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Modular logistics - effective distribution

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Paper discussed the impact of Physical Internet implementation on the supply chains of tomorrow. Particular attention was paid to the influence of modular units to efficiency of the logistics in distribution processes. Author presented the potential benefits of using modular formats.

Key words: Physical Internet, modular loading units, packaging, supply chain of tomorrow

Introduction

Demanding customer expects to receive a high quality product at the lowest price possible in the shortest possible time. Moreover, universal access to information allows him to compare any number of listings and to choose the most convenient for him. "Logistics is an integrated process of shaping and control of physical movement of products and their determinants in order to obtain information similar to the optimal relationship between the level of services provided and the level and structure of the costs"(Urbańska, 2008). Effective supply chain management allows companies to fully respond to the expectations of their customers while building a competitive advantage (Skowronek, Sariusz-Wolski, 2008). Volatility of market trends and consumer preferences requires companies flexibility and adaptability, which is unfortunately often associated with a costs increase. The main logistics objective is to optimize the processes by minimizing expenses while maintaining a high service quality.

The efficiency of the distribution and flow of goods in supply chains is a constant challenge for logistics practitioners and scientists. Despite many process optimization attempts, manufacturers, logistics operators, distributors and consumers still face very high costs associated with handling the flow of goods. This is reflected not only in the economic aspect, but also in the environmental and social aspects. Solving this problem is a global task. The aim of this great challenge is to enable the global sustainable development of the mobility of physical goods, their storage, creation (production, assembly, processing) and distribution. The achievement of this objective can be measured in three aspects: economic, environmental and social. From an economic point of view, freight logistics should generate the lowest possible costs for suppliers, customers and consumers, and maximise profits for logistics service providers. Reconciling these two objectives is only possible by increasing the efficiency of logistics processes. From an environmental perspective, the main task is to reduce energy consumption, increase the share of so-called "green energy" and reduce greenhouse gas emissions. In the social aspect, it is important to improve the quality of working or living conditions of people with difficulties in the area of logistics and their families, as well as to increase access to modern infrastructure for the general public.

1.Logistic challenges in FMCG industry

FMCG is a very dynamic industry. Manufacturers and distributors have to be agile in order to satisfy needs of the clients. Prices are quite low so are the profits. That's the reason why companies has to find the ways to minimize their logistics costs and find best possible solutions. It is said that logistics costs in the FMCG supply chains are 30 % of sales. That's the highest rate in comparison to all the other industry sectors.

Challenges of the FMCG industry handling primarily result from the massive scale of operation. This requires considerable resources and logistics management on a large scale. Distribution networks are becoming more and more complex, and therefore there is a need to pay more attention to the effective transportation systems and their optimization in the long run. Chain stores with hundreds of retail outlets have become an important customer for the producers, and with the scale of operations can influence the shape of the finished products. This leads to a situation where more and more producers are forced to adapt products to the needs of specific chain stores through a dedicated package and the necessity of keeping the retailers imposed terms and conditions of supply.

In FMCG industry products are quickly disappearing from the store shelves, therefore the logistics task is continuous inventory tracking and regular replenishment. Increasing delivery frequency reduces primary transport loading. The need to involve a huge amount of resources entrusts logistics service to outside companies. Support for the FMCG industry is realized by many logistics providers in the facilities dedicated to specific chain stores or selected manufacturers. Due to a large volume of flow dedicated warehouses are often located in logistics parks that have a very good access to the infrastructure. It needs to be mentioned that FMCG distribution networks remain fragmented. It causes problems in cooperation and at the same time is the reason why the cost are high and efficiency is hard to gain. Lack of transport collaboration on more frequent customer deliveries causes reduced vehicle fill. Delivery load utilization is often at the level of 50%.

Nowadays FMCG sector is really demanding in terms of logistic operations, however price is no longer the most important issue. When it comes to building the strategic partnership with a logistic service provider there are some new factors that play a significant role. First of all lead time and punctuality, access to the real time information about the process realization and smooth communication between engaged parties. What is more clients pay attention to distribution centers localization and transport conditions that would shorten delivery time. However, the factor that gains much importance recently is an ecological aspect. More and more clients even claim that eco factors are equal to economical.

The great diversity of products and the variability of volumes are the most characteristic features of the FMCG sector, which leads into the need of providing variety of services. The expectations placed in front of a logistics operator can be defined as achieving unlimited flexibility while maintaining the highest quality and the lowest possible cost concerning ecological aspects. Of course, such a perfect set of criteria is a challenge that requires a detailed analysis of the process and often to adjust to conflicting goals. Distribution systems of goods may differ from each other but regardless of the specifics of a supported product in case of fast-moving goods, logistics operator always has to reckon with the criterion of time and the requirement of process automation.

The FMCG industry is constantly changing resulting from a fierce fight for the customer. Although in the first instance this means

competition at the sales level, changes sooner or later also move to the entire production and logistics. The economic crisis primarily hit retail customer consumption. Purchasers today demand more favorable rate between quality and price, which has forced many manufacturers to look for room for savings. While in the case of savings on raw materials and production processes, changes reflect in the quality of the final product, the logistics savings does not necessarily mean a lower standard of customer service. And that is the greatest argument why the Inter-connected network should be taken into consideration. Moving from current dedicated networks to open agile consolidated system is an opportunity to accelerate systemic velocity and increase vehicle load. What's more such network enables growth of inter-modal flows in connection with improved communication between interested parties. Thanks to the Inter-connected network shared transport system allows high frequency deliveries.

2.Principles of the open logistic network

On the basis of the above facts in 2015, the three-year work under the European Horizon 2020 programme called Modulushca was completed, in which, as a Polish partner, the Institute of Logistics and Warehousing from Poznań took an active part. Modulushca is a project which in its activities referred to an innovative vision of the implementation of logistics processes called Physical Internet (Physical Internet Manifesto see: http://www.physicalinternetinitiative.org/). Its main task was to develop a universal framework for cooperation in an open logistic environment, assuming a complete and unwavering flow of information and cooperation going far beyond standard schemes. The concept of Physical Internet is based on full sharing of supply chains, resources and infrastructure.

The promotion of cooperation in the field of logistics services is dictated by the inefficiency and instability of the current organisation of the logistics system. Transport, due to incomplete use of cargo space and limited information on the availability of resources in real time, generates significant economic, social and environmental costs. Another important aspect affecting low operability, especially in FMCG distribution, is the lack of modularity of loads. This has a negative impact not only on the transport process, but also on handling and storage activities.

The Modulushca project, following new trends and meeting modern problems, influenced the introduction of a change in the approach to cooperation in the logistics system. Thanks to the joint activities of the world of science and business, members of the consortium developed innovative solutions based on both research work and practical experience of companies from all over Europe [Procter & Gamble, CHEP, ITENE, ILIM, EPFL, Jan De Rejik, Poste Italiane, ARMINES, Uni. Laval Canada, PTV, MEWERE, TU Graz, TU Berlin, Kirsen Global Security]. One of the main objectives of the project was to develop a model and prototype of a new standard of a logistics unit, which would allow to implement the idea of full cooperation and effective logistics organization within the FMCG distribution network (Montreuil, Meller, Ballot, 2010). The results of the development work to date will be presented below.

This innovative concept is based on three main pillars. First is the combined infrastructure. It means that companies start to take action aimed at optimizing the operation of such resources like storage space, vehicles capacities and production systems through sharing. The current situation shows that most companies are not in a position to fully exploit its potential, thereby freezing their capital. The market of logistics services will strive to create a common infrastructure. Logistics centres, hubs and transit points located all over the world will be widely available to all operators, thus creating one global network. The ability to use a large amount of docs will increase the efficiency of transport. The first tests of such activities were conducted by P&G and Tupperware. Thanks to the collaboration and joint programming of supplies they were able to reduce logistics costs by 15%, reduce CO2 emissions by 2 million tonnes per year and increase the vehicle utilization from 55% to 85%. But these are not the only such initiative in the market. Companies such as Walmart, HP, Volvo and Boeing are also heavily involved in the implementation of this concept among its business partners.

The second area is the introduction of modular cargo units. Trying to be achieved through the use of analogy of the Digital Internet data distribution in physical processes in the real world. Digital Internet does not provide the information but only transmits packets with embedded data. These packages are designed in such a way as to be easily recognizable by internet networks. Information in the package is closed and is not directly decoded by the network. The packet header contains all the information necessary for the identification and designation of transit routes to the destination. Digital Internet is based on protocols that structure the data packets regardless of the mode of transmission. In this way, they can be processed in different systems and networks such as modems, fibre optic cables, routers, local area networks, Intranet, Extranet and virtual private networks. (Sarraj, Ballot, Hakimi, Montreuil, 2014). Similarly to the Physical Internet (open logistics network) will not handle the goods directly (whether they are raw materials, components or finished products), but only manipulated specially designed modular containers that allow an encapsulation of these goods. Target solution involves a complete change of pallet system into modular loading units. This involves, of course, the adaptation of vehicles, handling equipment and warehouse space that will allow handling this type of packaging. However, simulations conducted for research projects clearly demonstrate that the investments made in the long term will help to significantly reduce logistics costs and losses related to the movement of goods. Containers thanks to the folding panels can create boxes of various sizes tailored to the individual needs of the sender (Montreuil, 2014).

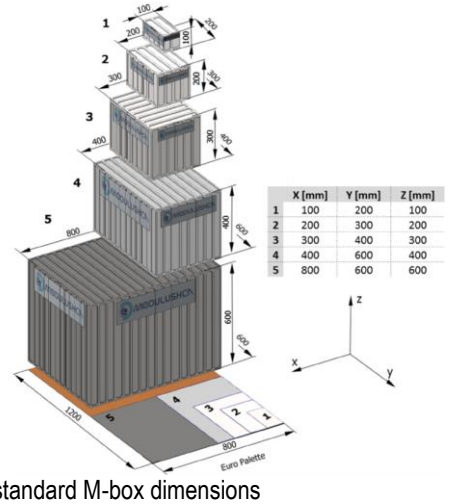

Fig. 1. Proposed standard M-box dimensions
Source:
https://www.researchgate.net/publication/283340613_Containers_for_the_Physical_Internet_requirements_and_engineering_design_related_to_FMCG_logistics

M-Boxes are easy for handling, storage, transport, loading and composition. They have a standard phrases recognizable throughout the system and are equipped with sensors and transmitters to maintaining full control during the transportation process. As a

result, shipping safety is maintained throughout the journey, and all actors involved in the distribution have full overview of the status of the order. Moreover, the package is reusable and easy to recycle.

The last pillar is the exchange of data. This is the most crucial element of the whole concept. Physical flow of information in the Physical Internet will operate through an integration of infrastructure. In the PI you would be able to report and organize the individual orders from your own ERP system in a standardized format, which will be processed into 'the cloud' and decrypted by the other participants in the process. An important aspect in this data exchange is the access level. The architecture concept, developed so far, has designated four areas. Information on the container (its designation, dimensions, special conditions of carriage) will be available to all, then the data associated with the transport process (detailed route and delivery address), reserved only for the carrier. Another area is an information covering the delivery data such as sender and recipient, description of goods, value of the contract and the terms and time of delivery. For this type of data only logistics operators and customs will get an access. Most sensitive information will be used only by the sender and recipient, and will be associated with contracts, number of orders, invoicing or discrepancies in the delivery.

Logistics operators, carriers and owners of the storage infrastructure will also share their detailed information. They will provide information on the availability of their resources, capacity and the status of implementation of orders. By combining all these data, the system will optimize the process and suggest the best possible solution for minimizing the cost of each of the participants in the process. Physical Internet is called the concept of win-win-win, because it allows the balanced growth of all actors in the supply chain. (Zdziarska, 2015)

3.Modular format in the distribution process

An important step towards the realisation of the Physical Internet concept is the aforementioned introduction of modular loading units in which goods will be securely sealed. To justify the need for such a solution, the Physical Internet can be treated as an analogy to the traditional digital Internet. Information is transmitted on the digital Internet and tangible goods on the Physical Internet. Information on the Internet is sent in the form of packets, appropriately marked. Thanks to the marking it is possible to identify the packet - names, senders and recipients, while the content itself, the information is "closed" in the packet and is available only to devices or persons with appropriate privileges. Markings are stored in a standardized form. Similarly, the Physical Internet will not "handle" goods directly, but only manipulate specially designed modular containers that allow for full protection of those goods, which responds to the fears of broadcasters that the placement in one warehouse or vehicle of products of competing companies may allow access to trade secrets.

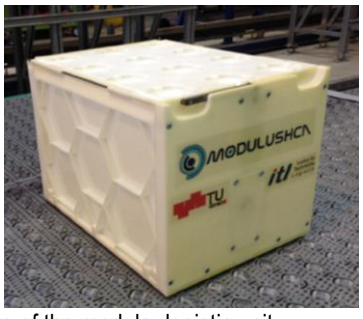

Fig. 2. Prototype of the modular logistic unit
Source:
https://www.researchgate.net/publication/283340613_Containers_for_the_Physical_Internet_requirements_and_engineering_design_related_to_FMCG_logistics

Modular loading units on the Physical Internet will be constructed in such a way that the elements can be joined together, folded out and folded several times, and ultimately easily recycled. A very interesting property envisaged by the creators of the Physical Internet concept is the possibility of using modular units as shop displays - through easy disconnection of selected walls. Modular loading units will be equipped with sensors that allow full control during the transport process - e.g. temperature, humidity, pressure, shocks. The units will be able to communicate with the Physical Internet system using transmitters sending information in a standardized e-Fright format available to authorized recipients (Landschutzer, Ehrentraut, Jodin, 2015)

Ultimately, the modular unit is to play the role of both collective packaging for products (equivalent to e.g. cardboard) and an alternative transport unit (equivalent to e.g. a pallet).

4.Potential benefits of implementation

- Preventing the spread of commercial information of competitors, such as transported volumes or new packaging for promotional campaigns
- Increased willingness to share means of transport and warehouse resources in distribution processes by competitors - reduction of operating costs
- Full monitoring of storage, transport conditions and geolocation during the entire distribution process (especially in the case of fresh products or products sensitive to temperature/humidity changes)
- Simplified identification of product liability for damage due to real-time data access (e.g. compensation from carriers)
- Possibility of easy consolidation of loads due to modularity of units - more efficient use of loading space - reduction of transport costs
- Use of data transmission from packaging sensors according to the global standard GS1 - eFright allowing companies to easily exchange goods and information at international level
- Possibility of creating new packaging sizes according to needs thanks to modularity of folding panels

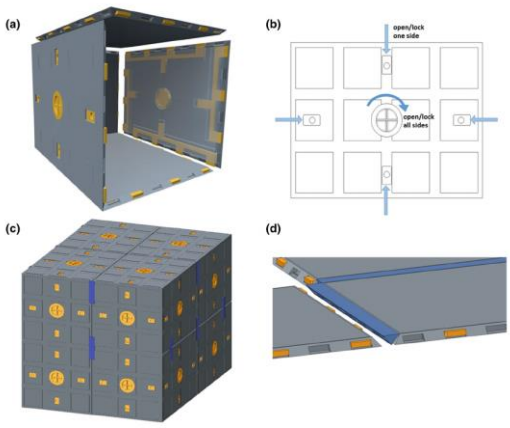

Fig. 3. Proposed outerdimensions for the M-box
Source:
https://www.researchgate.net/publication/283340613_Containers_for_the_Physical_Internet_requirements_and_engineering_design_related_to_FMCG_logistics

Summary

Physical Internet concept that was first introduced to FMCG distribution shows that efficiency growth can be achieved by sharing resources, information exchange and new reusable and recyclable

packaging under the condition of willingness to collaborate among involved parties. Physical Internet shows the new approach towards logistics operations and its positive impact on efficiency and cost reduction need to be further examined.

Full implementation of the concept of Physical Internet, i.e. the flow of products and commercial information in the safest and most cost-effective way, according to initial estimates, this is the work planned for the next 20 years. Despite the fact that it seems to be a rather distant horizon, the logistics industry environment is already intensively developing tools supporting cooperation in supply networks. Most activities are currently focused on IT solutions, although FMCG companies more and more often point to the need for increased activity in the area of collective packaging.

Standardization of flows and reloading operations, and thus reduction of logistics costs in the low-margin fast-moving goods industry is a key factor in building a competitive position. Speaking of PI-box, apart from standardization of this unit, the possibility of its modelling and use as a shop display, its significant feature is the ability to fully monitor the condition of goods and the course of the distribution process in real time. It is also a key factor giving a sense of security and appropriate protection of shipments on the Physical Internet (Ballot, Montreuil, Meller, 2014). Taking into account the above benefits, the concept of the Physical Internet with the use of standard modular units (M-box) seems to be an interesting alternative to the pallet transport system, which, although so well known and well-established from the logistic point of view, still leaves a lot to be desired.

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Modularna logistyka – efektywna dystrybucja

W dokumencie omówiono wpływ wdrożenia Fizycznego Internetu na łańcuchy dostaw przyszłości. Szczególną uwagę zwrócono na wpływ jednostek modułowych na efektywność logistyki w procesach dystrybucji. Autorzy przedstawili potencjalne korzyści płynące z zastosowania formatów modułowych.

Słowa kluczowe: Fizyczny Internet, modularna jednostka ładunkowa, opakowanie, łańcuchy dostaw przyszłości

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