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THE IMPACT OF NEW TECHNOLOGIES ON SUPPLY CHAIN MANAGEMENT IN THE ARMED FORCES

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Summary:

The aim of this article is to analyze the impact of new technologies on supply chain management in the Armed Forces. The supply chain is not limited to the operations related to the physical movement of goods, but also includes the management of relations with suppliers and customers. However, the supply chain management, through the integration and coordination of both information and goods flow, is a main factor of the well-developed customer service. The changes in military logistics imposed the necessity of implementation of the modern information technologies in the Polish Armed Forces. The Polish Army has adopted the Integrated Multi-level Information System of the Ministry of Defense (ZWSI RON). The article describes various technologies used in supply chain management including information, communication and automatic identification technologies. The author emphasizes that modern technologies are essential to enhance supply chain competitiveness and performance by improving the overall effectiveness and efficiency of the logistic system. Moreover, implementing of various innovative technologies shortens the time required for the fulfillment of tasks as well as reduces their labor consumption.

Keywords:

supply chain, management, new technologies, automatic identification, electronic data interchange

INTRODUCTION

The Greek word *logistikos* (the art of counting or calculation) constitutes one of the sources of the term 'logistics'. Contemporary understanding of logistics is associated with the French word *logistique*, which according to the military terminology refers to

the practical relocation of an army while maintaining its continuous supply as well as engineering and staff activities. Not only does the logistics cover the activities related to the physical movement of goods but also the management of relations with suppliers and consignees (customers). Nonetheless, the logistic management serves to meet the customers' demands owing to integration and coordination of the activities within the supply chain.

The Council of Logistics Management (CLM) defines the logistics as the part of the supply chain, consisting in planning, executing and monitoring the effectiveness and efficiency of the goods' flow and storage, services and the accompanied information from places of their origin to places of their consumption in order to meet the requirements of the customers1.

The notion of the logistic supply chain is regularly defined as the optimally organized flow of tangible assets from the original sources of acquiring (supplying) to the consumers' end parts of the chain through various links and intermediate stages. The optimality criterion relates mainly to different efficiency and effectiveness measures, which in the case of the military logistics translates into maximization of reliability, security and guarantee of supplies, whereas, as for the commercial logistics this criterion refers to the cost-effect relation and indicates the need to minimize costs of the logistic processes[2].

The supply chain covers all stages required to satisfy the customer's needs. It commences from suppliers, flows through a producer, distribution, retail sale and reaches the last link – a customer.

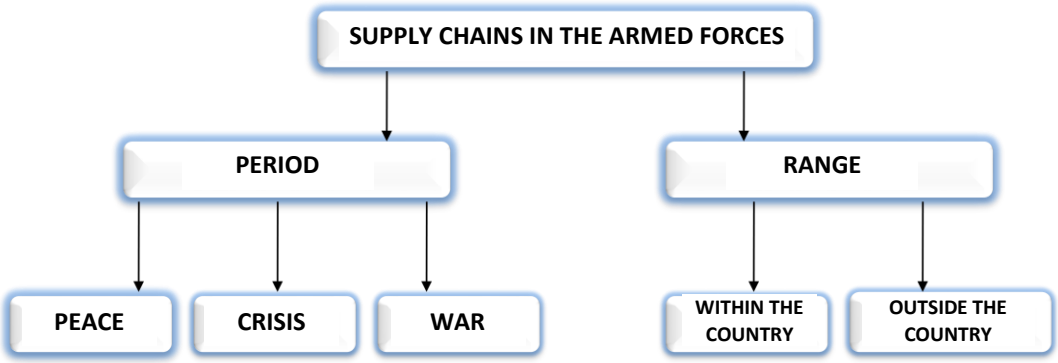


Fig. 1. Division of the supply chains in the Armed Forces

Source: Own study

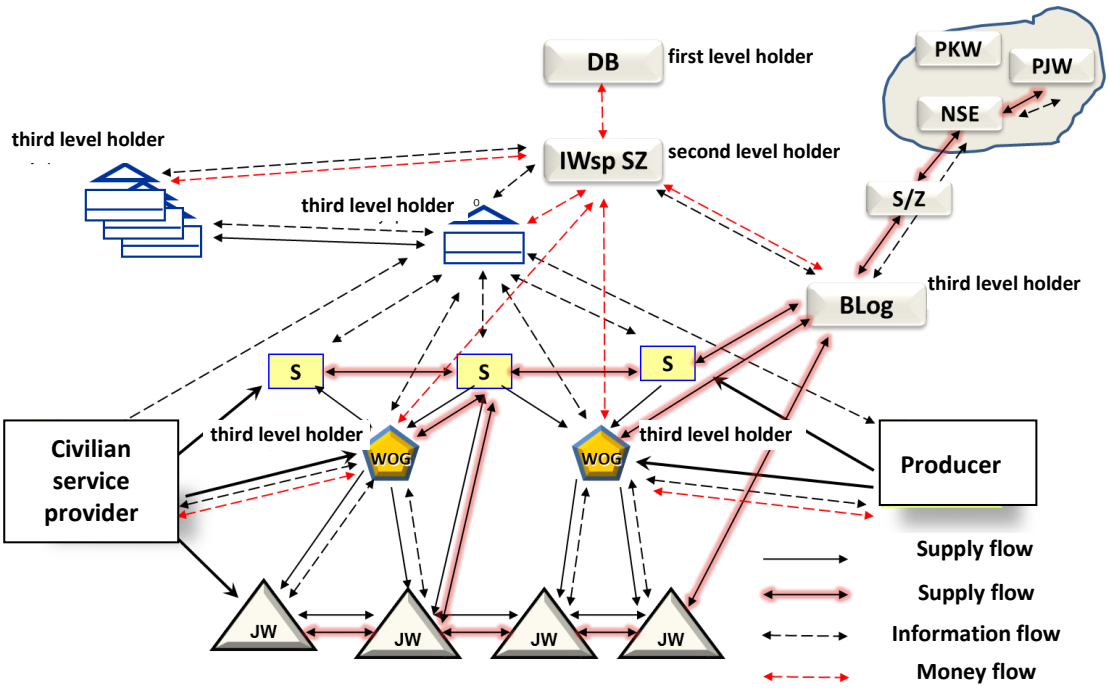
While analyzing the supply chain in the Armed Forces (Fig. 1), its particular links can be distinguished. Taking into account the activities of the logistics during the peacetime, the components of such a chain are as follows: the link acquiring logistic resources for the Armed Forces on the civilian market, the link dealing with storage and mainte-

[1] J. Witkowski, *Zarządzanie łańcuchem dostaw*, PWE, Warsaw 2003, p. 27.

[2] K. Ficoń, *Logistyka w Zatoce Perskiej*, Przegląd Logistyczny, Kwartalnik, September 2009, No 3 (007), p. 35.

nance of the acquired resources, and the link distributing resources to military units – final recipients. During the wartime, on the other hand, the simplified system of troops' supply can be distinguished. The system can include: in the rear area – the static links in the form of Regional Logistic Bases (RBLog) and the mobile ones represented by Logistic Brigades (Blog). In the main battle area the system is based on the logistic (supply) units subordinated to tactical formations, units or sub-units[3].

As far as the range of supply chain in the Armed Forces is concerned, its additional component aimed at delivering supplies for the Polish Military Contingent (PKW) fulfilling tasks outside the country can be identified. In this case the primary supply chain organized in the country by RBLog and Blog is extended by the subsequent link in the form of a carrier, which by various modes of transport (air, sea, road and rail) delivers supplies to the *National Support Element* (NSE) which provides goods to the Polish Military Unit (PJW). Considering the logistic system of the Polish Armed Forces it can be stated that the logistic network is incorporated into the supply system.



LEGEND:

DB – budget holder
IWsp SZ – Inspectorate for Armed Forces Support
JW – Military Unit
NSE – National Support Element
PJW – Polish Military Unit
PKW – Polish Military Contingent
S – Store
S/Z – Carrier
WOG – Military Support Unit

Fig. 2. Organization of the logistic network in the Polish Armed Forces

Source: Own study

[3] Z. Malinowski, *Logistyka w wojsku – od łańcucha logistycznego do sieci logistycznej*, [in:] Integracja w logistyce wojskowej, sci. ed. Nyszk W., Smyk S., AON, Warsaw 2015, p. 106.

According to Brzeziński[4], the logistic network in the Armed Forces can be defined as the determined system of mutually correlated point and line objects intended to manage both the information flow and the flow of goods, which supply the troops. However, in his deliberations, the attention was not paid to the financial resources and the transfer of the ownership rights between a vendor and a consumer. Additionally, the logistic network should also cover the evacuation of the supply assets from the separated stores of the subsequent Regional Logistic Bases or to the stores of military units, military support units, support units to the other prepared and secured locations. The decentralization of the support assets is also to be taken into consideration.

Such a defined logistic network consists of static and mobile infrastructure, characteristics describing features of the infrastructure elements, flows of resources supplying the troops and the organizational sub-system connecting the flows with the infrastructure's elements. Within the framework of the adopted system the node points of the logistic network in the Armed Forces can be described as follows: static RBLog stores (operational and strategic reserves), military support units, support units technical workshops, airports, ports, hospitals and ambulatories, logistic units (sub-units) and the infrastructure set up by them (tactical reserve) and the supported forces. The linear elements of the infrastructure are to be regarded as the nodes, which facilitate the flow of the goods and rendering the services. They are as follows: roads, railways, inland waterways, pipelines, air corridors, sea lanes and ad-hoc established transport routes[5].

The management of the supply chain developed by the Global Supply Chain Forum does not contradict the cited definition of the logistics and consists in the integration of the key economic processes, from an initial provider to a final user, providing products, services and information, which constitute the added value for clients and other stakeholders[6].

The new technologies appearing on the market create strategic opportunities for an organization to build competitive advantage in various logistics' functional areas and manage the supply chain. However, the level of success depends on the tailoring of the appropriate technology to a certain application, availability adequate to the infrastructure's needs, the culture and management of the organization's policy. The pace of identification, gathering, processing, analyzing and transmission of data at the significant level of accuracy and reliability has radically increased in logistics, information flow, communication and automation technologies. Thus, the new technologies are the measures directed at increasing the efficiency and therefore competiveness of companies. They play a significant role in the management of the supply chain through the contribution of the growth of overall effectiveness and efficiency of the logistic sys-

[4] M. Brzeziński, *Sieci logistyczne w wojsku*, Wojskowa Akademia Techniczna, Logistyka No 2/ 2009, p. 7.

[5] Z. Malinowski, Logistyka w wojsku – od łańcucha …, p. 112.

[6] D.M. Lambeert, M.C. Cooper, Supply Chain Management: Implementation Issues and Research Opportunities, International Journal of Logistics Management 1998, vol. 9, No. 2; L.M. Ellram, M.C. Cooper, Characteristics of Supply Chain Management and the Implications for Purchasing and Logistics Strategy, International Journal of Logistics Management 1993, No. 2.

tem. In civilian logistics a variety of the new technologies are more broadly applied, whereas in the Armed Forces the process of their adaptation has been sluggish.

The leading-edge technologies used in logistics and management of the supply chain can be collated in three groups:

- Automatic Identification Technology;
- Communication Technology;
- Information Technology.

1. AUTOMATIC IDENTIFICATION SYSTEM

The Automatic Data Capture (ADC) – previously called Al, AutoID or AIDS – is the term used to describe gathering automatic data (information) about an object and its subsequent entering to a computer system without a keyboard. The numerous methods of the automatic identification can be distinguished, among which the most well-known are as follows: bar codes, radio frequency identification (RFID), smart cards technologies (memory and microprocessor cards), biometric technologies (dactyloscopy, voice identification and Optical Character Recognition (OCR). The automatic identification can be applied to track containers, packages, cartons or trucks carrying goods for customers. The accuracy, cost saving, the speed of data collection, the convenient storage and processing of data and information can be classified as the benefits resulting from the application of Auto ID system.

The automatic identification was initially applied in trading of various kinds of basic consumables. In order to facilitate the customer service, the fiscal cash registers equipped with the scanners allowing for reading the bar codes placed on the products were implemented. The applied solution contributed to shortening the time needed for customer service and led to minimizing the errors perpetrated during the service conducted in the traditional manner.

Nowadays the bar codes (labels of various types) also serve to mark transport units and means of transport. Not only does it improve the management of the transportation fleet but also, as a consequence, leads to the optimization of its use. The possibility of tracking the transport (e.g. the status of orders in courier companies), on the other hand, enables more efficient customer service. Drawing the conclusion from the current experiences it can be stated that the automatic identification contributes to[7]:

- swift and errorless identification of the records of held stocks;
- ensuring the swift access to the information regarding the stored stocks;
- tracking the current status of stocks in storages;
- facilitating the conduct of inventories.

The information printed on a bar code includes: the country code, the name of the product, the specifics of the product, the date of manufacture, the name of the pro-

[7] Cf. E. Gołębska, (ed.): *Kompendium wiedzy o logistyce*, PWN, Warsaw-Poznań 2002 pp. 160-167; J. Majewski, *Informatyka w magazynie*, ILiM, Poznań 2006, pp. 95-102.

ducer etc. Those data are essential for the identification of products and the administration of stocks. Currently, bar codes are used in numerous industries such as: retail sale, pharmacy, consumer and electronic goods sale, car distribution etc.

The idea behind products labeling with universal codes has always been present in the supply chain; however, it was not until 1970 that the Logocicon Company developed the standard close to the universal code of products identification (SKU – Stock Keeping Unit) by the barcodes[8]. Its initial implementation was carried out in the Marsh chain in Troy, Ohio, in 1974. The implementation of the products code was aimed at improving the customer service and gathering the adequate date at the points of sale. The originated movement in favor of automatic products identification was of significant importance for the information flow in the supply chain. The Electronic Commerce Council of Canada (ECCC) and Uniform Code Council (UPC) in the United States dealt with the standardization until 2005. In 1998 the decision was made regarding the congeneric integration of the Universal Product Code (UPC) system with the European Article Number (EAN) system, therefore, currently one global system (EAN.UCC) is used. In 2005 the Global Forum GS1 (*Global System One*) was held during which the name EAN International was officially changed into GS1.

It is to be underlined that bar codes offer various applications in the variety of logistics' activities and affect the management of the supply chain. They are as follows:

- trade unit identification (GTIN - Global Trade Item Number), where any product or service which flows through the supply chain and can be priced is considered as a commercial unit;
- logistic unit identification (SSCC - Serial Shipping Container Code) refers to units created for transportation and storage purposes (e.g. pallet or container loading units) and undergo the identification, tracking and management processes during the flow through the supply chain;
- identification of a company's permanent resources of the stocks nature i.e. returnable-reusable packages and pallets;
- location identification (GLN - Global Location Number) serves for the identification of objects which can be provided with an address (e.g. Electronic Data interchange (EDI) messages), companies and sale points;
- identification of service relations conferred to recipients;
- other applications such as marking vouchers, return documents, invoices, courier deliveries, cell phones, prescriptions, pharmaceuticals etc.

It is of the utmost importance for the military logistics as by the Decision of the Ministry of National Defense published on 7th January 2014[9] suppliers delivering goods to the Ministry of National Defense are obliged to marked them with bar codes. The Deci-

[8] A. Kostecka, *Największe innowacje w logistyce*, Euro Logistics, February-March No 1/2011 (62), p. 20.

[9] *The Decision No 3 of the Ministry of National Defense dated 3rd January 2014 on the guidelines defining the requirements concerning bar code marking of products delivered to the Ministry of National Defense, Official Journal of MOD, pos. 11.*

sion stems from the implementation of the so-called dual use strategy, both in the civilian and military economy, consequently leading to the synergy effect[10].

The radio frequency identification systems were created immediately after the radio had been invented. Initially, they were applied practically for the military purposes. The Identification Friend or Foe (IFF) is the first and the most commonly military system used among Radio Frequency Identification (RFID), which was originally employed in the radiolocation and the aviation, afterwards in the navy and the artillery[11]. Currently, Wojskowe Zakłady Uzbrojenia S.A. in Grudziądz has the target identification system IFF - Mark XII Mod 4, UPGRADE Mod 5 and Mod S, which is the latest generation system, integrating passive optoelectronic sensors operating in the spectra ranging from visible to thermal as the measures of observation, detection, recognition and identification of flying targets. The system is integrated with the active IFF system in the NATO Mark XII Mod 4 standard with the active crypto computer, with the possibility of being extended to the NATO Mark XIIA Mod 5 and Mod S standard[12].

The RFID system was rapidly developed in 1991 after the Operation Desert Storm, during which after having the vast quantities of supplies deployed across the ocean, the massive delays and numerous mistakes occurred[13].

The lack of technology that could ensure thorough examination of the content of containers, pallets or crates without the need of their opening or unpacking enforced the contract signed by the Pentagon in 1994 with the Savi Company under which the In-Transit-Visibility (ITV) network was to be built and maintained. Practical implementation of the decision at the beginning of the 21st century enabled the American Armed Forces to launch the largest in the world tracking supplies system utilizing the RFID technology, which covered 4000 points in more than 40 countries. It is to be mentioned that in 1995 during the operation in Bosna 35% of supplies was RFID tagged, whereas in 2001 in Afghanistan up to 85%[14].

The RFID technology is based on low-power radio signals necessary for wireless data exchange between a transponder (RFID labels) and a reader. Currently applied RFID readers are able to process hundreds of labels within its range. The RFID tag consists of the processor and the antenna, usually coated on the insulator layer. The data are recorded in the cache memory, and then transmitted via the antenna (Fig. 3).

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[10] Cf. A. Kosmacz-Chodorowska, *Kody kreskowe GS1 w Silach Zbrojnych RP*, Logistyka No 4/2016, p. 62.

[11] K. Orłowski, *Zastosowanie technologii RFID w wojskowym systemie śledzenia zasobów*, Systemy Logistyczne Wojsk No 36/2010, p. 107.

[12] http://wzu.vipserv.org/sites/default/files/Systemy_IFF.pdf, (10.09.2016).

[13] R. Hoffmann, *Systemy identyfikacji wyrobów - infrastruktura informatyczna uwzględniająca technologię RFID w systemach logistycznych*, [in:] Perspektywy informatyzacji logistyki Wojska Polskiego, Logis. Wewn. 4/2006, SG WP, Warsaw 2006.

[14] Ł. Kamiński, *Technologia RFID w amerykańskich siłach zbrojnych: od logistyki do zarządzania personelem*, Systemy Logistyczne Wojsk No 40/2014, WAT, Warsaw 2014, p. 131.

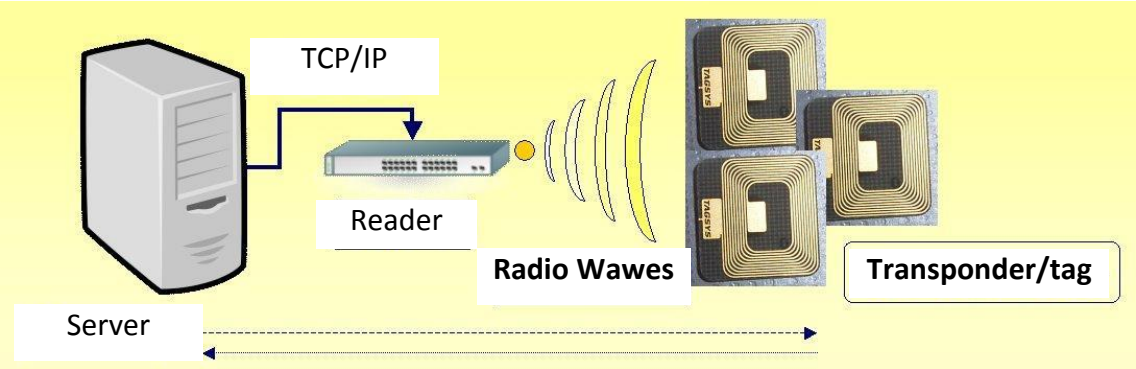

Fig. 3. Construction and operation of RFID

Source: P. Niemojewski, Wprowadzenie do technologii RFID, Konferencja „Płatności bezstykowe – dziś i jutro", Medien Service, Warsaw, May 18, 2007.

The RFID technology not only enables identification of goods but also particular persons, animals or objects. The basic facts weigh in favor of the application of radio technologies[15]:

- application of the digital memory with RFID enables multiple data recording;
- RFID labels (tags) operate in a wide temperature range and are environmentally resistant;
- transponders are information carriers extremely difficult to counterfeit owing to their serial number coded using radio frequency, which is granted by the producer at the production phase and cannot be modified, whereas the data recorded by users require appropriate software and hardware and, what is more, can be protected by passwords;
- durability of information carriers is counted in years, whereas the amount of readings is measured in millions.

Currently two types of transponders are used[16]:

- passive - without a power source inside the transponder;
- active - with a battery or storage battery inside the transponder.

It should be underlined that contemporarily the RFID technology has the lowest ratio of reading errors appearance from among other automatic identification technologies. Therefore, it is being increasingly applied in various segments of the economy. Its main advantages include: increased effectiveness of the freight flow, decreased material losses and improvement of customer service. RFID labels can be used repeatedly, do not require the direct contact with the reader and can be read and written therefore, in many cases, due to the possibility of reducing the workload and materials consumption needed for marking, they can be cheaper than the bar code technology. Thus, the

[15] Perspektywy Informatyzacji Logistyki Wojska Polskiego, Sztab Generalny WP, Warsaw 2006.

[16] R. Milewski, G. Stankiewicz, Systemy informatyczne w logistyce, WSO WLąd, Wrocław 2014, p. 65.

benefits of the RFID system should be seen from the long-term perspective not only based on the comparison of unit prices from readers and tags.

2. COMMUNICATION TECHNOLOGIES

The communication (verbal or written), which constitutes the indispensable element of the functioning of companies, simultaneously plays a significant role in achieving success by a company. However, the development of new technologies revolutionized those technics. In this section of the article, a several number of communication technologies constituting the elements which enable an excellent customer service and lead to increased competiveness through ensuring the appropriate speed and accuracy of the communication are presented.

Electronic data interchange (EDI) enables to replace business documents by standard electronic messages. The modern telecommunication offers varied options of messages' transmission under EDI with the support of public telecommunication networks and private networks providing supplementary services such as: Value Added Network (VAN) or the Internet[17]. The elements of EDI create the logic network (Fig. 4).

X12 is the main standard in the USA and EDIFACT in other countries. Nowadays all organizations responsible for EDI standardization decide to migrate towards the EDIFACT standard[18].

At present EDI provides the basis for the electronic market – the technology underpinning the ground for such strategies as: Continuous Replenishment in the retail sector, Just-in-Time (JiT) in the production sphere, transport tracking as a part of distribution process and electronic payments performed in each of market environments.

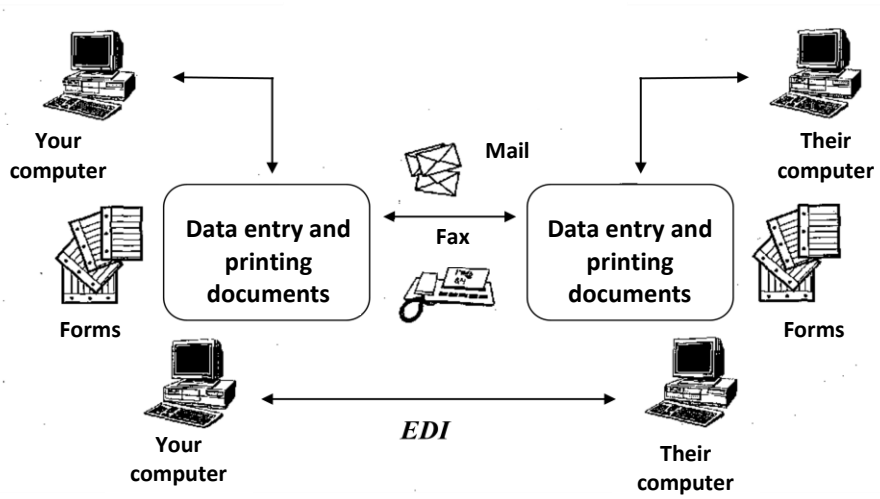

Fig. 4. Electronic documentation exchange vs. traditional methods

Source: E. Gołębska, (ed.): Kompendium wiedzy o logistyce, PWN, Warsaw-Poznań 2002, p.169.

[17] A. Szymonik, Logistyka i zarządzanie łańcuchem dostaw, part 2, Difin, Warsaw 2011, p. 141.

[18] http://www.edi.pl/index.php/przewodnik/standardy, (20.09.2016).

The advantages offered by the EDI technology application in the logistics and supply chain management include:

- faster conclusion of transactions due to the real time transfer of documents in the supply chain;
- improvements of the project cycle enabling faster product's implementation on the market;
- production processes' time and cost savings (application of JiT);
- eliminating the need to repeatedly enter the same data to various information systems;
- reducing the overall administrative costs owing to eliminating the manually performed processes with the usage of traditional documents;
- improvement of corporative commercial relations between the parties in the supply chain and creating barriers to competitors.

Therefore, it is allowed to assume that EDI is a strategic economic 'catalyst' integrating business entities and individual customers (i.e. clients, suppliers, banks and logistic firms), influencing the partnership relations based on improved procedures, enhanced information exchange, higher productivity and longer lasting trade ties.

The Very Small Aperture Terminal (VSAT) technology was developed in the United States of America in the 1980s. It uses Digital Video Broadcasting - Return Channel System (DVB-RCS) standard that allows merging the data transmission of the VSAT technology with the transmission of the TV signal based on DVB system. The Very Small Aperture Terminal is used in the military communication as well. The satellite communication channels play a significant role in collecting data in real time and their exchange essential for appropriate customer service. In order to track goods the antenna transmitting data is mounted on a carrier's vehicle, which ensures the communication between a driver, a consignor and a consignee. The read signal enables acquiring the information about the current position of the delivery vehicle. Wal-Mart, the giant in the retail sale in the USA, exemplifies the application of this system for controlling the stocks' movements.

Global Positioning System (GPS) constitutes another solution. It is the most accurate system of vehicles tracking used in the developed countries, which provides the position with up to 1 meter in terms of the latitude and the longitude. The position of the vehicle acquired by the system can be delivered to a consignor or a consignee's mobile telephone through the satellite transmission network or through the Internet to end receivers.

Geographic Information System (GIS) is the system of acquiring, processing, verifying, integrating, manipulating analyzing and presenting data that are spatially related to the Earth. Most frequently it comprises the spatial database and the appropriate software. When integrated with the GPS it is used in logistic operations to monitor and track consignments with the accuracy of a road or a street in a given city.

The application of the Automated Guided Vehicles (AGV) systems is also an important option. Monitoring the position and controlling the operation of the AGV platform trucks are executed by the central computer system collecting data received from the vehicles, which after the analysis are sent back correcting the position and the route of the platform truck[19]. The AGV trucks used in warehouses are electromagnetically controlled. The faultless movement can be achieved by the truck's sensors reading the electromagnetic field emitted by cords placed along the transport route. Owing to the special sensors, the AGV vehicle follows the reading to the destination, stopping only in designated points[20].

The new generation AGV system uses laser control. The new Laser Guide Vehicles (LGV) system is the laser controlled automated vehicle improving the extent indoor transport logistics to the maximum, reducing costs and avoiding the need to install cords permanently attached to the ground. By means of reflective elements placed in different parts of a warehouse, vehicles, owing to the laser head, self - direct towards the respective position[21].

3. INFORMATION TECHNOLOGIES

Information Technology (IT) consists of hardware and software that register, analyze and provide the information wherever it is required. This is because contemporary management of the supply chain is defined as a skillful synchronization of demand and supply's streams between the links constituting its components. Whereas searching the compromise between the dynamics and effectiveness of the chain requires placing the appropriate limit point between the products' stream shaped on the *pull* basis and the products' stream shaped according to the sale forecast based on the *push* principle[22].

Table 1 presents the most common systems supporting logistic management and the supply chain exploited in practice.

Table 1. Systems supporting logistic management and the supply chain exploited in practice.

System name in Polish	Abbreviation applied	Full English name
planowanie potrzeb materiałowych	MRP	*Materials Requirement Planning*
planowanie zasobów produkcyjnych	MRP II	*Manufacturing Resources Planning*
planowanie zasobów dystrybucji	DRP	*Distribution Resources Planning*

[19] See: Namita Singh P.V., Sarngadharan Prabir K. P., *AGV scheduling for automated material distribution: a case study*, Journal of Intelligent Manufacturing 2011, 22, 219-228.

[20] L. Kurzak, R. Sałek, *Problemy wykorzystywania zautomatyzowanych systemów AGV w wewnątrzzakładowej dystrybucji materiałów budowlanych*, [in:] Scientific Journals of Częstochowa University of Technology No 167, Construction J.17, Częstochowa 2011, p. 103.

[21] https://www.logismarket.pl/system-logistics/pojazd-sterowany-laserowo-agv/1081712010-736384120-p.html, (16.09.2016).

[22] J. Witkowski, *Zarządzanie …*, p. 52-53.

System name in Polish	Abbreviation applied	Full English name
łączące funkcje kalendarzowe i bazy danych	CM	*Contact Management*
automatyzujące biznesowe zadania sprzedażowe	SFA	*Sales Force Automation*
zarządzania zasobami przedsiębiorstwa	ERP	*Enterprise Resource Planning*
efektywnej obsługi konsumenta	ECR	*Efficient Consumer Response*
zarządzania relacjami z klientem	CRM	*Consumer Relationship Management*
pozwalające wykonywać złożone operacje planistyczne i symulacyjne wraz z optymalizacją	APS	*Advanced Planning System*
zarządzanie łańcuchem dostaw	SCM	*Supply Chain Management*

Source: own study based on A. Szymonik, Logistyka i zarządzanie łańcuchem dostaw, część 2, Difin, Warsaw 2011, p. 106.

The possession of the relevant class advanced information systems is essential in order to build the network of the external links between companies within the framework of the supply chain. It is considered that it should be the class ERP advanced systems enabling expansion of business opportunities to cover e-business. Currently, the ERP II system, recognizing the external elements of the business environment, constitutes such the solution. It is used in the majority of companies in Western Europe and NATO member states i.e. the USA, Canada and Turkey.

The ERP system facilitates the optimization of the supply chain management and affects the increase of competiveness through taking advantage of the following benefits:

- shorter response time to a customer's demand;
- inventory and logistic costs minimization;
- improvement of stock rotation speed;
- possibility of processing information to support the decision process.

The Hindustan Lever, the Colgate and the Nestle companies obtained the above-mentioned benefits through the implementation of the ERP system into their supply chains.

The SAP ERP 6.0 system (integrated modular software package created by SAP) was applied within the framework of ZWSIRON in the Polish Armed Forces. The Uniform Materiel Index (Polish abbreviation JIM) constituted the basis for ZWSIRON implementation. It is the sequence of 13-digit alphanumeric signs allowing unequivocal identification of particular goods and their simultaneous differentiation from any other supply product.

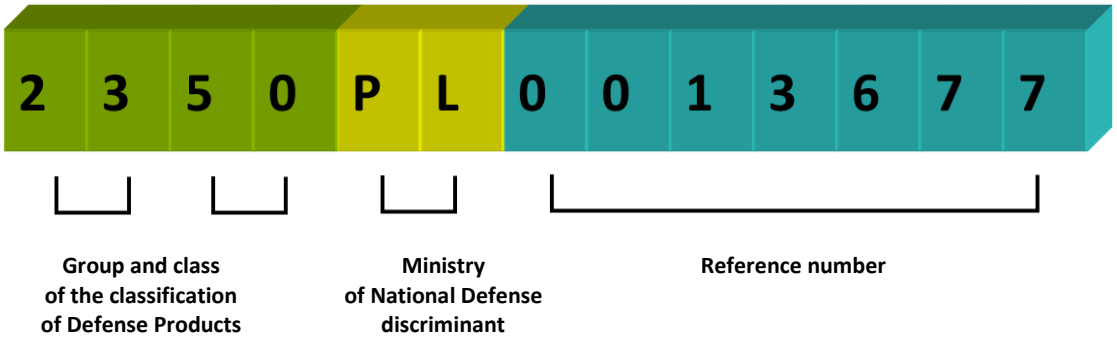

Fig 5. Composition of Uniform Materiel Index

Source: own study

In the JIM structure the grouping system of products' nomenclatures according to the groups and classes was adopted based on the Regulation of the Council of Ministers of 29th January 1999 on Classification of Defensive Products (*Polish* KWO). Figure 5 presents the composition of JIM that consists of three elements: the code of the supply item (the group and the class), the Ministry of National Defense discriminant and the reference number assigned by the system. The national discriminant in the form of PL letters was adopted in order to differentiate the materiel index from the NATO Stock Number (NDN). The fact that the reference number is assigned in the order of the applications submitted by the administrators leads to the situation in which the products of the different supply classes appear alongside. The applied reference number does not guarantee any division, but unifies all products without functional or technical and operational connections. The hierarchical classifier provides such the division.

It should be underlined that creation and deployment of the centralized, integrated and unified information system supporting finance, logistic and human recourses management thus ensuring the standardization of the operation, data exchange and integration between the organizational units of the Ministry of National Defense in these areas was the objective of ZWSIRON implementation. The financial management module incorporates such areas a: human resources database (civilian employees and soldiers) data related to the sphere of payment; account (civilian employees' and soldiers' salaries and military annuities and pensions); civil-law agreements database; keeping tax office, Social Security Board and bank accounts; keeping the accounts by budget holders; preparation of financial statements (including to the Ministry of Finance); running quality and quantity records; financial planning (including a task aspect), control of the execution of budget and correction of financial plans. Another area concerns the management of logistics, in the framework of which the following spheres are served: supply (acquisition, storage and distribution of recourses); utilization of military equipment (*Polish* SpW); infrastructure management, management of military movement and transportation, medical support, planning (including material planning), normalization and logistic reporting. The last, human recourses management module covers: human resources database (persons under military qualification, soldiers, civilian employees, military annuities and pensions); activities related to military discipline, structural and establishment activities, planning of the progress and devel-

opment of soldiers' career, mobilization and replenishment records and human resources management reporting.

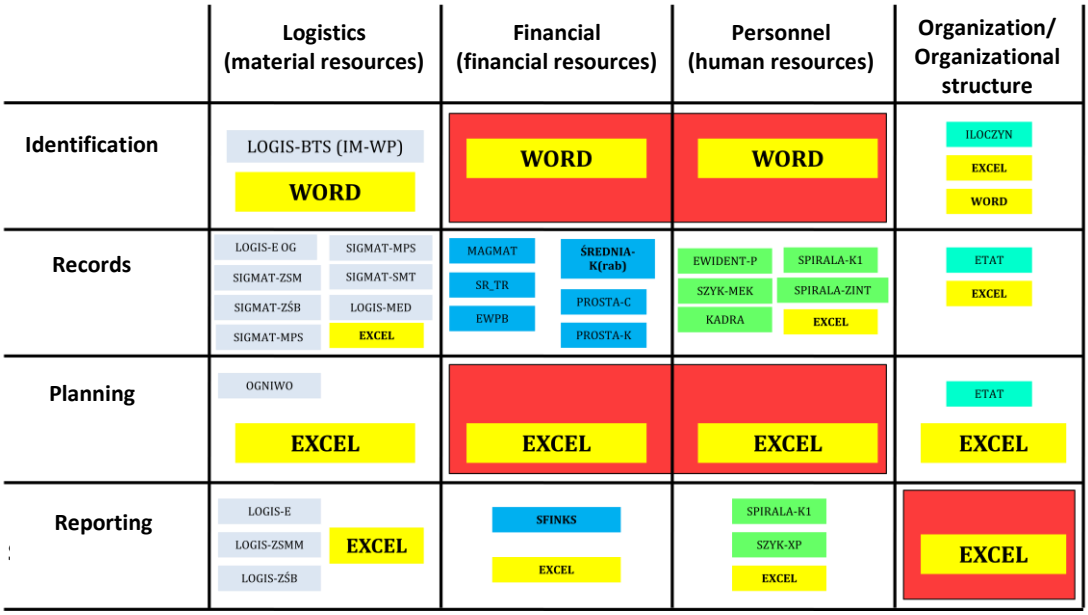

Fig. 6. Recourse management legacy solutions

Source: Prezentacja: Zintegrowany Wieloszczeblowy System Informatyczny Resortu Obrony Narodowej, Resortowe Centrum Zarządzania Projektami Informatycznymi, p. 8

The hitherto existing management of the Polish Armed Forces' resources consists in utilization of various types of software (Fig. 6). In order to integrate the system of the resources management, the final ZWSIRON functional architecture presumes functioning interconnected branch modules (specialized) created based on the assumptions resulting from identified and optimized templates of the processes occurring in the Ministry of National Defense in the area of resources management. The application of the process analysis will allow creating information solutions that will not be dedicated to functional segments but will support and integrate the implementation of the relevant identified stages of the processes by particular organizational units.

It is noticeable that ZWSIRON modules will function on the various organizational levels and the data coming from them will be aggregated in the Ministerial Data Warehouse. Whereas previously identified basic data, alongside the process analysis, will form the basis for ZWSIRON functioning. The data include:

- Uniform Materiel Index – the orderly manner of description of goods used in the Ministry of National Defense;
- Uniform Departmental Accounts Plan – containing the common for the entire Ministry of National Defense catalog of synthetic accounts and the way of booking economic operations;
- dictionary data related to the management of human resources (military specialties, etc.).

The DRP (Distribution Requirements Planning) system is defined as the system determining the demand for the reserves in particular distribution centers of an enterprise[23]. It constitutes a consecutive IT tool and simultaneously a sophisticated approach to planning which takes into account several distribution stages and characteristics of the distribution system. The DRP system facilitates consolidation of consignments to many locations spread over a broad geographical area; hence it influences the reduction of transportation costs. Furthermore, it improves the visibility of reserves in the supply chain contributing to their lowering and the warehouse space demand.

It should be emphasized that the DRP system mirrors the MRP system and takes advantages of identical operational principles[24].

The Automated Resource Tracking System (ARTS) is an IT tool that provides the real-time information regarding the level of reserves at the disposal of all supply chain's entities. To replenish the missing stock the information is provided directly to a supplier who reacts on consignees' demands delivering the relevant stock in required quantity and time, preserving the product quality and optimizing at the same time the reserves in the entire supply chain.

CONCLUSIONS

It follows from the above considerations that the information technologies used in enterprises constituting the links of the supply chain as well as the automated identification and uniform identification standard are the essential prerequisites of the e-inclusion supporting the supply chain management. In addition, other factors such as the electronic data interchange and the integrated information system play a significant role as well. However, the whole information flow should be reliable and protected against the unauthorized access.

It is to be underlined that the new information technologies form the basis for increasing the competiveness of the supply chain and its efficiency through the improvement of the overall efficiency and effectiveness of the logistic system. For that reason, the adoption of the appropriate technology for various logistic activities or sub-processes is crucial for any company in order to gain competitive advantage on the modern market.

The integration in the supply chain is possible owing to the available technology and leads to the growth of goods and information flows' effectiveness only when parties constituting the links of the supply chain decide to adopt the appropriate strategy.

The current deliberations indicate that the tasks regarding the preparation and the support of the forces assigned to operations within or outside the country are associated with acquisition, storage, consolidation, deconsolidation and distribution of resources subsumed in five classes of supply. This illustrates the need to refine the effectiveness of the information and resources flow in the supply chain and their adaptation to the logistic concept (including material) of a land component designated to an oper-

[23] *Logistyka dystrybucji*, ed. by K. Rutkowski, Difin, Warsaw 2001, p. 159.

[24] *Logistyka w przedsiębiorstwie, przewodnik do ćwiczeń*, ed. by G. Radziejowska, Gliwice 2001, p. 53.

ation. Inclusion of the advanced integrated information systems into the command of troops in the contemporary world, with highlighting the automated identification of the supplies in the researched area, allows tailoring the structures of logistic (supply) subunits to the modern management of military formations. This modern military leadership shows, among others, the possibility and the need of the application of the advanced information technologies improving the logistic (material) support of military components assigned to internal operations and Polish Military Contingents deployed to operations outside the country. It can be assumed that the application of GS1 standards existing on the civil market and their appropriate adaptation to the military logistic requirements would be the cheapest and the simplest solution. Thus, IT systems of civil suppliers and military consignees may become the factor integrating their supply chains, simultaneously reconciling requirements and conditions for the functioning of civil and military logistics.

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