



# World Scientific News

An International Scientific Journal

WSN 105 (2018) 122-133

EISSN 2392-2192

---

---

## Rationalization of warehouse space as an element of business management in the context of sustainable development

**Justyna Imiołczyk**

Faculty of Management, Czestochowa University of Technology, Czestochowa, Poland

E-mail address: [justyna.celica@gmail.com](mailto:justyna.celica@gmail.com)

### ABSTRACT

The subject of consideration of the following study is the application of the principles of sustainable development in shaping the company's warehouse space. Sustainable enterprise development exists when enterprises take care of their external and internal environment, and implement the principles of rational management in all areas of activity. Proper storage space management is associated with the rationalization of many important aspects of the organization's activities. The article presents the most important assumptions of the concept of sustainable development and the mechanism of functioning of this concept in relation to the management of the enterprise in the area of shaping the warehouse space. Based on the description of Danone's activity, an attempt was made to find elements of sustainable development in the development of storage space

**Keywords:** sustainable development, warehousing, company management, rationalization of warehouse space

### 1. INTRODUCTION

There are many definitions of sustainable development. While trying to find their common point, one can note the assumption about the interdependence and equivalence of three aspects such as ecology, economics and society. Optimizing mutual relations between

society, economy and the environment requires the development of new, more efficient and environmentally friendly technologies, introducing restrictions on the use of natural resources, energy consumption and elimination of polluting forms of production harmful to the environment, as well as changing the current hierarchy of values, in which the environmental aspect is put in first place. The idea of a sustainable striving to preserve natural resources and ecosystems means that we should strive not only to change the forms of economic activity, but also to limit consumption. [1] Enterprises play a key role in the sustainable development of the economy.

It is therefore to be expected that they will take responsibility for their impact on the environment. In the past, the protection of the environment and resources did not occupy a proper place in the minds of managers. Currently, the public and many public institutions are increasingly turning to companies to take into account the principles of the concept of sustainable development in business management. This aspect has become a new challenge for the organization. In response to increasing environmental awareness and social responsibility, sustainable development is implemented in the various spheres of activity also in the logistics area. Sustainable development should become an integral part of business management, and in particular include logistics related departments in an area that can implement many activities contributing to increasing its level. [2]

## **2. DEVELOPMENT OF STORAGE SPACE IN THE ASPECT OF THE CONCEPT OF SUSTAINABLE DEVELOPMENT OF ENTERPRISES**

The development of the company is its gradual increase in achievements and market position. Thus, development is such an orderly change in which progress is made. It can be determined by stating the improvement of the most important economic indicators of organizations such as, for example, profit, turnover, employment levels and non-economic indicators (working conditions, organization culture, actions for employees, relations with external entities), it should be noted that non-economic indicators often they influence the growth of economic indicators. Development is defined as a directional change, irreversible and ordered. The changes initiated by the management staff do not always lead to progress, they may contribute to the deterioration of the company's situation (regressive direction) or may not significantly affect the organization's activity despite taking specific actions (conservative direction). An important aspect of the development are the company's relations with the environment as well as the position and brand of the organization. The use of unfair practices to increase profits, or the sale of lower quality products leads to a weakening position and credibility, which in the long term is disadvantageous for the company. [3]

Recently, an increase in the importance of green technology has been observed, which is to a large extent due to new legal regulations. The need to reduce pollution or emission of harmful substances for the environment and the introduction of fees for oversize production contributes to the increase in the profitability of pro-ecological solutions.

Another factor increasing the popularity of pro-ecological solutions is associated with a trend based on social sensitivity or sustainable development, which is positively perceived by the environment and translates into image success.

Contemporary economy is forced to implement solutions reducing its negative impact on the natural environment. This also applies to logistics to a large extent. Increasing

European restrictions relating to exhaust emissions necessitate the reduction of pollution emitted by heavy vehicles, but significant changes are also taking place in the warehouse management.

Balanced warehouses are constantly implemented and improved solutions. They use modern technologies and organizational changes. They should be primarily ecological and energy-saving, use as little energy as possible and emit little pollution. For their construction, environmentally friendly materials and, where possible, recyclable materials should be used, and most equipment should have the characteristics of environmentally friendly products. [4]

### **3. SHAPING THE STORAGE SPACE –THE DANONE CASE STUDY**

The Danone Group was founded in 1973. On the Polish market, Danone products appeared for the first time in 1990. Initially, they were imported, but at the end of 1992 it was decided to start production in a Warsaw factory - in leased halls of the Wola Dairy. [5]

As one of the CSR leaders (corporate social responsibility defined as formulating the company's goals than only in terms of economic interest, but also including social and ecological aspects in the business, and building a dialogue with stakeholders) [6]. For years, the company has been consistently trying to minimize the negative impact of its operations on the natural environment. Danone assumes that nature-friendly management must take into account all the company's activities affecting the environment, starting from the concept of a new product, through obtaining raw materials necessary for its production, production process, transporting products to customers and consumers to the fate of packaging, which consumption of the product may become a disruptive for the environment.

Strategic programs of social involvement of Danone in Poland are focused on the fight against malnutrition of children. To this end, the company has initiated a nationwide Share Meal program, whose main goal is to fight against malnutrition in Poland

The development of warehouse space is a complicated decision-making and organizational process. The first problem faced by the management of an enterprise investing in the construction of a warehouse is to plan the distribution of areas in the warehouse. [7]. Danone Sp. z o. o. has a warehouse in Panattoni Park Świącice. The Polish branch of the global industry leader has a modern distribution center, Panattoni, located in Świącice near Warsaw. It is a build-to-suit investment (BTS), with an area of 13,600 m<sup>2</sup> with the possibility of extending the building to 16,300 m<sup>2</sup>. The facility consists of an office and warehouse part, which is characterized by solutions of the FMCG industry, including controlled temperature (from 4 °C to 6 °C in the warehouse section). [8]

Danone cooperates with Kuehne und Nagel, which serves the distribution center for fresh dairy products in the southern part of Poland. The contract concerns an object in the Park ProLogis Park in Chorzów where the company manages the warehouse space and provides services of receiving and receiving goods, storage, sorting, repacking and preparation of orders exactly on time (the Just in Time concept is one of the most commonly used logistics concepts that provides material and other resources for production in strictly specified quantities and at precisely the time when their use is necessary) [9]. Kuehne und Nagel has developed software that allows you to combine your own inventory management system with the existing IT architecture of Danone.



**Figure 1.** Panattoni Park Świącice  
[Source: Information material for the Panattoni Europe distribution center 2018]



**Figure 1.** Kuehne und Nagel warehouse  
[Source: Information materials of Kuehne + Nagel 2018]

Outside of Poland, Kuehne und Nagel provides logistics services to Danone on many strategic markets, such as France, Ukraine, Brazil and Italy. [10]

The quantity and size of the area of individual areas depends mainly on the type of the assortment stored and on the specificity of the activity carried out by the enterprise. For this reason, the choice of the method of managing storage and picking zones is one of the most important problems faced by management in optimizing the use of storage space.

The storage and storage process is mainly influenced by the technology and storage technology. Storage technology applies to tasks that are performed in the storage process. However, the storage technique is called a set of buildings, devices and their appropriate arrangement in order to perform specific tasks in the storage process. The choice of storage method of the assortment in the warehouse depends also on the type of stored goods, which is why it is a difficult and very important organizational factor. The location of goods in the storage zone depends on the cycle of warehouse operations, labor consumption, the size of the storage space needs and the specifics of warehouse management. In the storage area, the most common methods of stock placement are The quantity and size of the area of individual areas depends mainly on the type of the assortment stored and on the specificity of the activity carried out by the enterprise. For this reason, the choice of the method of managing storage and picking zones is one of the most important problems faced by management in optimizing the use of storage space.

The storage and storage process is mainly influenced by the technology and storage technology. Storage technology applies to tasks that are performed in the storage process. However, the storage technique is called a set of buildings, devices and their appropriate arrangement in order to perform specific tasks in the storage process. The choice of storage method of the assortment in the warehouse depends also on the type of stored goods, which is why it is a difficult and very important organizational factor. The location of goods in the storage zone depends on the cycle of warehouse operations, labor consumption, the size of the storage space needs and the specifics of warehouse management. In the storage area, the most common methods of stock placement are:

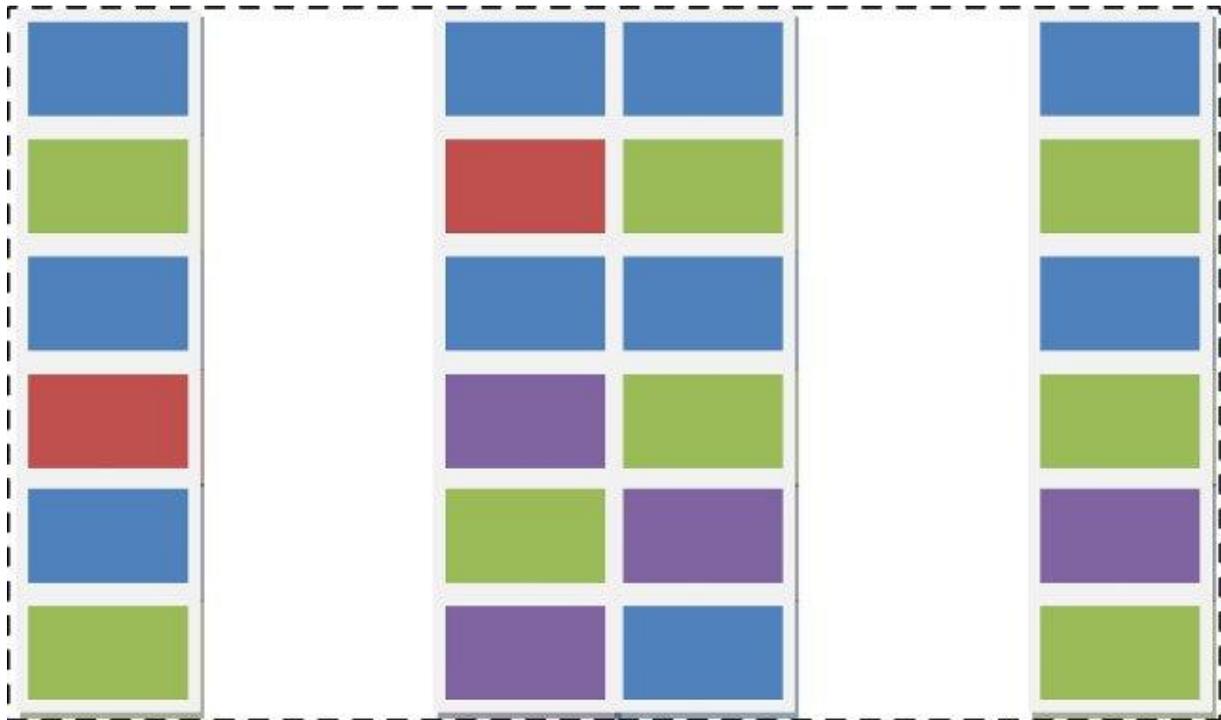
- the method of permanent storage places,
- method according to rotation,
- method according to storage levels,
- method according to the type of loading units

The method of free storage places consists in placing the goods delivered to the warehouse in free bookshelves. It is a method that absorbs storage space at the level of average inventory of each assortment, but at the same time requires the use of appropriate technologies: [11]

- use of logistic labels for marking of loading units and individual packages,
- marking all storage locations with the accuracy of the socket.

The method of free storage places, however, requires control related to the management of the storage space by means of dispatch tables. In large warehouses, the control function over the implementation of this method of storage space management is taken over by the WMS class IT system. The use of the discussed method makes it possible to maximally use

the space designated for storage of goods and continuous control of inventory for particular assortments.



**Figure 2.** The method of free storage places

[Source: Own study based on Hsieh, Ling-feng, and Lihui Tsai. The optimum design of a warehouse system on order picking efficiency. *The International Journal of Advanced Manufacturing Technology* 28.5-6 (2006): 626-637]

The method of permanent storage places allows storage of the same goods in one place in the warehouse. This is due to the fact that thanks to this method particular assortments are assigned to permanent constituent parts (sockets, sectors, rows, component fields, etc.). The discussed method is most often used in the case of warehouses characterized by a small degree of assortment diversity, because it gives the possibility of transparent management of storage areas, quickly finding the desired goods (even without the help of an IT system) and performing tasks related to picking. The essence of the method of permanent storage locations is shown in Figure 3. [11]

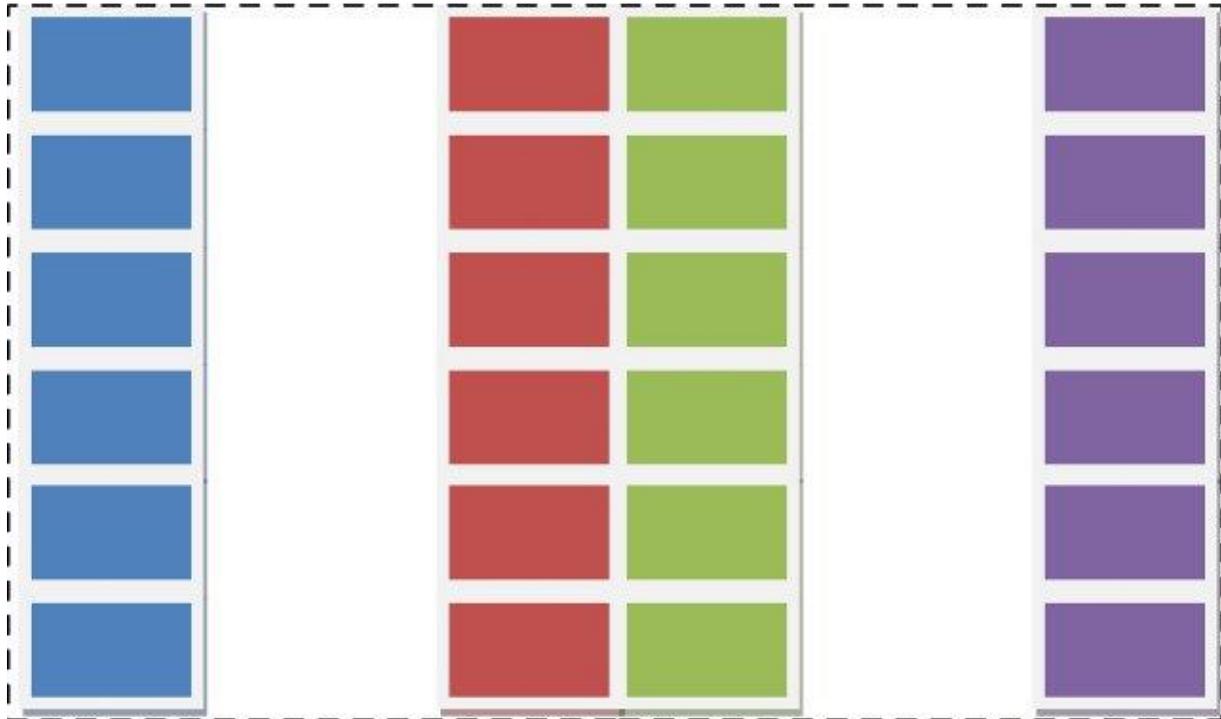
The basic disadvantages of this method include the relatively low use of storage space. This is due to the need to "reserve" free storage spaces for the needs of assortments, which are currently not available in the warehouse. It should be remembered at the same time that the method of permanent storage places needs space for storage of goods, equal to the maximum stock of each assortment present in the warehouse.

The method according to rotation, ie the frequency of issuing, consists in shortening the transport routes and the distance of goods moving in the warehouse through the rational distribution of assortments in rows of shelves in relation to the shelves. The size of the rotation of individual warehouse items, which result from the frequency of releases, is

decisive. Depending on the frequency of releases, appropriate groups are assigned to each assortment labeled with the letters A, B and C. where:

The method of permanent storage locations for storage locations is shown in Figure 2. [11]

- A these are positions with the highest frequency,
- B are positions with average rotation,
- C is the lowest rotation.



**Figure 3.** The method of permanent storage locations for storage location

[Source: Own study based on Hsieh, Ling-feng, and Lihui Tsai. The optimum design of a warehouse system on order picking efficiency. *The International Journal of Advanced Manufacturing Technology* 28.5-6 (2006): 626-637.]

In a warehouse characterized by a horizontal layout, the assortment assigned to group A is placed near the road connecting the entrance and exit of goods in the storage area. In the case of a vertical layout, the range is placed:

- in accordance with the characteristics of lifting the means of transport (average lifting height) in the case of warehouses operated by a stacker or high stackers,
- in accordance with ergonomic principles for human work in the case of manually operated magazines.

The method according to storage levels consists in sorting assortments according to the weight of loads. The division consists in assigning to each assortment a group marked with the letters A, B, C where:

- A these are loads weighing over 600 kg,

- B are loads with an average mass of 400-600 kg,
- C light loads up to 400 kg.

The method according to the storage levels is reduced to the arrangement of loading units in the shelves, taking into account the division into storage levels in such a way that the units of group A are located on the lowest pallet slots, group B in medium and group C in the highest seats. The basic criterion for such a separation is work safety, but also the conditions for handling efficiency.

The method according to the type of loading units is used in mechanized picking warehouses, characterized by a large number of various assortments stored on high storage racks. [12] The assortment is divided into the following groups:

- oversized choices, having dimensions larger than the dimensions of a standardized pallet load unit. For this reason, they do not fit in the normal shelf sockets, so they must be stored in the storage area for oversized items, eg in open spaces, on the square, under the shelter,
- normal products with dimensions compliant with the requirements of standardized pallet units, can be stored in universal bookshelves,
- small-sized products stored in small-sized packaging, such as: bags, cardboard boxes, welds. They require storage in special storage containers.

The described methods are not rigid rules for storing goods in a warehouse. The aim of the methods is to optimize, so very often there is a situation in which the mixing of individual methods is the most effective approach. Appropriate selection of the method depends on the requirements for the stock to be stored, and on the function to be performed by the warehouse in the supply chain. When analyzing the above methods, one should, however, remember to consider the expiry date of stored goods when planning storage space development.

The picking process consists in combining, collecting and compiling goods based on orders placed by customers. After the appropriate marking of completing orders, it is forwarded its shipping area, from which it is sent to the customer using various means of transport (eg, delivery truck, plane, train). The following division of the picking process is distinguished:

- completing at the place of preparation, i.e. static picking, consists in carrying out the order placed in the storage area by applying the "man-to-goods" principle. It should be remembered that if the order consists of a large quantity of goods, the employee needs a cart for transporting materials. Completing according to the "man-to-goods" principle can be performed using the following manual, mechanized and automated systems. The manual system consists in using the hand truck with which the warehouse worker moves around the storage area by selecting the goods that were placed in the order. The mechanized system uses a stacking trolley or racking racks. An employee who operates such a device executes orders, which include an assortment located on high storage racks. The automated system involves the operator only to operate the IT system, by means of which he assigns tasks that are performed by the system of belts and conveyors. The use of the IT system in the warehouse increases the efficiency of the customer's order fulfillment, but at the same time requires significant financial outlays. In the case of a warehouse with a small area,

where the implementation of customer orders does not create any difficulties for the warehouseman, using a fully automated system is not viable.

- completing in a designated place (other than the storage area), i.e. dynamic picking consists in the fact that goods in loading units are transported to the place where the picking process takes place as well as the execution of a specific order. This type of picking is carried out in accordance with the "goods to man" principle, using a mechanized and automated system. The mechanized system is carried out with the use of a universal lift truck, a universal shelf stacker and various types of conveyors, in order to speed up the transport of goods from the place of storage to the place where the picking process takes place. On the other hand, the automated system, like in the case of the "man-made" picking system, uses rack-mounted stackers and automatically controlled conveyors. [13]

Danone has implemented modern storage methods such as pick-to-voice voice control technology, gravity racks and automation of picking processes.

Vocollect voice-controlled technologies introduced in Danone increase efficiency and reduce errors in warehouse logistics. Maintaining inventory at optimal levels and increasing the level of customer service has become one of the priorities. Customer satisfaction is connected with the necessity of quick and efficient service - delivering the right products on time and in perfect condition. Warehouse operations must be efficient and the acceptance, handling and dispatch of products should be carried out with as few errors as possible. Mistakes in manual picking are expensive, both in terms of direct costs of transport and repacking, as well as damage resulting from the loss of dissatisfied customers. In recent years, in warehouse logistics, voice technologies have been used with great success, which allow employees to hear and respond to commands via headsets and microphones, keeping hands free, which translates into higher productivity. Such a system usually consists of headphones with a microphone and a belt with a computer device connected wirelessly to the company's IT system. High accuracy and increase in productivity contributed to a significant popularization of this technology in the warehouses of many industries.

The potential of this technology is not limited to manual storage systems. Technologies can be extended to many warehouse tasks, from registration and storage of goods to the synchronization of handling and management of forklift truck drivers. The software that recognizes human speech is already sensitive enough to operate effectively in noisy and dynamic environments, which is why managers are introducing this technology to subsequent sections of the supply chain. Warehouse employees can receive voice commands, ask questions and report without using paper documentation and without having to return to the picking point. Enterprises also report a reduction in the number of accidents and an increase in job satisfaction as a result of switching to voice systems. There are also additional benefits in the field of occupational safety, because employees can perform their tasks maintaining a more appropriate posture. [14]

Gravity racks are racks designed for storing fast rotation goods. A collective packaging in the form of a carton, package or container with goods in smaller packages is available on the wall of the rack, usually equipped with a horizontal line with a conveyor. The product is replenished from the second, back side of the rack. The advantages of the system include, first of all, collision-free work of supply and order picking teams, high density of goods on the warehouse surface, easy and transparent system of fast rotation goods storage, lower cost

compared to automatic machines and semi-automatic machines, unloading method according to the FIFO principle. [15]

Another solution used in the company is to automate the processes of complementation. It consists in replacing the employee with machines during pallet picking, labeling and transport to the appropriate warehouse. It is an automated system based on the palletization of the product by the robots, which found itself at the end of the production line, and then on its transport to the wrapping and labeling devices using laser-controlled vehicles. Such a system is attractive, among others due to the fact that the technologies are very flexible, so you can easily adapt them to any production plant. The entire process can be supervised using the WMS [16] system, which contributes to the reduction of product service costs. The strong point of the company is the creation of solutions enabling the cooperation of devices with forklifts in the vicinity of storage racks.

The issue of picking pallets for shipment is similar. On the basis of the order, the vehicles collect the pallet and transport it to the place of picking, from where the warehouse worker transports it to the proper vehicle. The whole process can be supervised by a warehouse management system, which increases the attractiveness of this solution.

In this system you can automate activities related to moving pallets between the production department and the warehouse, and replace workers with machines when preparing pallets in accordance with customer orders. The improvement of warehouse processes does not have to be limited only to the full automation of the warehouse. It may apply to selected storage processes, eg picking - picking systems are becoming more and more popular among warehouse managers.

An example of this type of system can be the Voice Picking voice control system. [17]

#### **4. CONCLUSIONS**

Sustainable development can be seen as a source of innovation, especially when it translates into increased profits. The perception of the company by the environment as an environmentally friendly entity contributes to the improvement of its image. Taking into account environmental aspects in running a business also affects the reduction of costs due to the lower consumption of materials and components, and also allows you to generate additional income and create new ventures. It should be assumed that more and more organizations will be interested in implementations in the area of sustainable development.

The management of the warehouse plays a very important role in the sphere of activity of each enterprise. The manner of storage management and the application of principles used in the storage and picking up of goods affect the competitive position of the company and the level of customer service. The dairy industry must ensure that products are perceived by consumers as fresh and healthy .. In the case of the dairy industry, the process of storage space management requires even more work and commitment from the enterprise than it is in organizations with other specific activities. In the development of the dairy store, the most important thing is that the products keep their freshness and reach the final recipient as soon as possible. Therefore, manufacturers follow a lot of rules to improve the storage process, such as FIFO, FEFO, and introduce newer storage technologies such as pick-to-voice or gravity racks. An important element of storing food and dairy products is to maintain the right temperature in the store and the use of appropriate refrigeration systems.

Danone, like other companies representing the branch of the dairy industry, must ensure proper storage, storage and transport of products. In all Danone factories in the world there is Danone Quality Card, which sets the highest standards for safety and quality of products. In order to improve the quality of products, Danone adheres to the quality standards ISO 22000: 2005, ISO / TS 22002-1, as well as the environmental management system ISO 14001: 2004. As a responsible social company, Danone goes beyond the generally accepted standards for safety and quality of products. It ensures quality control over the entire time the product is created, from the farm from which the milk comes to the factory. As a result, both the company and the growers can be sure that the consumers are supplied with products of the highest quality milk, whose origin and production conditions are fully known and comply with the regulations. The company monitors production at every stage, and then checks the conditions of transport and storage of our products in warehouses and warehouses

## **References**

- [1] Martínez-Alier, Joan, et al. Sustainable de-growth: Mapping the context, criticisms and future prospects of an emergent paradigm. *Ecological economics* 69.9 (2010): 1741-1747.
- [2] Mishra, Nishikant, V. Kumar, and Felix TS Chan. A multi-agent architecture for reverse logistics in a green supply chain. *International Journal of Production Research* 50.9 (2012): 2396-2406.
- [3] Laursen, Keld, and Ammon Salter. Open for innovation: the role of openness in explaining innovation performance among UK manufacturing firms. *Strategic management journal* 27.2 (2006): 131-150.
- [4] Meneghetti, Antonella, and Luca Monti. Greening the food supply chain: an optimisation model for sustainable design of refrigerated automated warehouses. *International Journal of Production Research* 53.21 (2015): 6567-6587.
- [5] Kolk, Ans, and Rob Van Tulder. International business, corporate social responsibility and sustainable development. *International business review* 19.2 (2010): 119-125.
- [6] van den Berg, Jeroen P., and Willem HM Zijm. Models for warehouse management: Classification and examples. *International journal of production economics* 59.1-3 (1999): 519-528.
- [7] Zheng, Qiubao, and Hidenori Kimura. Just-in-Time Modeling for Function Prediction and Its Applications. *Asian Journal of Control* 3.1 (2001): 35-44.
- [8] Carter, Craig R., and Dale S. Rogers. A framework of sustainable supply chain management: moving toward new theory. *International journal of physical distribution & logistics management* 38.5 (2008): 360-387.
- [9] Rouwenhorst, Bart, et al. Warehouse design and control: Framework and literature review. *European Journal of Operational Research* 122.3 (2000): 515-533.

- [10] Autry, Chad W., et al. Warehouse management systems: resource commitment, capabilities, and organizational performance. *Journal of Business Logistics* 26.2 (2005): 165-183.
- [11] Ramaa, A., K. N. Subramanya, and T. M. Rangaswamy. Impact of warehouse management system in a supply chain. *International Journal of Computer Applications* 54.1 (2012).
- [12] Chow, Harry KH, et al. Design of a RFID case-based resource management system for warehouse operations. *Expert systems with applications* 30.4 (2006): 561-576.