

## **DEVELOPMENT OF IT INFRASTRUCTURE TO OPTIMIZE LOGISTICS OPERATIONS IN THE SEGMENT OF COLD CHAIN**

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*Scientific paper*

### *Abstract*

An important segment in the development of good business is the development of information technology, which is especially pronounced in the area of logistics operations. This paper analyses trends in the application of information technology in storage and transportation of food products that require refrigeration or freezing in order not to lose their nutritional properties and maintain their quality.

The market of frozen products has been on the rise in recent years, although in Southeastern Europe the consumption per capita is lower than in Western Europe. It is expected that the consumption of these products will significantly increase in the next few years as a result of the changing lifestyle (less time, consumption of a variety of foods from all over the world throughout the year, etc.).

Because of technology advancements and logistics strategies, the cold storage of perishable items has become an important stage in the distribution between manufacturers/processors and retail locations. Fresh and deep frozen production continues to increase to meet worldwide demand, and technology has created a wider range of usage for that kind of products and the ability to transport products.

The hypothesis of this paper is that further research and development of information technology solutions would, beside existing ideas, provide faster and more efficient distribution and storage of food products which require special

conditions, and it would ensure the profitability of the companies and their stronger business position in the global market.

**Key words:** optimization, logistics operations, cold chain, IT infrastructure

## 1. INTRODUCTION

The goal of most managers to make all costs variable is impossible to fulfil, but the right decisions at the right time make most outstanding ones able to get closer to achieving that goal. Certain business activities are increasingly being outsourced, because when something is outsourced and you arrange a job with an expert for that particular operation, then the service is delivered on the money-for-service principle (Lacković, 2014, p. 111).

From the cost reduction aspect, i.e., less service and lower costs up to the level no service - no cost, lead to the desire to make most of the business related costs variable.

Logistics costs account for a significant share of the total costs of the company, in manufacturing and retail. Retailers and manufacturers have recognized the importance of logistics costs in the total costs of the company. Because of the cost size, companies are forced to find a more efficient solution for their logistics operations taking into account not only the cost but also quality of service. Retailers are creating their own storage capacities, and forcing manufacturers to move logistics operations on their centralized storages. As a consequence, reduces the number of the deliveries which manufacturers need to distribute and their own distribution network becomes inefficient and unprofitable.

Looking at the issues in terms of logistics, the more goods produced/sold, the higher costs and vice versa, so the long-term use of outsourcing logistics services significantly reduces the costs of one's own employees, depreciation, energy and the like, waiting to get turnover to its previous value.

All effects of business cycle fluctuations are transferred to the service providing company that must combine its services with services offered by a number of different clients to compensate fluctuations and make their business profitable. If to this we add savings referring to investing one's own capital in storage facilities, vehicles, computer equipment and systems, quality management systems, employee training and development, it is more than obvious that this is most frequently worth outsourcing.

On the other hand, companies that offer outsourcing of logistics operations have great responsibility when it comes to the goods, which are often very sensitive to changes in the storage and shipping conditions.

For companies that are engaged in this activity, except for investments in facilities and vehicles, it is important to invest in internal processes to ensure safety of food and other goods throughout the logistics chain.

At the present time, it is important to constantly harmonize the internal procedures with the European processes and standards, and to have these procedures supported by IT.

There is a necessity for the use of state-of-the-art IT to support daily operations, and at the same time to record all data in order to ensure full traceability. This ensures the quality of logistics services so that in case of any non-conformity of goods the companies could quickly withdraw products from the market and provide data for possible changes in procedures and working methods that lead to the aforementioned non-compliance, which is particularly important during transport, storage and distribution of food that require the fulfilment of the highest standards of safety.

Cold-chain, on which research of this paper was focused, is a special form of logistics and a complex cryogenic system, which compose by a number of links, the overall processes from the procurement, processing, distribution, retail to consumption are all under lower temperature. It is outlined a specific supply chain system, with perishable food purchased or fished from the origin places, the procedures of processing, storing, transporting, distributing and marketing are under required low temperature to ensure the safety, reduce losses and prevent pollution (QingYing & Zhimin, 2011).

According to the basic functions of logistics, cold-chain operations can be divided into the following four areas: supplement (producing, processing, purchasing, checking and accepting), storage (storing, loading, handling and sorting), transportation (transport, loading, handling and distribution) and consumption (transport, storing, sorting) (Yanyan & Yu Yin, 2009).

In order to build confidence and trust with their clients and enhance their prestige in the market, it is more difficult for companies engaged in logistics operations to hold the "IFS Logistics" certification (international standard for transportation, storage and distribution), which has as a prerequisite ISO 9001 and HACCP certifications brought together under the umbrella of the "IFS Logistics" which defines in detail food safety by specifications of each particular product and clearly defined procedures.

The paper analyses trends in the application of information technology and logistics in general, but particular attention is focused on the segment of cold chain, i.e., storage and transportation of food products that require refrigeration or freezing.

The complexity and responsibility of this work is accompanied by a large role played by money and time with constant questioning when to invest and in what.

"RALU Logistics", the leading independent regional logistics Croatian company in the field of cold chain, is a company mentioned in this paper as a positive example worthy of attention that has recognized the market needs for a reliable provider of logistics services in the field of refrigerated and deep frozen products, is constantly investing in the most modern solutions using IT infrastructure offered in the market.

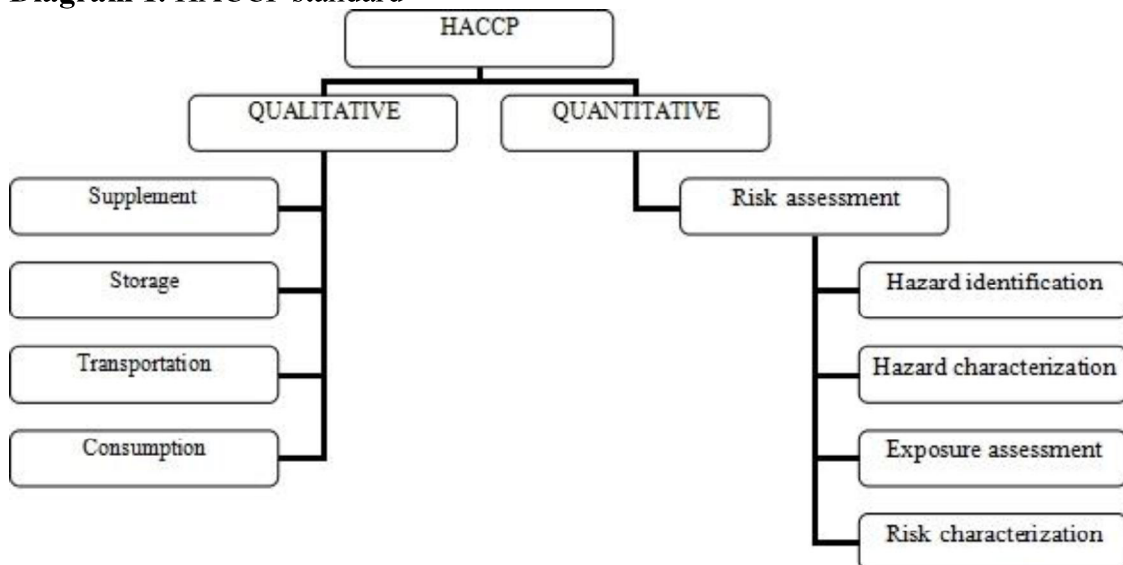
## **2. IT INFRASTRUCTURE**

### **2.1 IT infrastructure in logistics**

Companies utilize IT infrastructures in order to ensure food quality and conform with the HACCP (Hazard Analysis and Critical Control Point) standards during transport, which makes IT infrastructures an important factor of business quality and significant instrument of business success ensurance. HACCP standard is a tool for

the analysis of the cold chain processes, assessment of potential risks for each operation link, and identification of critical control points. It gives the appropriate risk weights, so as to ensure the safety, quality and reliability of the cold chain (QingYing & Zhimin, 2011). From the biological, chemical and physical perspective, it combines qualitative and quantitative analysis methods to identify risks and assess the weight of each risk, so as to determine the critical control points and establish internal relations between hazards and risks.

**Diagram 1.** HACCP standard



Source: Authors

The paper gives an analysis of IT infrastructures currently present in the labor market in the logistics operations segment, particularly cold chain. IT infrastructures in the area of logistics are commonly used in wired or wireless monitoring the transport of goods, and RFID (radio frequency identification). These IT infrastructures include monitoring vehicle location, monitoring the temperature of cooling chamber vehicles, determining the origin of goods transported and the like.

Most often tracking vehicles use the GPS (Global Positioning System) that transmits information about the position of the vehicle, the parameters of the vehicle, driving time and the like. Using GPS vehicle tracking technology makes available to the client the parameters of temperature and geographical location of their goods.

GPS technology was integrated with RFID technology in order to develop the technology to gather complete data. The main disadvantages of GPS technology are limited area coverage, dependence on the battery and human intervention.

RFID technology is increasingly superseding the bar code technology and is used in all aspects of life – access control (RFID cards, bracelets, pendants – for example records of employees' working time), cashless payment (bank cards, coffee makers, museum admissions, transport, etc.), identification equipment, vehicles, industrial applications (the label is usually on the product). In synergy with other technologies (GPS and wireless) it is commonly used in transport, logistics, production and control.

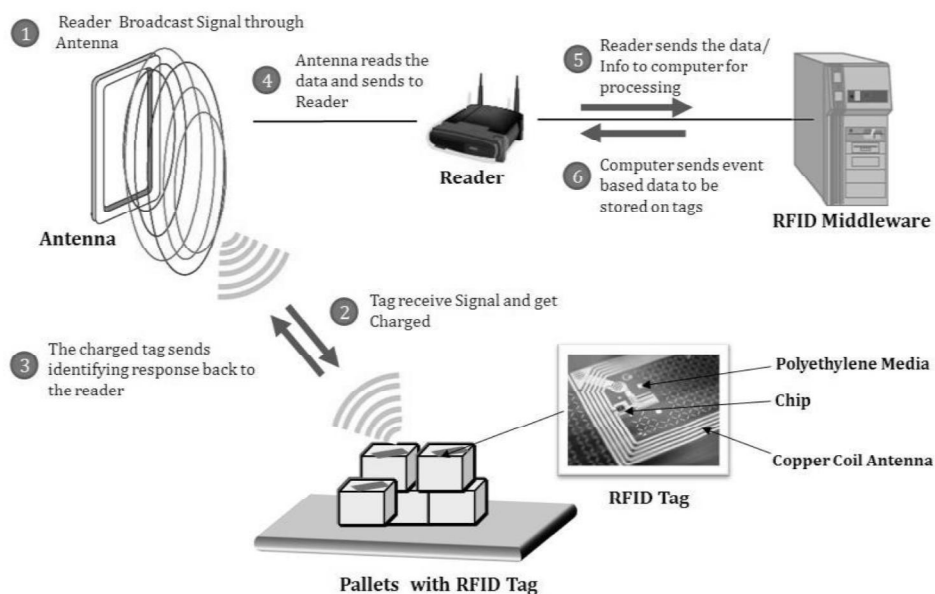
The basic principle of the RFID technology usage is the reading of the essential characteristics of the product / property / animals which are stored on the RFID tag.

RFID readers read and / or write data after transmitting radio waves stored in the memory chips in the RFID tag (Cej et al., 2012, p.152). RFID tags are placed on a product or integrated into an object and they contain all the necessary data which are read without contact (e.g. contactless payment of bills in stores using bank cards). RFID tags can be divided into three main types with respect to the source of energy used to power them:

- a) active tags - use a battery to power the tag transmitter and receiver to broadcast their own signals to readers within the life of batteries;
- b) semi-passive tags - contain built-in batteries to power the chip's circuitry, resist interference and circumvent a lack of power from the reader signal due to long distance. They are different from active tags in that they only transmit data at the time a response is received;
- c) passive tags - derive their power from the field generated by the reader without having an active transmitter to transfer the information stored.

The principle of communication between a RFID tag and its reader and the processing of data on the computer is shown in Figure 1.

**Figure 1.** The working principle of RFID technology



Source: Infinium Solutionz Pvt. Ltd. [available at: [http://122.182.4.125/infiniumwebsite/Tech\\_RFID.aspx](http://122.182.4.125/infiniumwebsite/Tech_RFID.aspx), accessed June 14, 2015]

The frequency range determines the characteristics of the system, i.e. the range of reading and reading speed data, which is shown in Table 1. From the table it can be concluded that for transport and logistics based on an RFID system the best solution would be the ultra high frequency (UHF) RFID with (active) transponder because of the communication range of ten meters, which can be upgraded for an additional range of up to a hundred meters, while the battery life is up to ten years. It is possible to embed various sensors into active RFID transponders, such as temperature sensors necessary for monitoring of perishable goods, humidity, vibration, light and radiation sensors (CARNet CERT & LS&S, 2007).

**Table 1.** Comparison of RFID Frequency Band and Their Respective Applications

Frequency	Maximal range and type of RFID tag	Cost of Tags	Data speed	Applications
Low Frequency (LF) 125 – 134 KHz	<0.5m (passive)	High	Low	Animal identification, access control, identification of objects with high percentage of water
High Frequency (HF) 13.56 MHz	up to 1 m (passive)	Medium to Low	Low to moderate	Smart cards, payments, access and passage control
Ultra High Frequency (UHF) 433, 868-928 MHz	3-6m (passive) up to 10m (active)	Low	Moderate to high	Logistics and supply chain, baggage tracking, warehouse and logistics applications, remote locking of vehicles
Microwave (SHF) 2.4/5.8 GHz	10m-15m (passive) 20-40m (active)	High	high	For systems which require long distance for operation: identification of vehicles (tolls and tunnels, parking lots, garages), airline baggage

Source: The Hong Kong Polytechnic University, Overview of RFID Technology, [available at: [http://www.rfid.ise.polyu.edu.hk/en/RFID\\_ov.html#2](http://www.rfid.ise.polyu.edu.hk/en/RFID_ov.html#2), accessed June 14, 2015]

## 2.2 IT infrastructure in cold chain logistics

Temperature monitoring during transport of goods in cold storages has been for years an important part in the cold supply chain in order to optimize logistics costs. One of the first monitoring temperature technologies in logistics was the use of chart recorders shown in Figure 2. The technical disadvantage of this device is that the data are written onto paper and manually interpreted. That is the limitation of applicability to a large number of data that needs to be processed in real time.



**Figure 2.** Chart recorder

Source: Ashford Instrumentation Ltd [available at: <http://www.ashfordinstrumentation.com>, accessed July 7, 2015]

Later widespread devices for temperature monitoring during transport of goods were digital or analog electronic devices (named "data loggers") with an integrated sensor for measuring and tracking temperature data over time - one such device is shown in Figure 3 (Dada & Thiesse, 2008, p. 142). The disadvantage of such devices is difficult access to measured data because the device must be connected, e.g. via serial cable.

**Figure 3.** Temperature logger

Source: Global Sensors [available at: <http://www.global-sensors.com/TemperatureAndHumidityLoggers.htm>, accessed July 1, 2015]

There are concepts which are different from the above mentioned devices: inexpensive labels based on chemical, physical or microbiological reactions that show an easily-measurable time and temperature dependent change (TTI – Time-Temperature Indicators) (Figure 4). The color shift on the TTI label can easily be read and understood and does not require an additional reader device (Dada & Thiesse, 2008, p. 143). Main disadvantages of these devices are: they do not have digital information, they require manual examination and they do not allow for remote monitoring.

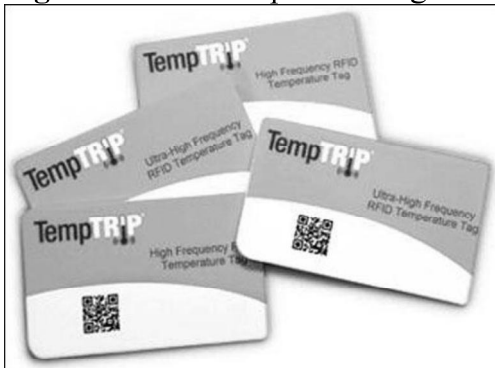
**Figure 4.** Time-Temperature Indicator



Source: Freshpoint [available at: <http://www.freshpoint-tti.com>, accessed July 7, 2015]

The best choice in recent years have been RFID-based sensor tags (Figure 5) which allow for fully automatic data collection in real time. Temperature sensors are integrated with RFID, they continuously record temperature readings and store them in the tag's memory and at any point in the process these readings can be accessed by an RF reader and forwarded to an organization's information system (Dada & Thiesse, 2008, p. 143). Radio frequency identification in recent years has been increasingly used in logistics and supply chain management.

**Figure 5.** RFID temperature tag



Source: TempTrip [available at: <http://temptrip.com/>, accessed July 7, 2015]

Monitoring in the supply chain has now evolved. Very promising technologies in several fields (environmental monitoring, cold chain control, traceability, etc.) are Wireless Sensor Technologies (WST). WST appertains to Wireless Sensor Networks (WSN) and RFID based sensor devices. WSN contains wireless sensor nodes that have a microprocessor for data processing, storage capabilities, radio chip for wireless communication with which to communicate with a gateway unit which can communicate with other computers via other networks (LAN, WLAN, CAN or WWAN). Integration of WSN and RFID provides a significant improvement on monitoring. This integration, with software agents and intermodal containers, facilitates the development of the "intelligent container" system.

Nowadays, cloud computing as a new business model has a profound impact on the entire information technology across the industry. At the same time, cold chain logistics increasingly demands fresh and frozen food, along with customers' rigorous requirements. Cloud computing in cold chain logistics helps to achieve the highest



quality IT services with minimal investment. In this environment cold chain logistics can provide: database controlled, real-time monitoring, data calculation, logbook recording, query, report generation, etc.

### 2.3 Recent IT applications in transport

In recent years, development of sensor networks used in logistics has focused on the development of an intelligent transport system labeled “intelligent container” system. Much international research is focused especially on the management and control of transport of perishable goods. Some of the IT applications are summarized in Table 2.

**Table 2.** Summary of IT applications in transport

Category	Subject	References
RFID	Pineapple supply chain	Amador et al., 2009.
WSN	Real-time monitoring of fruit logistics	Ruiz-Garcia et al., 2008.
RFID & WSN	Raw Brazilian sugar supply chain	Fray da Silva et al., 2015.
RFID & WSN	Aquaculture supply chain	Parreño-Marchante et al., 2014.

Source: Authors

## 3. A REPRESENTATIVE EXAMPLE OF A LOGISTICS COMPANY IN CROATIA

The “RALU Logistics” company has specialized in accordance with recognized potential, and created the image of a reliable logistics partner that could provide a high-quality and complete logistics service operating according to EU standards.

To effectively manage partner requests referring to specified requirements (e.g., a certain delivery at a specific time with least possible costs) it is necessary to establish an efficient and optimal logistics system (Segetlija, 2013, p.19). It is known that for the provision of such network it is necessary to manage two main functions: logistics planning and logistics controlling (Frazelle, 2002, p.125).

The role of logistics planning is to ensure the overall efficiency of the logistics system to ensure a competitive position. It is in this part that independent logistics companies exploit synergy of many clients from their portfolio in order to distribute the cost of distribution to a greater amount of goods.

Successful logistics service providers pay particular attention to the development of logistics controlling in order to control the effectiveness of logistics services provided within the anticipated financial framework.

In order to better control costs, it is necessary to continuously report on the results of the logistics operations, such as measuring the efficiency of existing logistics capacity. For this purpose, “RALU Logistics” carries out weekly monitoring of KPI (i.e., Key Performance Indicators) values in order to evaluate its own effectiveness.

This company has defined its mission, and it seeks to execute the mission every day. It provides timely and efficient services to its clients trying to achieve at the same time a satisfactory level of profitability for the company.

In order to reach this goal, performance parameters are to be measured continuously, such as capacity utilization of trucks, storage capacity utilization, efficiency in warehouse workers, profit per mile and the like.

In a market of increasingly demanding clients and increasing competition among 3PL providers<sup>1</sup>, “RALU Logistics” is developing in the direction of meeting the various demands of clients, expansion of service offerings, and narrow specialization in the logistics activity. In addition to standard logistics operations, transportation, storage and distribution, they also offer product repackaging services, product labelling services, reverse logistics services (Goetschalckx & Fleischmann, 2005, p.102), logistics services in certain regions, customs and excise storage as well as the implementation of the highest quality standards in all operations (IFS<sup>2</sup>, ISO 9001, HACCP).

Being aware of the sensitivity of the products entrusted to them by their clients (i.e., refrigerated and deep frozen products) and the flow of goods, “RALU logistics” has implemented state-of-the-art equipment and information technology in order to ensure quality of service, because only satisfied and happy customers guarantee a successful and sustainable market position.

The vision of this company is to become the leading independent provider of the integrated logistics service “from factory to shelf” in the cold chain segment in Southeast Europe, which includes international transportation and all possible forms of warehouse operations.

Without proper and high-quality infrastructure it is impossible to deal with logistics; hence the construction of the RALU LDC (i.e., the logistics and distribution center) in Rugvica along with investments in transportation and vehicles represents a solid foundation for the expected success of the activity the company is involved in. The construction of the LDC in Rugvica created the conditions for developing fully operational logistics business in the region.

The new RALU center consists of two main facilities, i.e., a warehouse – a cold storage facility and a transportation support facility. The entire warehouse with chambers, just like all handling zones and additional service zones, are under temperature-controlled conditions, which might, depending on the needs, go to -25°C. The transportation support facility, except for the service itself, includes an internal fuel pump, automatic truck wash and a rest area for drivers.

The LDC occupies an area of 117,000 m<sup>2</sup> so that sufficient space is reserved for the future rapid increase in capacity. In Croatia, “RALU Logistics” employs more than 200 employees, and together with companies in Serbia and Hungary it has more than 300 employees. The new LDC in Croatia created the conditions to increase the number of employees in the next few years.

By the construction of the new logistics and distribution center the company has

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<sup>1</sup> 3PL is an English abbreviation for Third-Party Logistics and it implies logistics activities carried out by a third party. It is identified with logistics outsourcing. Many global companies today are advertised as 3PL companies.

<sup>2</sup> International Food Standard.

become the leader in the field of both storage capacity and manipulation of frozen and refrigerated products.

In addition to investments in the logistics and distribution center in Rugvica worth HRK150 million, the company also invested in the fleet of vehicles, which was complemented by 90 refrigerator trucks manufactured by a renowned German manufacturer.

Investments in new trucks are extremely important, because over 70% of company's turnover in the field of transport is booked from clients from the EU. Although RALU has been operating for the last 25 years, this company is still relatively unknown in Europe; hence it has to prove its quality by providing superior levels of service, much more than logistics and transport companies in Western Europe that affirmed their positions long time ago. They are aware of the fact that this is feasible only with trucks of the highest level of quality that, in addition to lower costs (fuel consumption, tolls, maintenance), ensure the accuracy and reliability of the provision of services. Projections for the future have indicated that it is necessary to take into account the conditions in which companies operate in most EU countries, e.g., less polluting trucks (Euro 6), which RALU Logistics has also recently purchased, pay a lower toll rate and lower environmental taxes. In Croatia, this issue has not been regulated yet by law, but it is likely to be harmonized with relevant EU legislation.

This company recognizes the importance of ongoing investments for the purpose of achieving competitiveness.

For these reasons, "RALU Logistics" renewed most of their fleet after only four years, which is far above the average in the region, or at the level of the best EU companies. The company has always had refrigerator trucks of the best quality providing optimal solutions to distribution. Refrigerator trucks, for example, are equipped with sophisticated and modern equipment for communication and monitoring of the operating parameters of vehicles, as well as condition and temperature of goods in real time, and the GPS tracking system is constantly in contact with the dispatching unit.

By the implementation of the new SAP<sup>3</sup> information system, one of the leading business management information systems in the world, in all parts of business operations (from accounting and finance to warehouse operations), as well as the continued education of employees, "RALU Logistics" increasingly ensures that they have their client's trust. The company has implemented RFID based WMS (warehouse management software), and route planning software, they offer the possibility of electronic data interchange (EDI) with retail facilities for receiving orders.

In order to facilitate the deep frozen mode of operation, the company implemented a pick-to-voice system, and it is planned to offer all services referring to sales planning and forecasting of necessary supplies on the basis of historical data, taking into account all the specific days affecting the sale (end of school year, public holidays, etc.). In this way, "RALU Logistics" will offer to their clients a complete logistics solution – starting with inventory planning to delivery of products on retail store shelves.

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<sup>3</sup> Systems, Applications & Products, the renowned German company which produces software.

As an independent supplier of integrated logistics services, this company differs from its competition because it is focused only on superior level of logistics services. Its clients are chain stores and manufacturers for whom the price is not the only and the most important element, but they pay attention to reliability, guarantee cold chain integrity and traceability, and maintain the highest level of product safety.

As an independent logistics company, “RALU Logistics” can simultaneously provide logistics services to clients who may also be market competitors and offer them the opportunity to be focused on their core businesses.

As a logistics specialist, through its own synergy “RALU Logistics” can offer optimal logistics services aware that any form of business competition increases with the growth of focus on their own core business. Increasing knowledge of the business world that no one can be perfect in all elements of business operation and outsourcing impose the necessity of the existence of companies such as “RALU Logistics”.

This company aims to be the first choice of those who will outsource cold chain logistics from their core business activity, so their investment and development focus exclusively on processes and equipment essential to logistics operations of that form.

It also differs from its competition by the level of systems implemented to maintain the quality of goods and the cold chain integrity. As forerunners in Croatia, they have implemented the IFS (International Food Standard) in logistics, and they strive toward a leadership position in the area of quality assurance and food safety as well.

Offering a complete service with its own equipment that enables taking delivery of the goods anywhere in Europe makes that company different from others.

Due to the environment the company operates in, it is slow to reach the intended results. The process of economic integration of the Republic of Croatia into the EU is taking place more slowly than expected because foreign companies have belatedly recognized and used a good geostrategic position of Croatia in terms of logistics.

On the other hand, the crisis and the decline in the purchasing power have slightly slowed down the plans to develop toward the east, and since Europe has opened to us, we have opened to the competition in transportation. The result is a drop in the prices dictated by companies from countries with a lower standard of living and lower labor and business costs, which joined the EU before Croatia and thus managed to adapt well (e.g., Lithuania, Romania, Bulgaria). These companies are now our competitors.

Eastern Europe countries have also recognized transportation as an important part of the export-oriented industry and the development of this industry is thus encouraged by various measures.

Regardless of everything, since Croatia joined the EU the share of transport “RALU Logistics” has done for its clients is constantly increasing, and the long-term sustainability of transport is evident in the further development of specialized transportation within the EU and by using their own vehicles in the provision of integrated logistics services.

#### 4. THE SITUATION IN CROATIA AND COMPETITIVE COMPANIES AND LOGISTICS OPERATIONS IN THE SEGMENT OF COLD CHAIN

Currently, there are small shifts in the development of the logistics market in Croatia. We believe it is important to point out that without growth and investment in manufacturing and export and with no increase in consumption, there no serious progress will be registered in this economic activity.

Investments of “RALU Logistics” in the construction of the logistics and distribution center in Rugvica is one of the few major investments in logistics in the Croatian territory, but many analyses have shown that in terms of logistics Croatia lags behind trends in developed markets in many respects, e.g., only 30 per cent of logistics is outsourced, while 70 per cent still remains in house. From producers to small traders, everybody does everything, but it is clear that this trend will have to change. There must be specialization and outsourcing, because companies are becoming less competitive and they spend their capital on ancillary activities. This gives hope that the logistics services market will wake up quickly and change the image in the market.

**Table 3:** The analysis of competition in the provision of logistics services in the cold chain segment in the Republic of Croatia

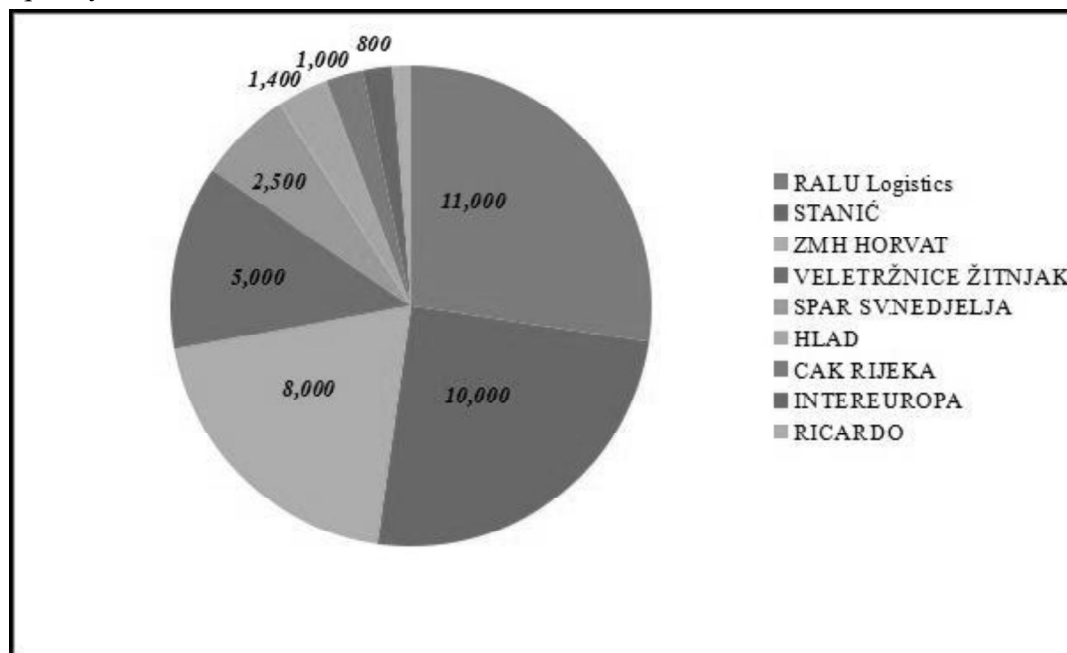
	Warehousing	Distribution	No of refrigerator trucks
<b>RALU Logistics</b>	11,000 PP <sup>4</sup>	national	180
Competitor	Warehousing	Distribution	No of refrigerator trucks
LOGISTICS COMPANIES			
<b>Stanić</b>	10,000 PP	national	100
<b>ZMH Horvat</b>	8,000 PP	national	outsourcing
<b>Veletržnice Žitnjak</b>	5,000 PP	n/a	
<b>Spar sv. Nedjelja</b>	2,500 PP	n/a	
<b>HLAD</b>	1,400 PP	n/a	
<b>CAK Rijeka</b>	1,000 PP	national	outsourcing
<b>Intereuropa</b>	800 PP	not refrigerated	
<b>Ricardo</b>	500 PP	Slavonia	15
MANUFACTURERS			
<b>Dukat</b>	9,000 PP	national	50+outsourcing (100)
<b>LEDO</b>	4,000 PP	national	150

<sup>4</sup> PP stands for pallet positions.

	Warehousing	Distribution	No of refrigerator trucks
<b>PIK Vrbovec + Zvijezda</b>	3,000 PP	national	140
<b>Mlinar</b>	1,000 PP	only for their own use	
<b>Pan pek</b>	1,000 PP	only for their own use	
<b>Private carriers</b>		used by Vindija, Gavrilović, Meggle	
<b>TOTAL</b>	<b>58,700 PP</b>		

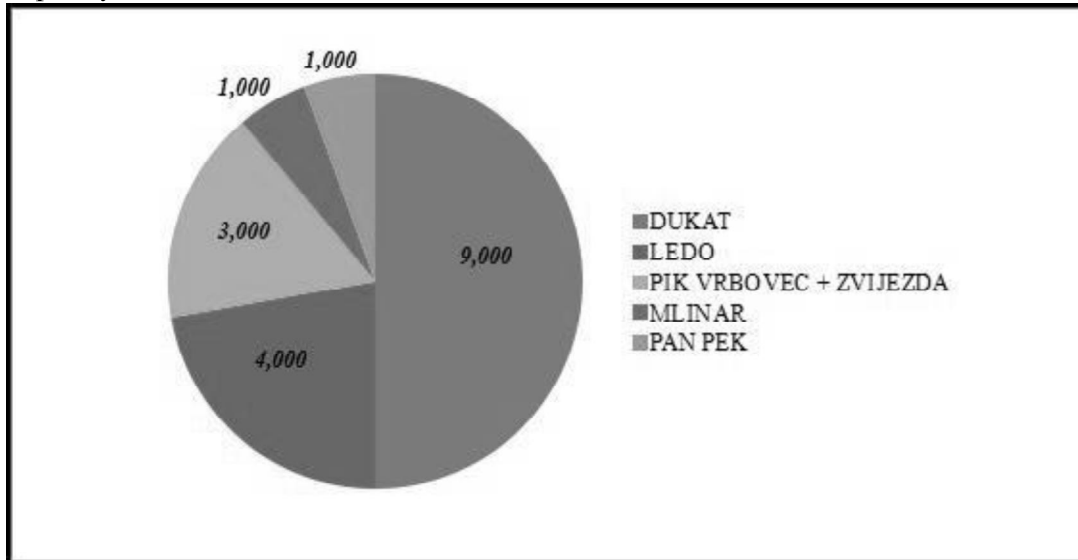
Source: RALU Logistics

**Chart 1.** Logistics companies - the number of pallet positions of refrigerated storage capacity



Source: RALU Logistics



**Chart 2.** Manufacturers - the number of pallet positions of refrigerated storage capacity

Source: RALU Logistics

## 5. CONCLUSION

The paper provides specific measures improved in the use of IT technology to make the turnover rate of cold chain. This interdisciplinary paper gives a detailed analysis of the necessary IT infrastructure well-known in the market. Its usefulness in certain segments of logistics operations has been demonstrated, and by using an example of a leader in Southeast Europe in the segment of cold chain, we tried not only to provide guidelines for the future development of companies in this business segment, but also to open space for new research in this direction in order to optimize work in this sector as much as possible by means of synergy of IT and economic knowledge.

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