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THE HOLISTIC APPROACH OF E-LOGISTICS IN INTELLIGENT ORGANIZATIONS

Summary: Organizations are changing, or are capable of changing, profoundly in the information society of today. Intelligence organizations have the abilities to: adapt to changing situations; influence and shape their environment if necessary and to find a new milieu or reconfigure the business processes. Intelligent organizations is based on organization-wide e-logistics of interconnected solutions primarily related to operations. By integrating these and other potentially critical business functions, intelligent organization is a powerful tool for integrating and managing information to ultimately drive greater business performance and efficiency. But like so many other aspects of information technology, intelligent organization is always evolving and successful ICT professionals are highly conscious of the need for credible information on the trends and innovations that are reshaping, and can and will reshape the landscape of e-logistics use and implementation. This paper discusses how to deploy advanced e-logistics in Polish SME's information systems as intelligent organizations.

Keywords: ERP, ICT, intelligent organization, IoT, knowledge economy.

Introduction

The globalization processes of the world economy create the necessity to take fast and effective measures to adapt the operations of an organization to new market conditions. Advanced ICT solutions (*Information and Communication Technology*), which are the basic competitive factor of business organizations, are particularly open to the introduction of all types of innovation that may give a chance to increase the management efficiency. This fact contributes to financing subsequent research on new technologies and is the self-perpetuating mechanism of the search for innovative solutions. One of such areas includes the

properly designed and applied logistics systems in organizations. Due to the use of modern ICT solutions within the application of advanced organizational-IT solutions, they are called e-logistics [Grawe, 2009; Wiczerzycki, 2012]. The term means the broad application of the state-of-the-art ICT technologies to support management of business processes in an organization, e.g. within production, warehouse management, and order services as well as the management support with its business environment (in particular, the supply and distribution chains).

In the dimension of practical implementation, the applied ICT technologies are a mixture of hardware-software-organizational solutions, such as database and data wholesale technologies, communication technologies (wire, wireless, and hybrid), automatic identification methods (bar codes, RFID), computer aided manufacturing (CAM), supply chain management (SCM), enterprise resource planning systems (ERP), advanced planning systems (APS), customer relationship management systems (CRM), supplier relationship management systems (SRM), product life management systems (PLM), manufacturing execution systems (MES), warehouse management systems (WMS), satellite location systems (GPS, Galileo, Glonass), advanced business intelligence systems (BI), and the Internet of Things (IoT) [Vongsingthong, 2014; Wiczerzycki, 2012]. All these systems are implemented in a suitable data processing model (classical one or in cloud computing). Such technologies constitute a unique IT ecosystem, which enables to operate and develop advanced ICT solutions as attributes of innovation in intelligent organizations in the knowledge economy.

The aim of this paper is to give a holistic presentation of the characteristics and implementation conditions of advanced e-logistics solutions based on state-of-the-art of Polish SME's as intelligent organizations.

1. The essence of intelligent organizations

The holistic approach (Greek *holos* – whole) is a concept (contrary to reductionism), according to which any and all phenomena create global systems that are subject to specific rules that cannot be deduced based on knowledge about the rules that govern their components. The whole cannot be boiled down to the sum of its elements. This approach will enable to treat ICT conditionings in the context of the final effectiveness of discussed solutions [Quinn, 2002]. The development of ICT solutions is conditioned by the development of systems that support the operation of modern organizations, in particular advanced ICT systems. In the present world of business, where the largest organizations operate globally, the nature of their operation is the effective communication. There-

fore, the development of ICT and communication technologies is so essential. The growing importance of knowledge economy within global markets is determined by the operation of the more and more developed cooperation bonds.

The importance of ICT in modern organizations is growing at a breathtaking pace. Knowledge in the area of management combined with the familiarity with specialist conditions of IT solutions gives the synergy effect, which contributes to the higher competitiveness of an organization. Every implemented innovation that improves the quality of services in existing logistics chains should be characterised by [Adamczewski, 2015; Grawe, 2009]:

- reliability – a supplier should fulfil all expectations of a client concerning an order,
- lead time – detailing the time of an action that affects costs – it is often an important factor taken into account when selecting a logistics operator,
- the functionality of an operation – considering e.g. the option of technical cooperation,
- efficient communication – monitoring the transfer of cargo, materials, goods, payments, and information management, and
- integrity (the reliable presentation of possibilities and next rendering services in accordance with declarations).

Technological development in the scope of information and communication processes has recently become an indicator of advancing dynamics of economic management processes and their global-wise complexity. Trends in the field of the social media as well as mobile, analytical and cloud solutions, the so called SMAC (*Social, Mobile, Analytics, Cloud*) seen on the market of ICT services constitute a direct answer to growing needs of users of these solutions. Global determinants influencing the functioning of economic organizations and an increasing degree of co-dependency of logistic processes have resulted in the fact that modern market mechanisms are characterized by significant dynamics of changes of the economic environment. The measure of their adjustment is the possibility of building competitive advantage of intelligent organizations with the use of, among others, such factors as knowledge or intellectual capital of the staff, which allow for the implementation of development strategies. The key role is played by advanced ICT solutions supporting management processes executed by these organizations through the application of organization.

A intelligent organization is the one, which rests its operation philosophy on knowledge management. This term was popularized in the 1990s due to growing development of ICT, dynamically changing economic surroundings and the growth in market competition. A intelligent organization is a learning organ-

ization, with the capacity for creating, gaining, organizing and sharing knowledge and using the knowledge for the purpose of increasing the operational effectiveness and competitiveness on the global market. The idea of such an organization is founded on the system approach to the organization, namely treating it as a complex organism based on existing structures and implemented processes, with particular emphasis on the role of knowledge. In this approach – called the “fifth discipline” – owing to knowledge and relevant tools, all components of the organization and its staff are able to cooperate skillfully to implement defined objectives [Waltz, 2003]. By this, the whole organization operates as an intelligent, well-functioning organism in competitive surroundings. It clarifies mutual relations between the goal-achieving methods and their comprehension, problem-solving methods and internal as well as external communication.

The most important attributes characterizing intelligent organizations include, among others [Grösser, 2012; Schwaninger, 2010]:

- pace and flexibility of operation,
- the ability to observe the environment,
- the ability to diagnose market signals early and react to changes in the environment,
- the ability to implement new, knowledge-based solutions in a quick manner and, owing to this, achieve economic benefits.

The growing volume of information used in a intelligent organization increases its significance. Traditional production factors: land, labour and capital are losing importance to the benefit of the key resource, which in creative functioning of the organization is the knowledge; it stands for intangible resources associated with human action, the application of which may be the grounds for gaining competitive advantage. Knowledge may be treated as information placed in organizational context and the ability of its effective use in the organization's operation. This means that knowledge resources comprise data on customers, products, processes, environment etc. in a formalized form (documents, databases) and non-codified (the employees' knowledge).

In practical terms the effective co-dependency of these elements means the necessity of the use of advanced ICT solutions within the framework of economic organization's ICT system. It uses technical, technological and organizational innovations appearing over the recent years. They comprise nearly all areas of logistic activity, from the development of the means of transport and equipment, through the organization and management of material and raw material flow to the development of structures of systems performing logistics processes. The area of their operation is the implementation of virtual processes in the environ-

ment of extensive ICT networks (most frequently the Internet is the technological platform) aimed at the coordination and integration of business partners in the supply chain [Graham, 2013].

2. Advanced ICT systems in e-logistics

In the increasingly complex economic conditions, ICT systems that increase incomes and optimise costs are valued most. Therefore, ERP systems (*Enterprise Resource Planning*) have enjoyed major popularity for a long time, both to serve clients and in the back-office area, without affecting directly the processes of selling goods and services. A well-configured ERP system may be a source of savings for any organization; moreover, it enables to take decisions faster and in a more flexible manner. In the times of economic crisis, organizational changes that stem from the correct use of information gathered by an enterprise about business processes and resources may be the cheapest way of their development [Graham, 2013; Magnier-Watanabe, 2009].

In the last few years, investments in ICT equipment have been growing dynamically, which means that great many economic organizations have already purchased suitable IT infrastructure that may operate efficiently in the next few years. At this point, therefore, they may focus on buying business software, such as ERP. The foundation for a success in an enterprise is the ability to plan and achieve business objectives consistently. This task is the more difficult the faster an organization develops. ERP systems are ICT systems that integrate all aspects of a business operation. Advanced ERP systems enable to collect data concerning the on-going operation and, primarily, transfer it into knowledge necessary to take right business decisions. On the other hand, enterprises that already use an ERP system should invest in modules that will increase its functionalities. The most commonly recommended ones are the solutions designed for sale and purchase management processes, because they make it possible to standardise the buying process while using the economies of scale, which is especially important for organizations of distributed infrastructure. On the other hand, enterprises that decide to take brave competitive actions need to have tools that will make it possible for them to carry out detailed analyses of information coming from the market.

The application of Business Intelligence tools enables to understand preferences of customers better and to analyse sales results in order to eliminate less profitable products and activities [Graham, 2013; Koronios, 2010]. Analyses conducted based on information aggregated by ERP systems often underlie most

business initiatives in numerous enterprises. Even the simplest solutions may prove useful, as they enable to estimate operational risks and limit potential hazards that result from problems of organizations that are situated within a shared supply chain. The economic crisis will contribute to creating closer links between businesses that operate within supply chains, due to the necessary exchange of services and process integration. Additional benefits will follow within the synergy effect. The analysis of enterprise operations is the key element of strategic management. Having complete knowledge, an organization may take right decisions and, consequently, improve its competitive position. Owing to the immediate access to valid data, the management/directors have knowledge that enables them to raise the working efficiency of specific departments in an enterprise. After all, in the situation of strong competition on a market, decisions taken in the area of management affect the market position most.

Enterprises that develop dynamically focus more on the flexible and modern ICT solutions with extended analytic functions. Analytic modules should provide fast access to current data, reporting and comparing results of the enterprise. It means that ERP systems have to be provided with standard reports but also with their easy generation for the needs of an end user. Access to contextual information important for different users, which should guarantee the coordination of daily business activities with the general strategy of an enterprise should also be an important functionality of a system. Considering the implementation of a modern ERP system, one has to take into account the changes an organization is subject to, for example those related to its development, employment, growing demands, and the extension of sale markets. Therefore, it is a good idea to choose flexible systems that enable the prompt modification and extension with new components facilitating the adaptation to individual user expectations. A well-thought-out decision concerning a selected ERP system will make it possible to gain substantial savings in the future, as the needs of the enterprise in this respect will increase. Therefore, a selected ERP system should be sufficiently scalable and flexible. It should be characterised by the maximally simplified service interface. Preferably, it should be accessible via any website browser. Finally, its implementation should be fast, while simple modifications should be available without the necessity to change a source code.

3. Internet of Things in e-logistics

New ICT technologies, e.g. in the scope of automatic identification, wireless communication, satellite localization or Internet of Things are facing a new challenge. The Internet of Things is a concept according to which unambiguously

identifiable items may indirectly or directly gather, process, or exchange data via a global network. Such items comprise, for example, household appliances, lighting and heating installations. The term was used for the very first time in 1999 by Kevin Ashton and since then it has undergone quite an evolution. It is sometimes applied interchangeably with a term “Internet of everything”, which describes a network of people, processes, data and intelligent connected to the Internet. The term was created by CISCO Company and has been currently replaced by a term “Internet of Things” [Höller, 2014; Vongsingthong, 2014].

Over the last fifty years, ICT has been subject to two key transformations. The first one took place in 1960s and 1970s together with the appearance of solutions supporting automatization of processes, designing (CAD) and manufacturing resource planning (MRP II). The second transformation was the result of the emergence of the Internet and associated solutions. It is assumed that the Internet of Things shall be a driving force of the third wave of changes.

The Internet of intelligent is such a popular concept that it leaves much room for interpretation. The term can be used to describe any unambiguously identifiable thing able to – Indirectly or directly – gather and process data. The number of such devices grows dramatically together with the number of possible applications. The Internet of intelligent is closely associated with the *big data* area – as its largest benefit is the efficient gathering and processing of large amounts of information [Perera, 2015]. Three features distinguishing the Internet of Things comprise context, ubiquity and optimization. The first one refers to the possibility of advanced interaction between the item and its surroundings, immediate response to the changes, etc. Under this feature, the items provide information on, for example, location, physical or weather conditions. Ubiquity corresponds to the fact that today there are more things of this kind (items, objects) than people connected to the network. In the near future they will communicate with each other on a large scale. Optimization stands for functionality of each thing (item, object).

The Internet of Things is a concept that is both fashionable and leaves large space for interpretation. This term can be used to describe in fact each and every explicitly identifiable object that is capable of, directly or indirectly, collecting and processing data. The number of such devices keeps growing dramatically, likewise the number of their potential uses. The big data area is closely related to this solution, as the effective collection and processing of large volumes of information are among the greatest benefits offered by IoT [Höller, 2014].

Three characteristics that distinguish the Internet of Things are context, omnipresence, and optimization. The first quality refers to the possibility of ad-

vanced interaction between a thing and the environment and its immediate reaction to changes, etc. Within this characteristic, things supply information, e.g. about localization, the physical status or atmospheric conditions. The omnipresence reflects the fact that already today the number of things (objects) is greater than the number of people connected to the global network. In the near future, they will communicate on a large scale. Optimization is the expression of functionality that is brought by each and every thing (object). Owing to the spread of Internet of Things, such solutions are becoming an integral part of each and every product. Sensors, processors, and their specialist software are integrated into their functionality (they in fact become their *sine qua non* condition) and are combined with the advanced data analysis. This leads directly to the creation of new and improved products (services), which enables the visible jump in economic efficiency [Perera, 2015].

4. ICT development in e-logistics

The development of advanced ERP systems stimulates the demand for supporting the above-mentioned ICT analytic tools within business intelligence. Such solutions contribute to the effective support of decision processes. The so-called business analytics is becoming an increasingly common topic [Graham, 2013; Koronios, 2010]. It covers tools and applications used to analyse, monitor, model, present, and report data that support decision taking. To this purpose, data wholesales, supply chain operational analyses, analytic CRM systems, in-depth financial analyses, and efficiency indicators of enterprises are utilised. Users of such solutions work on a strategic level of enterprises, based on certain data aggregates. This is related to the problem of data integration and synchronization. Data integration starts from the potential to use numerous data sources, both via dedicated interfaces and the use of standard ODBC mechanisms (*Open DataBase Connectivity*). Data may come from relational or hierarchical databases, structural files as well as from ERP systems. Therefore, such connections should make it possible not only to read data but also to record and process them. In case of most enterprises, there are numerous ICT environments and access mechanisms should make it possible to obtain data from different platforms (as far as possible without the use of intermediate files).

ERP/BI solutions are not subject to fast changes, but phenomena have developed that may affect this class of application software fundamentally. They include [Graham, 2013; Koronios, 2010; Perera, 2015]:

- the widespread use of network enterprise solutions,

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- the growing business importance of mobile solutions,
 - the increasing flexibility of ERP systems owing to the more and more flexible solutions with other applications and mobile devices, provided with functions known from social media,
 - the growing use of a cloud computing model in ERP systems, which is particularly important in case of the SME sector (costs lower by up to 20% are a main incentive),
 - the increasing interest in ERP sectoral systems (they shorten the time and cost of their implementation), within which the targeted solutions of a specific problem occur with the functionality limited to the service of a single business process (maximum a few processes), giving fast return on investment,
 - the general departure from functional models in favour of serving specific business processes, which in the ICT dimension constitute the reflection of information services, and
 - the spread of Internet of Things – in such solutions smart devices are used to read statuses in real time.

It is noteworthy that two technological innovations in particular, namely cloud processing and Internet of Things, have a major impact on the present shape of practical solutions in e-economy. The former may occur in numerous variants, such as [Koronios, 2010]:

- SaaS (*Software as a Service*),
- PaaS (*Platform as a Service*),
- IaaS (*Infrastructure as a Service*),
- Collocation – one of the oldest and simplest services in a cloud, called hoteling, which involves renting a room (or its part) on a server.

According to studies carried out by the author¹, such solutions have been applied already in 49% of surveyed entities (or there were specific plans of their use) and were selected mostly due to benefits they provide, which can be presented as follows (percentage in the surveyed population) [Adamczewski, 2015]:

- the effective access to ICT resources – 57%,
- focusing on business processes rather than on the maintenance of ICT infrastructure – 25%,
- lower costs of ICT solution operation – 19%,
- the availability of highest class technologies without investments – 12%, and
- the flexibility of cost accounting – 10%.

¹ In 2014-2015, the study encompassed the representative sample of 120 SMEs from Mazowieckie and Wielkopolskie voivodeships (Poland).

To supplement such results, it is noteworthy that only 10% of respondents excluded the application of this processing model, while almost 80% preferred global suppliers of such technologies. Undoubtedly, the cloud computing market is one of the fastest growing segments of the ICT market in Poland now. The number of customers taking advantage of cloud solutions has been growing, boosting vendors' revenue. The private cloud is the prevailing model. The Polish cloud computing market continues to grow at a very fast pace. In 2014 its growth rate was 29%, with the market value arriving at 286 PLN m [Report PMR, 2015]. The development of the cloud computing market is driven by several factors. However, the popularity of such solutions primarily results from financial (a change in the manner of charging users for supplied cloud services) and business factors (greater flexibility in business operations).

Conclusions

The accelerating technical and economic-social advancement and the growing dynamics of changes and the related uncertainty are becoming important conditionings for the operation of modern economic organizations. Such organizations, in order to counteract such uncertainty, have to exhibit considerable flexibility as the basic attribute of intelligent organizations in the integrated development. A decisive role in this respect is played by advanced ICT solutions of e-logistics.

The demand for advanced ICT of e-logistics solutions that support business processes in intelligent organizations will keep growing, because such organizations, due to the nature of economic activities, are interested in the optimum use of their resources in order to gain maximum benefits from the invested capital. The growing offer of ICT solutions available on the Polish market enables organizations to make a selection depending on their business needs and financial capacities, while ICT support of the whole chain of supplies is becoming not only a challenge of a competitive market but in fact the necessity to meet the growing demands of clients in the area of their effective service. When production and ICT technologies are similar, the sources of competitive advantage are to be searched for in effectively designed and efficient advanced ICT solutions of intelligent organizations, which gains even more importance considering the growing demands of market mechanisms of the knowledge economy within integrated development.

Modern ICT solutions of e-logistics using the so-called 3rd ICT platform, i.e. Mobility, Big Data, Cloud computing and Social Business (media) contribute

directly to the increased efficiency of business processes, hence raising the competitiveness of organizations on the global market. Therefore, it is important that they should be analysed holistically, which will guarantee the final effect of synergy.

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HOLISTYCZNE UJĘCIE E-LOGISTYKI W ORGANIZACJACH INTELIGENTNYCH

Streszczenie: Procesy globalizacji gospodarki światowej generują konieczność szybkich i efektywnych działań skutkujących dostosowaniem działalności organizacji do nowych warunków rynkowych. Zaawansowane rozwiązania ICT (*Information and Communication Technology*), będące podstawowym czynnikiem konkurencyjności organizacji gospodarczych, są szczególnie podatne na wprowadzanie wszelkiego typu innowacji, które mają szansę na podnoszenie efektywności gospodarowania. Przekłada się to na finansowanie kolejnych badań nad nowymi technologiami i stanowi samonapędzający się mechanizm poszukiwania nowych rozwiązań innowacyjnych. Do jednych z takich obszarów należą właściwie zaprojektowane i stosowane systemy logistyczne w organizacji, które z uwagi na wykorzystywanie nowoczesnych rozwiązań ICT w zakresie stosowania zaawansowanych rozwiązań organizacyjno-informatycznych określa się mianem e-logistyki. Oznacza to szerokie zastosowanie najnowszych technologii teleinformatycznych do wspomagania zarządzania procesów biznesowych organizacji, np. w zakresie produkcji, gospodarki magazynowej czy obsługi zamówień oraz do wspomagania zarządzania jej otoczeniem biznesowym (zwłaszcza łańcuchami dostaw zaopatrzenia i dystrybucji). Celem artykułu jest ukazanie w ujęciu holistycznym istoty oraz uwarunkowań zaawansowanych rozwiązań e-logistyki na gruncie innowacyjnych organizacji inteligentnych.

Słowa kluczowe: ERP, gospodarka oparta na wiedzy, ICT, internet rzeczy, organizacja inteligentna.