GREEN INFORMATION TECHNOLOGY IN LOGISTICS ENTERPRISE

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Abstract: Green or environmentally friendly Information Technology (IT) refers to goods and services considered to inflict minimal or no harm to the environment. Enterprise information systems undoubtedly should undertake the burden of facilitating the waste emission and electric power usage reduction by pursuing a low waste supply chain management practice and energy cost-efficient IT. The paper aims to present co-packing enterprise information system case study for support of that thesis.

Key words: green IT, management information system, greening information system, logistics enterprise

Introduction

Contemporary approach to Green IT is a long-term approach that includes business and environmental factors. Starting with the immediate or tactical actions, such as switching off monitors, the strategic approach goes into long term planning, at least for 3-5 years, that will include environmental issues in the business strategy. Green IT is defined as the study and practice of designing, manufacturing, using, and disposing of computers, servers, and associated subsystems (such as monitors, printers, storage devices, and networking and communication systems) efficiently and effectively with minimal or no impact on the environment, therefore the business organization is able to achieve economic viability and improve system performance and use, while taking into account the social and ethical responsibilities (Unhelkar, 2011). The paper is to reveal the problem of greening IT in logistics enterprise. The paper consists of four parts. At first, the green IT and the greening IT are explained. Next, authors focus on greening IT in product life cycle approach and in management information systems. The third part covers the presentation of logistics enterprises in co-packing industry. The last part consists of the analysis of enterprise information systems for co-packing industry and for waste management. The case study on E.T. Ewa Tomczak company is presented there.

Green Information Technology

Sooner or later, business organizations make decisions to adopt a large set of strategies in a wide spectrum comprising green IT, pure compliance to environmental standards, implementation of incremental changes to adapt to

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emerging trends. Businesses will shape their green strategies as a result of objective and perceived influence of consumers' preferences, relationships with suppliers, and the pressures of new market entrants, non-governmental institutions, civil society, unions and employees, shareholders and regulatory institutions. Unsurprisingly, strong shareholder influence is important in all sectors to this respect. Any green innovation is supposed to yield profit according to traditional profitability criteria. The impulse of a single manager conviction is also often a significant transformational driver (Galharret,Wang, 2011).

To represent technology within an environmental context, some researchers have coined terms such as environmental technology, sustainability, green IT or green computing. According to Wati and Koo green IT covers all activities and efforts that incorporate ecologically friendly technologies and processes into the entire lifecycle of information and communication technology, where the sustainable operation of a data centre performs a central role in that domain, focusing on the reduction of energy consumption during the operation of the data centre (Wati, Koo, 2011). For the practitioners, green IT means technologies and initiatives designed to reduce the power, cooling, and real estate expenses associated with IT operations. Shrivastava (1995) defined environmental technologies as "production equipment, methods and procedures, product designs, and product delivery mechanisms that conserve energy and natural resources, minimize the environmental load of human activities, and protect the natural environment". The green IT facilitates different forms of competitive advantage in three dimensions of technology: infrastructure, usage and strategy (Wati, Koo, 2011). Infrastructure value refers to the nature of hardware and software platforms, constant enhancements of these platforms, the nature of network and data architecture, and the corporate standards for the procurement and deployment of IT assets. The usage value refers to the IT characteristics that address the prioritization, planning, budgeting and daily delivery of operations and services. The strategy value concerns the manner in which the companies use their IT capabilities to generate knowledge. An important focus of environmental technologies is to improve the performance of manufacturing processes. This can be achieved through the production system redesign to reduce environmental impacts, to increase the use of cleaner technologies and higher-efficiency production techniques.

The label 'green' and 'sustainable' are applied interchangeably with little understanding of what they mean. For Beal (2011) to be a green business means bringing the operations into compliance with all environmental regulations. According to Murugesan the environmental sustainability is realized in three different ways:

− greening IT systems and usage: the efficient and effective design, manufacture, use and disposal of computer hardware, software and communication systems;
− using IT to support environmental sustainability: empowerment, support, assistance, and leverage of other enterprise-wide environmental initiatives;

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- using IT to create green awareness among stakeholders and promote green initiatives (Murugesan, 2011).
- Some of the opportunities for that are as follows:
- software tools for analysing, modelling and simulating environmental impacts and for environmental risk management,
- platforms for eco-management and emission trading,
- tools for auditing and reporting energy consumption,
- environmental knowledge management systems, environmental ontologies,
- environmental information system engineering, including geographical information systems,
- urban environment planning tools and systems,
- technologies for interoperable environmental monitoring networks,
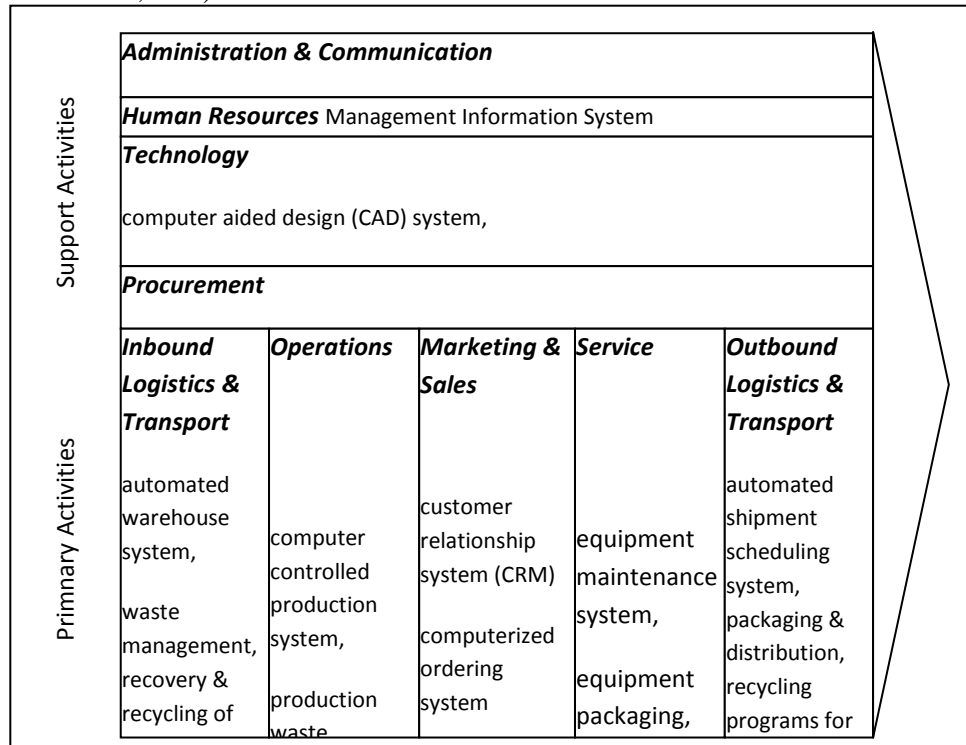- tools for optimizing organizational workflows (Murugesan, Gangadharan, 2012).

Greening IT in Management Information Systems

Although according to Laudon and Laudon (2012) information technology consists of all the hardware and software that a firm needs to use in order to achieve its business objectives, an information system can be defined technically as a set of interrelated components that collect, process, store and distribute information to support decision making and control in a business organization. Beyond the support of decision making, coordination and control, information systems may also help managers analyze problems, visualize complex objects and create new products.

The life cycle approach is well known since business system development, and it is useful to manage the products as well as to analyse the entire process of greening IT. A life cycle approach means that company recognizes the influence of managerial decisions on what happens at each of the points of product life, so they can balance trade-offs and positively impact the economy, the environment and the society. The company is able to identify both the opportunities and risks of a product or technology all the way from raw materials to disposal. The product life cycle includes the following stages: raw material extraction and processing, design and production, packaging and distribution, product use and maintenance, product disposal, recovery, reuse, and recycling of materials and components (Remmen *et al.*, 2007). Each stage generates useful goods and waste, demands the packaging of them, needs energy and releases gases that contribute to climate change. The life cycle approach is a powerful tool to help companies better understand the environmental effects of their technology usage, thus providing valuable information regarding opportunities to improve environmental performance (Wati, Koo, 2011).

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However, in this paper the Michael Porter value chain model is applied to emphasize the role of green IT and greening information system functionalities. Generally known, major business functions are as follows:

− sales and marketing of organization's products and services,
− manufacturing and delivering products and services,
− finance and accounting of the organization's assets and maintaining the organization's financial records,
− human resources management: attracting, developing and maintaining the organization's labour force and maintaining employees' records (Laudon, Laudon,2012).

Support Activities					
Administration & Communication					
Human Resources Management Information System					
Technology computer aided design (CAD) system,					
Procurement					

	Inbound Logistics & Transport	*Operations*	*Marketing & Sales*	*Service*	*Outbound Logistics & Transport*
Primary Activities	automated warehouse system, waste management, recovery & recycling of	computer controlled production system, production waste	customer relationship system (CRM) computerized ordering system	equipment maintenance system, equipment packaging,	automated shipment scheduling system, packaging & distribution, recycling programs for

Figure 1.The value chain model as the foundation of management information system functionalities specification
Source: own work based on [Porter, 1985]

The figure 1 provides examples of computerized information systems for both primary and support activities of a firm that can add a margin of value to a firm's product or services. Figure 1 covers functionalities of greening information system i.e., green IT management system, power use and emissions control system, waste management, recovery & recycling of materials, packaging and components, product repair and reuse, equipment packaging, reuse and recycling of equipment. Generally, greening information systems is a software system that provides support to the business to implement its environmentally responsible business strategies

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(Unhelkar, 2011). So, this system should cover various structural aspects of the business. The system can be a standalone application or can be included in an integrated information system as it is in the case of total quality management (TQM) system. The greening information system should have processes and applications that help analyze the data, identify the trends, and collaborate with other external systems of waste management.

Co-packing Enterprise

The rational, optimized the distribution of goods is conditioned by a high degree of packaging so the packaging and packaging logistics have a particularly significant role in management information system for logistics.

Nowadays, in a rapidly changing market, the agile reconfiguration of goods in the supply chain can be an extremely important element of success. The processes in co-packing enterprise are related with change of the configuration of clients goods and include:

− re-packaging with the possibility of labeling products,
− assembling of goods,
− packaging of goods.

Packaging is the process. Packaged product, the packaging and the packaging process construct the total logistic packaging system. The package itself consists of properly formed packaging and auxiliary materials.

Assembling of goods are based on an order of client and the co-packing enterprise creates a new logistic unit of customer's goods in accordance with the specification. These may be mixed pallets, mixed cartons or other types of mixtures as defined by the client.

Packaging of goods is the creation of new sets of goods from various types of goods in compliance with formula, packaging and labeling according to the guidelines provided by the client. Packaging is an important part of the packaging process, which can do individually as well as in combination with other services related to packing, shipping, or co-packing, e.g.:

− re-packing,
− labeling,
− completing,
− preparation of sets and samples,
− foliating,
− other non-standard forms of packing.

The logistics co-packing enterprises offer processes such as:

− sticking labels, stickers, codes, holograms, etc.,
− inserting them anywhere or to a specific page flyers, brochures, inserts, etc.,
− pasting sachets, samples, gadgets, leaflets using pellets adhesive tapes, adhesives, etc.,
− packaging and repackaging products packaging for retail,

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‒ preparing promotional,
‒ preparation of sets for holidays and special occasions,
‒ recovery of products, gadgets, samples, quality control,
‒ other works in line with customer expectations.

The lack of adequate policies related to the management of packaging can lead to many problems affecting the efficiency of the entire supply chain. Errors in the package are mainly due to poor packaging design, use of improper materials, improper packaging or finally misconduct during transport. There are also disadvantages caused by improper storage or shipping errors in customization. The right approach to the process of co-packing provides a solution to these problems.

The main examples of enterprise of co-packing industry in Poland are KMC Services Sp. z o. o. (http://kmc-services.com.pl), E.T. Ewa Tomczak (www.etpromo.pl), Customeritum Centrum Obsługi Klienta i Logistyki Sp. z o. o. (http://customeritum.pl).

The case study of logistic management information system of E.T. Ewa Tomczak enterprise

An example of a company dealing with co-packing of food and industrial products is the company E.T. Ewa Tomczak (www.etpromo.pl). The enterprise uses plastic packaging, paper, or thermoformed film (PVC, PET) according to the principles of environmental protection in the order fulfillment process.

The company's activity is focused on the use of different packaging according to customer's design, for example:
‒ horizontal packaging (e.g. FlowPack packing),
‒ vertical packaging (e.g. Transwrap packing),
‒ packaging in sachets (e.g. packing with Fill and Seal machine),
‒ cellophane overwrapping,
‒ stretch filming,
‒ sealing (high frequency sealing, thermal sealing, ultrasound sealing, impulse sealing),
‒ case packing,
‒ marking (thermal transfer marking, InkJet marking),
‒ labeling (one side label, two sides label),
‒ sticking (hot sticking, glue gel sticking, two sides tape sticking),
‒ seaming (two cup machinery seaming),
‒ manual packing (labeling, packing, punching, folding).

The implementation of new form of logistics management and the processes of co-packing in E.T. Ewa Tomczak company are based on quality policy and used the highest quality standards of ISO and other individual standards of clients, e.g. ISO 14001 for recycling of packing products, ISO 22005 for identification of client product. The enterprise includes recovery and full use of the material in the process according to the requirements of ISO 14001.

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The case study of logistics enterprise information system is based on analyses of business processes in E.T. Ewa Tomczak company. The whole of logistics processes in this enterprise are integrated with each other and logistics processes are affecting each other. They remain in a particular relationship with the environment creating a logistics system that specifies:

− how logistics processes run,
− a set of techniques for performing logistics,
− a set of measures of logistic processes implementation.

The logistics systems shall be deliberately integrated as space and temporal movement of materials and related information in order to provide the desired level of customer service at minimum cost and minimum capital investment. Control in logistic systems is done by using logistic management. The most important examples of logistics processes, which can influence on the proper co-packing management, are the ordering and acceptance of components, the ordering and acceptance of auxiliary materials, finished product release, etc. The proposals of logistics information system can be implemented in Intense System and Comarch CDNXL System.

The process of ordering and acceptance of components

The ordering process and the adoption of the storage components are initiated by the registration of the contract for sale of finished products. The order of production is generated after signing and confirmation the contract, it is necessary for the correct calculation of the number of needed components. The next step is to make a rough plan of the order, while the actions of bookings are generated for individual components. Ultimately, the order will be planned in detail lately. The next task of the process that generated the balance of goods and a document, which are necessary to calculate the number of components, will use the bookings generated during the planning commission. It should be noted that to correctly calculate the necessary amount of components and auxiliary materials, system analyzes many external parameters such as the so-called reservations, norms, placed orders, work orders, etc.. Next, the document of order/orders to suppliers is generated. That part of the process is followed by physical delivery. The delivery is implemented as the procedure of acceptance of the goods. This procedure consists of admission procedures of unload of the car and ticket printing pallet. The receipt of goods is initialized by generating a CDNXL System purchase order. The main document at this stage of the process is a protocol of unloading the car. The document is printed for completion by the warehouseman in the delivery process. Data from the document is completed by the warehouseman and are inserted into the Intense System.

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The process of ordering and acceptance of auxiliary materials

The flow of the ordering process and the adoption of auxiliary materials are the same as in the case of ordering and acceptance of the components. However, instead of the protocol, the car can be unload after the confirmation on a document of quality compatibility of product and, in addition, the verification of readability of EAN barcode is performed by using barcode readers. Based on these evidence, it is decided to admit to taking delivery. Next, the flow of the process is similar to the supply of components.

The finished product release

The finished product release begins after advising of a delivery. In the absence of advising, process starts from forecast or plans (schedules) to deliver the products. Regardless of how the initiation is realized, the process should aim to register each sales order. Then, on the basis of that contract, the Comarch CDNXL external release document is generated. Next, document named list of loading is specified and generated in the Intense System. The conformity or non-conformity of the goods or product data are realized in this way. In a further step, the admission card to load the car is generated in the Intense System. Positive confirmation form allows to load the car and automatically generates the storage issue document that goes to the terminal barcode, where the products are verified through the mobile warehouse application. The negative sign directs the application form to the appropriate department, where the decision is made whether to permit for the car loading. Approval of the document on a mobile device generates automatic referral notification process of shipping. During this process, the transport documents are prepared. The CDNXL System creates the documents and shipping packages for the document CMR.

The others issues in the area of logistics processes contains:

− co-operation with mobile devices in the process of adoption, publication, transfer and inventory of goods/products (in order to speed up and eliminate errors in the process),
− optimization of the structure and algorithm of receiving and shipment of goods in the context of Euro-type pallets use, optimization of the storage capacity of more different products in one place and storage pallet allergens (to speed up the distribution and collection of goods from the warehouse shelves and to increase the quality of the process),
− integration of workflows in the Intense System (to ensure continuity of the flow of information and central access to information)
− improvement of the quality of processes of adoption and publication of goods,
− integration of attachments through the use of additional system objects defined in editable data cells, previously available only in the annexes as binary data (for improving the control and analysis),

- the introduction of control messages concerning such expiry dates, allergens, temperature (in order to increase the quality of the process),
- extending the possibility to save and edit more data (in order to increase data integration),
- export data to Intrastat System declaration to the customs office to speed up the process,
- optimization of the algorithm for calculating the date of manufacture by adding the parameter number of days for packing up,
- reporting by sending an e-mail of the impending expiry date,
- blocking of expiring goods (in order to increase the quality of the process),
- support for the process of inventory (in order to speed up the process).

Summary

The article covered discussion on logistic management processes in co-packing industry in the context of greening IT, and the case study of co-packing enterprise E.T. Ewa Tomczak. Presented in the paper processes of logistics in management of co-packing enterprise include ordering and acceptance of components, ordering and acceptance of auxiliary materials and finished product release. The scope of processes of logistic information system in E.T. Ewa Tomczak company supported by implemented Intense System and Comarch CDNXL System is rather narrow in comparison with challenges created by the proponents of greening information systems. The co-packing enterprises information system should also include more details of green IT management system, like power use and emissions control system, waste management, recovery and recycling of materials, reuse and recycling of equipment, tools for auditing and reporting energy consumption and its influence on the natural environment. The further development of the system will be the topic of the future research.

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ZIELONA INFORMATYKA W PRZEDSIĘBIORSTWIE LOGISTYCZNYM

Streszczenie: Informatyka zielona lub przyjazna środowisku (green IT) obejmuje produkty i usługi informatyczne, które mają minimalne lub żadne szkodliwe oddziaływanie dla środowiska naturalnego człowieka. Systemy informatyczne biznesu bez wątpienia powinny podjąć wysiłek zmniejszenia emisji szkodliwych substancji i działania na rzecz zmniejszenia zużycia energii elektrycznej przez rozwój praktyk zarządzania łańcuchami dostaw o niskiej emisji substancji szkodliwych oraz przez wdrażanie energooszczędnych systemów informatycznych. Celem artykułu jest prezentacja modelu funkcjonalności systemu informatycznego dla wspomagania zarządzania opakowaniami produktów w przedsiębiorstwie.

Słowa kluczowe: zielona logistyka, systemy informatyczne zarządzania, ekologiczny system informacyjny, przedsiębiorstwo logistyczne

在物流企業綠色信息技術

摘要：綠色或環保信息技術（IT）是指貨物，並考慮到造成很少或沒有對環境的危害服務。企業信息系統無疑應該承擔的促進追求一個低浪費的供應鏈管理實踐和能源成本效益的 IT 廢棄物排放和電力使用量減少了負擔。本文旨在介紹合作包裝企業信息系統案例研究支持這一論斷。

關鍵詞：綠色 IT，管理信息系統，綠化信息系統，物流企業。