

REINGENEERING OF REVERSE LOGISTICS IN CONTEXT OF SUSTAINABLE DEVELOPMENT IN PRODUCTION BUSINESSES IN SLOVAKIA

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Abstract: Fast development of technologies does only bring positives, but also negative aspects influencing man and his behaviour towards environment. In companies, there has been a growing interest for company process reengineering in order to assure achieving company objectives. One of these processes is also reverse logistics aiming not only to secure financial prosperity of a company, but also diffusion of business interests with interests of customers and state. Aim of this article is to create ideological model of reverse logistics, based on questionnaire survey performed on a sample of selected businesses of production character in Slovakia, on grounds of suggested solutions and arrangements aimed at optimisation of reverse logistics conditions in context of sustainable development in production businesses in Slovakia. Results of the survey and established recommendations regarding reverse logistics reengineering pointed out an importance of the issue and necessity to deal with this issue in every production business in Slovakia.

Keywords: reverse logistics, sustainable development, environment

1 Introduction

Currently, in times of products of science-technological revolution, every day there are millions of new products produced. Hence, managers in every company are interested in those areas allowing reengineering of company processes and assurance of achieving company objectives. One of these processes is reverse logistics. For the first time, its management appeared in 70 years of 20th century, but this topic did not get sufficient attention. It could be pictured as reverse flow of product or its packaging from consumer back to supplier or producer. This process is carried out especially due to clearance and waste materials and packaging. Task of reverse logistics is not only to secure financial prosperity of business, but also diffusion of business interests with interests of customers and state. State interests might be fulfilled with help of reverse logistics from point of positive environmental impact, which is achieved in process of reverse flow.

Nowadays, there is a high consumption of energy, materials, product in the world and hence, there is a lot of waste created. It is very important to find and apply solutions to this problem. One of keys to this solution is reverse logistics in context of sustainable development. Reverse logistics allows us to process and collect used or disputed goods, components, products, packaging, excessive supplies and use or valorise them in a certain way with regards of environment and health of public. Management of reverse flows is significant and key from point of profits, image as well as protection of environment.

2 Literature review

Company has started to realise negative implications on environment and has started to form environmental politics dedicated to improvement of quality of environment, health and living conditions of public. This politics are amended by legal norms. A great emphasis is placed on reverse logistics while its importance is still growing. There are also other terms connected with the term reverse logistics and those are reversible logistics, waste logistics, convertible logistics or recycling logistics. In the following part of this article, we will look closer on attitudes and opinions of authors on reverse logistics and sustainable development.

One of first authors considering reverse logistics is considered to be P. Murphy. In his thoughts and ideas he used the term reversible distribution which matches the current name - reverse logistics. Reversible distribution was defined as movement of goods from customer to producer via all distribution channels.¹

Importance of reverse logistics was pointed out by authors A. Dianne Mollenkopf and David J. Closs, who stressed that in time the importance of reverse logistics grows and companies start will start to realise potential hidden in reverse flows. For a long time reverse flows were understood as undesirable side products of logistics chains and companies concentrated on decreased charges for this business area, instead of trying to differentiate themselves and hence gain competitive advantage.²

M. Thierry, M. Salomon, J. Van Nunen and L. Van Wassenhove created the term „Product Recovery Management“. This term involves management of all used or eliminated products, components and materials, company is responsible for. Authors categorise possibilities regarding handling of reverse flows and those are: direct use, repair, renovation, reformation, cannibalisation and recycling. This structure is pictured in more details in table 1.³

Table 1: Structure - repair, renovation, reformation, cannibalisation and recycling

	Degree of disassembling	Quality requirements	Final product
Repair	To degree of product	Put product into functional state	Some parts are fixed or substituted by other ones
Renovation	To degree of module	Check all modules and upgrade to specified degree	Some modules are fixed or substituted (by the same or improved)
Reformation	To degree of parts	Check all modules and parts and upgrade product to state "as new"	Used and new modules/parts are combined into new, potentially improved product
Cannibalisation	On selected parts	Depends on the process in which are parts further used	Part of components is used again, others are recycled or disposed
Recycling	To degree of material	High quality, when material is used for new components	Material are used again for production of new parts

Dale S. Rogers and Ronald S. Tibben-Lembke defined reverse logistics with emphasis on objectives and logistics processes as process of planning, implementation and control of originality, financially favourable flow of raw materials, materials, worked materials, final products and related information from their consumption to their origin aimed to create value, or other disposal.⁴

Craig R. Carter and Lisa M. Ellram characterise reverse logistics as a process applied by companies to reengineer environmental behaviour with use of recycling, reduction of the amount of used materials and repeated use.⁵

According to A. Dupal' and Z. Marečková reverse logistics can be understood as a process of planning, implementation and control of reverse flows of materials, intermediate products,

¹ Murphy, P.: *A preliminary study of transportation and warehousing aspects of reverse distribution*. In Transportation Journal. ISSN 0041-1612, 1986, vol. 25, no. 4, pp. 12-21.

² Mollenkopf, Dianne A., Closs, David J.: *The Hidden Value in Reverse Logistic*. In Supply Chain Management Review. ISSN 1521-9747, 2005, vol. 9, no. 5, pp. 34-43.

³ Thierry, M., Salomon, M., Van Nunen, J., Van Wassenhove, L.: *Strategic issues in product recovery management*. In California Management Review. ISSN 0008-1256, 1995, vol. 37, no. 2, pp. 114-135.

⁴ Rogers, D. S., Tibben-Lembke, R. S.: *Going Backwards: Reverse Logistics Trends and Practices*. Pittsburgh: Reverse Logistics Executive Council, 1999. pp. 2-20. ISBN 978-0967461908.

⁵ Carter, Craig R., Ellram, Lisa M.: *Reverse logistics: a review of the literature and framework for future investigation*. In Journal of Business Logistics. ISSN 0197-6729, 1998, vol. 19, no. 1, pp. 85-102.

packaging and final products, from production, distribution or point of consumption to point of recovery or appropriate ridding of.⁶

Authors H. R. Lourenço and J. P. Soto characterised basic elements of reverse logistics in form of transparent following table 2.⁷

Table 2: Basic elements of reverse logistics

What is?	Input	Activity	Outcomes	From	To
Process	Eliminated products	Planning	Repeatedly used products	Point of collection	Producers
Task	Used products	Implementation	Recycling		Central collection point
Abilities	Products or parts distributed in preference	Control	Reformation		Point of creation
Activity	Packages or products with dangerous characteristics	Collection	Disposal		
	Information	Transport	Reduction		
	Ingredients	Storage	Management		
	Worked supplies	Acceptation	Again achieved products		
	Final products	Packaging			
	Related information	Transportation			
		Reduction			
		Management			
		Disposition			

V. Jayaraman, L. Yadong and E. M. Findlay in reverse flows state tangible and intangible competitive advantages. Tangible competitive advantages include: recuperation of value from used products; offer of green products, returned goods offer information regarding sale effectivity; prolonged period and option to choose place to return goods increases growth of online and offline purchases. Intangible competitive advantages involve: improved company image; possibility for small businesses and suppliers to gain information from returned product; opportunity to estimate customer reactions, opinions and satisfaction of physical parameters of returned products.⁸

In accordance with M. Džubáková there is given norm ISO 14001: 2015, for increased company performance in relation with environment for organisations feeling responsible for environment and trying to systematically manage their own processes and products with an objective to protect environment and sustainable development.⁹

In recent years, according to Wenjuan Wang many industries have realized that reverse logistics is a necessity for sustainable competitiveness. Reverse logistics has become a key competence in modern supply chains. And it has been a field of importance for organizations due to growing environmental concerns, legislation, corporate social responsibility and sustainable competitiveness.¹⁰

⁶ Dupař, A., Marečková, Z.: *Vplyv zelenej a reverznej logistiky na tvorbu a ochranu životného prostredia*. 1. vyd. Bratislava : Vydavateľstvo EKONÓM, 2011. 32 p. ISBN 978-80-225-3193-1.

⁷ Lourenço, H. R., Soto, J. P.: *Reverse Logistics Models and Applications: A Recoverable Production Planning Model*. Barcelona: Department of Economics and Management, Universitat Pompeu Fabra, 2002. 4 p. Available at: <https://repositori.upf.edu/bitstream/handle/10230/1164/636.pdf?sequence=1>.

⁸ Jayaraman, V., Yadong L., Findlay, E. M.: *Creating Competitive Advantages Through New Value Creation: A Reverse Logistics Perspective*. In Academy of Management Perspectives. ISSN 1558-9080, 2007, vol. 21, no. 2, pp. 56-73.

⁹ Džubáková, M.: *Revízia normy ISO 14001 a vplyv na environmentálny manažérsky systém*. In Vplyv environmentálnych nástrojov na zvyšovanie konkurencieschopnosti a udržateľnosti podnikov - I. : zborník príspevkov z vedeckého seminára Katedry manažmentu výroby a logistiky pri príležitosti týždňa vedy a techniky 2015, Bratislava: Katedra manažmentu výroby a logistiky FPM EU, 2015. ISBN 978-80-225-4193-0, pp. 1-2.

¹⁰ Wang, W.: *A Decision Method for Returns Logistics Based on the Customer's Behaviour in E-commerce*. In Procedia Computer Science. ISSN 1877-0509, 2015, vol. 60, no. 1, pp. 1506-1515.

3 Methodology and data

Aim of this article is to create ideological model of reverse logistics, based on questionnaire survey performed on a sample of selected businesses of production character in Slovakia, on grounds of suggested solutions and arrangements aimed at optimisation of reverse logistics conditions in context of sustainable development in production businesses in Slovakia.

Critical area: $\chi^2_p > \chi^2_{1-\alpha} [(r-1).(s-1)]$ when α is level of importance, or $(1-\alpha)$ is credibility. $\chi^2_{1-\alpha} [(r-1).(s-1)]$

At level of importance 0,05:

$$\chi^2_{1-\alpha} [(r-1).(s-1)] = \chi^2_{0,95} [(5-1).(5-1)] = 16$$

With credibility 0,95 or at the level of importance 0,05 we accept the hypothesis that there is statistically important dependency between coefficients.

Calculation for chi-quadrat:

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

Chi -quadrat = 19.971

Calculation for degree of freedom $df=(s-1)*(r-1)$

$$Df=(3-1)*(3-1)$$

$$Df= 4$$

$$p= 0.00284073$$

Hypothesis was not confirmed as the value of $p < 0,05$

If we discovered, there is an association between statistical elements we can precede to the next analysis which is characterization of intensity of association based on relation.

$$Q = \frac{(ab).(a\beta) - (a\beta).(ab)}{(ab).(a\beta) + (a\beta).(ab)}$$

where, a = statistical variation and b = statistical variation;

$$Q = 0,8668$$

4 Data analysis

Selected production businesses in Slovakia participating on survey are fully declaring their responsibility to protect environment. They also commit to follow legislation requirements and focus their primary activities in correspondence with principles of permanently sustainable development and criteria of environmental system of management. Implications of production processes on environment are therefore considered always ahead. In times of realisation itself companies must follow principles of management of environmental protection and waste management, saving energy, water and application of the best affordable technologies.

To achieve these objectives to respect reverse logistics, prevention of waste creation, limitation of its amount and decrease of dangerous characteristics of waste is necessary to consider general principles of environmental protection, such as principle of cautiousness and principle of permanent sustainability. Also it is vital to consider technical feasibility and economic viability, source protection, environmental protection and protection of human health.

It is a social responsibility of every company to improve security and ecologic safety of products throughout their entire durability, to save sources and minimise impact on environment. Every company, in times of its existence, is monitored by

¹¹ Pacáková, V. et al.: *Štatistická indukcia pre ekonómov a manažérov*. 1. vyd. Bratislava: Wolters Kluwer, 2015. pp. 67-90. ISBN 978-80-8168-081-6.

executive administration whether there could be found any violations or non-fulfilment of environmental legislation in times of its activity.

Within environmental management there is one of production businesses in survey that implements basic principles to achieve permanently sustainable development. These principles are as follows: environmental education – where company increases awareness of its employees via courses and presentations; management of chemical substances – where company attempts to substitute solvents on base of siccative organic substances used in soldering, degreasing and cleaning processes by solvents on base of water; slowdown global warming – there is focus on decreased amount of greenhouse gases released into atmosphere and at the same time it is focused on acquisition of 100 % of electric energy produced from renewable resources, like water, solar, wind, geothermal energy and energy of biomass; guarantee of environmental products – its aim is to reduce amount of harmful substances and apply program Green Partner, which includes list of forbidden, limited and controlled substances; apply principle 3R – Reduce, Reuse, Recycle when handling waste.

In survey we found out that one of production businesses is attempting optimisation of natural gas consumption for heating its facilities by 5 %, decrease of electric energy consumption to light production halls by 10 %, installation of economy lighting in production halls; implementation of economy measures to save drinking water; reduce noise level in production halls by 5 %.

5 Results and discussion

Based on survey performed on a sample of selected companies located in Slovakia we came to following statements. We investigated that in production businesses there are tons of waste produced annually, that include for example cardboard, polystyrene and foils. Companies try to recycle these wastes in a most appropriate manner, and hence decrease charges to dispose the waste. In one of the production businesses there was produced waste in volume of 10 480 020 kg in a previous year. Its growth has increased in given company gradually and it is related to expansion of production and increased amount of produced goods. In another production business they managed to decrease volume of waste by 9 780 kg in years 2014 and 2015. This company states the reason to be application of program “Returned packages”. The principle of this program is that it is based on 3R in sphere of rational use of resources and subsequent waste production. Some of important factors determining whether to apply program “Returned Packages” are distance of supplier, size of component and its quality. In an undisclosed company there are two types of waste handling: depreciation and disposal. Depreciation is use of physical, chemical and biological characteristics of waste. Disposal is handling waste that do not harm environment.

In survey we investigated that the greatest volume of waste is represented by waste resulting from production process. Some other waste materials are for example plastics and paper, which is related to cardboard, in which there are packed individual components necessary for production process. There are other wastes in companies such as oils, dangerous waste and communal waste. In production process there exist certain percentage of spoilt goods; company tries to identify them immediately throughout regular control operations to depreciate them or process them further. This is secured by processes of reverse logistics. This reverse process might be applied to precede preventable creation of undesired waste, especially in early processes of production where product have not passed irreversible process and it is still possible to fix it or process for different use.

In one of production businesses plastic waste represented 30 % of waste for year 2015. Company reasons this claiming that plastic is not part of their products, but they referred to plastic pallets to plastics waste in 2015, while in previous years company used europallets. There could be also included plastic

containers used to store components necessary for productions, pet bottles, polystyrene, plastic rolls, pet foils and plastic covers. Production waste represents 33 % of entire waste of company with the equal percentage share 33 % of paper waste, where there belong cardboards used for lorry lining which protects goods from physical damage during transportation and to store smaller kinds of products. There was lower percentage of dangerous waste with 2 % and oils with 3 %. Communal waste represented 1 % of waste in 2015.

In 2015, in one production business the greatest volume of waste was represented by metal waste that is not returned back to production process. Farther, there is communal was that constitutes 18 % and is plumbless and ever-present part of waste management of given company, stainless waste 5 %, dangerous waste 2 %. The lowest representation is by aluminium waste 1 %, paper and cardboard 1 % and plastics 1 % which does not represent considerable percentage of waste management out of entire volume of waste.

In another production company, there is applied colour concept of waste classification. Yellow waste bins are dedicated for plastic waste such as pet bottles, waste plastics, and plastic foils which represents 44 % of entire waste. Blue bins are designed for cardboard and boxboard which is 9 % of company’s waste. Glass belongs to green bins and represents only 1 % of the waste. Remains of paint, waste thinners, lead batteries, oils, organic solvents, waste oil all represent 3 % of waste and this type of waste bellows to red bins. In brown bins there is placed household waste which presents 3 % of waste. These waste bins are made of plastic and therefore they are assigned for collection of separated non-flammable waste. For collection of flammable and dangerous waste there are metal bins, this type of waste presents also 3 % of waste. In the company there is also waste formed of scrap iron and it represents 13 % and parts of other non-specified blending wastes with 24 %.

Based on survey performed on a sample of production businesses located in Slovakia we investigated how businesses perceive environmental politics of a business, sustainable development, reverse logistics and processes related to minimisation of negative impacts of business activities on environment.

Based on results of a survey it can be established that every production business applies environmental politics of a business and their employees are aware of it. This possibility was marked by 69,63 % of respondents, 15,8 % of companies stated they are not aware and only 10,87 % of companies cannot answer this question. Employees of a company are made aware of this environmental politics at the time of starting in the company, as every newly accepted employee must pass compulsory training, which is renewed for employees annually, every two years depending on the production business. In case employees work with dangerous waste, they have specialised training with regards on treating of dangerous waste, while this training is repeated every year. Environmental politics in companies is available for all employees in specifications, manifestations and intranet of every company.

What are environmental objectives of a company for the upcoming year? 95 % of companies are familiar with these objectives as it is essential part of the company influencing other activities of a business. 3 % of respondents do not know what environmental objectives of their company are and 2 % of respondents cannot answer this question. Many of production business are planning to continue in their current environmental plans and for example one chosen production business would like to reduce CO₂ emission production from their consumption of electric and thermal energy by 10 363 t of CO₂; decrease water consumption by 2710 m³; depreciate waste by more than 98 %; assure there is no accident with effect on environment; secure there are no forbidden substances in final products; improve environmental and energetic awareness of employees. How is company planning to handle waste in upcoming years? 82 % of employees participating on questionnaire survey knows,

how company plans to handle the waste, only 5 % of respondents do not know how company plans to handle the waste issue and only 13 % cannot answer the question. Many businesses have their own projects arranged for upcoming years, while every year they plan further improvements. With assistance of these projects they save material and economic sources as well as environment. One of production businesses sees large potential in returnable packages, where the biggest contribution is in plastic containers, because their positives are perceived but not only ecologists but also by economy. In this group, manager can see improvement for environment in company in form of designed dimensions and types of packages based on requirements or experience in manipulation with components. Significant advantage of these designs is immediate change according to requirements of suppliers what would not be possible with foreign suppliers.

Another production business has started to apply project "Green factory". Fundamental of this project is rational utilisation of energies with aim to decrease consumption of electric energy by 200 000 kWh in comparison with previous year. The most energy 45 % out of all energy is consumed by air conditioning and compressors. The second is lighting with 34 %. The least of electric energy is spent in gatehouse and kitchen which represents only 2 %. Company stated that this year they introduced changes in form of replacement of equipment in server room, where there was not only achieved lowered energy consumption but also savings on cooling of the whole server system. Another activity was optimisation of camera system in the company, where formal televisions were replaced by new ones, more ecological models. There were also installed heat insulating foils in administration spaces, which creates further savings on cooling and heating.

6 Conclusions

Correct functioning of successful production business in current dynamic business environment requires appropriate management and coordination of all in-house and out-houses processes. Unification of all managerial tasks leads to gradual fulfilment of company objectives. Continually increasing competitiveness caused that progress in all managerial areas is focused on acquiring and attracting customers among all competing business. Due to this trend of rivalry it is important for companies to focus on wider scale of activities and seek areas where they could improve the current state. In past, reverse logistics was forgettable factor in creating company strategy, but nowadays there is more emphasis put on this factor. Are of reverse logistics could be perceived as subgroup of logistics as whole, it even has wider field of access and its activities enter into many company factors. Task of reverse logistics is to again use returned goods, materials, it enters areas of disputes and it also deals with recycling processes. These individual functional activities have impact on company finances in decrease of expenses throughout reversible use of materials, another factor is customers perceiving ecological activities of a business emerging from recycling processes. Sustainable, socially responsible business is in interest of company and helps to fulfil relation towards legislation requirements, most often regarding area of environment.

Our recommendation in sphere of reverse logistics in context of sustainable development in companies is to create logistic entity itself in every production business. This sphere requires initial expenses in company to equip administrative spaces, means, or expenses necessary for new job positions, but as a result in long term it means step forward and benefit in context of sustainable development in sphere of reverse logistics. Some advantages of creation of individual logistic entity and its separation from classic logistics can be witnessed in improved coordination of activities in area of logistics, in better organisational division and solutions in area of reverse logistics, improved public opinion, option of better direction and control of expenses and better allocation of responsibilities and powers in area of sustainable development.

Further we would like to point out to sustainable development in every production business that belongs to pillars. There are three

pillars and those are economic, social and environmental. Every production business directed towards sustainability must consider these pillars. Economic pillar includes employees, because they create expenses in form of wages. Expenses will appear, as we recommend change of wage structure of employees in production businesses which brings lowered expenses for waste separation. Employees would be motivated to keep correct work habits and to come with suggestions of improvement to their supervisors.

Social pillar involves employee training which increases knowledge of environmental area. The aim of the training is for every employee to think of what could be done to support production business in fulfilment of environmental objectives of a company. Environmental pillar could involve setting objectives to decrease burdening of environment. Results of questionnaire survey and our recommendation within reengineering of reverse logistics processes in context of sustainable development showed the importance of this issue and necessity to deal with this issue in every production business in Slovakia.

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