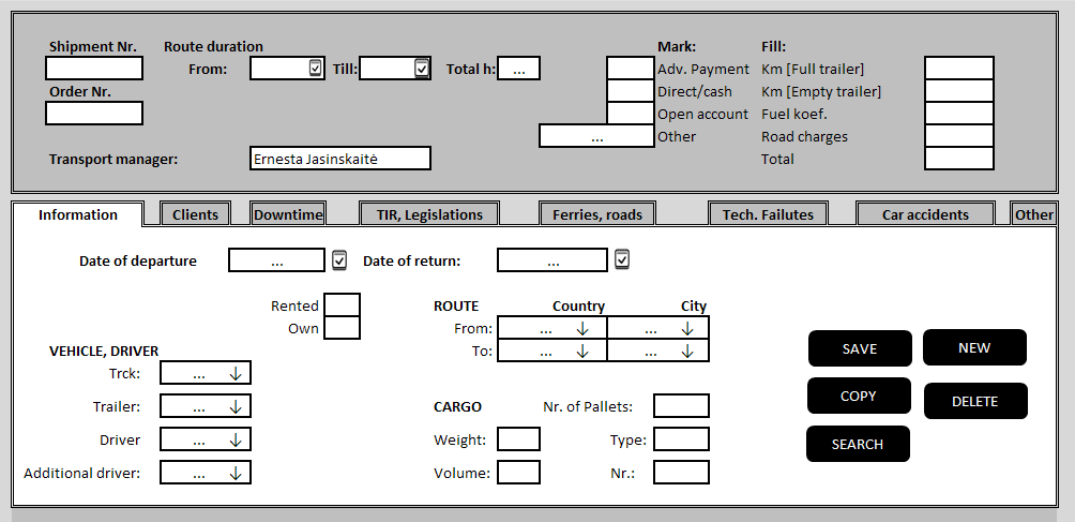
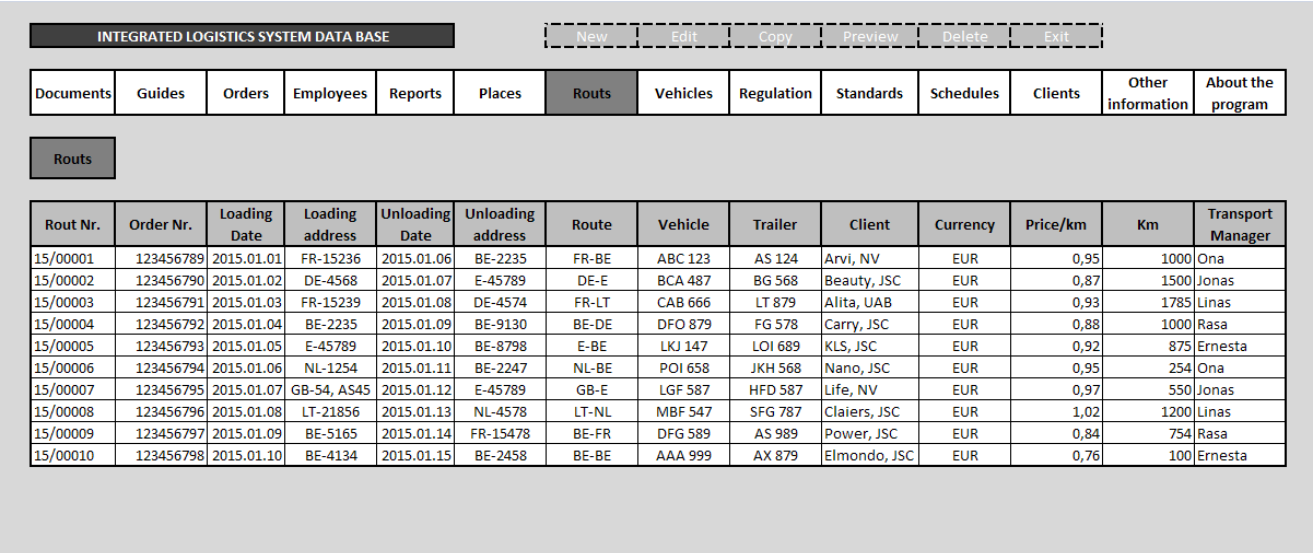


Fig.4.3. Template for the registration of new order in the data base

Functions should be:

- Easy handling (Easy to enter, edit, delete or view data by using the most advanced filters);
- Easy data access and sharing even online if needed;
- Data export/import to/from accounting or other programs - possibility to view automatically generated documents (contracts, invoices, etc.);
- Possibility to convert generated reports to PDF, JPEG, Excel and PNG formats;
- Multilingual system - system provided in Lithuania and English language completely and available to translate the basic information to other language (like for France, Germany).
- Flexible and versatile search;
- Additional order-filling options (multiple cargos, transit points registration, auto order generation);
- CMR accounting – near every accomplished delivery the CMR and other documents should be attached and available to display or send online;
- Possibility to notify customers about the status of their consignments;
- Automatically generated order management documents (tasks for driver; generated contracts with customers, shipping list for warehouse).
- One of the most important function is that customers could send the order by fulfilling the necessary window for entering the data (like Fig. 4.3) and managers would receive this info immediately with alert. The data would be saved in the program automatically (wit opportunity to be edited or deleted).



Rout Nr.	Order Nr.	Loading Date	Loading address	Unloading Date	Unloading address	Route	Vehicle	Trailer	Client	Currency	Price/km	Km	Transport Manager
15/00001	123456789	2015.01.01	FR-15236	2015.01.06	BE-2235	FR-BE	ABC 123	AS 124	Arvi, NV	EUR	0,95	1000	Ona
15/00002	123456790	2015.01.02	DE-4568	2015.01.07	E-45789	DE-E	BCA 487	BG 568	Beauty, JSC	EUR	0,87	1500	Jonas
15/00003	123456791	2015.01.03	FR-15239	2015.01.08	DE-4574	FR-LT	CAB 666	LT 879	Alita, UAB	EUR	0,93	1785	Linas
15/00004	123456792	2015.01.04	BE-2235	2015.01.09	BE-9130	BE-DE	DFO 879	FG 578	Carry, JSC	EUR	0,88	1000	Rasa
15/00005	123456793	2015.01.05	E-45789	2015.01.10	BE-8798	E-BE	LKJ 147	LOI 689	KLS, JSC	EUR	0,92	875	Ernesta
15/00006	123456794	2015.01.06	NL-1254	2015.01.11	BE-2247	NL-BE	POI 658	JKH 568	Nano, JSC	EUR	0,95	254	Ona
15/00007	123456795	2015.01.07	GB-54, AS45	2015.01.12	E-45789	GB-E	LGF 587	HFD 587	Life, NV	EUR	0,97	550	Jonas
15/00008	123456796	2015.01.08	LT-21856	2015.01.13	NL-4578	LT-NL	MBF 547	SFG 787	Claiers, JSC	EUR	1,02	1200	Linas
15/00009	123456797	2015.01.09	BE-5165	2015.01.14	FR-15478	BE-FR	DFG 589	AS 989	Power, JSC	EUR	0,84	754	Rasa
15/00010	123456798	2015.01.10	BE-4134	2015.01.15	BE-2458	BE-BE	AAA 999	AX 879	Elmondo, JSC	EUR	0,76	100	Ernesta

Fig. 4.4. The report of accomplished transports in the Data base

The aim is that accumulated data from installed equipment (like tablets or smart phones held in trucks and used by drivers) is transferred into the data base, here data are processed and stored in memory. The purpose of this module to hold and provide as needed all necessary information about transport at the right time. The basic information should be provide and viewed, as shown in the template of data base window (Fig. 4.4.).

Reports

There should be given any report associated with vehicles journey, routes, cargo types, kilometres, velocity, fuel consumption, technical specifications, about clients or their payment and so on.. any type of report, involved in logistics should be provided to view.

The basic and primary first window for reports selection should look like the template below (Fig. 4.5.):

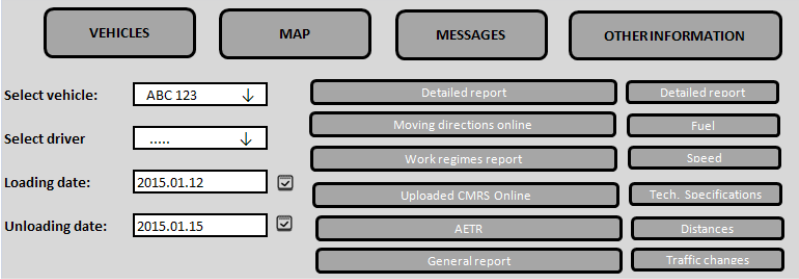


Fig. 4.5. Reports generation template

In this window we should choose the truck or trailer number, driver or just route start or end dates and see provided information by clicking on any report type, which we would like to see. After choosing the right report, we can print it, send it to customer or just save in our computer or other device as smart phone or tab.

Route planning and control [30]

The main necessary functions for routes management and planning [31-33]:

Monitor vehicle's real-time position in digital maps and obtain telemetric data reports about fuel consumption, driven distance, standstill/ driving time; also individual preferences (e.g. allow arrival and departure in restricted zones or avoid ferries/toll roads);

- Alternative routes gathering and coordination of selected routes; also customizable route closures and weightings of cargo;
- Show restrictions in height, width, length, total weight and axle load.
- Provide banned roads (such like as road signs "> 3.5 tons", restrictions of transport of hazardous goods) and observation of permanent road works, long-term road closures and the latest traffic or weather conditions.
- The prescribed driving and rest periods as well as remaining driving and shift times of drivers;

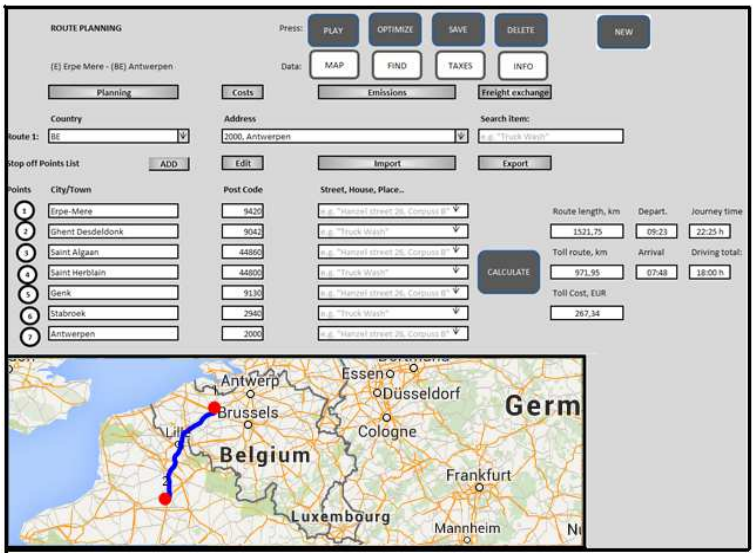


Fig. 4.6. Routes planning template

As we can see from figure above (Fig. 4.6.) the routes planning should be seen as in this window: the general points for loading or unloading (cities, post codes and countries) and the line drawn on the map of possible route. The calculations should provide not only the one route, but the most optimal one, with ration of less kilometres/with less expenditures for roads. By choosing all necessary points for trip, we can see calculations of kilometres and costs of road in those places.

Navigation system

Navigators are necessary to fully meet up-to-date requirements of logistics and transportation service providers. Navigation module should offer a faster orientation in an unknown territory enable its users to send a travel destination directly to the driver in an accurate and timely manner. The course of the route can be monitored with means to plan a route for each vehicle, optimize it with shortest kilometres and less taxes costing for roads by sending this information directly to the driver's. The course of the route should be monitored real time in computer screen and controlled or adjusted. Also the new system allows various information (like showing points of destination directly on the map) to be sent between the user and driver without taking much time. Work efficiency is increased by real time monitoring of vehicle's movement, fast and easy dispatch of travel destination, updates in travel route and other relevant information consequently, allowing one person to control bigger amount of vehicle at the same time.

The main idea of appropriate navigation system is to accurately show there is the truck for transport managers and to show the right route of travel for drivers. In figure below (Fig. 4.7.), we can see how vehicles in the west part of Europe are located and travelling. This is the basic window template, which should be shown for transport managers.

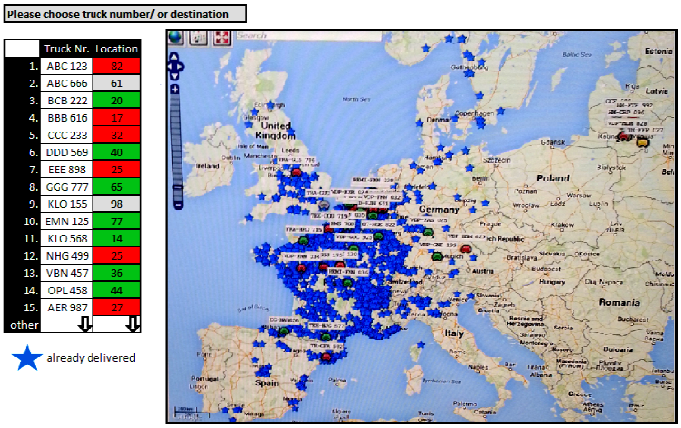


Fig. 4.7. Vehicle's destination on map template

The goal of navigation modules to prevent human errors that can cause long delays in reaching travel destination.GPS needs to be accurate, reliable and easy to use. A large touch screen display, 3D mapping and voice guidance ensure this reliability. The best function for navigation is opportunity to watch real streets views, buildings and all necessary places for loading or unloading of cargo, like in the examples of (Fig.4.8.) and (Fig. 4.9) below:

Fig. 4.8. Displayed view of one Antwerpen industrial zone by satellite provided view [31]

Fig. 4.8. Displayed view of that same Antwerpen industrial zone by showing real views [31]

As we could zoom in closer, the views of streets, buildings and local details are revealed. These abilities are provided by made photography's and usage of "Google Maps" for their preview, which by going one by another can look like online watching of the street. It is a very useful opportunity for finding difficult areas. The ability to preview these streets should be give ot only for the transport managers, but also to the drivers.

Fleet management and communication control system's functions

This module, called as Messenger should perform such functions:

- Display the track of a vehicle's trip on the map - show the points of given orders destination.
- Receive automatic notifications when vehicles enter or leave a particular geographical zone
- View the list of orders and their current state.
- Refresh information as 5 seconds.
- View all orders of a selected vehicle.
- Locate vehicles on the map (search from a list or sort by group).
- Current driver of a vehicle can be called directly on the phone.
- View the details of recent trips by vehicle, including the trip distance, duration, start and finish position.

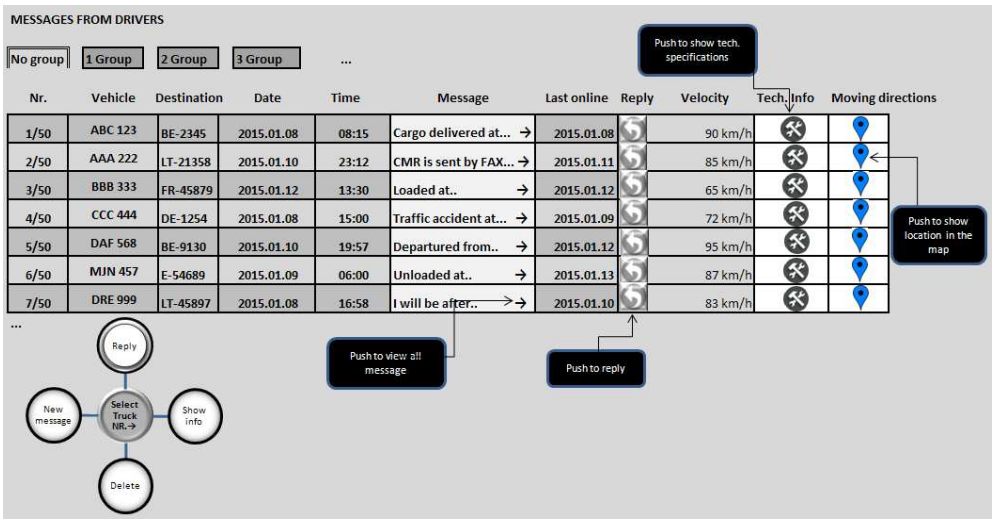


Fig. 4.9. The messenger window template on transport manager's screen

I the figure above (Fig. 4.9.) we can see how do transport manager's could see gained messages from drivers on the logistic's management software window. As we see we can also see the location and velocity of driver, it's speed and tech. information.

Driver or manager can be informed trough alarm function via SMS, Garmin or e-mail when:

- Truck crosses state border of Lithuania Republic or any other determined country.

- Truck reaches or crosses the geographical area marked; or then arrives to appointed destination.
- Truck is in use not in set working time.
- Receive alerts when an order is overdue.

In the figure below (Fig. 4.10.) we can see the display, how does the received message from transport manager or client looks should look on driver's tab or smart phone. The view of it should be easily understandable, readable and clear. In this example the driver received the message there to deliver and unloading the cargo. The map and loading destination point (marked red point) immediately appeared on his screen.

Fig. 4.10. The example how should look message received on the driver's tab

Weather and Traffic detection [40]

The ability to view real-time weather data such as hurricane or rain storms; existing traffic jams or accidents and plan vehicle's routing accordingly to it. The availability to dynamic traffic information can help to save time, fuel consumptions or even all transport.

Fuel Card Reconciliation

The fuel control is also accomplished by logistics enterprises. The fuel pouring must be controlled and fallowed. Flexible, reporting options allow to easily identify suspicious transactions or unauthorized use of fuel cards (such as AS24 cards, used in JSC "KM Logistics"). Other benefits include fuel card spending controls, fuel discounts and consumption irregularities.

Powerful Automated Reports

Flexible reporting function with a full suite of reports, ranging from simple, primary reports till very detailed ones. Run reports by vehicle, fleet, driver or team. All are generated in an easy-to-read format that can be printed, saved or set to send automatically to one or more recipients.

Electronic version of documents

It is necessary and sufficient to gain all necessary documentation from loading and unloading

places, like CMRs (CMR – example is given in Annex 1) and other leading documentation. All these documents should be clearly, brightly and understandable photographed or scanned. It is the basic and the most imported document, required in every point of transport destination.

The general information of cargo should be fulfilled as by example of filling template (in Fig. 4.11.) above. It should include shipment and order numbers, dates, addresses, information about vehicle and cargo size or type.

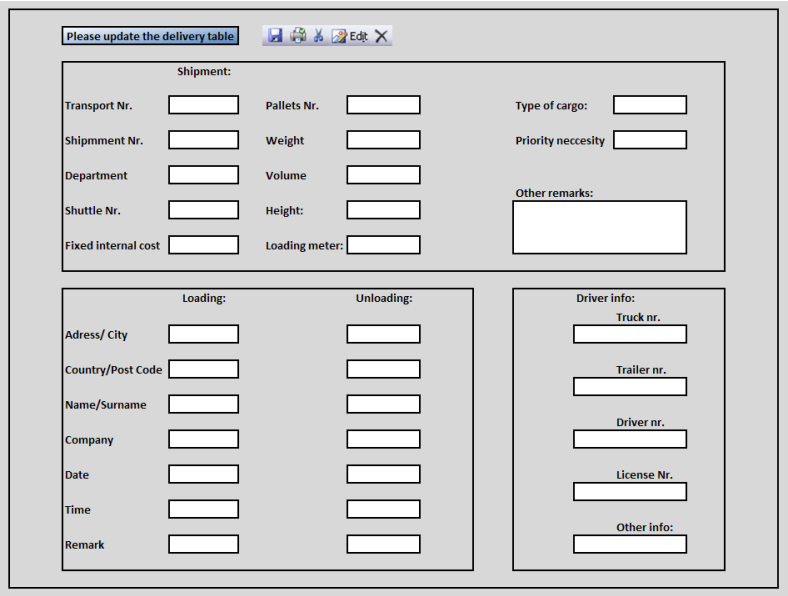


Fig. 4.11. The general information for every shipment

Barcoding. With this newly designed logistic's management software's integration the new tablets and smarth phones (Fig.4.12.) will be presented for drivers, which will be able to clearly photography, hold all necessary data and navigation systems, maps and other useful information. One of function will be integrated 2 D bar coding, for coding the cargos and automatically generate and fulfilling general information about the shipment order and cargo to the database. Built into the software Bar Coding requires additional equipment (bar code readers) and can provide both error-free input as well as less writing by the technicians [42].

Fig. 4.12.The new automated tablets with various functions [42]

The Tab Description

Tab, pc or a smart phone, integrated together with a barcode scanner, RFID reader, fingerprint sensor, Bluetooth printer, police-use BTS, etc. with superior performance can be utilized in a wide range of scenarios. They are important for: identity verification, inventory management, access control, timing & attendance [42]. The technical specifications of tablets, which could be used by drivers with this program, are shown in (Annex 2).

These modules for logistic's management software shows the main required features and goals of this program, which are necessary for logistic's management. Now it is necessary to develop the main algorithms and steps of program. These algorithms are necessary in respect to distribute the necessary data or functions in the program; there step by step we could set the necessary operations and processes in logistics management software.

5. DEVELOPING THE ALGORITHM AND THE MAIN SEQUENCE OF STEPS FOR THE PROGRAM

After overview of the main functions and displays, which should be given in the logistics management software, we can now organize the main modules. The plan that program will be completely finished, installed and integrated with the help of IT specialists in JSC “KM Logistics” till the year of 2016. For now company can use only a few available functions, like sending or receiving the files from drivers and communication with them with Garmin. For now the example, how to create the program with entering the right sequence of algorithm can be created by App inventor help online, which could be further used by smart phones or Tabs at any time. App Inventor is a blocks-based programming tool that allows starting programming and building fully functional apps for any Android and smart devices [50].

The initial window of created by the app is shown in (Fig. 5.1.)

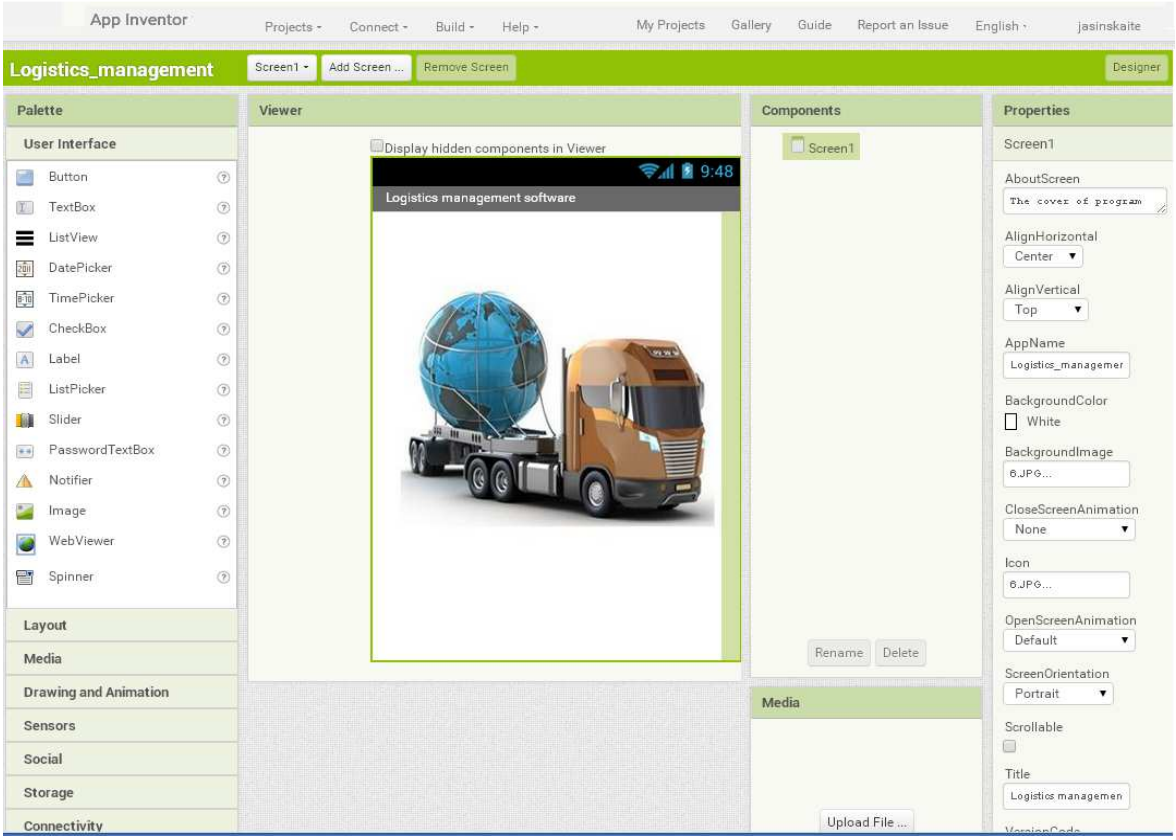


Fig. 5.1. The initial window – the creation of cover for program [50]

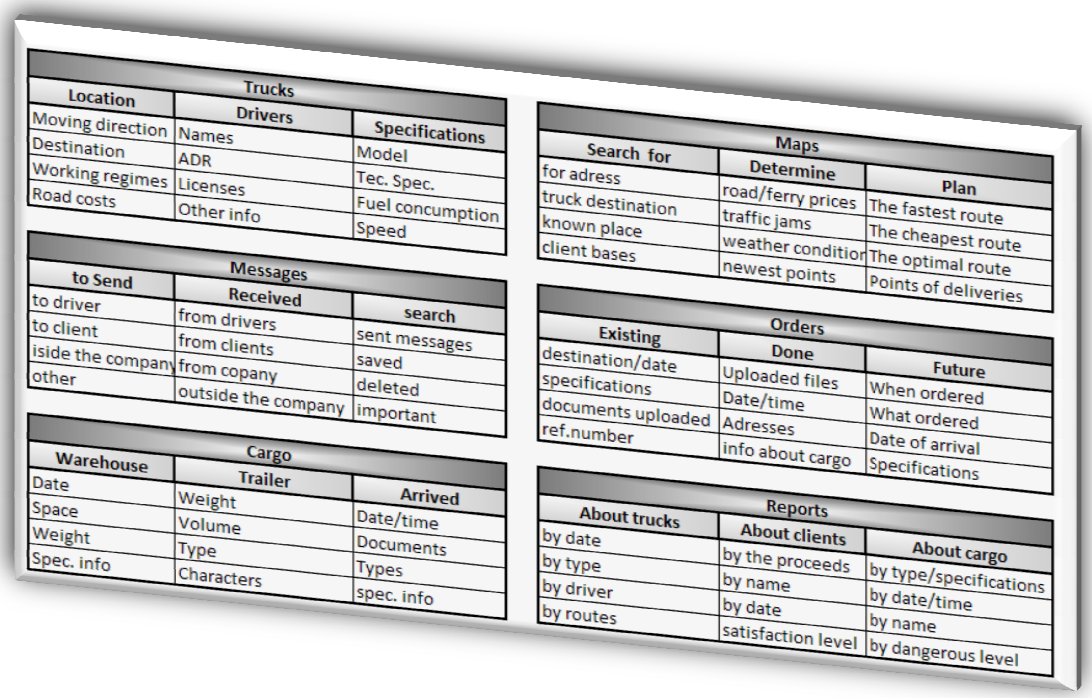
The main functions, necessary for creating the program are [50]:

– Define of variables;

– Crating of blocks;
– Create algorithm (sequences);
– List manipulation and picking;
– Determine location sensors;
– Use notifiers for displaying messages;
– Data base creation;
– Text manipulation and simulation [50].

The basic and simplified idea how to create a program, is to create blocks, sequence of them and to create algorithm with simple programmable control commands, like: “then”, “do”,”if”, “else” and etc. These all command words are installed for app creation and we just need to create algorithm, which would control them.

The algorithm is written by basic desirable research, by choosing what kind action we would like to do or what kind of information we would like to see:



Trucks		
Location	Drivers	Specifications
Moving direction	Names	Model
Destination	ADR	Tec. Spec.
Working regimes	Licenses	Fuel concumption
Road costs	Other info	Speed

Messages		
to Send	Received	search
to driver	from drivers	sent messages
to client	from clients	saved
iside the company	from copany	deleted
other	outside the company	important

Cargo		
Warehouse	Trailer	Arrived
Date	Weight	Date/time
Space	Volume	Documents
Weight	Type	Types
Spec. info	Characters	spec. info

Maps		
Search for	Determine	Plan
for adress	road/ferry prices	The fastest route
truck destination	traffic jams	The cheapest route
known place	weather condition	The optimal route
client bases	newest points	Points of deliveries

Orders		
Existing	Done	Future
destination/date	Uploaded files	When ordered
specifications	Date/time	What ordered
documents uploaded	Adresses	Date of arrival
ref.number	info about cargo	Specifications

Reports		
About trucks	About clients	About cargo
by date	by the proceeds	by type/specifications
by type	by name	by date/time
by driver	by date	by name
by routes	satisfaction level	by dangerous level

Fig. 5.2. Figure of the basic alternative variables in the program

Before creating the program, the plan of what kind information and action we want to reach must be made, these plans should be written as general algorithms for each of the main groups listed above (Fig. 5.2.). The algorithm must be created for chosen basic themes: “Trucks”, “Maps”, “Messages”, “Orders”, “Cargo”, “Reports”.

In the algorithm for first variable – “Trucks” (Shown in Annex10) we can start the program by searching the location of truck, to view it on map or search the working regimes by selected date.

We can filter the desirable information by truck or trailer number, by driver name or by region. With the written data base, we can easily view the information about truck specifications, view uploaded files, like driver licenses or documents of truck, like insurance, technical inspection or look over tachograph data. Also we can see the truck's speed at the moment, calculate the resting time till delivery or to plan the delivery for other date.

In the theme about "Maps" (Annex 8) we can see the algorithm, necessary for a program to gain information about desirable destinations. Here we can search for address, determine the road conditions or to plan the optimal route for delivery by automated calculation of road taxes and road types.

In the figure below (Fig. 5.3.) we can see the algorithm, which would let us to communicate with drivers, clients, or our collaborators inside or outside the company online. By selecting "Messages" button, we can write a new message or read the received ones, also to view or send necessary documents or information about orders.

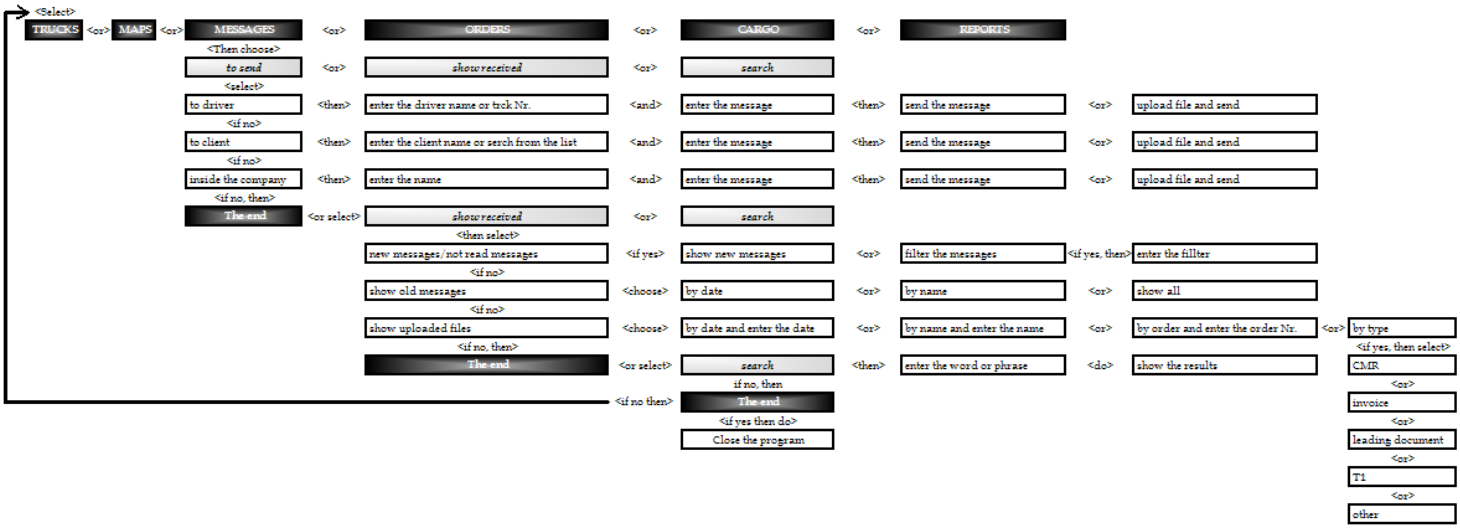


Fig. 5.3. The algorithm to provide communication

For every delivery to be fulfilled, it is necessary to have availability to view all information about orders – the cargo type and specifications, delivery dates and points of deliveries. To gather this information the algorithm about orders information preview must be developed (Annex 9). There we can choose to preview and get information about completed, existing or not started, but received orders. This sequence of steps in the program, can let us to filter the orders and to plan the best way how to accomplish them and to save the information for further preview.

In the figure below (Fig. 5.4.) we can see the algorithm to gather information about cargo. Here we can choose and get information from data base, to see automatically provided information

from trailers and warehouses or to calculate necessary parameters about left free space (for example in trailer) by entering the quantities and parameters of loaded goods.

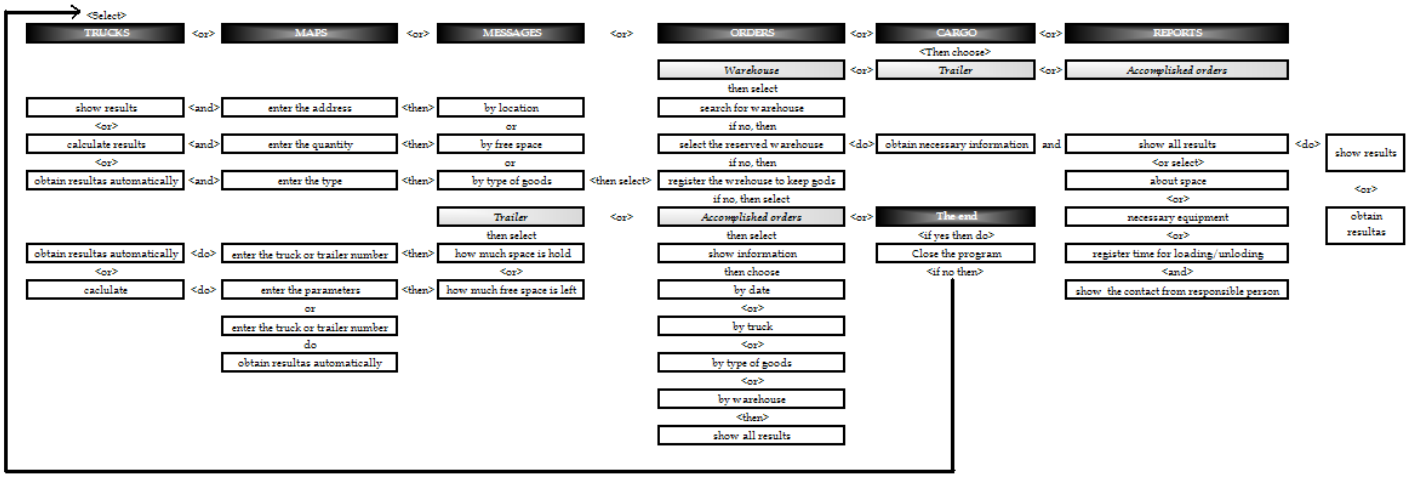


Fig. 5.4. The algorithm for to control information about cargo

After availability to get or control required information about trucks, drivers, points of deliveries, planned routes, goods and warehouses, we can now account with the algorithm for provision of reports (Fig. 5.5.). Here we can select the desirable report type by any filter and preview necessary parameters, routes, uploaded files, calculate expenditures and time losses or savings.

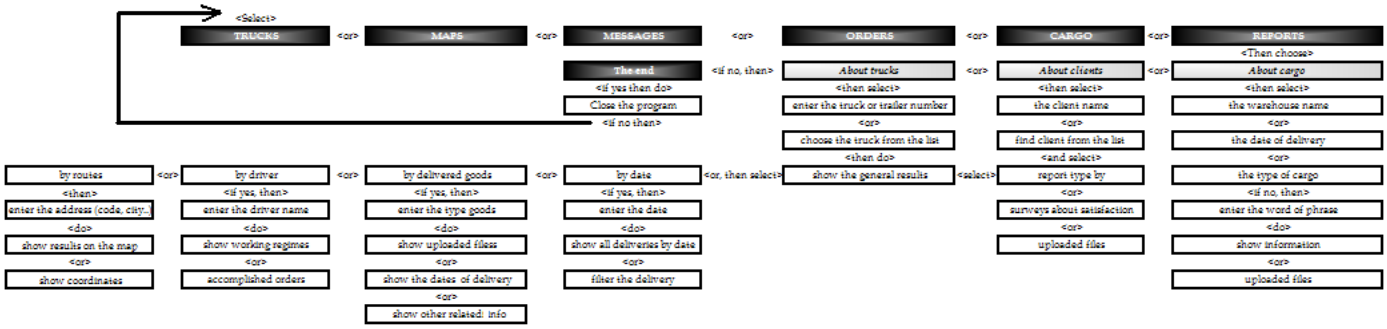


Fig. 5.5. The algorithm for reports accounting

All detailed information sources, navigation system, tracking program, automated cargo measurements, online communication and correctly arranged algorithm s together can create an unique program to provide the highest quality logistic's management and control. However, all of these algorithms must be programmed and accurately entered to ensure successful programs working.

The example how we can create the detailed algorithm, which could provide us to find the necessary address with the help of app inventor, can be showed below (Fig. 5.8.).

For this example by using list manipulation and text manipulation, also data base, notifier, location sensors and maps we can create the algorithm to find the necessary address. The list of commands (here called blocks) is provided by app inventor and we do not to enter the commands manually (Fig. 5.6.). The app inventor provide blocks to make a list, enter the text or variable name, to give command for control and proceed.

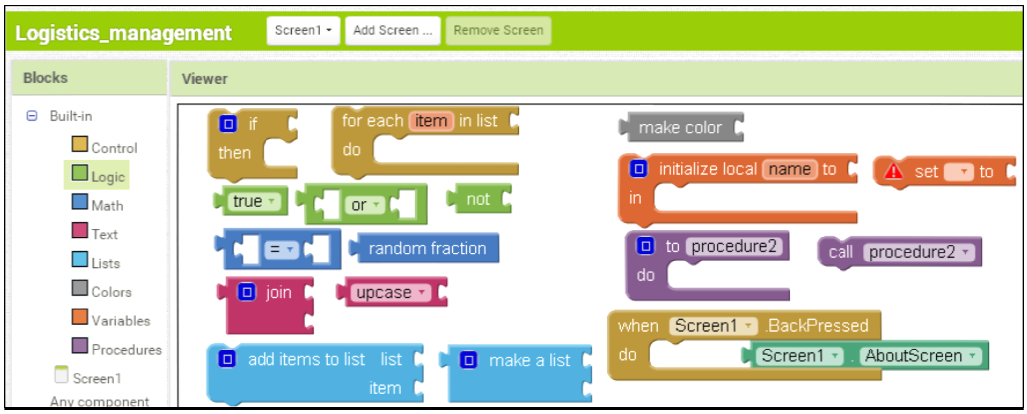


Fig. 5.6. The examples of blocks necessary to create algorithm for the program [50]

Here by the online app inventor, we can create the algorithm for necessary address research. In the procedure, we also check our database to find out if there are any stored addresses. If no data, then we just use an empty list. These written commands can create the screens (which would be provided in program and showed on tab, Smartphone or computer. By making such and similar algorithm s below (Fig. 5.7) and by giving the right commands we can gather the real views of screens received.

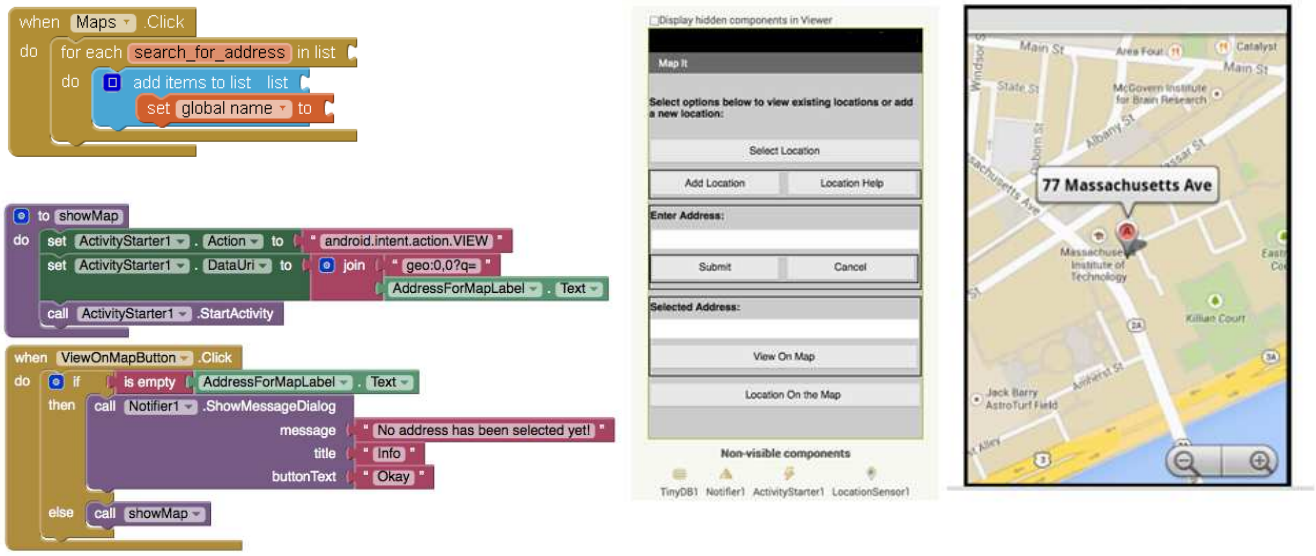


Fig. 5.7. Creating the algorithm with app inventor to find the address on the map [50]

6. THE OPTIMIZATED PROCESSES IN LOGISTICS CHAIN

6.1. PROBLEMS, OCCURRING DURING EVERY TRANSPORT AND THEIR SOLUTIONS

During every orders performance and execution of the transport various problems occur, which must be as soon as possible eliminated. This logistics management software was created due to avoid or solve these problems as soon as possible without making negative consequences. Here will be given the main 10 occurring problems in the logistics sector and given logistics management software's solutions to avoid of them.

1) The lack of information and not accurate orders gathering or understanding. The orders from clients are sent by emails or can be told by made call. In this case, we meet with simple human errors, like not accurate, listed quantity of goods, short come of information about type of cargo, or not accurate named delivery address or date. The solution is to use data base online, there the clients would upload the orders online with detailed information of transport, entered necessary reference numbers, time of arrival and could upload other necessary files, like custom documents.

2) Not accurate calculation of working, driving and rest regimes of driver. Now the rest time left for driving is told by drivers, by their shown tachograph data or calculated manually by adapting the rules of AETR. The program should calculate and show rest time for driving automatically, by reordered accurate movements of truck and by entered formulas for calculating the rest driving time for next coming week. For example, as we know, the driving time can not exceed 90 h driving per 2 weeks, but sometimes it is too complicated to calculate the rest left time for driving manually and drivers exceeds their time, which cost the penalties from police.

3) Shortage of language skills. Almost 90 % of all Lithuanian drivers, which are driving in Europe in our days does not speak English, Germany, France or other necessary language. It is very difficult for them to communicate with clients or warehouses. For example, even then the client want to tell that the driver will need to wait a little bit for loading, it becomes a very difficult situation, which at first cost dissatisfaction about driver from client point of view. Even the manager can not help to the driver in some situations then taking account language understandings. For example, in France almost no one does not speak in English and then the truck need to go for repair it is very difficult to explain the situation with some service. The solution is automated programs translation function, which could automatically translate any information about gathered order, types and quantities of goods or could just simply translate any basic words of phrases, necessary for drivers.

4) Shortage of drivers communication level or shortage of knowledge. Not all the drivers are professionals or educated persons. The managers before let them go to work as drivers in Europe in

“KM Logistics” try to instruct them and give the necessary technical knowledge (like types of how to support the cargo), but sometimes it is not enough for drivers to remember or apply the information in real work. The solution is training program for drivers available in this logistics management software, there are also located information about all rules for driving, road signs, legislations, restrictions, laws, technical specifications and provided online as needed.

5) Shortage of necessary documents. All accomplished transports are paid only then they are proofed that they are completed. The CMR and other it’s leading documents, like T1, weigh notes or delivery notes must be sent to the clients. The problem is that these documents are sometimes not clear or are unreadable (because they are written usually by driver manually) or they sometimes can be lost during multiple cargo transportation. The solution is availability by this program to make photos and upload the files online after every delivery or to send these documents from clients online, which would be fulfilled by computer help.

6) Not accurate addresses. Every day the new companies appears and new industrial zones are built in all the Europe. The older navigation systems can not find these new buildings, or to show accurate roads and points of loadings and deliveries. A lot of time is wasted for searching the addresses and planning the shortest routes for drivers. The solution is that this system would use self-regenerating GPS system and would provide online views of streets to managers and to the drivers.

7) Large expenditures for roads taxes. The largest minus of any driving company is that their drivers spend to much money to pay for taxes, because they do not know which roads are taxes and which of them is free to go (like national roads). The solution is that this logistics management software will have function, to calculate automatically expenditures for taxes and provide the best optimal routes for transportation, depending by the time of arrival. For example, if the delivery is not given on fixed time, the route for driver can be automatically calculated and chosen with a little longer distance, but free of taxes.

8) Not accurate quantities of goods. This is almost the most often occurring problem, during every transport. Sometimes not accurate type of cargo is registered, not accurate quantity is calculated or not the real weight or parameters are loaded. For this reason, one of the main functions, which will be provided with this new program, is gathering information about goods, like automatically calculated weight of loaded cargo in trailers. It is will be done by using integrated sensors in trailers, which automatically would provide us necessary technical parameters of the loading.

9) The large occurrence of human errors. Before this program development, all data was entered to the data base manually, which costs a lot of uncertainties and discrepancies. One of the main goal of this program, is to accomplish as much tasks as possible automatically as one of the example is the reordering of completed routes online to the program.

10) Customer dissatisfaction. Every business, as well as the logistics sector is focused on customer needs. Not matter what kind problems occur, the most important thing is to solve them as fast as possible and to provide the best service for customers. The largest dissatisfaction occurs, then clients do not receive necessary information at the right time (like CMRs), the driver late to the appointed places or then it takes too long time in one or another place, because of not misunderstanding between people involved or not accurate parameters of cargo. The solution of program for this problem to solve, includes all it's functions together and provide them to work efficiently.

These mentioned problems there the reason for the logistics's management software appearance and development in Lithuanian industry. By appropriate it's application and usage, the best outcomes can be gained and the highest quality service could be provided.

6.2. THE IMPROVED AND OPTIMIZED PARAMETERS IN LOGISTICS SECTOR

The main parameters, which could let to estimate the quality and worthwhile of any transportation are: saved time and expenditures, higher efficiency and profitability and ensured satisfaction level of customers. Logistics sector in any company usually hold about 5 % of total expenses, so management of this sector and it's development is very important. Transportation, for instance, is one key area where unnecessary supply chain cost can be incurred. Inaccuracies in load planning lead to longer cycle times and higher operating costs. The appropriate management of logistics can become and optimizing strategy to save the expenditures. Logistics operations are complex and the parameters are difficult to measure. Challenges include collecting error-free information from routine processes and reconciling financial entries related to logistics. The best optimization of any transport, is to load the largest possible cargo to the trailer and to find the shortest route with free of roads charges and less fuel consumptions.

The main evaluate logistics performance measures are [51]:

- Logistics cost (e.g., expenses and return on assets);
- Logistics productivity (e.g., orders shipped per hour and transport container utilization);
- Logistics quality (e.g., inventory accuracy and shipment damage occurrence, as well as determined customer's satisfaction level);
- Logistics cycle time (e.g., in-transit time and order entry time);
- Safety logistics ensuring (e. g. number of accidents, ensuring the drivers health and trucks's services);

The figure below (6.1.) shows the main categories of transportation expenditures. It holds at the basic the costs for vehicle, like service and maintenance costs and running costs, which depends

the most from fuel and taxes expenditures. The recommendations are: to minimize expenditures by optimal routes planning, by using all possible driver's time and fulfilling free space then loading the trailer, by atomizing the loading processes and increasing productivity.

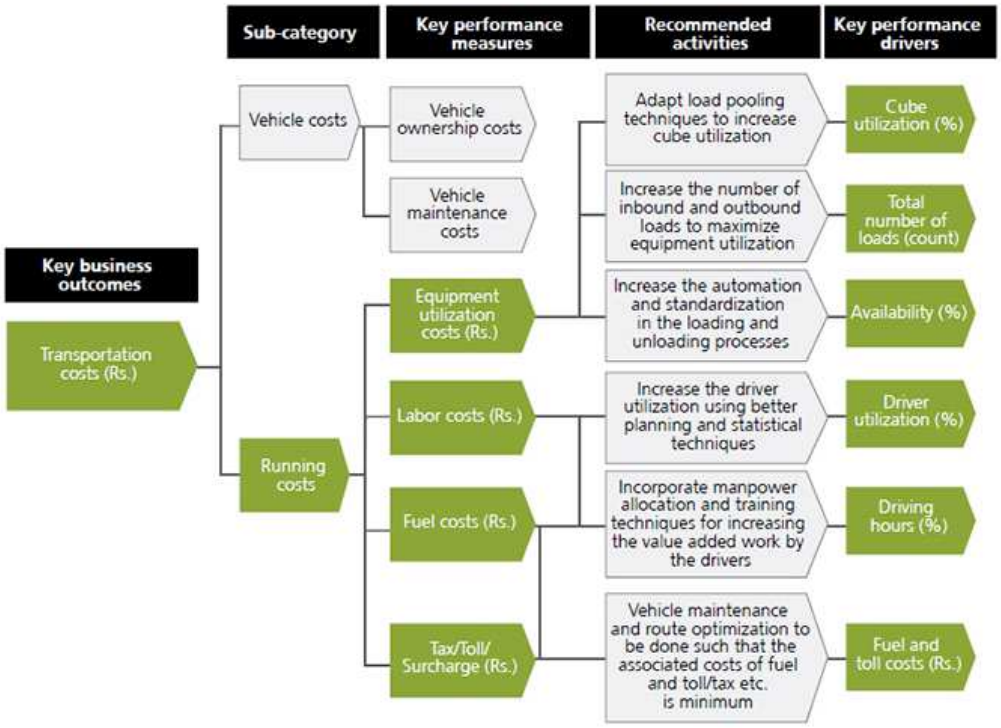


Fig. 6.1. Metrics tree for transport expenditures dependence [51]

The full logistics management software is committed by out IT specialists from JSC "KM Logistics" to be finished till the day of 2016.01.01. Till this day we are collaborating with "Apsaugos centras", which confidentially let us to use private developed functions: the drivers can send us photo online, we can trace and check the location of drivers online. We can check the jammed traffics online; by usage "Tom Tom" functions, plan the routes by calculating taxed road online and to find the accurate addresses as fast as possible. Also we can now communicate with drivers and to give ability for customers to trace the trucks, as well as we can. By the end of committed day till 2016 we will get such functions of: automated orders gathering to the data base, automated recording of every routes to data base, uploading the documents (like CMRs) near every route automatically; communication with customers by the program (not by emails); automated translation of words and phrases online; automated calculation and verifying of sent kilometres by clients' automated gathering results of loaded and unloaded trailers and so on.

The main goals of the system are to monitor, evaluate, analyze and optimize the logistics, by managing inventory and optimizing transportation. Quantitative and qualitative measures can

determined for any logistics chain. Every step in the supply chain should be seen as a service receiver (from suppliers) as well as a service provider (to users). The management of stocks and the quality of services received will affect the quality of services provided. Actual performance should be compared with the goals and objectives established for the program, which defines the level of service logistics. It is important to make this distinction when there is a requirement to improve service provided to the final user or consumer [52].

Key Performance Indicators (KPIs) can be defined as specific evaluation, used to monitor performance of the processes [52]. The examples of such evaluation can be:

- Percentage of damaged or returned goods/ by all transported goods at one month;
- Total lost of money on taxes and fuel consumption/by driven kilometres every month;
- Percentage of on time deliveries with ratio of all deliveries per month
- Percentage of saved space in trailer and ratio of fully delivered cargo/ by all transports made per month.

In "KM Logistics" we calculated and compared parameters of such indicators before a half of year ago at 2014 November month and at 2015 May month that we could compare them. We need to pay attention that a half of a year ago the enterprise did not have any of the most important listed functions, just ability to trace the trucks online.

Overview of situation of the company at 2014.10.01:

The JSC "KM Logistics" collaborated with 7 driving companies and managed 50 trucks.

The enterprise collaborated with 5 different clients.

The driven average kilometres per month for 1 truck was – 10 000 km.

The price paid for 1 driven km from clients to JSC "KM Logistics" – 0,90 Eur/ km (without VAT).

The price paid for 1 driven km from JSC "KM Logistics" to the driving company – 0,85 Eur/ km (without VAT).

The average numbers of completed routes per month (taking term of 30 days) for 1 truck:

20 completed orders/per month.

The average number of damaged/returned/or complained goods for 1 truck - 5 cases/per month.

Received average number of complaining situations from clients about delays of arrival - for 1 truck - about 10 cases/per month.

Average Time in loading/ unloading places (taking time from arrived time and registration, loading/unloading and till the documents receiving and leaving time) – 1h 45 min.

Expenditures of taxed roads per month for one truck: 1000 Eur/per month.

Average expenditures for fuel consumption by one truck (by taking average fuel consumption 33 l /for 100 km and average fuel price of 1,15 Eur for 1 l) – 3 795 Eur for 1 truck/ per month.

Total revenues earned from clients is shown below (Eq. 6.1.). Taking in account 50 numbers of trucks, their average driven kilometres per month 10000 km and average tariff of one payable km of 0, 90 Eur.

$$50 \text{ x } 10000 \text{ x } 0{,}90 = 450\,000 \text{ Eur} \qquad \text{(Eq. 6.1.)}$$

Total earnings to the JSC “KM Logistics” per month, including 50 trucks, their average driven kilometres per month and tariff of 0,05 Eur, which the enterprise keep from clients is calculated below (Eg. 6.2.). The tariff of 0,5 Eur is calculated by taking 5,5 % of gained tariff from clients of 0,90 Eur/km.

$$50 \text{ x } 10000 \text{ x } 0,\ 05 = 25\,000 \text{ Eur} \qquad \text{(Eq. 6.2.)}$$

Total earnings gained by driving companies (taking 7 driving companies together) is shown below in (Eq. 6.3.). These numbers is the sum of gained profit from 50 trucks together by deducting average price spent for taxed roads of 1000 Eur and average expenditures for fuel consumption of 3795 Eur.

$$50 \text{ x } 10000 \text{ x } 0{,}85 – 50 \text{ x } (\ 1000 + 3795) = 185\,250 \text{ Eur} \qquad \text{(Eq. 6.3.)}$$

Average profit gained by 1 driving company (Eg. 6.4.):

$$185250 \div 7 = 26\,464 \text{ Eur} \qquad \text{(Eq. 6.4.)}$$

This price depends on number of trucks. The average number of trucks, - 7 trucks for 1 driving company, so we can calculate the average profit gained by one truck per month for driving company:

$$26464 \div 7 = 3\,781 \text{ Eur} \qquad \text{(Eq. 6.4.)}$$

Now we can overview these parameters of 2015 May month with developed the main logistics processes and applied of listed functions:

The JSC “KM Logistics” is now collaborating with 9 driving companies and managed 72 trucks.

The enterprise collaborated with 9 different clients, which provides different transport directions (UK, Spain, France and other west Europe departments).

The driven average kilometres per month for 1 truck was – 12 500 km.

The price paid for 1 driven km from clients to JSC "KM Logistics" – 0,97 Eur/ km + 50 % paid of taxed roads expenditures (without VAT). The tariff increased in 6 months because of provided qualified service and larger numbers of completed orders. The tariff is average number paid by all clients. It usually range from 0,95 Eur/km till 1,00 Eur/km and the expenditures for taxed roads depends on the regions. For example trucks which are working with UK countries are paid from clients for ferries.

The price paid for 1 driven km from JSC "KM Logistics" to the driving company – 0,90 Eur/ km (without VAT) +50 % of taxed roads expenditures

The average numbers of completed routes per month (taking term of 30 days) for 1 truck:

30 completed orders/per month. This number increased because of more precise planning of orders, by completing them much faster.

The average number of damaged/returned/or complained goods for 1 truck - 2 cases/per month.

Received average number of complaining from clients about delays of arrival - for 1 truck about 3 cases/per month.

Average Time in loading/unloading places (taking time from arrived time and registration, loading/unloading and till the documents receiving and leaving time) – 35 min.

Expenditures of taxed roads per month for one truck: 800 Eur/per month (for average driven 12500 km).

Average expenditures for fuel consumption by one truck (by taking average fuel consumption 30 l /for 100 km and average fuel price of 1,15 Eur for 1 l) – 4313 Eur for 1 truck/per month. These numbers are calculated, by taking account driven kilometres of 12500 km per month and fuel consumption of 30 l because of the usage of Euro 5 standard trucks.

We can calculate (In Eq. 6.5.) the sum of earned money from clients by taking 72 trucks together, average nr. Of driven kilometres and payable amount of 50 % of roads expenditures:

$$72 \text{ x } 12500 \text{ x } 0{,}97+(800/2) = 873400 \text{ Eur} \qquad \text{(Eq. 6.5.)}$$

Earning for JSC "KM Logistics" is calculated in (Eq. 6.6.), by multiplying the number of 72 managed trucks, their driven kilometres and the tariff for 1 km.

$$72 \text{ x } 12500 \text{ x } 0{,}07 = 63000 \text{ Eur} \qquad \text{(Eq. 6.6.)}$$

Total profit for 1 driving company with average number of 8 trucks for 1 of all 9 driving companies (Eq. 6.7). These numbers does not include the expenditures for drivers wages and spent money for services and repairs of trucks or rent price for 1 trailer per month. This number includes total amount paid buy clients with deducting the amount kept by expeditors, spent money for fuel and 50 % of roads expenditures.

$$(873400 - 63000 - 72 \times (4313 + 800*0{,}5)) / 9 = 52340 \text{ Eur} \qquad \text{(Eq. 6.7.)}$$

The average profit gained by one truck per month for driving company is calculated below (Eq. 6.8.), by dividing from the average number of 8 trucks, belonging to each of driving companies.

$$52340 \div 8 = 6542 \text{ Eur} \qquad \text{(Eq. 6.8.)}$$

By comparing gained results (Fig. 6.2.) We can now make such conclusions: the larger earnings for the JSC “KM Logistics” and driving company depends on larger driver kilometres, larger number of completed orders, and larger number of trucks as well as reduced expenditures for taxed roads and fuel. We can see that profit gained by one truck increased by 73 %, because he driven 25 % more kilometres. By automated loading/unloading of trailer it saves 3 times more time in the points of destinations. Because of ability to calculate taxed roads ant to plan optimal route, the expenditures for roads decreased by 20 %. By providing qualified performance of orders, less delays and secured cargo the tariff for driven kilometres there also increased.

Parameter	Period		Improvement, %
	2014, November	2015, May	
Average driven km, per month	10 000 km	12 500 km	25%
Nr. of customers	5	9	80%
Nr. of driving companies	7	9	29%
Number of trucks	50	72	44%
Average Nr. of completed orders for 1 truck	20	30	50%
Average Nr. of delays for 1 truck	10 cases/per month	2 cases/per month	80%
Average number of complaintsfor 1 truck	5 cases/per month	3 cases/per month	40%
Average Time in loading/ unloading places	1h 45 min	35 min	33%
Tarrif of 1 km, Eur	0,90 Eur/km	0, 97 Eur/km + 50% of taxed roads expenditures	10%
Expenditures of taxed roads for 1 truck	1000 Eur/per month	800 Eur/per month	20%
Average expenditures for fuel consumption	3795 Eur for 1 truck/ per month	4313 Eur for 1 truck/ per month*	15%
Pofit gained by "KM Logistics"	25 000 Eur	63 000 Eur	152%
Pofit gained by driving company	26 464 Eur / per month	52 340 Eur/ per month	98%
Profit gained by one truck	3 781 Eur/ per month	6 542 Eur/per month	73%

* taking account that driven kilometres are 25 % larger

Fig. 6.2. Improved parameters in logistics sector by 6 months period

The main parameter, which could show us the results of accomplished transport quality is - satisfaction rate of customers. It can be accomplished by monthly made surveys of customers about:

- Satisfaction of accomplished logistics services. etc. such parameters like time and completed number of orders.
- Determination of services with the greatest importance;
- Determine customers needs of the future;
- To find out the customers opinion about managers/drivers communication skills;
- To ask evaluate the logistics service in 10 points system with various questionnaire.

The surveys should be repeated by a concrete period of time (for example every month), and the customers opinion should be compared after every survey.

One more important parameter: lead time is the time between gathering an order till delivery it to the final destination. Delivery too early or too late may incur unnecessary costs from additional warehousing or additional transport required.

In the enterprise JSC "KM Logistics" we observed the rate of satisfaction level of our the largest customer (there are our 15 trucks are working with at this day) by every month we gave for him questions about services fulfilment, and asked to evaluate these questions in 10 points system. In the figure below (Fig. 6.2.) we can see, how the satisfaction level changed in 5 month period.

Customers Surwey, 2015								
Nr.	Questions	Month, 2015						
		January	February	March	April	May	Total	%
1.	Are You Satisfies about delivery times?	6	7	8	9	9	39	78%
2.	Are You satisfies about planning the routes?	7	7	9	9	9	41	82%
3.	Are You satisfied with logistics manager work?	8	8	9	9	10	44	88%
4.	Are You satisfied about divers work?	6	7	7	8	8	36	72%
5.	Do You have ability to tracking the vehicle?	1	1	1	7	8	18	36%
6.	Are You satsifed about provided information?	4	5	5	8	8	30	60%
7.	Is the information provided for You at the right time?	7	7	7	8	8	37	74%
8.	Are You satsifed about the tools provided for communication?	3	3	3	7	7	23	46%
9.	Please rate the accuracy of our document processing and invoicing	5	5	5	7	8	30	60%
10.	Would You like to get more trucks from our side?	7	7	8	9	10	41	82%
11.	Do You think, that we are enough flexible to solve variuos problems?	5	5	6	8	8	32	64%
12.	Are we compliance with You instructions?	7	7	7	8	9	38	76%
13.	Please rate the overall level of service provided from our company	7	7	7	8	8	37	74%
	Total	73	76	82	105	110	446	69%
	%	56%	58%	63%	80%	84%	69%	

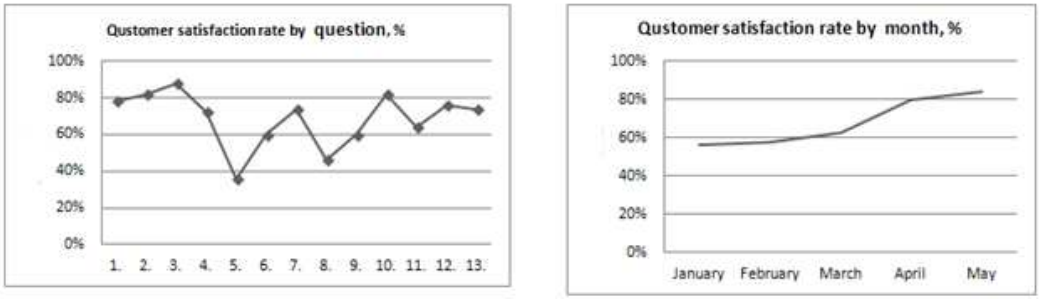


Fig. 6.2. Customer satisfaction rate by months and by improvement spheres

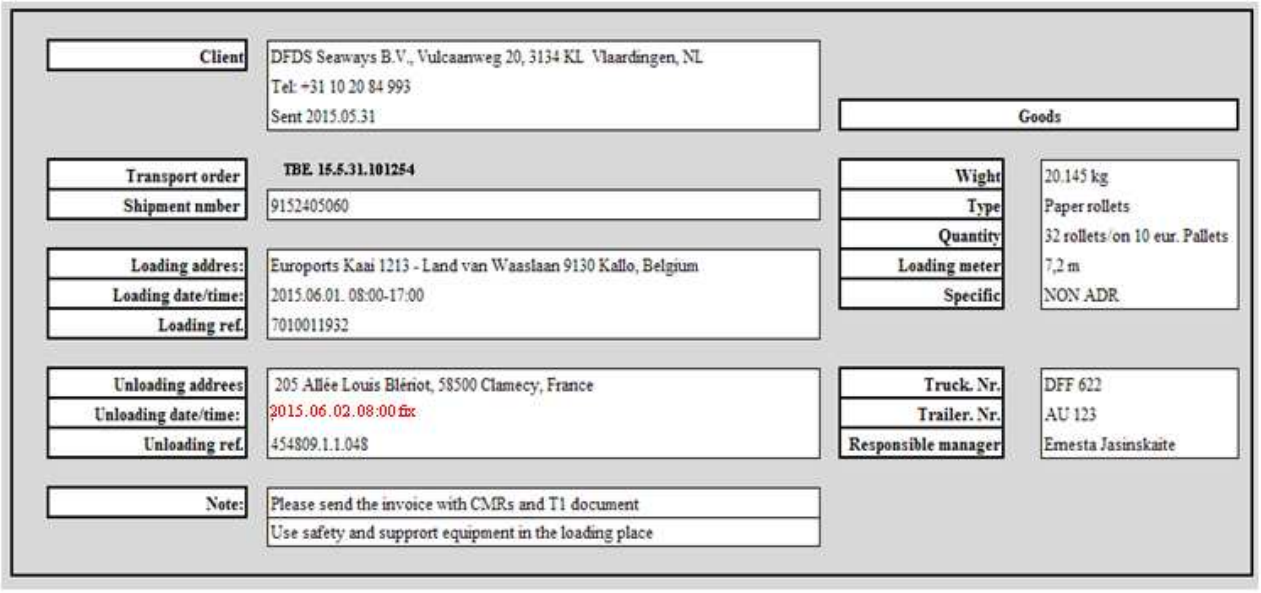
From the figure above (Fig. 6.2.) we can see that customer satisfaction level is growing every month, by adding necessary functions for logistics management, like:

Like at March by applied the function of calculating drivers time regimes automatically, the customer satisfaction level started to increase. At April we applied the function for tracking the vehicles for customer online, the graph shows the incensement of qualitative service in respect to this function.

All aspect and overall level of provided services increasing every month, by adding necessary functions, because of proper management and development of processes. However the general satisfaction level is now hold only 69 %, which means that we still have room for improvement. With fully integrated logistics management software with all necessary functions we can forecast that customers quality service could increase till 90 % and more.

Now we can compare the logistics processes in manual way and the one with fully developed logistics management software by taking a simple usual transport order.

For example we receive such order, which is shown below (Fig. 6.3.).



Client	DFDS Seaways B.V., Vulcaanweg 20, 3134 KL Vlaardingen, NL Tel: +31 10 20 84 993 Sent 2015.05.31			
		Goods		
Transport order	TBE. 15.5.31.101254	Wight	20.145 kg	
Shipment number	9152405060	Type	Paper rollets	
		Quantity	32 rollets/on 10 eur. Pallets	
Loading addres:	Euroports Kaai 1213 - Land van Waaslaan 9130 Kallo, Belgium	Loading meter	7,2 m	
Loading date/time:	2015.06.01. 08:00-17:00	Specific	NON ADR	
Loading ref.	7010011932			
Unloading addrees	205 Allée Louis Blériot, 58500 Clamecy, France	Truck. Nr.	DFF 622	
Unloading date/time:	2015.06.02.08:00 fix	Trailer. Nr.	AU 123	
Unloading ref.	454809.1.1.048	Responsible manager	Emesta Jasinskaite	
Note:	Please send the invoice with CMRs and T1 document Use safety and supprort equipment in the loading place			

Fig 6.3. The example of received order

We need to take an empty trailer from client, which is located in NL-3134 KL Vlaardingen, and to go for load to 9130 Kallo, Belgium at 15.06.01 between their working hours from 08:00-17:00 and bring it to the point of destination to 58500 Clamecy, France on fixed time at 2015.06.02 08:00. We will load 32 paper rolls of the weight 20145 kg. Such cargo is one of the most dangerous to take care, because paper can be damaged very easily by not appropriate support.

From the client located in NL-3134 KL Vlaardingen till Euroports, Kallo we have 100,34 km – it is about 1 h 30 min driving time. From this loading place till unloading place in FR-58500 Clamecy, we have more 555 km (about 8 h driving). We have all over: 655, 34 km – about 9 h 34 min driving. The average time for loading/unloading manually takes about 1 h 45 min, so we have 3, 5 h for both actions - loading and unloading. The driver max working time per day is 15 h. After every 4,5 h driving he need to make 45 min break, the maximum time of driving is 10 h per day (only two times per week). We can state that the driver started driving at 06.01 from 08:00 and he was in the clients's parking in NL.. In manually way, this order will take such consumptions:

- 1 h for communication with manager and client – getting details about the order by phone or email;

- 30 min, for finding the coordinates of loading place;

- 20 min, for explaining the route to the driver about loading details and sending coordinates my phone;

- 1 h 30 min to take the empty trailer from client (hanging the trailer, checking the existing equipment and necessary supporting tools in trailer);

- 1 h 30 min driving from client till be loading place in Belgium;

- 1 h 45 min for loading (includes registration, loading, supporting, receiving documents);

- 15 min communication with driver about loaded cargo, and sending the confirmation of finished loading to the customer;

- 10 min for searching the unloading address's coordinates for the driver.

There will be spent about 7 h time from the gathered order at 08:00 and the driver would start driving to the unloading place from 15:00.

- We have 555, 34 km till the unloading place (about 8 h driving) + 45 min pause. The total day's working time (of 15 h working) will finish as 23:00, the driver still can drive 8h 30 min max time this day. He won't reach the unloading place because at 16:00-18:0 the traffic is very jammed at Paris and he would stuck in Paris for about 2 h.

- His time will be finished at 23:00 and there will be left for him about 100 km (1h 25 min) driving till the unloading place.

- The driver can make the shortened rest time of minimum 9 h rest and start driving again at 08:00.

- We will be late to the unloading place at least about 1h 25 min, if he will find the correct address at the first time.

- The unloading will take about 1h 30 min.

- At 11:00 the manager will call to the client to tell about completed route. Of course the client will be dissatisfied about delay.

- For the expenditures of roads there will be spent 100 Eur by going on the direct way by Paris.

- The driven kilometres will be calculated by the client, and manually entered by the manager to the data base. In this case the kilometres will be 655 km. With the tariff of 0,90 Eur/km the expeditors will be paid by 589, 50 Eur. For the driving company they will pay (by tariff of 0,85 Eur) – 556,75 Eur. The fuel expenditures will take about 220 Eur. The driving company would earn only 236, 75 Eur for this completed order (Eq. 6.9.):

$$655 \text{ x } 0,85 – 220 – 100 = 236, 75 \text{ Eur} \qquad \text{(Eq. 6.9)}$$

The invoice is paid only then CMR is sent together with an invoice after 30 days term from sending it to the client.

By using automated solutions and logistic's management software we would save time for communication with clients and driver; in loading and unloading places; we would save on roads expenditures and would plan a driver's working regime in more professionally way.

In respect to automated gathering of order and writing it to the data base, it will be seen by manager and driver at that same time. The manager just need to confirm the order by sending only one word "Yes" to the client.

As we will calculate that we have max time for that day of driving left (10 h) and that we can make 9 h rest, we know that we need to arrive to the unloading place till 23:00, that after 9 h time of rest at night, at 08:00 to be started to unload.

We will save the time for taking trailer from client, because info about it's holding equipment will be written automatically in the data base.

By starting driving from 08:00 we can see how this order will be fulfilled:

- 3 min for order to be automatically recorded in the data base and confirmed.

- The trailer will be taken from client by 30 min.

- 5 min for finding the right address, this is because the system automatically by gathered the order started to search for addresses and their coordinates are shown to the drivers automatically.

- 1 h 30 min driving from client till be loading place in Belgium;

- the loading will take about 30 min, because the requested of loading will be sent to the loading place and the truck will be registered to load at 10:00. Automatically loading the trailer will take 25 min. The information about loaded cargo weight will appear in the data base, which will confirm to the client about completed loading.

- 10:40 the driver will start immediately driving to the unloading place to France.

- The logistics management software will automatically provide the alternative routes till the unloading place. By checking the traffic conditions, taxed routes and distance, the manager will choose a longer distance (Fig. 6.4.), which is market by “2” solution. We will go not by Paris, but by F-51390 Rosnay. It will take 596 km , but we will avoid of jammed traffics and will save on expenditures of taxed roads (it will cost 15 Eur).

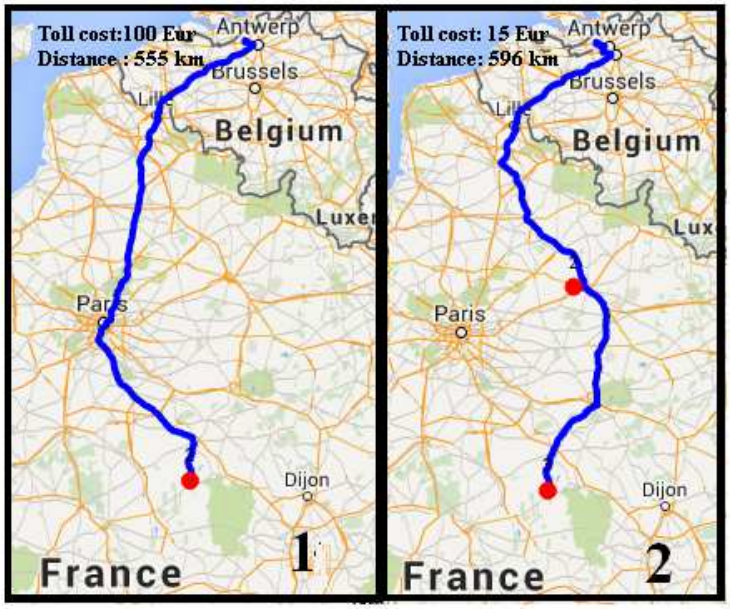


Fig. 6. 4. The alternative routes provided

The driving time will take 8h 40 min + 45 min pause. As the driver will start going from 10:40 from the loading place in Kallo. He will be in the unloading place till 22:05. He will make 9 h of rest and 07:05 will be ready for unload. As the unloading in automatically will take about 35 min, the light sensor will capture information about empty trailer, and the information will be transmitted automatically to the data base. The client and manager will get an automatically send message about delivered cargo. The driver will make photo and will upload the received documents online, which will be able to see by the client and manager. The client will be satisfied by completed order and will pay 0,97 Eur + 50 % of taxed roads tarrif for 1 driven km.

As the client calculates and pay kilometres by calculating the shortest distance, he will pay amount of:

$$655 \text{ x } 0,97 = 635,35 \text{ Eur} \qquad \text{(Eq. 6.10)}$$

The driving company from this completed order will earn (Eq. 6.11):

$$655 \text{ x } 0,90 - 15 \text{ x } 0,50 - 237,25 = 344,75 \text{ Eur} \qquad \text{(Eq. 6.11)}$$

In the formula above we take 655 driven kilometres with tariff of 0,90 Eur for each driven km and deduct the expenditures of taxed roads of 7,5 Eur and fuel consumption for driven total 596 km (by calculating fuel consumption of 30 l/100 km with the price of fuel – 1,15 Eur).

By comparing the gathered parameters in manually and usually planning the logistics processes we find out that, the JSC ”KM Logistics” would earn – 32, 75 Eur and the driving company would earn 236, 75 Eur, but it will cost the delay of 1 h 30 min and dissatisfaction of customer. By managing the logistics processes automatically with usage of generated functions, the order would be filled completely and at the right time and place. The JSC “KM Logistics” would earn 45,85 Eur, and the driving company with lower expenses for taxed roads would earn 344, 75 Eur. These calculations are just general examples, how the developed necessary functions for logistics could optimize the logistics processes and would gain the larger profit for expeditors and for the driving companies.

The main aim of this work was to optimize and develop the logistics processes. The main occurring problems there evaluated and decisions to solve or to avoid them there prepared by developing the main functions for the program:

1) The lack of information and not accurate orders gathering or understanding. The solution is to use data base online, there the clients would upload the orders online with detailed information of transport, entered necessary reference numbers, time of arrival and could upload other necessary files, like custom documents for viewing them online.

2) Not accurate calculation of working, driving and rest regimes of driver. The program calculate and show rest time for driving automatically, by reordered accurate movements of truck and by entered formulas for calculating the rest driving time for next coming week.

3) Shortage of language skills. The solution is automated programs translation function, which could automatically translate any information about gathered order, types and quantities of goods or could just simply translate any basic words of phrases, necessary for drivers.

4) Shortage of drivers communication level or shortage of knowledge. The solution is training program for drivers available in this logistics management software

5) Shortage of necessary documents. Solution: function of making photo and uploading the file online.

6) Not accurate addresses. The solution is that this system would use self-regenerating GPS system and would provide online views of streets to managers and to the drivers.

7) Large expenditures for roads taxes. Solution: automatically calculated expenditures for taxes and provide the best optimal routes for transportation.

8) Not accurate quantities of goods loaded. Solution: with the sensors help, automatically calculated technical parameters of the loading state are sent to the data base automatically.

9) Occurrence of human errors. Solution: recording of completed routes online to the program. Automatically loading the trailers in the loading/unloading places.

10) Low satisfaction level. Solution: provide the best service for customers by solving various problems immediately and ensuring the delivery on the right time at the right place.

6.3. VISON, GOALS AND FORECASTS OF THE FUTURE ABOUT LOGISTICS MANAGEMENT DEVELOPMENT IN LITHUANIA

The main objectives of this chapter:

1. To prepare and analyze SWOT analysis for the development of logistics sector in Lithuania and computerized logistic's management software development in Lithuania

2. To glance over the logistic's management software and demand in the Lithuanian market and to forecast future perspectives of this software's demand in Lithuania and Europe and to analyze possible this program improvements in the future.

6.3.1. SWOT analysis for Lithuanian logistics sector

The object of the SWOT analysis (Fig. 6.5.) is to foresee further perspectives and measures of the automated logistics sector development and opportunity of management system's integration for Lithuanian transport management by indicating how the Lithuanian logistics sector is competitive with other countries and meets the increasing needs in transport and warehousing services markets.

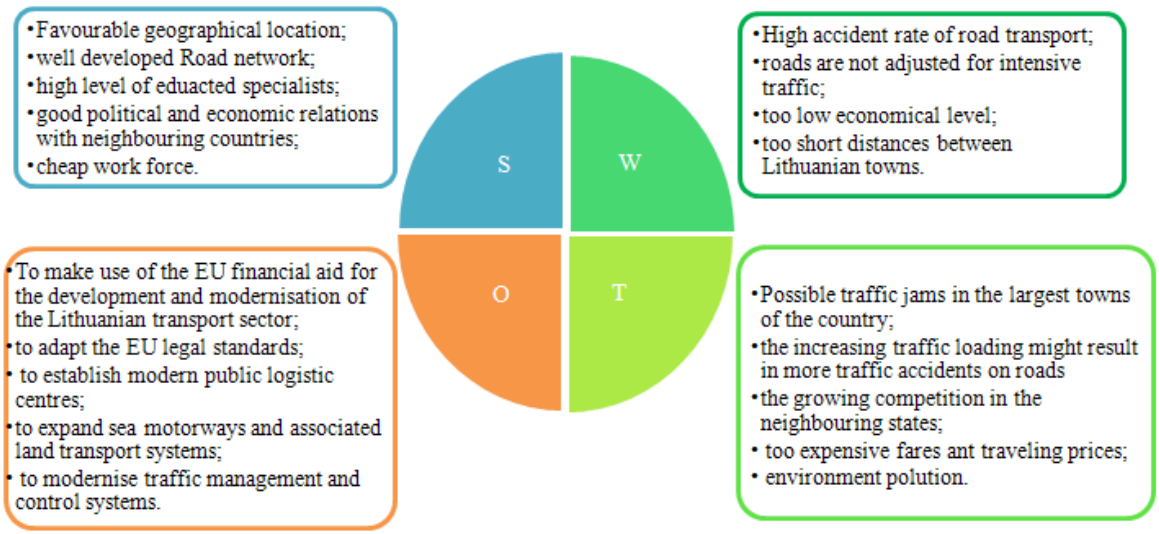


Fig. 6.5. SWOT analysis for Lithuanian logistics sector

Strenghts

The geographical situation of the Lithuania country is favourable for transit – we are almost in the middle of Europe, we have 3 air ports and a sea port in Klaipeda. We have well-developed road network and a high quality system of their maintenance and repair. Also we do not have any large disagreements with neighbouring countries and transport sector is almost all privatized with Lithuanian enterprises and government. We have experienced scientific potential of the transport sector and educated personnel. We have comparatively high tourism potential and a cheap work force. One more strength is that we have qualified work force, which is able to manage and use the computerized programs. These are the main reasons why our country has a big potential to develop and enlarge logistics sector.

Weaknesses

Lithuanian is to small country to develop logistics inside the country between customers of abroad. Road and railway connections with EU countries via Poland is poor. The network of electrified railway lines, urban and suburban buses is not enough developed. There are also no bypasses in some cities of the country and the larger part of all Lithuanian roads are not adjusted for intensive traffic. There are no legal and organisational basis for the promotion of intermodal transport and mechanism for organisation, coordination and development of combined services of transport is not created [60]. Also there is high accident rate of road transport and captured negative environmental impact of transport.

Opportunities

The main goal of Lithuanian logistics service is to adapt the EU legal standards and to make use of the EU financial aid for the development and modernisation of the Lithuanian transport sector. Also to establish modern public logistic centres in Kaunas, Klaipėda, Vilnius and, by necessity in other regions (Panevėžys, Marijampole, Šiauliai) as well, and to integrate them into the network of transport logistic centres of the Baltic Sea region. One more opportunity is to effectively establish positions in the transport service market of the continental Europe and to expand sea, air and land transport systems. Also to modernise traffic management and control systems, i.e. to maintain traffic safety, and improve the throughput of streets and roads. The largest opportunity is to develop computerized system, as like logistics management software ad to stay competitiveness in logistics sector.

Threats

One of the largest threat is insufficient coordination of actions with the neighbouring countries when developing the trans-European networks [60]. Also the traffic jams in the largest towns of the country and the increasing traffic loading might result in more traffic accidents on roads and polluted environment. The growing competition in the neighbouring states resulting from

the expansion of transport (ports, logistic centres, sea motorways) is sometimes against the interests of Lithuania. The logistics management is not enough developed and it could results in poor quality and low satisfaction level of customers. The main threat is that development of new computerized systems or automation equipment is too expensive for Lithuanian companies.

By made SWOT analysis in Lithuanian logistics sector we can now establish the main goals and visions from the Lithuanian point of view.

6.3.2. Goals and vision of Lithuanian logistics sector development

The analysis of the state of the Lithuanian logistics sector enables defining the following key long-term goals of the Lithuanian logistics system development:

- to achieve the highest level of transport service quality and the best technical parameters;
- to effectively cooperate with the neighbouring countries and to become an integral and important link of the transport system in the Baltic Sea region;
- to enable people of Lithuania and their cargo to conveniently and rapidly reach main cultural, tourism and commercial centres of Europe;
- to effectively serve the interests of Lithuania and the enlarged EU, to increase competitive capacity in international markets;
- to present the best service of logistics with newest technologies and qualified personnel and be known in all over the world;
- to reach high quality transportation and warehousing services by applying JIT (Just-In-Time) planningopportunities;
- to develop transport infrastructure, intermodal transport system, information technologies and intelligent transport systems;
- to protect environment and guarantee traffic safety;
- stimulate economy of the region by creating new jobs within modern business
- to organize, manage, modernize and automize all possible steps in logistics sector and maximize usage of all opportunities offered by economic market.

6.3.3. Forecasts of the developed Lithuanian logistics system

With increasingly technology level and automatization we can forecast logistics sector view after 10 years. By 2025, in Lithuania, a modern and sustainable multimodal transport system, which by it’s technical parameters, safety and service quality will guarantee the highest level for Lithuania in all EU Member States, have to be created. Effectively interacting with transport

systems of its neighbouring states, it will enable the business sector to successfully expand its activities, and people of Lithuania will be able to conveniently reach European tourism, culture and business centres with minimum time and money losses and best outcomes and satisfaction. The Lithuanian transport sector will become an important element and by providing high quality services and educated employees it will serve common needs and interests of Lithuania and the enlarged EU. Therefore, the development and modernisation of logistics infrastructure are one of the essential measures that ensure economic progress in Lithuania.

By developed technology level and IT solutions all logistics sector stages and management steps will be automated and all information will be available for everyone involved in this business. Also all loading, unloading, warehousing steps will be automated – robots will work with cargo transactions between trailers and warehousing and measurements of weights and technical parameters will be made with sensors helps. Also the fuel and truck's transition will by changed by electric drive and environment will be secured. All addresses for delivery will be clear and constantly renewable and computer will be able to translate all information in any language. All necessary documents like CMRs and delivery notes will be kept in one data base near every accomplished transport. All possible logistics spheres will be automated, however any autopmated technologies can not work without the interaction of human. Thus the experienced logistics managers, qualified drivers and engineers always will be necessary for appropriate logistics management processes.

CONCLUSIONS

In this work there was developed and integrated the new computerized logistics management software and system in purpose to optimize the logistics processes in Lithuanian transport company. Together with the automated solutions for distribution of warehouse and automatic trailer's loadings/ unloading it is able to observe, plan and control the main logistics steps in Lithuanian enterprises.

The computerized systems and automated machines are ideal for increasing space utilization up to 90%, productivity levels by 90% and accuracy to 99.9%. By using logistic's management system, the basic logistics steps are organized, planned and managed automatically, in respect we can control inventory levels and maximize the use of warehouse space, distribute and deliver products more faster and accurately, fulfil the customer needs and increase company's profitability.

The main tasks in this work were completed:

1. There was analyze Lithuanian logistics sector and indicated problematic aspects in logistics processes.

– Lithuanian geographical zone is very favorable for investments;

– The main problems there indicated in logistics sector, such like loss in time, large expenditures and low service level provided.

2. There was provide technological solutions, such as integration of AS/RS, automated truck loading systems and installation of various sensors, suitable for controlling distribution in warehouses as well as provision of fast 2-3 times faster loading/unloading of trailers.

3. There was developed necessary functions for program, which are able to ensure the Logistics management processes improvement and to solve often appearing problems. With the provided functions, we ensured main larger outcomes of:

– Driven 25 % more kilometers per month;

– Increased number of trucks and number of clients by 80 %;

– Saved time for orders fulfillment till 60 % (including saved time for transportation and faster loadings/unloading);

– Saved expenditures for taxed roads and fuel consumption by 20 %;

– Enlarged profit by 100 %

– Increased level of customer's satisfaction by 69 %

4. There was prepared solutions, designed models and algorithms of the logistic's management software. The models depends on what kind information we want to get from the program and how properly to plan and manage the logistics activities. The 6 main variables there chosen: "Maps", "Trucks", "Orders", "Cargo", "Messages, "Reports".

5. Provided economic analysis, forecasts and benefits of this program. The main forecast is that this program will be used by all transportation companies in Lithuania, which is collaborating with foreign countries. The automated solutions to manage the logistics sector will be applied in all possible spheres, from automated orders gathering, automated loadings and management of all processes.

Every transport manager who is responsible of management goods has to keep an eye on truck routes, transport costs and time. The logistic's management software installation with proper automation solutions will offer global logistics visibility, automated reporting, the newest navigation system, bar-code scanning, and more innovation solutions. By easily implement and usage, any enterprise can lower their expenditures, reduce labour and fuel costs by minimizing idle time and total mileage while getting the larger quantity of orders completed and provided service of higher level, just with appropriate automated management and organization of warehousing and transportation.

The investment into new technologies like automated systems and equipment, installation of new programs like logistics management software could ensure the highest quality and profit in logistics sector, can provide it's development in Lithuania and ensure competitiveness across all Europe.

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ABBREVIATIONS

3PL/4PL - Third Party Logistics/Fourth Party Logistics

AETR - Vehicles Engaged in International Road Transport rules

AGV - automatic guided vehicle

AOM – Advanced Order Management

AS/RS – Automated Storage/ Retrieval Systems.

BOL – Bill of Lading

CAD – Computer Aided Design.

CAME – Computer Aided Manufacturing Engineering

CAN BUS - A controller area network

CIM – Computer Integrated Manufacturing

CMR - Standardized document for cross-border transport of Cargo by Road

CPFR – Collaborative Planning and Forecasting Replenishmen

CSP - Central Monitoring Panel

DNV - is one of the world's leading certification bodies/registrars offering the latest in management systems certification services.

DRP – Distribution Resources Planning

ECR – Efficient Customer Response

EDGE - Enhanced Data rates for GSM Evolution or Enhanced GPRS.

EOQ – Economic Order Quantity

FIFO – First in First Out

GPRS - General Packet Radio Service.

GSN - Global Standart for Mobile Communications

LIFO – Last In First Out

OEM - Original equipment manufacturer .

POD – Point of Delivery

RFID - Radio Frequency Identification

RFID – Radio Frequency Identification

SCM – Supply Chain Management

SDC – Secure digital card

SKU – Stock-Keeping Unit

TIR Convention- Convention on International Transport of Goods.

TMS – Transportation Management System

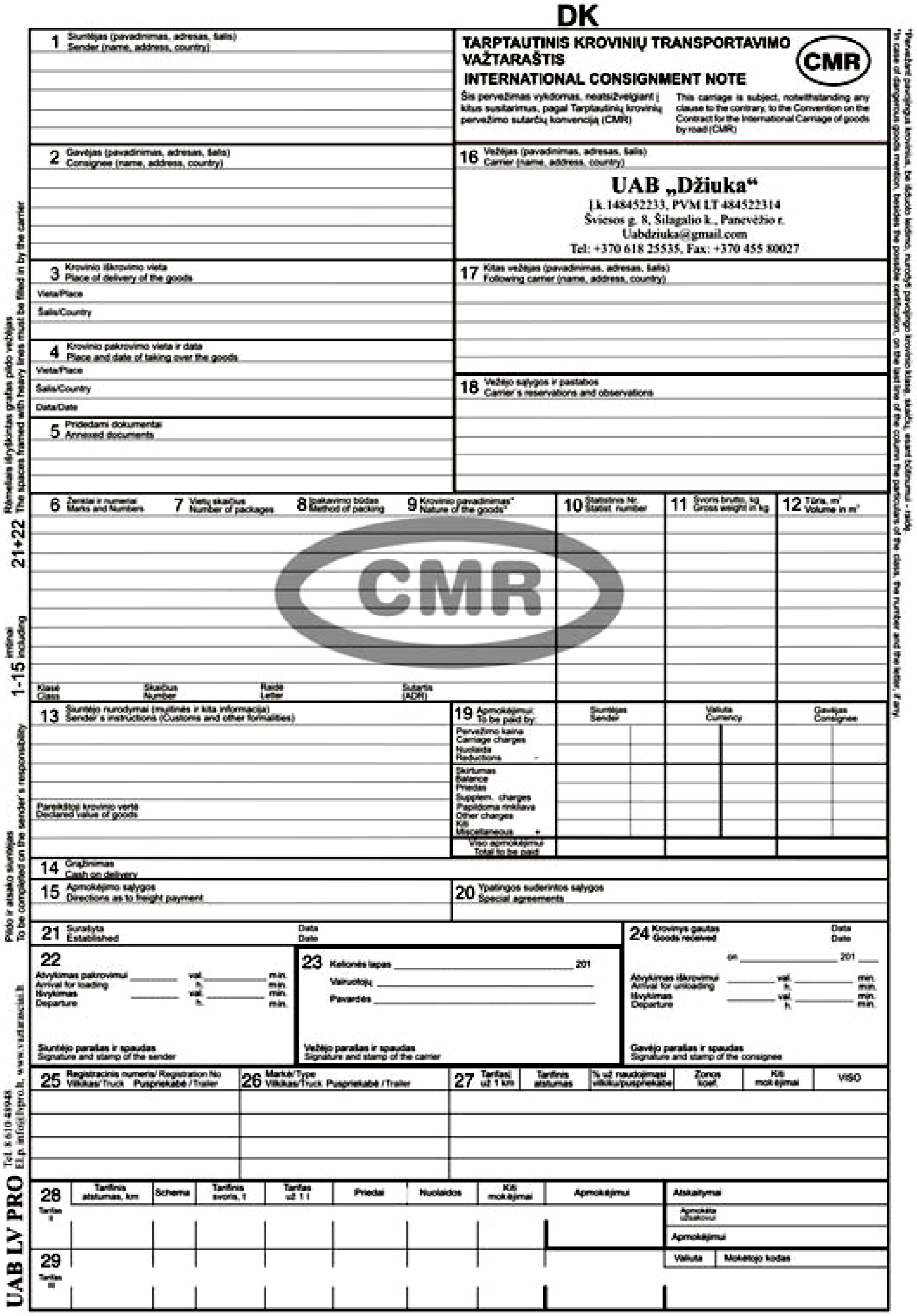
WLAN - wireless local area network.

WMS – Warehouse Management System

ANNEXES

Annex 1

The example of CMR. Available online at: [http://www.vaztarasciai.lt/]



DK

1 Siuntėjas (pavadinimas, adresas, šalis) / Sender (name, address, country)

TARPTAUTINIS KROVINIŲ TRANSPORTAVIMO VAŽTARAŠTIS

INTERNATIONAL CONSIGNMENT NOTE

CMR

Šis pervežimas vykdomas, neatsižvelgiant į kitus susitarimus, pagal Tarptautinių krovinių pervežimo sutarčių konvenciją (CMR)

This carriage is subject, notwithstanding any clause to the contrary, to the Convention on the Contract for the International Carriage of goods by road (CMR)

2 Gavėjas (pavadinimas, adresas, šalis) / Consignee (name, address, country)

16 Vežėjas (pavadinimas, adresas, šalis) / Carrier (name, address, country)

UAB „Džiuka“

Į.k.148452233, PVM LT 484522314

Šviesos g. 8, Šilagalio k., Panevėžio r.

Uabdziuka@gmail.com

Tel: +370 618 25535, Fax: +370 455 80027

3 Krovinio iškrovimo vieta / Place of delivery of the goods

Vieta/Place

Šalis/Country

17 Kitas vežėjas (pavadinimas, adresas, šalis) / Following carrier (name, address, country)

4 Krovinio pakrovimo vieta ir data / Place and date of taking over the goods

Vieta/Place

Šalis/Country

Data/Date

18 Vežėjo sąlygos ir pastabos / Carrier's reservations and observations

5 Pridedami dokumentai / Annexed documents

6 Ženklai ir numeriai / Marks and Numbers	7 Vietų skaičius / Number of packages	8 Įpakavimo būdas / Method of packing	9 Krovinio pavadinimas* / Nature of the goods*	10 Statistinis Nr. / Statist. number	11 Svoris brutto, kg / Gross weight in kg	12 Tūris, m³ / Volume in m³
Klasė / Class	Skaičius / Number	Raidė / Letter	Sutartis (ADR)			

13 Siuntėjo nurodymai (muitinės ir kita informacija) / Sender's instructions (Customs and other formalities)

Pareikštoji krovinio vertė / Declared value of goods

19 Apmokėjimui: / To be paid by:	Siuntėjas / Sender	Valiuta / Currency	Gavėjas / Consignee
Pervežimo kaina / Carriage charges			
Nuolaida / Reductions -			
Skirtumas / Balance			
Priedai / Supplem. charges			
Papildoma rinkliava / Other charges			
Kiti / Miscellaneous +			
Viso apmokėjimui / Total to be paid			

14 Grąžinimas / Cash on delivery

15 Apmokėjimo sąlygos / Directions as to freight payment

20 Ypatingos suderintos sąlygos / Special agreements

21 Surašyta / Established — Data / Date

22 Atvykimas pakrovimui / Arrival for loading ___ val. / h. ___ min. / Išvykimas / Departure ___ val. / h. ___ min.

Siuntėjo parašas ir spaudas / Signature and stamp of the sender

23 Kelionės lapas ___ 201 / Vairuotojų ___ / Pavardės ___

Vežėjo parašas ir spaudas / Signature and stamp of the carrier

24 Krovinys gautas / Goods received — Data / Date — on ___ 201 ___

Atvykimas iškrovimui / Arrival for unloading ___ val. / h. ___ min. / Išvykimas / Departure ___ val. / h. ___ min.

Gavėjo parašas ir spaudas / Signature and stamp of the consignee

25 Registracinis numeris / Registration No — Vilkikas/Truck, Puspriekabė/Trailer

26 Markė/Type — Vilkikas/Truck, Puspriekabė/Trailer

27 Tarifas už 1 km | Tarifinis atstumas | % už naudojimąsi vilkiku/puspriekabe | Zonos koef. | Kiti mokėjimai | VISO

28 Tarifas II | Tarifinis atstumas, km | Schema | Tarifinis svoris, t | Tarifas už 1 t | Priedai | Nuolaidos | Kiti mokėjimai | Apmokėjimui | Atskaitymai | Apmokėta užsakovui | Apmokėjimui

29 Tarifas III | Valiuta | Mokėtojo kodas

Rėmeliais išryškintas grafas pildo vežėjas / The spaces framed with heavy lines must be filled in by the carrier

21+22 / 1-15 imtinai / including

Pildo ir atsako siuntėjas / To be completed on the sender's responsibility

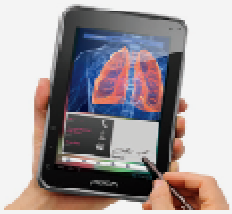
UAB LV PRO Tel. 8 610 48948, El. p. info@lvpro.lt, www.vaztarasciai.lt

*Pavojingi krovinio atveju, be išduoto leidimo, nurodyti pavojingo krovinio klasę, skaičių, esant būtinumui - raidę. / *In case of dangerous goods mention, besides the possible certification, on the last line of the column the particulars of the class, the number and the letter, if any.

Annex 2

Tech. specifications for android tablet BP50 [42]

Android Business Tablet



SPECIFICATIONS

PHYSICAL CHARACTERISTICS	
DIMENSIONS (W X H X D)	198 x 125 x 13.5 mm / 7.7 x 4.9 x 0.5 inch
WEIGHT	462g / 1lb (including battery)
DISPLAY	Eyelluminate™ Display; 7-inch LED-backlit widescreen Multi-Touch display with IPS technology; 1280 x 800 pixel; Crystal Clear View at all Angles(even under direct Sunlight); Covered with Anti FingerPrint Coated Corning® Gorilla Glass®
KEYPAD	Virtual
BATTERY	Replaceable & rechargeable 14.8-watt-hour(4,000mAh) lithium-polymer battery
EXPANSION SLOT	User-accessible MicroSD slot for removable memory card up to 32G
SIM/SAM SLOT	1 SIM
AUDIO	Loud Speaker and microphone
CAMERA	Rear: 5 megapixel Autofocus LED Flash; Video recording, HD with audio; Front: 2 megapixel Webcam
GPS	Autonomous GPS, Assisted GPS, Electronic Compass
SENSOR	Gyroscope; Motion Sensor; Ambient Light Sensor
PERFORMANCE CHARACTERISTICS	
CPU	Powerful Dual Core Processor
OS	Android 4.0
MEMORY	1 GB
STORAGE	16 GB
INTERFACE	Docking connector; 1 Micro HDMI; Headset Jack
USER ENVIRONMENT CHARACTERISTICS	
DURABILITY	TankSmith™ Technology; IP65 Sealing; Multiple 1.2m/4ft. drop per MIL STD 810G; Multiple 1.8m/6ft. drop per MIL STD 810G(Applying the Rugged Plug)
VIBRATION	4Gs peak, 5Hz to 2kHz, 1 hour duration per axis
OPERATING TEMP	-20℃ to 60℃ / -4℉ to 131℉
STORAGE TEMP	-25℃ to 70℃ / -13℉ to 158℉
HUMIDITY	95% non-condensing
ESD	+/-15kv Air, +/-8kv contact, +/-2kv charge body
DISINFECTANTS SUGGESTION	91% Isopropyl Alcohol + 9% Water; Alcohol Prep Pads; Alkyl Diamino Ethyl Glycine Hydrochloride; Ammonium Chloride; Anios D.D.S.H; Cavi Wipes; Ethylene Glycol; Hexanios G+R; Iodophors; Klercide B; POVIDONE IODINE; PVP-I Prep Pads Triad; SANI-CLOTH HB; SANI-CLOTH PLUS; Sodium Hypochlorite; SUPER SANI-CLOTH; SURFA'SAFE Virkon; Viraguard
INTEGRATED RADIO OPTIONS	
WWAN RADIO	Optional, HSPA+/HSPA/UMTS, EDGE/GSM
WLAN RADIO	Optional, 802.11a/b/g/n WI-FI (802.11n 2.4GHz and 5GHz) with Rigorous Security In Full Support: WPA, WPA2, 802.1X, WEP, AES-CCMP, TKIP
WPAN RADIO	Optional, Bluetooth V2.1 + EDR
NFC	Optional, NFC(Near Field Communication), All Types Supported(MIFARE/CALYPSO/FELICA/ETC.); ISO21481 (NFCIP-2), TypeA, Type B
SECURITY CHARACTERISTICS	
SECURITY	Stonewall Security™
PERIPHERALS	
OPTIONS	Smart Plug (Available Options): Magstripe Reader(w/ JIS2 Option), Smartcard Reader, 1D/2D Barcode Scanner, SAM Slot; Rugged Plug; Snap-On: USB Client, USB Host, Power Jack; 1Slot Cradle; 4Slot Battery Toaster; Vehicle Mount; Hand Strap; Blue-Pen

• Please ask your sales representative for the specs not listed above.

• Capacity and hours decreases with time and usage; battery hours can vary according to configuration, applications in use, as well as the operating conditions.

Bluebird Inc. (Corporate Headquarters)

SEI Tower 13~14F, 467-14, Dogok-dong, Gangnam-gu, Seoul, Korea (ROK)

Phone. +82.70.7730.8000 Fax. +82.2.6499.2242

Website mypidion.com

Annex 3

Standards for AS/RS installation [16-20]

Standards for AS/RS installation

AS/RS systems (explained in chapter 2.2.) includes technical association, electrical, mechanical parameters and all these parameters with ensured quality must comply with relevant standards:

MH24.1: Safety standard for horizontal carousel material handling and associated equipment [16]. The purpose of this standard is to provide for safe operation and maintenance of various constructions equipment.

B30.13 - 2003: Storage/Retrieval (S/R) machines and associated equipment [16]. The provisions of this safety standard applying to S/R machines shall apply equally to the construction, installation, inspection, testing, maintenance, and operation of aisle transfer cars and any load handling equipment which is part of or attached to S/R machines or aisle transfer cars.

ANSI standard ANSI/TIA/EIA-422-B defines signal levels and electrical characteristics of balanced voltage differential interface circuits [17]. It specifies electrical characteristics of a digital signalling circuit. Differential signalling can transmit data at rates as high as 10 Mbit/s, or may be sent on cables as long as 1500 meters.

RS-422 and RS-485 Standards [18] are known today, are balanced data-transmission schemes that offer robust solutions for transmitting data over long distances and noisy environments. RS-485 specifications allow only one driver to send data at a time, and up to 32 unit loads [18].

ISO family Standards [20]:

- ISO 9001:2000 Quality Management on continual performance improvement.
- ISO 14000 Environmental Quality Management. Minimising harmful effects on the environment and continual improvement of environmental performance.
- ISO 14001 and 14004 set standards for Environmental Quality Management System.
- ISO 28000 Security in the Supply Chain – Risk based.
- EN 12798:1999 A model safety management system for dangerous cargoes.
- EN 13011:2000 Best practice for goods transport chains [20]: requires a QMS to be in place: Service Provider must make a declaration of quality in terms of measurable parameters; service provider must carry out own assessments at regular intervals.
- ISO 28000 requires to apply risk assessment to their element of the supply chain.
- ISO 22301 Business Continuity Management
- An ISO 14001 Environmental Management System responsibilities
- ISO 39001 Road Traffic Safety Management

The Universal Logistics Standard is a strategic framework for managing disaster response among local, state, regional and federal disaster response personnel. Its intended use is as a foundation on which local, state and federal emergency management stakeholders build a comprehensive disaster logistics program [41].

Annex 4

Applicable softwares and devices for automated warehousing inspection [23]

Automated inventory management systems

Automated warehouse management can be integrated together with logistics management software, AS/RS systems and warehouse inventory control equipment, like: barcode software, inventory detectors, devices management solutions and security systems.

Automated warehouse Tracking Management System consists of several components listed below [17-18]:

1. WMS Software and RFID Software;
2. ID Card and Inventory Softwares;
3. Mobile computer or mobile device;
4. Barcode Software together with Barcode Scanner and Barcode Printer;
5. Wireless Infrastructure;
6. Event and Time tracking softwares.

The examples of necessary devices for such automated warehouse management are shown below:

Annex 5

Selected CS 100 Cargo Sensor [55]

Catalogue is available online at: [http://www.orbcomm.com/uploads/CS-100-Cargo-Sensor.pdf]

FEATURES

Maximize trailer utilization and efficiency

Increase trailer turn time

Eliminate unnecessary yard checks

Monitor and control detention billing

Prevent theft and ensure cargo safety

Quick, easy installation

Advanced Sensor Technology

ORBCOMM's durable **CS 100** Cargo Sensor can be integrated with our award-winning **GT 1100** asset tracking solution to detect the presence or absence of cargo (Empty / Not Empty) inside standard trailers, providing greater asset visibility and security. Using ultrasonic technology, the CS 100 monitors the trailer and can immediately send an alert if there is a change in load status or if the sensor is damaged or removed. With the CS 100, fleet owners will no longer worry about arriving at a customer site to pick up an empty trailer only to find that it is still loaded.

The CS 100 can be configured over-the-air and integrated with additional sensors for maximum efficiency and flexibility. This sensor can also be easily installed in a safe, discrete location inside the trailer to minimize cargo damage.

The CS 100 provides accurate, reliable updates and historical data on the trailer's arrival, loaded condition and status based on a customizable reporting schedule through ORBCOMM's robust web application. By integrating the high-performance CS 100 into ORBCOMM's GT 1100 system, fleet owners can eliminate unnecessary yard checks, increase trailer turn time, improve customer satisfaction, and ultimately maximize profitability.

CS 100 SPECIFICATIONS

Dimensions: 7.6" x 3.8" x 2.9" (193 mm x 96.5 mm x 97 mm) with Bracket

Weight: 15 oz. (425 g)

Mounting: Bracket on Plywood or Metal

Operating Temperature: -30C to 70C (-22F to 158F) @ 95% RH

Storage Temperature: -40C to 85C (-40F to 185F)

Vibration: AAR M-1002 4.13.2.3

Shock: AAR CE-UG-04-3001

Humidity: 95%

Power: 9V Sourced from ORBCOMM's GT 1100

Range: Up to Maximum of 20 Feet (Multi-zone, 53 Feet Option Available*)

Annex 6

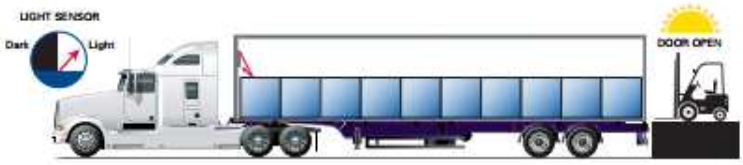
Full length Cargo Sensor work principle

Brochure. Is available to download online from: [www.id-systems.com]

Full-Length Cargo Sensor

VeriWise Cargo Sensor Detects Cargo and Inside Light Level

Integrated light sensor provides added loading activity visibility and low power consumption to maximize untethered battery life.



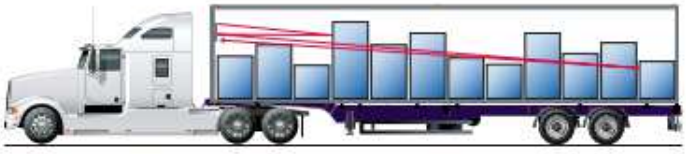
- "Loaded-Light" report with first cargo detected while light level is high (indicating door open and loading in progress)
- Light level sampled every 5 seconds while loading
- Loading continues until complete

- Light level goes low when doors are closed
- "Loaded-Dark" report sent indicating loading complete and asset ready for pickup

- Load state most critical attribute after asset location
- Detect cargo anywhere in 53' space
- Original install or optional accessory addedd later
- Over-the-Air (OTA) configured and upgradable

- Four independent sensing modes to ensure accuracy
  - Floor Mode
  - Short Range
  - Long Range
  - Proximity

- Short Range and Floor Mode sensing is effective when the load is at the nose of the trailer or up to 20' from the front of the trailer
- Cargo assumed to be ≥ 2' above the floor



- Long Range sensing is effective when loads are positioned in the rear or irregular in height
- Effective at range of 20' - 53' from the sensor
- Sensing range effective up to 2' from rear door

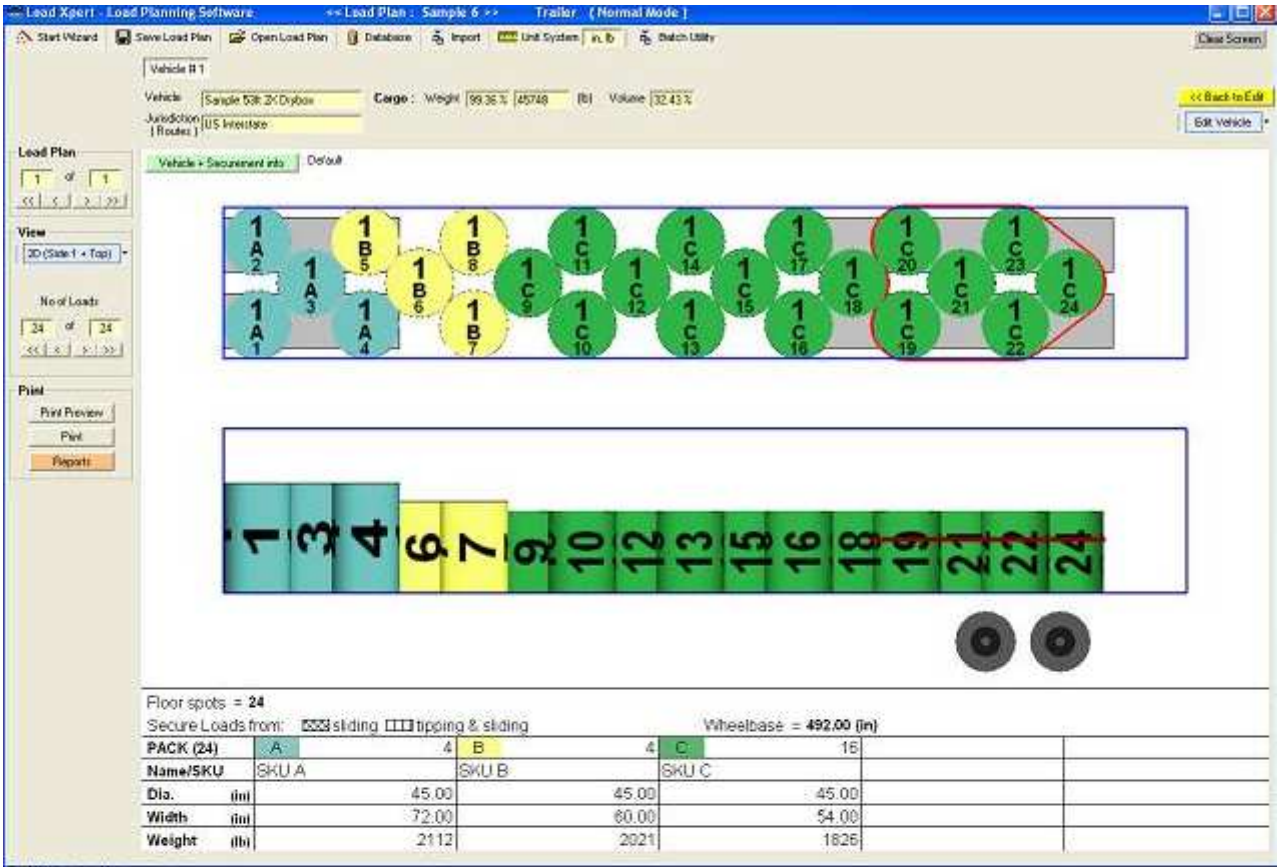
- Proximity sensing is effective when the load is directly facing the cargo sensor (cubed out) as traditional ranging methods are ineffective

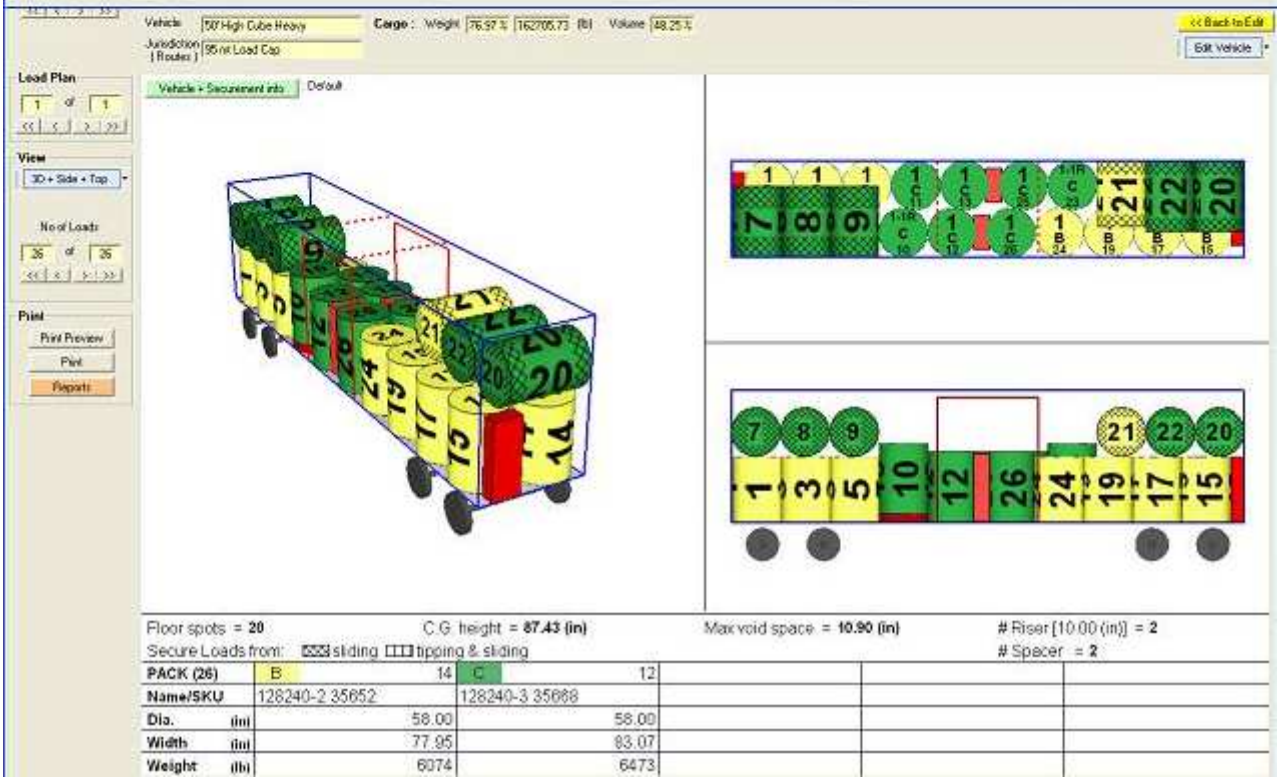
All specifications are subject to change for product improvement without notice.

Annex 7

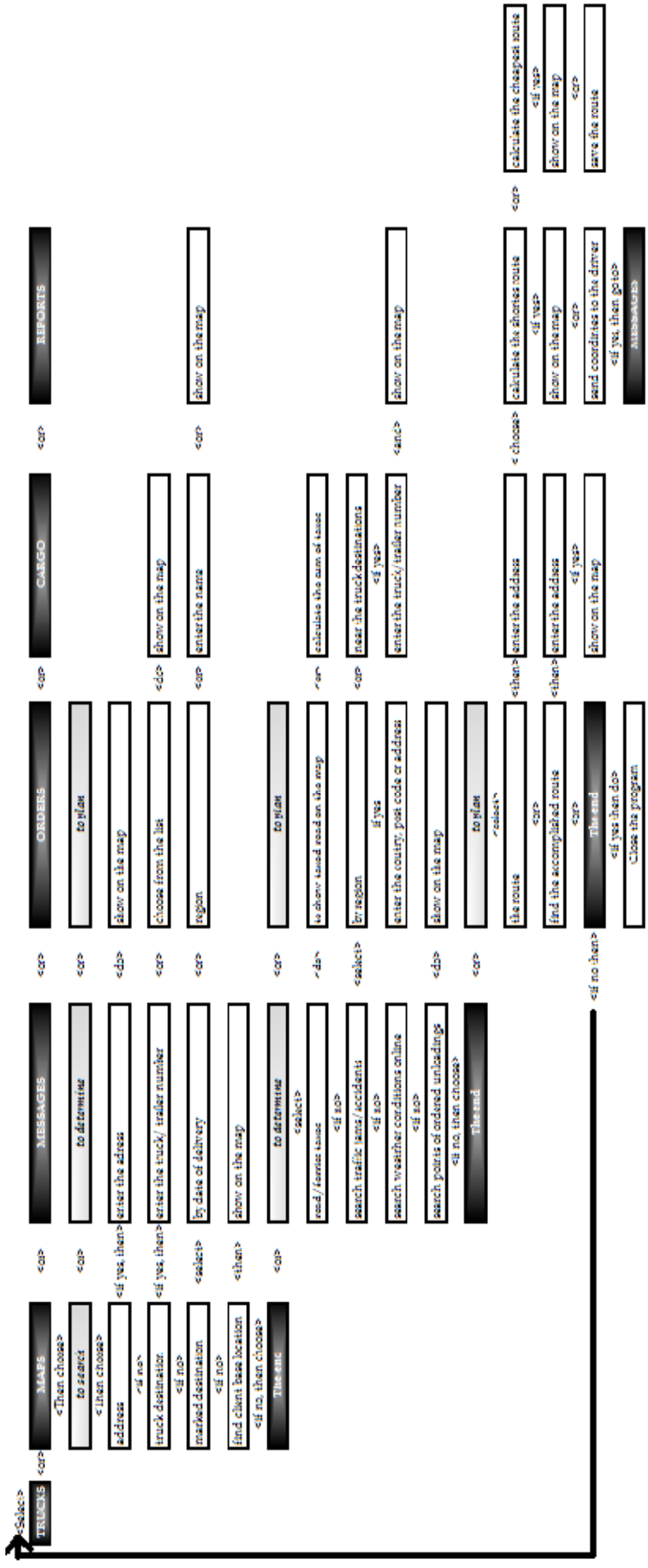
Loading solutions provided by Load Xpert Software. The trailer is loaded by paper rolls

Available Demo version online at: [http://www.loadxpert.com/] [58]

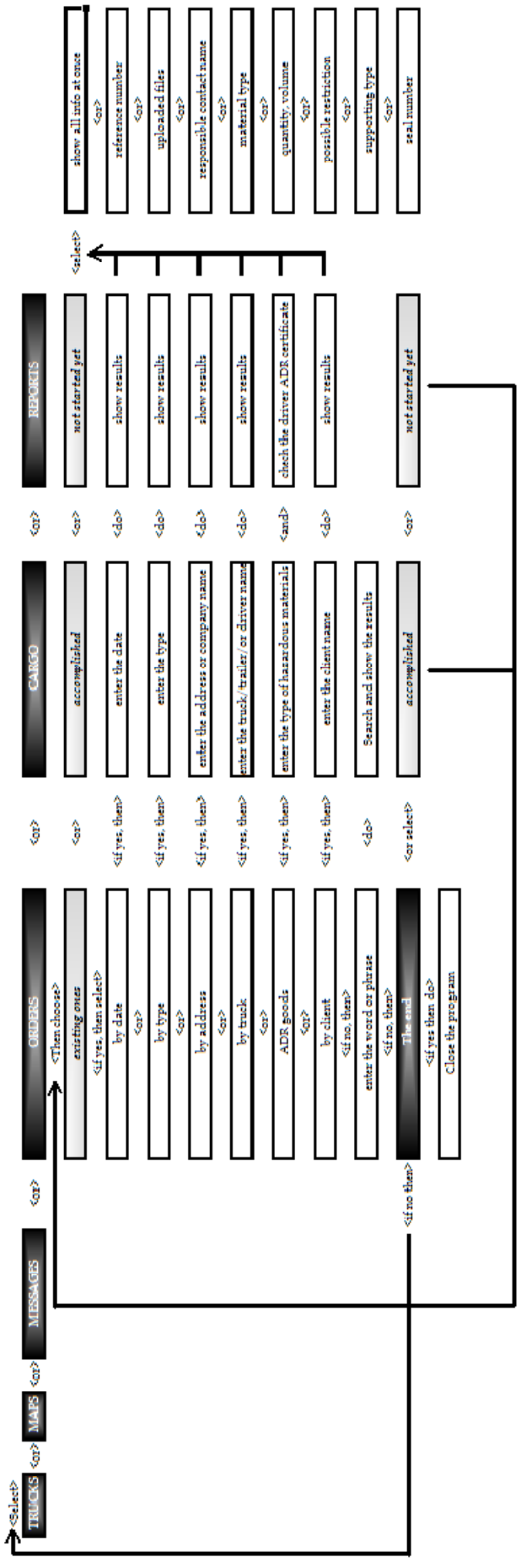




Annex 8
The algorithm to gain information about “Maps”



Annex 9
The algorithm to gain information about “Orders”



Annex 10
The algorithm to gain information about “Trucks”