

INDUSTRY 4.0 FROM THE ASPECT OF LOGISTICS INNOVATIONS

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ABSTRACT

In our paper, we are describing the industry 4.0 (including the smart factories, smart products, software and processes) from the aspect of innovation, especially logistics innovation. The Supply Chain related new products, methods, etc. are not part of our paper, our focal point is the companies' internal operation, their own development opportunities via industrial benchmarks. The benefit our study is the better understanding of the future's manufacturing processes, highlighting the competitiveness of each technologies. We shall focus on the entrepreneurs' continuous cost efficient efforts in order to the sustainable financial development.

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INTRODUCTION

As the global competition request, the companies shall reply to the questions of the continuously arriving challenges. In our paper we introduce the theoretical background of the logistics, the innovation, the industry 4.0 and their connection points.

1. DEFINITION OF THE LOGISTICS WITHIN THE LITERATURE

The material flow in the global economy relates to the bigger, stronger countries, like the USA. According to the most popular SCM organization of the US, the Council of Supply Chain Professionals (former Council of SCM), and definition of logistics is the following:

The process of planning, implementing, and controlling procedures for the efficient and effective transportation and storage of goods including services, and related information from the point of origin to the point of consumption for the purpose of conforming to customer requirements. This definition includes inbound, outbound, internal, and external movements. [1]

Later, the definition was corrected and the whole of it was inserted into the context of supply chain, the focus is on the economic and business.

From engineering point of view – according to the words of The International Society of Logistics at USA, the logistics shall be regarded as a professional discipline that ensures the successful support of the product throughout its life. From design engineering to manufacturing and materials, packaging and marketing, and distribution and disposition, logistics involves every possible phase of the product support process. [2]

The difference between the two understandings is the process focus, the CSCP's expression is stronger, because it considers the cost factors too.

According to the HALPIM (Hungarian Association of Logistics, Procurement and Inventory Management), the logistics is the summary of scientifically and practical knowledge, experience and methods, which are able to plan to execute the coordination of products, services, resources and information within and between systems in order to the process related optimal total cost and the satisfaction of the end users'.

2. THE LOGISTICS' CONNECTION TO THE COMPETITIVENESS

According to the opinion of the most quoted researcher of the supply chain, Professor Zoltan Szegedi's opinion, the main territories of the logistics is the procurement (supply of raw material), distribution, inventory management, warehousing, transportation, order management and their informatical background [3].

The logistic processes are related to the core business activity of a company (e.g. manufacturing), and to those poter qualified activities which are considered as supporting functions (e.g. corporate finance). After entering to the market, the competitive position shall be kept, one solution from the many opportunities is the rationalization of the company's cost (including the cost of the manufacturing and logistics). At a given manufacturing-cost function, the result of the manufacturing shall grow or the cost shall be lower level.

On the field of procurement, discovering new sources (and tracking the cost and comparing the plan-fact data, as logistics controlling), on the field of distribution the increasing of capacity utilization. On the field of inventory management the application of more precise models at the calculation and on the field of transportation, the combination of transportation methods and routes, on the field of ICT, the interned based solutions (special, logistics related solutions as fleet management, etc.) can result cost reduction.

3. THE THEORETICAL BACKGROUND OF INNOVATION

Adam Smith writes that one (from three) of the most important factor of the economic development is the machinery invention, which replaces and multiplies the human performance [4].

Based on the above, we shall consider that until today, there is an active debate within the professionals about the definition of the innovation. Sometimes, the innovation is mixed/identified or separated from the invention. Having Freeman's, a well known researcher's opinion, I divide the two definitions as follows: Innovation, when the result of an invention is used by wide range of people and it is somehow influences the life of people, the activity of companies or processes of the society. In opposite, the invention is an idea, a draft or a model, a new or a corrected tool for a product, process or a system [5].

From economical point of view, I think that the invention may related to the first commercial transaction, which can cover a new product, process of system, giving a new aspect to the Smith given technical development.

The most cited definition of the innovation comes from Schumpeter, but we would like to hereby note that at the time of the creation of the definition, the innovation as expression was not popular, therefore –similarly to the above mentioned Smith- Schumpeter had defined the development, but the scientific result is the following components' combination [6]:

1. New products or development of a previous one
2. New process, especially at manufacturing
3. New promotional opportunities
4. New sources
5. New organization

Having the Schumpeterian definition and Professor Szegedi's separation of the tasks, we can define the logistics innovation as follows: invention based commercial result, what are procurement, distribution, inventory management, warehousing, transportation, order management and their ICT background related new products, new processes, new promotional opportunities, new sources or new organization, which help to keep the competitiveness on the market.

4. APPLIED INNOVATION IN THE INDUSTRY

The development of information technology, ever-smarter devices, the growing role of the internet, as well as the appearance of cloud services that are merging technology and services all magnify the importance of computational data-processing and information services in the industry. The development of miniaturization and communication technologies make it possible for the ever-smarter micro-computers and embedded systems to communicate wirelessly over the World Wide Web. As a result, the physical and virtual world is increasingly merging creating a new, so-called cyber-physical system. The increased competition –mostly because of the continuously growing production of the Asian industry and innovation- makes obvious that the manufacturing industries shall have a solution, what they can reflect to the challenges with [7].

Cyber-physical systems are based on two increasingly converging innovation: in one hand on the technology of embedded systems, where a super-efficient 'compact computer' integrates every possible material, sensor and transmitter.

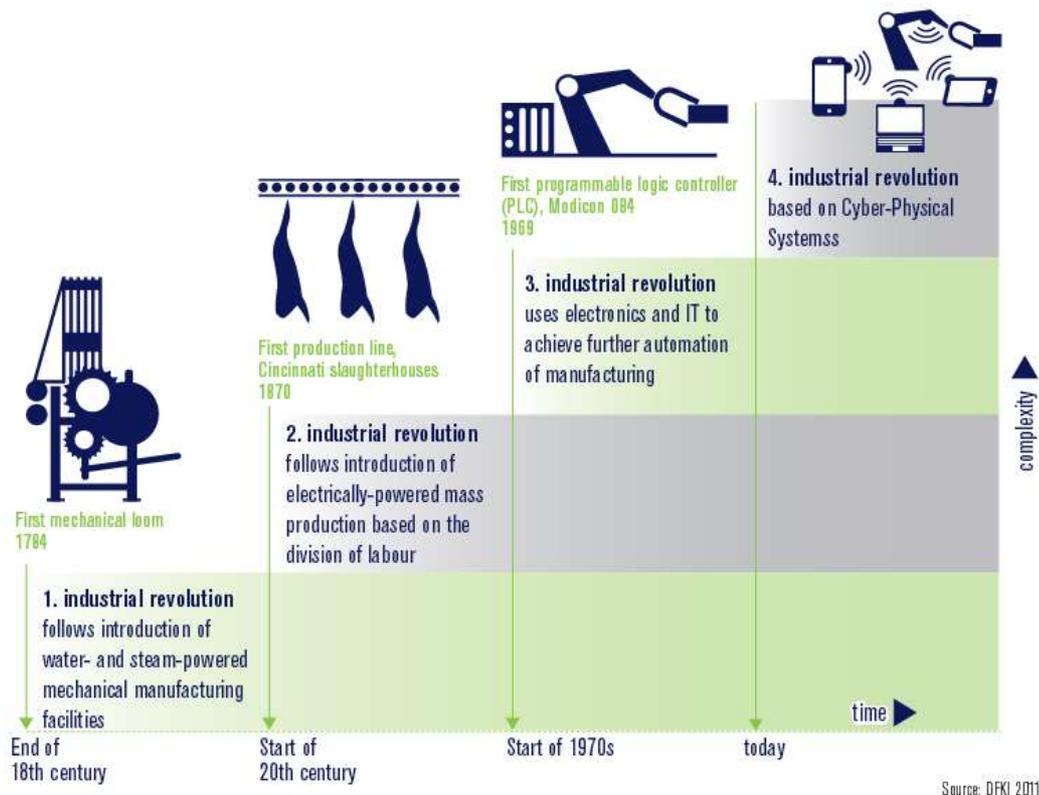
On the other hand, global data networks make the transmission and procession of large amounts of data possible. Therefore, cyber-physical systems are basically consisting of networks and connections of embedded systems over the internet, and any production component can be a part of them.

We would like to hereby show those components what are challenges to the XXI. Century industry according to our opinion:

- global competition
- market volatility
- customer designed product
- time-to-market and transportation performance
- sustainability of the product life cycle
- productivity and resource-efficiency
- lack of physical professional workers [8]

The German Federal Ministry of Education and Research called for Industrie 4.0 based on this technological evolution. This vision of a fourth industrial revolution is centered around the integration of the CPS into the logistical systems as well as around the introduction of devices and services into production processes, influencing value creation, business-models and corporate structures. This all creates a paradigm-change so important that it is not an exaggeration to be called the fourth industrial revolution [9].

Diagram 1 The four stages of the Industrial revolution



Source: DFKI,2011

The elaboration of this topic is started already in the USA under the name of 'Smart Manufacturing Leadership Coalition'[10].

According to the expansion of the ICT solutions, the future's manufacturing processes shall be imagined with definitely less personnel than now, similarly to the status at the beginning of the XIX. Century, from the aspect of personnel at the manufactures against the new technical solutions (machines) in the factories.

Using software (synthetizing the result of plenty of mathematical and engineering researches) at the smart factories in order to create smart products shall be the future [11]. The cyber-physical systems are based on technological developments which are converging to each other: from one side, the emended systems' basis technology, where the extra efficient small computers integrate all possible material and object what have sensors and signals. On the other side, there are global data systems, what make possible the huge quantity of data transfer and processing.

The innovative solutions at the manufacturing can contribute to the companies' competitiveness across reducing the overall cost or lift the revenue because of the better utilization of resources.

Industrial benchmarks are the basics of the innovation, because the automotive industry can "borrow" ideas from other sectors, use materials what previously were used at aero planes (or re-using metal components and seriously reduce their waste and reduce the need of brand new components.) A network like the industry 4.0 makes up-to-date data available from the status and environment of the machines. The high complexity control can be managed from far physical distance, furthermore, the cyber-physical systems make the value chain controllable during the whole product life cycle [12].

The matrix structure of the international companies can help to share the information with wide range of co-workers in order to ask their development suggestions from different professional point of view. The cyber-physical system can create the link between the resources, objects, information and people, what changes the industry fundamentally [13].

Because of the Industry 4.0 [14] the economy (and indirectly the whole of the society) is in front of a global change. The physical distance between the business partners becomes pointless, the regional or local clusters shall be replaced with the global economy. The role of the cities and regions shall be visible at the given answers to the question of innovation milieu and how does the regional economic development environment look like and how competitive is the region.

The connection between the regions, the logistics innovation and the industry 4.0 is the competitiveness [15], because the regional environment shall be attractive to the players in the industrial sector in order to settle plants to the region (wherever on the planet as they are independent from the most of the resources because of the global trade and economy). Those companies, who had settled down, are going to utilize the latest logistics related, developed solutions to manufacture there (actually, to create value there) not on other possible location globally.

Table 1 Comparison of the previous industrial revolution to the 4.0 version from logistics point of view

Industry 3.0	Logistic process	Industry 4.0
cost and risk reduction	procurement	sustainable allowances strategic
logistic total cost control	distribution	web based resource optimization
excel based calculations	inventory management	web based and connected databases and real time big data management
RFID and similar technologies	warehousing	intelligent vehicles and storing facilities
route and time optimization	transportation	intelligent vehicles and routes
ERP systems next to each other, link is just the order itself	order management	connected, automatized information and material flow
focus on automation	their ICT background	focus on network

Source: own creation of the authors

CONCLUSION

As part of the industry 4.0 solutions and applied tools, the logistics innovations are contributing to the corporate competitiveness and makes the manufacturing processes more efficient.

Compared to the previous processes, the new manufacturing is based on the complex big data management and the connection of the participants within the whole duration, from the component procurement until the finished product transportation to the customer.

The customer focus in the manufacturing makes the tailor made solutions more complex because of the different needs, therefore the servicers (manufacturers) shall be ready to offer a huge variety of components and methods. (One hundred years ago, Mr. Henry Ford was able to offer one type car in one color. Nowadays, car manufacturers are developing new vehicles based on each other's chassis, in uncountable variations and colors).

The new, innovative equipment (as for example, the drones within intra logistic processes) are part of the connected machinery, therefore the automatized and network-component systems making the companies operation more efficient, making the big data workable and making it possible, for machines to make (and control) machines without the man on the other end of the leash.

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