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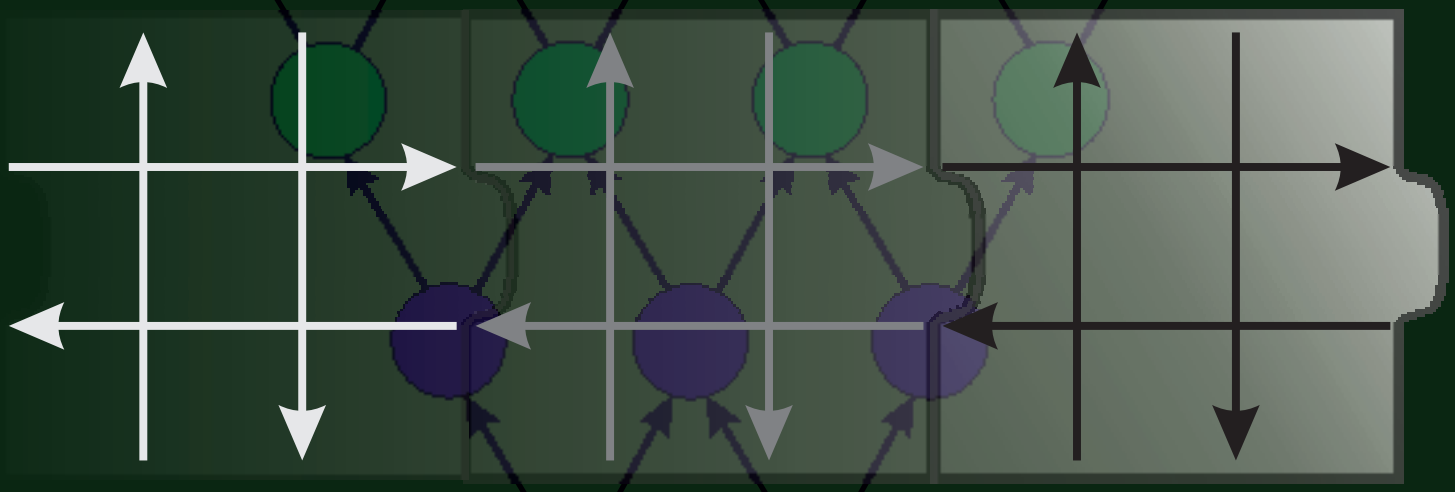

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DIGITIZATION OF BUSINESS PROCESSES AND TECNOMATIX AS A COMPREHENSIVE PACKAGE INSTRUMENT FOR THE CREATION OF THE DIGITAL FACTORY

Marek Kliment
TU of Košice, Faculty SjF, Institute of Technologies and Management, Department of Industrial Engineering and Management, Němcovej 32, 042 00 Kosice, e-mail: marek.kliment@tuke.sk
Peter Trebuňa
TU of Košice, Faculty SjF, Institute of Technologies and Management, Department of Industrial Engineering and Management, Němcovej 32, 042 00 Kosice, e-mail: peter.trebuna@tuke.sk
Jaromír Markovič
Slovak legal metrology, Hviezdoslavova 31, 97401 Banská Bystrica, e-mail: slm@slm.sk

Keywords: digitization, digital factory, simulation, planning, production
Abstract: Current trends in the development of a dynamic and turbulent world economy are largely digitization. Once upon the implementation and application of new production, made the setting and testing of variants directly to the production lines for their full operation. First production tested, set its standards and then began the production program. These procedures were but very costly and lengthy and on-going businesses big money and precious time. Gradual deployment of various software techniques, these processes are transferred into digital form. Technology has come to the point that all business and production processes nowadays we can make this into a digital form. In this way we manufacture everything in detail and test plan prior to the launch date line. Such technology is called Digital Factory.

1 Introduction

Digital factory is a virtual reflection of the real company that shows business processes in a virtual environment. Digital factory mainly supports planning, simulation, optimization and performance prediction manufacturing complex products. Basically, the digital firm serving the thorough preparation of production before it begins physical production. Digital enterprise systems represent an innovative step in the gradual creation of methods and tools to support business processes in the total life cycle of the product.

2 What Is Digital Factory?

Digital factory is mainly corporate strategy. It is an integrated and coherent set of software tools, processes and methods aimed at reducing the times swell up new production, accelerating the change to increase its efficiency. Works with digital models of real production, in which the forward in the digital environment verify and optimize the products themselves, all processes, activities, material flows and tools. To be well analyzed, processed, optimized set, and then put into physical production. Digital Factory concept begins with the formation of the product, its proposal. The product should be constructed from the start so that it is the easiest and most efficient to manufacture. Nowadays designers to work using CAD systems, it is very rare that the models or drawings on paper physically draws on the drawing board as it was in the past. Creating digital data are put emphases on design methodology taking into account the needs of production and assembly. It is important that the data that are essential to running your business flowed in the right direction and be available whenever and wherever they are needed. Important part in the development of digital businesses are technological preparation of production and design, in which the design and simulate all and set for further processing. The effect of all the above mentioned processes and tools take effect their integration into a single cooperating whole. Currently on the market a large number of software products that provide these options and their expansion are comparable with the period when they began to introduce CAD systems, which are now a common tool in many enterprises.

Figure 1 Simulation as part of the Digital Factory

3 What Is Digital Factory?

Digital Factory concept is promoted mainly due to large manufacturers, especially automakers. Advocates out there that have high batch manufacturing. Successfully, however, also used on routes where there is little serializability where you need to change quite often and converting lines. It is commonly used in the production of larger piece products. Gradually covers a wider range of types of production. It is very well applicable and wherever it is planned to hand made, or where a person enters into production, whether occupational activity, or simply as a supervisory body. It is intended wherever it is necessary to increase the production of production, reduce costs and increase efficiency.

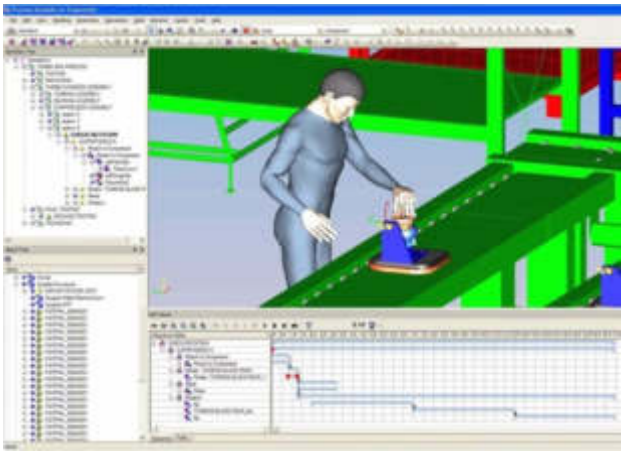

Figure 2 Simulation of people in the digital factory

Advantages introduction of digital enterprise:

- cost savings through better use of resources of 30%,
- cost savings achieved by optimizing material flows 35%,
- reduction in the number of machines, tools and workplaces by 40%,
- the total output growth in manufacturing by 15%,
- reduce time to market for new products by 30%.

As already mentioned, currently on the market and the number of providers of products are falling within the digital enterprise. One of these providers is also Siemens PLM Software and its products.

4 Tecnomatix and other products from Siemens PLM software

NX improves productivity through product development, delivering faster, more flexible modeling of individual components and assemblies, higher performance of several CAD applications used at the same time, more efficient digital simulation and more efficient manufacturing PLM Software Teamcenter connects people throughout the lifecycle with a single source of knowledge about products and processes Velocity Series is a comprehensive family of modular , yet integrated solutions across the product lifecycle management (PLM) in the midmarket . Medium allows manufacturers to compete effectively with larger companies with more funds available. Add to portfolio Velocity Series, Siemens falls Solid Edge with synchronous technology - is a complete 2D/3D CAD software based on the properties with excellent modeling of parts and assemblies, drafting, transparent data management , and inclusion of finite element analysis (FEA). 3DSync - is a tool designed to edit 3D CAD data, which, thanks to the synchronous technology facilitates designers to work with imported data engineering components and assemblies. It is intended for use in conjunction with existing CAD system helps engineers to reuse the data , thus reducing the cost and time needed for processing Tecnomatix ™ is a broad portfolio of digital manufacturing solutions that offer an innovative approach by linking various manufacturing engineering disciplines with the product , from the layout and design , process simulation and validation after implementation registration Siemens PLM Software includes several software tools for different areas of production , which can be interconnected. Tecnomatix suite of

tools allow industrial companies to use in practice, the concept of the digital enterprise, thus producing plans and projects, design, verify and optimize manufacturing processes and resources in the digital environment. Precise digital modeling, simulation and spatial (3D) visualization allow professionals working in development visualize, analyze future production process, thus limiting the possibility of errors that could occur during the start-up of production. Tecnomatix product portfolio is very extensive. It is composed of interconnected, but also separately usable software products (Fig. 3).

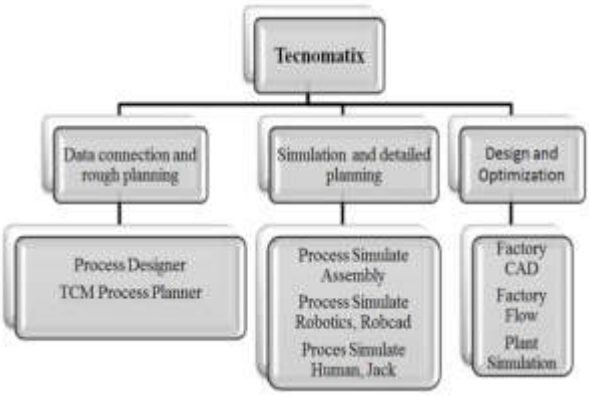

Figure 3 Tecnomatix distribution of modules according to the type of use

Key areas using Tecnomatix solutions are:

1. New product development - balanced production planning in accordance with product management ensures competitive advantages.

2. Synchronization value chain - the exchange of innovative ideas and synchronization requirements with the supply chain worldwide.

3. Enterprise data management - to benefit from the knowledge that the enterprise using Tecnomatix operates under the same rules of life- cycle portfolio.

4. Knowledge / intellectual property management – increasing the flow of information to ensure the success of the development process and give new insights for future development.

5. Match - automate data collection at the manufacturing to reduce risks and ensure compliance.

6. Efficiency of production - planning, creation and optimization of production processes to increase productivity, increase profitability and guaranteeing excellent quality.

7. Systems Engineering and Mechatronics - use system view and check electro - mechanical processes for the most efficient production facility.

Conclusion

Currently, the market for products of any kind is a huge competition as companies increasingly want to be one step ahead of their competitors, they must produce fast, high quality and also provide additional services at a good level. As the product life cycle shortens, it is often necessary to innovate products and production processes change. With these changes of production methods and processes is an essential tool for digital enterprise that helps all activities optimally set up and tested everything and plan before starting the physical production lines. It is important to choose the right tools for the realization of this goal. One of the right tools is the use of Tecnomatix product portfolio of products, which cover much of the modules in digital factory.

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TRANSPORT OF COUNTERFEIT GOODS

Dagmar Babčanová
Slovak university of Technology, Faculty of Materials Science and Technoplogy, Institute of Industrial Engineering and Management, Paulínska 16, 917 24 Trnava, Slovakia, dagmar.babcanova@stuba.sk

Keywords: transport, borders, intellectual property rights, counterfeiting, counterfeit goods, brand, trade mark
Abstract: The paper is focused on a current problem of transport of counterfeit goods in the European Union. Counterfeiting has a strong influence on the distribution organizations worldwide because most of counterfeit goods threaten the health and safety of consumers. Counterfeiting is a serious problem in the world economy today. The purpose of this paper is to point out the danger of counterfeiting in connection with the transport of Intellectual Property (IP) rights - infringing goods. Background of the paper's content is based on secondary data research of publicly available sources - international statistics and world reports.

1 Intellectual Property Rights

Intellectual property (IP) rights are the rights given to persons over the creations of their minds. They usually give the creators an exclusive right over the use of their creation for a certain period of time [29].

In general terms, intellectual property is any product of the human intellect that the law protects from unauthorized use by others. The ownership of intellectual property inherently creates a limited monopoly in the protected property [6].

Intellectual property rights are customarily divided into two main areas: [29]

1. Copyright and rights related to copyright (the rights of authors of literary and artistic works, rights of performers, producers of phonograms and broadcasting organizations).
2. Industrial property (trademarks, geographical indications, inventions (protected by patents), industrial designs and trade secrets).

For the purpose of our paper, we will deal with just one part of the industrial property – the trade mark, because trade marks can be easily counterfeit and distributed all over the world.

Clifton and Simmons describe brand as "*the most important and sustainable asset of any organization – whether a product - or service - based corporation or a not-for-profit concern – and it should be the central organizing principle behind every decision and every action.*" Any organization wanting to add value to day-to-day process and cost needs to think of itself as a brand [5]. American Marketing Association [24] defines brand as: *"Name, term, design, symbol, or any other feature that identifies one seller's good or service as distinct from those of other sellers."*

Brand Finance [4] defines brand as the *"Trade mark and associated intellectual property including the word mark and trade mark iconography"*. On the basis of existing definitions of the brand we define brand as: *"Perceptible sign of the organization and its products to the human senses, through which the customer is able to differentiate an organization and its products from others. Brand identifies organization and its products and at the same time differentiates it from the other competitors"* [3]. Legally protected "brand" becomes "a trade mark". Conditions for registrability of a trade mark in the Slovak Republic are given by The Act No 506/2009 Coll. on Trade marks. The term of protection of the registered trade mark is 10 years as from the filing date of the trade mark application [16].

According to the Industrial Property Office of the Slovak Republic, *"a trade mark proprietor shall have an exclusive right to use a trade mark in relation to his goods or services, for which a trade mark is registered."*

A trade mark owner uses the sign ® along with the trade mark. The owner of the trade mark is entitled to prevent third parties not having his consent from using in the course of trade a sign:

- identical with a trade mark for goods or services identical with those, for which a trade mark is registered;
- if because of its identity with or similarity to the trade mark and the identity or similarity of goods or services there exists a likelihood of confusion on the part of the public; the likelihood of confusion includes the likelihood of association of the trade mark;
- identical with or similar to the trade mark with the reputation in the territory of the Slovak Republic, not registered for identical or similar goods or services, if the use of that sign without due case takes unfair advantage of, or is detrimental to the distinctive character or the repute of trade mark [17].

As Gregory Pollack states in his article, many companies and brands in the global market are engaged in partnership marketing, marketing alliances, strategic partnerships or even in partnership brand marketing programs. The true success of partnership brand marketing lies in its power to open up new and alternative

channels of distribution for both the companies and the brands involved [22].

Brand (or legal protected brand = trademark) facilitates activities associated with the distribution of goods and also simplifies the process of ordering goods. Brand should be involved in the marketing program, and in all its parts, which are product, pricing, communication and distribution strategy. The last mentioned strategy solves problems within distribution channels. Through distribution channels manufacturers offer the brand to the wholesalers and retailers who sell branded goods. Manufacturers who wants to have a complete control over the whole distribution, they have to build up its own sales network.

2 Counterfeiting in the world

As Paul Paradise mentioned in his publication, by the 1970s, counterfeiting was costing U.S. companies billions of dollars, upwards of $100 billion in the years leading up to the Trademark Counterfeiting Act of 1984. Most counterfeit manufactures were small companies that once a civil suit was filed against them, would virtually disappear. Lack of penalties for counterfeiters also meant that products could be sold that were not safe and up to regulatory standards including medications, cosmetics, and machinery parts [21].

The garment industry is one of the largest areas of counterfeit goods. Louis Vuitton estimates that two to three million counterfeit Louis Vuitton pieces are produced each year (ca. twice the number of genuine products it manufactures). Therefor spends Louis Vuitton upwards of 5 % of its revenue fighting off counterfeiters; about 1,500 actions/civil proceedings. According to the International Trademark Association (INTA), between 1991 –1995, apparel and footwear companies lost 22 % of their sales, around $ 2.1 billion, due to trademark counterfeiting [20].

Area of automotive parts is also a large area of counterfeit goods. The U.S. automobile industry would employ another 200,000 - plus employees if it could manage to put counterfeit supplies out of business [18].
According to the Counterfeiting Intelligence Bureau (CIB) of the International Chamber of Commerce (ICC) of the World Business Organization (WBO), counterfeiting accounts for between 5 – 7 % of world trade ($ 600 billion a year). The Counterfeiting Intelligence Bureau (CIB) formed in 1985 (as a specialized bureau within Commercial Crime Services - CCS), protects industry from the damage caused by counterfeiting by gathering intelligence, making undercover enquiries, organizing the seizure of counterfeits, and providing expert advice and training to its members. Members of CIB are large multinational companies, trade associations, law firms, technology producers and investigative firms. Recognized by the British Home Office and World Customs Organization (WCO), the CIB has carried out more than 600 investigations in over 35 countries into counterfeit goods ranging from pharmaceuticals and alcoholic beverages, to furniture and wall coverings [14].
CIB analyses links between websites involved in the marketing and distribution of counterfeit products to identify vulnerabilities and trends [15].

3 Counterfeiting regulation in the European Union

Customs administrations of European Commission (EC) are active in enforcing IP rights at the EU borders. Regulation (EU) No 608/2013 issued in 2013 (came into effect in 1 January 2014) concerning customs enforcement of IP rights replaces Council Regulation (EC) No 1383/2003. The new regulation provides procedural rules for customs authorities to enforce intellectual property rights with regard to goods liable to customs supervision or customs control. *The new regulation* [8, 23]:

- expands the range of IP rights infringements covered,
- adjusts procedures in order to reduce administrative burdens and costs,
- ensures that high quality information is provided to customs so as to enable better risk management,
- includes measures to ensure that the interests of legitimate traders are protected.

If IP right holders feel that their IP rights have been infringed than they have to submit an application for action to the customs authorities. The identification and grounds for suspicion of an infringement rely on the information provided by industry in the application for action (such as the type of IP rights infringing goods, information on production and means of transport, physical characteristics of original goods, etc.). The European Commission with EU Member States has established a manual for right holders for lodging and processing applications for action. When right holders suspect that their rights might be infringed, they may lodge an application, requesting customs to take action [7].

4 Counterfeit goods and their import in the European Union

The involvement of European customs authorities with articles suspected of infringing IP rights such as trademarks, copyrights or patents is increasing year by year. Statistics published on a regular basis by the European Commission registered 86,854 cases of shipments suspected of violating IP rights in 2013, which is 3,619 less than the previous year 2012 [9].

According to World Intellectual Property Organization (WIPO), there are different ways that counterfeit goods can come to the attention of the authorities. IP rights owners themselves may become aware of distributors or retailers trading in counterfeit goods and bring the trade to the attention of the police. Also counterfeits may be

detected by law enforcement officers who are specifically empowered under trade mark legislation to take action against traders in counterfeit goods [27].

Another way in which action against counterfeit goods can be taken occurs at ports of entry of imports. If a trade mark owner becomes aware that consignments of counterfeit goods are on their way to the country, he can alert the customs authorities, who will keep watch for the goods and impound them when they arrive. Action can then be taken against the importer [27].

In 2014 The European Parliament has backed powers for customs bodies to seize counterfeit goods travelling through the EU. Years before customs could detain only fake goods suspected of entering the single market, rather than those heading for beyond EU borders [28].

The largest number of cases were detained through postal and express carrier transport (72 %), followed by air transport (17 %). Figure 1 shows most used means of transport to import suspected IP rights - infringing goods into the EU [9].

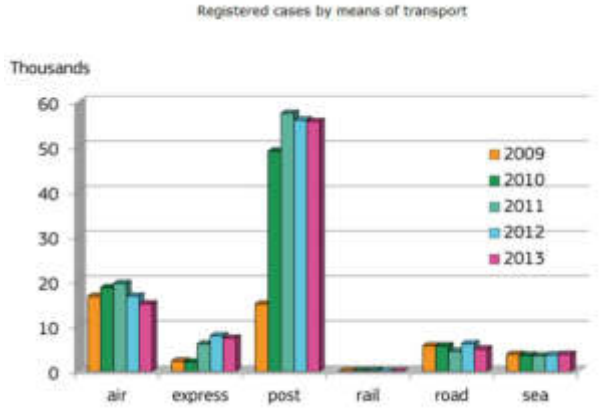

Figure 1 Registered cases by means of transport [9]

In comparison to the years 2010 – 2012, the trend in number of cases 2013 did not change extremely. Still are topped postal, airs and express transport - the most important means of transport in number of cases detained, whereas sea transport of containers is the main transport modality in number of articles [9].

Analyzing intellectual property statistics reports (Report on EU customs enforcement of intellectual property rights, Results at EU border) published by the EU from 2012 – 2014, gathered information show that in the reporting period 2011 – 2013 the percentage of cases detained through postal transport constitutes the largest amount in comparison to other means of transport (Table 1) [9, 10, 11].

Table 1 Cases by means of transport in % (2011 -2013) [9, 10, 11]

Mean of transport	2013	2012	2011
Air	17.32	18.52	21.46
Express courier	8.51	8.77	6.72
Post	64.00	61.82	62.91
Rail	0.03	0.00	0.19
Road	5.75	6.80	4.92
Sea	4.40	4.08	3.80

The percentage of articles detained through the sea transport constitutes the largest percentage unlike the other means of transport (Table 2) [9, 10, 11].

Table 2 Articles by means of transport in % (2011 - 2013) [9, 10, 11]

Mean of transport	2013	2012	2011
Air	10.83	14.47	5.02
Express courier	11.38	4.97	2.96
Post	3.09	2.68	1.67
Rail	0.17	0.00	0.10
Road	11.92	19.25	22.30
Sea	62.62	58.62	67.95

The percentage of value detained through the sea transport constitutes the largest percentage in contrast to other means of transport of IP rights infringing goods (Table 3) [9, 10, 11].

Table 3 Value by means of transport in % (2011 - 2013) [9, 10, 11]

Mean of transport	2013	2012	2011
Air	10.95	15.54	15.48
Express courier	5.61	4.75	6.70
Post	9.15	11.82	5.47
Rail	0.13	0.02	0.55
Road	8.06	11.99	8.30
Sea	66.10	55.88	63.50

According to IP rights statistics 2014 (Report on EU customs enforcement of intellectual property rights. Results at the EU border 2013), China is still the main country of provenance from where goods suspected of infringing an IP rights entered the European Union. In terms of product category, other countries appear as country of provenance, i.e. Egypt for foodstuffs, Turkey for perfumes and cosmetics and Hong Kong, China for other body care items, mobile phones, memory cards and sticks, ink cartridges and electrical household appliances. The cases related to postal and courier traffic accounted for 72 % of all detentions and principally concerned [9]:

- sport shoes,
- personal accessories like bags and wallets,
- clothing,
- sunglasses,
- watches.

In 2013, in over 92 % of all cases, customs action was started whilst the goods concerned were under an import procedure. In almost 5 % of the cases, goods were discovered whilst being in transit with a destination in the European Union and in 1 % of the cases goods were under re-export procedure with a destination outside the European Union [9].

Detailed information mentioned above are shown in proportions in Figure 2.

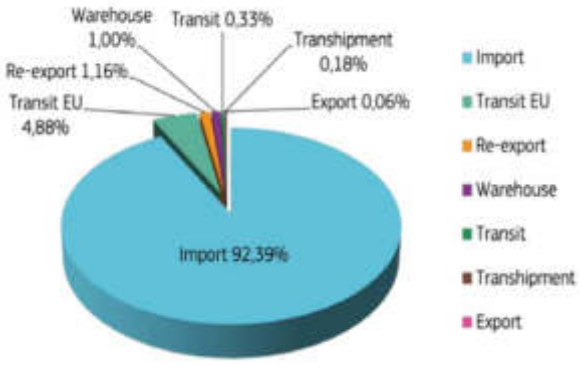

Figure 2 Breakdown of cases by procedure [9]

Figure 3 provides detailed proportions of countries of provenance by articles:

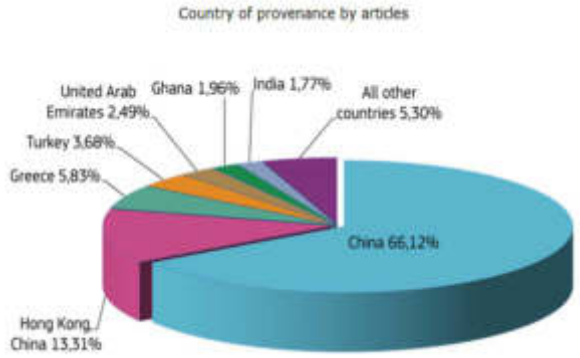

Figure 3 Country of provenance by articles [9]

The majority of articles detained by customs in 2013 were suspected of infringing a Community or national trade mark [9]. According to International Trademark Association (INTA) reports, in large number of cases, the European Union is transit territory. A substantial part of the commerce between Europe and the Far East is conducted through the North Sea ports of Antwerp, Rotterdam and Hamburg (cause is that the EU has a central position and excellent traffic facilities) [1]. Customs authorities of the EU member states (according to the Counterfeit Goods Regulation), care entitled to take action when goods crossing the EU's external borders are suspected of infringing IPR, irrespective of whether the consignment is only in transit or in transhipment through the EU Customs territory [1].

In cases of Nokia and Phillips, the European Court of Justice (ECJ) has held that customs officers in the EU cannot seize counterfeit goods which are merely transiting through the EU, if those goods are (or claim to be) ultimately destined for a non - EU country. Only counterfeit goods which are put on the market in the EU (or where there are sufficient grounds for suspecting this will be the case) can be impounded and destroyed [25].

According to The Guide for International Counsel: Customs Enforcement of IP Rights in Europe & Germany – The New Rules, the new Regulation does not change the situation for goods which are shipped from third - party countries into the European Union and intended for another third - party country. The new Regulation does not modify the solution given by the Court of Justice's decision in Philips and Nokia, wherein the Court decided that goods, prima facie not intended for the EU market, can nevertheless be seized if there is convincing evidence and substantial likelihood that the goods will be re-routed to sale on the EU market [20].

5 Fighting counterfeiting

Companies and organisations operating in today's global environment are faced with a growing complexity of their supply chain, with multiple tiers of trading partners, intermodal transport and cross-border trade issues. In a recent Aberdeen study, 78 % of Chief Supply Chain Officers identified improving extended supply chain visibility as a top priority [2].

There are many ways how to fight against counterfeiting. In 2007, GS1 and the World Customs Organization (WCO) signed a Memorandum of Understanding (MoU), recognizing their common business interests and providing a framework for further cooperation. One major initiative is to improve the effectiveness and efficiency of Customs administrations around the world by [12]:

1. Setting global standards to facilitate cross-border trade.
2. Securing the global supply chain.
3. Facilitating legitimate trade.

GS1 is an international not-for-profit association with Member Organisations in over 100 countries. GS1 is dedicated to the design and implementation of global standards and solutions to improve the efficiency and visibility of supply and demand chains globally and across sectors. The GS1 system of standards is the most widely used supply chain standards system in the world [12].

IPM (Interface Public - Members) is the WCO anti-counterfeiting tool, which enables right holders to give Customs officers direct access to information that would assist them in the detection of counterfeit goods. IPM provides [13]:

1. A database of product information (photos, packaging, routes, etc.) provided by Right Holders;
2. A Web-based interface accessible via Customs' Intranet allowing officers to consult the Rights Holders database.

Integration of IPM tool and GS1 standards is following (Figure 4):

1. Right Holders upload valuable product information to the IPM database;
2. Customs officer scans the GTIN of the product he/she inspects;
3. Customs officer accesses authentication data from IPM and registered product Identity information from GS1 services (which product, what is it).

Figure 4 IPM tool and GS1 Standards fitting [13]

By accessing key specific elements about the product they inspect on the ground, Customs officers are able to quickly detect counterfeit goods. IPM also enables officers to contact concerned Rights Holders immediately in order to verify their suspicions and initiate follow-up legal action [26].

WCO Secretary General, Kunio Mikuriya stated: "*Faced with the growing trade in counterfeit goods, the WCO and its Members are determined to work with GS1 and other concerned organizations to fight this menace in order to protect the health and safety of consumers across the globe.*" And also added: "*IPM's usefulness is now globally recognized by our private sector partners. Our cooperation with GS1 has enabled us to further develop IPM's functionalities making it even more accessible and reliable. IPM is undoubtedly an essential tool to help Customs officers distinguish between genuine and fake products.*" [26]

Conclusion

Systematic improvement of distribution channels should be an integral part of industry activities to fight counterfeiting, because one of the main challenges that counterfeiters face is distribution of their products.
Intellectual property right owners should be able monitor the movements of their products from manufacturers to the retailers. There is a need to co-work with distributors, suppliers, retailers and consumers to ensure the protection of intellectual property rights properly. The harder to get into the supply chain, the greater the chance for intellectual property rights protection.

The relationship between progress in IT technologies and anti-counterfeit solutions is indisputable. Generally, new technologies enable to be a step ahead of counterfeiters. However, progress in technologies entails positive aspect on the one hand and negative aspect on the other hand. Positive aspect is that intellectual property rights owners have latest anti-counterfeit tools and negative aspect implies also the possibility using IT advances in counterfeiting operations. Intellectual property rights owners should (in their own interests) should try to collect as much evidence of counterfeits as it is possible in the future and engage themselves in an active fight against illicit trading with counterfeit goods.

Regulatory authorities, intellectual property right owners, brand managers, supply chain managers, distribution organizations and IT specialists should work together to develop and implement appropriate counterfeit protection systems, new effective anti-counterfeit strategies.

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SIMULATION AS A MEANS OF ACTIVITY STREAMLINING OF CONTINUOUSLY AND DISCRETE PRODUCTION IN SPECIFIC ENTERPRISE

Martin Straka
TU of Košice, Faculty BERG, Logistics Institute of Industry and Transport, Park Komenského 14, 043 84 Košice, Slovakia, martin.straka@tuke.sk
Erik Žatkovič
Shangay - Volkswagen China, China, erik.zatkovic@volkswagen.sk
Róbert Schréter
University of Veterinary Medicine and Pharmacy in Košice, Department of Information and Communication Technology, Komenského 73, 041 81 Košice, Slovakia, robert.schreter@uvlf.sk

Keywords: simulation, ExtendSim, model, printing, enterprise
Abstract: The advantage of simulation is that it works with a model of real system, so it do not influence the system straight. The provision of quality simulation is also quality model, which has almost the same parameters as the real system. The goal of the project is to create a model and to try its different states, real or hypothetic. A system analysis is used for analysing and to reach of modelled system specifications. The base of synthesis is to create the simulation model. Described simulation model is the result of these steps. Description consists of the functional principle, importance and item setup. The section of variation calculations consists of several measured states of the system. At the output of every calculation, there lies summary of defined differences, their influence of gravure printing process in the technological and the economic aspects.

1 Introduction

Computer simulation in present time is the instrument, which is used in industry and science activities. It represents another possibility for optimization and upgrade of various processes, units, machines and activities. Today's time is characterized by a high degree of automation, robotics and informatization almost all parts of the manufacturing companies. Increasingly, highlight the need for streamlined operations of individual sections to ensure smooth company operations, at the condition of the lowest possible, respectively cost-effective. Increasing the efficiency of the production process is one of the ways to achieve higher earnings, respectively reduce costs [1]. One of the tools how to detect bottlenecks in the technological process, and which need to be "fine-tune" is just a simulation [2]. In contrast to interfering the operation of the production line is the intervention to the simulation model which represents this production line, without costs or negative impacts. In the event that solution is found by simulation and the simulation model, nothing precludes that solution was implemented into itself real process. Creation of the correct simulation model of course precedes acquiring sufficient theoretical knowledge (simulation technique, a specific simulation system, etc.), as well as the current state of the modelled system (system description, its elements and their mutual links) [3]. The results of the simulation model are monitored at every stage. It is possible to derive the impact on the overall system function of the changes that occur at the output of simulation [4].

Necessary value of simulation model depends on the characteristics of the real system - changing and experimenting with the system without interfering in the real system. The problem is in need to try many variations in terms of designing new solutions in the absence of technical equipment [5], [6]. The specific need for simulation model arises from the fact that in times of financial crisis are changes that have a major impact and impact also on customers of specific company, which was subsequently, reflected in itself production process of the company [7]. The simulation model and a simulation application contribute to eliminating these problems and reduce the impact to their customers and the market in general [8].

2 Simulation and its theoretical aspects

For creation of true of simulation model it is necessary to know in detail the actual workplace of firm, simulation techniques and have knowledge from other areas of logistics, such as production logistics and logistics of service processes. One of the main problems is a thorough analysis of material flows in the process of printing, which has a significant impact on the exactness of the simulation model in comparation with reality [9]. The basic principle of the simulation lies in a simplified representation of the real system, its simulation model describing only the properties of the real system which interest us [10]. After verifying and the validating of the

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simulation model, it followed realization of experiments using a simulation model. These simulation experiments suggest various "enhancements" of simulated system (variants of solving) and verify their impact on the modelled system. Results of these experiments are applied back to the real system, in order to improve its properties [11].

Simulation is not a utility that allows to obtain directly the optimal solution. Rather, it is support instrument that allows the designer to test the effects of their decisions on the simulation model [12]. Great advantage of this approach is that it is possible to visualize the future behaviour of the system and on this base of knowledge to implement its necessary interventions, in a real system [13]. When evaluating the simulation results, we must aware of that the results obtained by simulation are probable values of simulation model and it is necessary to understand it while using them in further work [14]. As already mentioned, the simulation does not have any systematic procedure, the application of which would mean automatically finding the optimum. For design of systems the simulation is therefore suitable for searching answers for the questions "What happens if ...?". In the event that it is a real system that does not work according our ideas, simulation helps to find an answer to the question "What now?" [9].

The model in the case of computer simulation becomes in final form a computer program, that should capture the structure of the modelled system, its dynamics and the its a probability character [15]. There are several reasons to give the simulation priority over the learning experience by experimenting with the real system - it is cheaper, faster (simulation time can run much faster than real), we can test many more possible scenarios, it is safe (It can be tested also for catastrophic variants), we can analysed also planned systems that do not exist yet [16].

3 Current enterprise short analysis

The company has been on Slovak and the European market for many years. At present, the company mainly focuses on the production and the printing of flexible films for the leading producers of food industry and the hygienic production. In the company there are four basic material flows, which are characterized by parts with final production. The first stream - film production: charging plastic granules in storage - film production - packaging - foil expedition. The second flow - packaging printed film: plastic granulate charging into storage - film production, or the input purchased foil - foil printing - lamination, or the metallization - cutting - packaging - expedition of printed foils. The third flow - production pockets and the bags: plastic granulate charging into storage - production of foils, or the input purchased foils - foil printing - cutting - making bags - packaging - expedition of bags. The fourth flow - making sachets: purchase foils - cutting - printing - laminating - making bags - packaging - bags expedition [17].

Department of printing as a system consists of elements (HSW and the HSR printing machines, auxiliaries parts) and their mutual links (flows of transport, information, materials) within the Department of printing can define several types of material flows (Figure 1). The main material flow represents the printed foils. Subsidiary flows are e.g. colour flow, residual foils, rollers. Side flows are part of service processes within the department gravure printing [17].

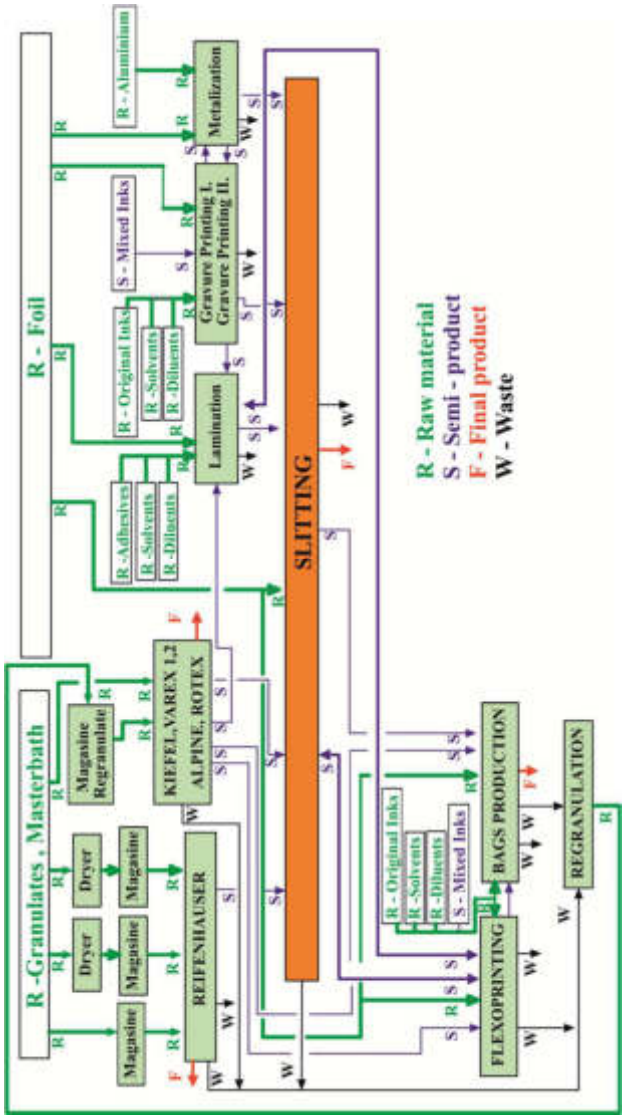

Figure 1 The scheme of production with the material flows

Printing department operates in cycles, where one cycle represents fitted of a single order. Each of this cycle consists of four phases, where are made the following operations:

1 Preparation phase (approx. 35 min)
a. preparation of foils,
b. preparation of scraper blades,
c. preparation of colours,

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d. preparation of press rollers and their transfer to the printing machine.

2 Installation phase (approx. 70 min)

a. rollers removal and their washing, the outpouring of colours, removing the rest of the unused foils from the previous order,

b. installation of press rollers, new coils of foils and the pouring new colours,

3. Running in (approx. 30 min)

a. set the machine for correct print, eventual fine tuning of tone colours,

4. Print (variable time depending on the size of order)

a. press monitoring,

b. installation of a new foils,

c. topping up of colours,

d. wash and the conservation of rollers from the previous order.

Phase no. 1 usually works with the phase no. 4 order so that the preparation of the next order expired at the latest time, when the previous order expires printing.

4 Creation of simulation model

ExtendSim simulation system was chosen for creating of a simulation model which can design continuous and discrete models (Figure 2). Model represents not only the actual printing (implementing blocks Activity), but simulates also coming of orders from the customer (block Generate) with the set attributes of the order [3].

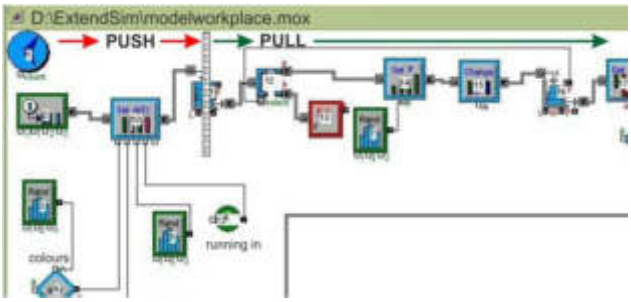

Figure 2 the breaking point between the PUSH and the PULL system in the simulation model of the printing workplace

Figure 3 was made two types of alternative calculations on the model:

1. based on the real state of the system - the role of these alternative calculations is to determine if and how the selected distribution of input interval of random number into the simulation model influence the use of individual devices, the finding what interval is effective for a given setting of the modelled system and the determine which machine represents bottleneck of the process.

2. based on hypothetical states - their task is to examine behaviour of system at a magnification and to reduce the number of machines.

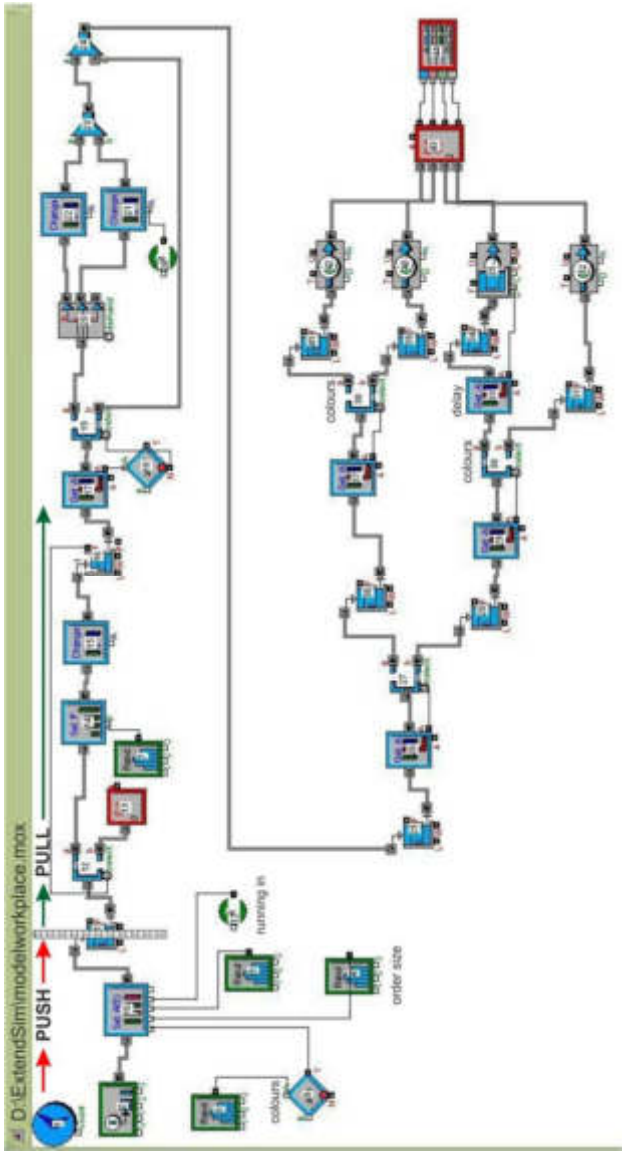

Figure 3 Simulation model of printing workplace in simulation system ExtendSim

In the alternative calculations there has been studied the impact of three types of distribution of arrival order into the company and the behaviour of the system, and this:

1. Triangular - setting the distribution is based on three values (minimum, maximum and the most likely value). To calculate the average value of the input is necessary to calculate average values.

2. Constant - generating of entry on the basis of a constant (constant time step).

3. Lognormal - distribution based on the natural logarithm of normal distribution. Entered are: mean (average) value and the standard deviation, for example 100 ± 25.

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For each type of the distribution there were made 4 set of values, each of 10 reps. During each calculation there were observed following values:

1. number of generated orders,
2. number of completed contracts,
3. number of pending orders,
4. machine utilization individually,
5. the use of machines globally.

For each group, after 10 repetitions it was calculated average values, which are worked further when creating addictions and the conclusions. Multiplication of calculations has been chosen because of averaging the results and to obviate possible deviations caused by extreme course of simulation in one repetition. Selected number of repetitions has proven to be sufficient; because the average value changed was from 8 repetitions are very small, around of 4%. The defined values have been derived from the following indicators:

1. The dependence of the number of completed orders from the average utilization of machines.

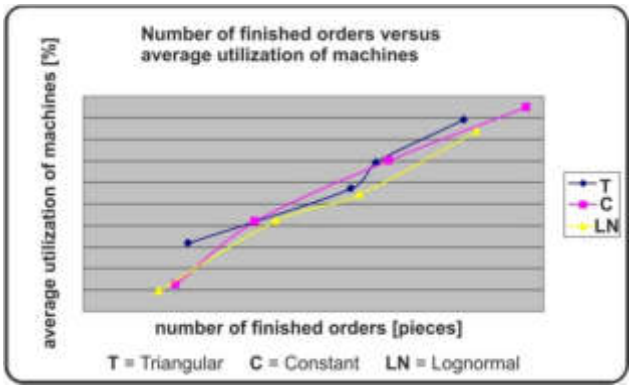

Figure 4 Curves of the average utilization of machines

The graph shows (Figure 4) that the average utilization of machines grows linearly with the number of completed orders for any type of the distribution of arrival requirements to the system. The optimal value of the average use of the machine (approx. 80-85%) is achieved for the volume of 15 completed orders the whole system for 24 hours, representing 1 order / machine / change (8 hrs.).

2. The ratio of equipped and the backlog of orders.

Graph shows (Figure 5) the ratio of equipped and backlog of orders in contemporary displaying of the average utilization of machines (size of the circle). In the chart there are visible two trends in depending:

a. The increase of the number of processed orders is more progressive than the increase of the backlog of orders. This trend can be observed in the range of values ⟨0;15⟩ equipped orders.

b. In the interval ⟨15;140⟩ is increase number of processed orders less than the increase in the backlog of orders.

Point of trend changes (15 equipped orders) can be regarded as effective ratio to number of processed and the backlog of orders. After that point is the increase of number of unserved orders more progressive then the increase of number of served orders.

3. The average utilization of machines.

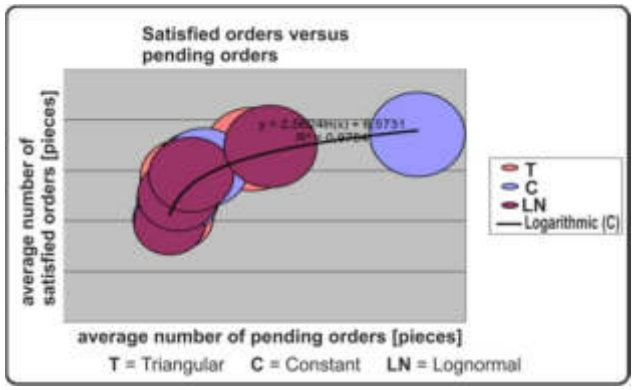

Figure 5 Graph ratio of equipped and the backlog of orders

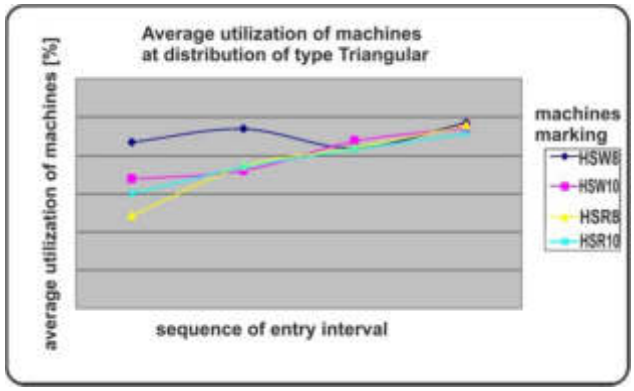

Figure 6 Curves of average machines utilization by distribution function type of Triangular

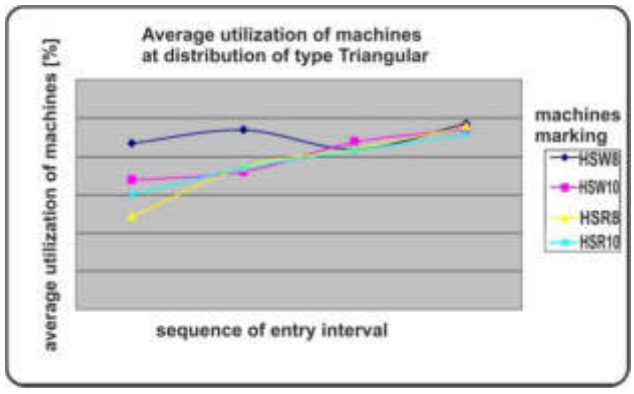

Figure 7 Curves of average machines utilization by distribution function type of Constant

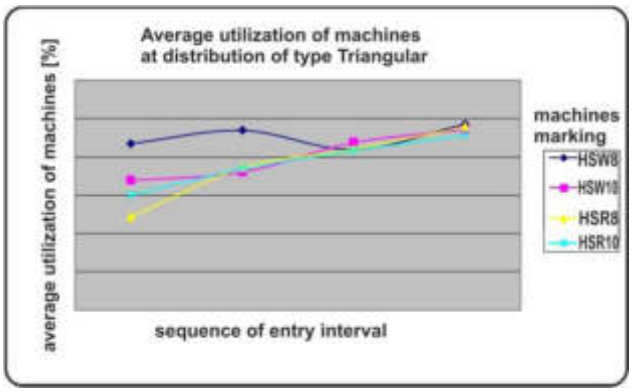

Figure 8 Curves of average machines utilization by distribution function type of Lognormal

From the graphs of the average utilization of machines it results (Figure 6, Figure 7, Figure 8), that the largest deviations in utilization of machines are in distribution function of type Lognormal and the smallest are in distribution function of type Triangular. For each type of the distribution the machine HSW8 is the busiest. Also machines with the 8 inking are busier than machines with the 10 inking too (Table 1).

Table 1 Total average utilization of machines

Machine	Average utilization total [%]
HSW8	90,76
HSW10	70,25
HSR8	78,18
HSR10	70,34
Average sum	77,3825

Conclusion

By simulation it has been found that none of the three types of distribution of random entry of order into the system change radically the behaviour of the simulation model, as well as the output parameters of the system. It follows, that the selected type of the distribution has not a significant impact on the behaviour of the system over other types of the distribution. It was also detected bottleneck of production process in the form of most utilization of the machine, which is HSW8 device, which can be seen also from graphs of the average utilization of machines. Its average utilization is 90.76 %. The least utilized machine can be considered HSW10 machine, which average utilization is 70.25 %. For effective of entry interval, i.e. one in which is the average utilization of machines in the values of 80-85% can be considered for different types of the distribution of following parameters:

1. Triangular – value T 10, 80, 40 (η=0,847),
2. Constant – value C 40 (η=0,851),
3. Lognormal – value LN 50, 20 (η=0,772).

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USING OF MULTI-CRITERIAL EVALUATION METHODS TO ASSESS POSITION OF THE OBJECT IN THE MARKET

Gabriela Ižaríková
TU of Košice, Faculty SjF, Institute of Special Technical Sciences, Department of Applied Mathematics and Informatics, Letná 9, 042 00 Košice, e-mail: gabriela.izarikova@tuke.sk

Keywords: financial indicators, method of simple order, weighted order sum method, standardized variable method, methods of order compliance
Abstract: The article deals with the evaluation of the firm's position. Recognition of market position among competitors but also among customers is important for the development of the company. A comparison can be made by using multi-criterial methods. The ranking of companies is based on different methods (method of simple order, weighted order sum method, point methods, standardized variable method). Compliance order will be assessed by the rank correlation coefficients. Acquired assessment of market state allows us to design a strategic.

1 Introduction

Currently in the market place exists a huge competition as naturally companies want to be one step ahead of their competitors. Know the market place as well as environment of customers, suppliers and the market competition is important for every company. The position of the company in terms of financial performance data and success in the market can be traced countless analyzes. Evaluation of the position will serve us to map out a strategy for future development. When comparing a distinction in the content and scope of a comprehensive comparison (overall results of companies) and partial matching (an area of management). In the case of intercompany (the pooling) comparisons should be considered a company belonging to the industry. In the selection of indicators should respect the principle of comparability. In selecting the sample which compares preserve material, time, size and formal comparability [1].

2 Indicators of financial and economic analysis

Area of financial and non-financial indicators, through which it is possible to identify the performance properties of companies is very wide. The most common indicators that characterize the performance of the company are mainly financial indicators which can be divided into absolute and relative [2].

Absolute indicators:

- EBET – Earnings before taxes,
- EAT – Earnings after taxes,
- Re – Revenue,
- PH – value added,
- Cash-flow.

The disadvantage of these indicators is that they can not be used for inter-comparison. But it can be eliminated, it means that these values are placed in proportion to some baseline. When analyzing the indicators should be taken into account internal and external influences. For example, the cost increase may be due to an investment that will yield the company, but also inefficiency [3].

Among the relative indicators are indicators of profitability, activity, liquidity. When indicators of profitability may explanatory power to distort net profit. Liquidity ratios have high explanatory power.

Profitability indicators:

- ROS – Return on Sales,
- RA Return on Assets,
- ROE Return on Equity,

Activityy indicators:

- CT - Capital Turnover,
- TC - Turnaround Commitments,
- TTOS - Total turnover of stocks,
- AOR - The amount of receivables,

Liquidity indicators:

- TL - Total Liquidity,
- IL - Immediate liquidity,
- QR - Quick ratio,
- I – Insolvency.

Among the indicators above the contribution analysis: ROS, ROE, CT , Tl. (Table 1)

Table 1 Financial indicators

Object	ROS	ROE	CT	TL
1.	**0,162**	**0,0915**	0,34	1,96
2.	0,154	0,068	0,35	2,19
3.	0,103	0,0471	**0,62**	1,25
4.	0,135	0,0835	0,51	1,61
5.	0,156	0,0694	0,17	1,23
6.	0,128	0,0562	0,29	0,77
7.	0,132	0,0789	0,46	0,75
8.	0,089	0,0715	0,52	1,2
9.	0,105	0,0697	0,15	1,56
10.	0,085	0,08	0,55	**0,67**

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3 Multi-criteria evaluation methods

To assess the position of companies (enterprises) on the market, it is possible to use different statistical methods [4]:

- Statistical location and variability (arithmetic mean - average, mode, median, standard deviation, variance, coefficient of variation).
- Methods of statistical analysis (determination of confidence intervals, parametric and non-parametric tests).
- Methods of qualitative and quantitative character interrelation analysis (regression and correlation analysis).
- Multi-criteria evaluation methods - comparison of companies based on several variables (order method, point method, the standardized variable method).

Which were Table 2 Basic characteristics

Characteristics	ROS	ROE	CT	TL
average value	0,1249	0,0716	0,3960	1,3190
standard deviation	0,0267	0,0123	0,1531	0,4884
Maximum	0,162	0,0915	0,62	2,19
Minimum	0,085	0,0471	0,15	0,67
Coefficients of variation	21,35%	17,23%	38,67%	37,03%

For purpose of comparison, we selected four indicators in ten objects (companies) which were compared by means of four methods [5]. Compliance was assessed by serial order coefficients. Table 2 shows the basic statistical characteristics of the monitored parameters.

3.1 Method of simple order (SOM)

Method of simple order is the simplest method of ranking, which evaluates the position of an object according to the serial number of the range objects. An indicator of productivity (ROS, ROE, CT) in which we try to maximize the ranking is determined from *1,2 ... n* by the number of objects, so that we assign the lowest value to the object with the highest value achieved. Performance indicator (TL) in which we try to minimize the ranking is determined from *1,2 ... n* by the number of objects, so that we assign the highest value to the object with the lowest value achieved. Integral indicator (d_i) is designated as a simple sum of the order [6]. The best is the object for which the integral indicator (d_i) is maximum, in case of indicators equality, an average of the order from objects which reached this value is carried out. The advantage of this method is the simplicity but it does not quantify, how much higher or lower the object is than the second one (Table 3).

Table 3 Method of simple order

Object	ROS	ROE	CT	TL	d_i	Order
1.	10	10	4	2	26	**3,5**
2.	8	3	5	1	17	**9**
3.	3	1	10	5	19	**7**
4.	7	9	7	3	26	**3,5**
5.	9	4	2	6	21	**6**
6.	5	2	3	8	18	**8**
7.	6	7	6	9	28	**1,5**
8.	2	6	8	7	25	**5**
9.	4	5	1	4	14	**10**
10.	1	8	9	10	28	**1,5**

3.2 Weighted order sum method (WSM)

Weighted order sum method appears to be the simplest method of multivariate comparisons considering the four methods [7]. It lies in the fact that the objects are ordered by each considered indicators. To the objects for which the indicator achieves the best value (the highest at maximization or the lowest at minimization), we assign a rank equal to the number of monitored objects (n) and object with the worst value of the order parameter (1).

If the same value of objects in one parameter occurs, we assign them the same rank, determined as the average of their respective order [8], [9], [10], [11].

We obtain indicator d_i by which the values are sequenced, as the sum of the order of individual parameters (p_{ij}) multiplied by the weight calculated parameters w_j:

$$d_i = \sum_{j=1}^{m} p_{ij}.w_j \qquad (1)$$

$i=1,2,...., n \quad j=1,2,....m \ (n=10, m=4)$

The object with the highest level of the indicator (d_i) is in the first place in the final order, the object with the second highest value is the second and so on (Table 4).

3.2.1 The determination of the parameter weights

The first step prior to the application of these methods is to determine the weights of indicators. We used the weights using the coefficients of variation from the relation:

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$$w_j = \frac{V_j}{\sum_{j=1}^{m} V_j} \quad , \quad \sum_{j=1}^{m} w_j = 1 \qquad (2)$$

$$V_j = \frac{s_j}{\bar{x}_j} = \frac{\sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(x_{ij} - \bar{x}_j\right)^2}}{\bar{x}_j} \qquad (3)$$

- w_j are the weights for the *j- th* indicator,
- m is the number of indicators,
- V_j is the coefficient of variation of the *j- th* indicator,
- s_j is the standard deviation of the *j- th* indicator,
- $\bar{x}_j$ is the average value of the *j- th* indicator.

$$w_1 = \frac{0{,}2135}{0{,}2135 + 0{,}1723 + 0{,}3867 + 0{,}3703} = 0{,}1868$$

$$w_2 = \frac{0{,}1723}{0{,}2135 + 0{,}1723 + 0{,}3867 + 0{,}3703} = 0{,}1507$$

$$w_3 = \frac{0{,}3867}{0{,}2135 + 0{,}1723 + 0{,}3867 + 0{,}3703} = 0{,}3384$$

$$w_4 = \frac{0{,}3703}{0{,}2135 + 0{,}1723 + 0{,}3867 + 0{,}3703} = 0{,}3240$$

$$d_1 = 10.0{,}1868 + 10.0{,}1507 + 4.0{,}3384 + 2.0{,}3240 = 5{,}3766 \approx 5{,}38$$

Table 4 Weighted order sum method

Object	Weights				d_i	order
	ROS	ROE	CT	TL		
	0,1868	0,1507	0,3384	0,3240		
1.	1,87	1,51	1,35	0,65	5,38	**6**
2.	1,49	0,45	1,69	0,32	3,96	**9**
3.	0,56	0,15	3,38	1,62	5,72	**5**
4.	1,31	1,36	2,37	0,97	6,01	**4**
5.	1,68	0,60	0,68	1,94	4,91	**7**
6.	0,93	0,30	1,02	2,59	4,84	**8**
7.	1,12	1,06	2,03	2,92	7,12	**2**
8.	0,37	0,90	2,71	2,27	6,25	**3**
9.	0,75	0,75	0,34	1,30	3,14	**10**
10.	0,19	1,21	3,05	3,24	7,68	**1**

3.3 Points methods (PM)

When points method assign the object which reached the best indicator value of 100 points and other objects are assigned points as follows:

- while maximizing indicator:

$$b_{ij} = \frac{x_{ij}}{x_{\max}}.100 \qquad (4)$$

- while minimizing indicator:

$$b_{ij} = \frac{x_{\min}}{x_{ij}}.100 \qquad (5)$$

- x_{ij} is the value of the *j- th* indicator of the *i- th* object
- $x_{\max}$ is the maximum value of the *j- th* indicator of the *i- th* object valuation 100 points
- $x_{\min}$ is the minimum value of the *j- th* indicator of the *i- th* object valuation 100 points
- b_{ij} is the is scored of the *i- th* object for the *j- th* indicator

The resulting sequence is obtained by the weighted arithmetic average of the scores for individual variables. The best is the object for which the integral indicator (d_i) maximum. Point method takes the bit size differences in the monitored indicators (Table 5).

Table 5 Points Methods

Object	ROS	ROE	CT	TL	d_i	order
1.	100	100	54,84	34,18	72,26	**4**
2.	95,06	74,32	56,45	30,59	64,11	**8**
3.	63,58	51,48	100	53,60	67,16	**7**
4.	83,33	91,26	82,26	41,61	74,62	**3**
5.	96,30	75,85	27,42	54,47	63,51	**9**
6.	79,01	61,42	46,77	87,01	68,56	**5**
7.	81,48	86,23	74,19	89,33	82,81	**1**
8.	54,94	78,14	83,87	55,83	68,20	**6**
9.	64,81	76,17	24,19	42,95	52,03	**10**
10.	52,47	87,43	88,71	100	82,15	**2**

$$b_{21} = \frac{0{,}154}{0{,}162}.100 = 95{,}06$$

$$b_{14} = \frac{0{,}67}{0{,}96}.100 = 34{,}18$$

3.4 Standardized variable method (SVM)

When applying the standardized method we transpose the values of individual parameters to the standardized form as follows:

- while maximizing the indicator:

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$$n_{ij} = \frac{x_{ij} - \bar{x}_j}{s_j} \quad (6)$$

- while minimizing the indicator:

$$n_{ij} = \frac{\bar{x}_j - x_{ij}}{s_j} \quad (7)$$

- x_{ij} is the value of the *j- th* indicator of the *i-th* object
- $\bar{x}_j$ is the average value of the *j- th* indicator
- s_j is the standard deviation of the *j- th* indicator,
- n_{ij} is thes standard value of the *i- th* object for the *j- th* indicator

The resulting sequence is obtained by the weighted arithmetic average of the scores for individual variables. The best is the object for which the integral indicator (d_i) maximum. The method of standardized variables takes the variability of indicators into account (Table 6).

Table 6 Standardized variable method

Object	ROS	ROE	CT	TL	d_i	order
1.	1,3895	1,6179	-0,3658	-1,3124	0,3323	**4**
2.	1,0899	-0,2927	-0,3005	-1,7834	-0,3217	**9**
3.	-0,8202	-1,9919	1,4631	0,1413	-0,3019	**8**
4.	0,3783	0,9675	0,7446	-0,5958	0,3736	**3**
5.	1,1648	-0,1789	-1,4762	0,1822	-0,0770	**6**
6.	0,1161	-1,2520	-0,6924	1,1241	-0,1761	**7**
7.	0,2659	0,5935	0,4180	1,1650	0,6106	**1**
8.	-1,3446	-0,0081	0,8099	0,2437	-0,0748	**5**
9.	-0,7453	-0,1545	-1,6068	-0,4934	-0,7500	**10**
10.	-1,4944	0,6829	1,0059	1,3288	0,3808	**2**

$$n_{11} = \frac{0{,}162 - 0{,}1249}{0{,}0267} = 1{,}3895$$

$$n_{14} = \frac{1{,}3190 - 1{,}96}{0{,}4884} = -1{,}3124$$

4 Methods of order compliance

The compliance of the object order (companies, firms) as a result of the used methods can be assessed by means of the rank correlation coefficients: *Spearman's rank correlation coefficient, Kendall's coefficient of concordance.*

Table 7 quantified evaluation of ten objects, their order using four multi-criteria evaluation methods. All methods give approximately equal results.

Spearman's rank correlation coefficient measures the interrelation of two orders (x_i, y_i , - pairs are serial numbers):

$$r_s = 1 - \frac{6\sum_{i=1}^{n}(x_i - y_i)^2}{n.(n^2 - 1)}. \quad (8)$$

Table 7 . Order by methods

Object	Methods			
	SOM	WSM	PM	SVM
1.	3,5	6	4	4
2.	9	9	8	9
3.	7	5	7	8
4.	3,5	4	3	3
5.	6	7	9	6
6.	8	8	5	7
7.	1,5	2	1	1
8.	5	3	6	5
9.	10	10	10	10
10.	1,5	1	2	2

If we have equal values we use the *rectified version* of *Spearman's rank correlation coefficient*:

$$r_s = 1 - \frac{6\sum_{i=1}^{n}(x_i - y_i)^2}{n.(n^2 - 1) - c} \quad (9)$$

c is the correction factor, $c = \sum_{j=1}^{k}\left(c^3{}_j - c_j\right)$,

c_j - the number of times in the first or in the second file.

Kendall's coefficient of concordance generalizes *Spearman's rank correlation coefficient* for more than two-dimensional file (A_{ij} - sum of serial numbers that have been assigned to the *i-th* object):

$$r_K = \frac{12}{r^2\left(n^3 - n\right)}\sum_{i=1}^{n} A_i^2 - 3\frac{n+1}{n-1}. \quad (10)$$

For equally ranked objects:

$$r_K = \frac{12[\sum_{i=1}^{n} A_i^2 - \frac{r^2 n(n+1)^2}{4}]}{r\left[rn\left(n^2 - 1\right) - c\right]}. \quad (11)$$

Spearman's rank correlation coefficient and Kendall's coefficient of concordance reach values from the interval $\langle -1,1 \rangle$. If the orders are completely identical then $r_s = 1$, if they are completely opposite, then $r_s = -1$, if $r_s = 0$, then both orders are independent. Calculated coefficients indicate a high consistency of the methods used among objects of a given file (Table 8).

Table 8 Spearman's rank correlation coefficient

Object	$(x_i - y_i)^2$					
	SOM WSM	SOM PM	SOM SVM	WSM PM	WSM SVM	PM SVM
1.	6,25	0,25	0,25	4	4	0
2.	0	1	0	1	0	1
3.	4	0	1	4	9	1
4.	0,25	0,25	0,25	1	1	0
5.	1	9	0	4	1	9
6.	0	9	1	9	1	4
7.	0,25	0,25	0,25	1	1	0
8.	4	1	0	9	4	1
9.	0	0	0	0	0	0
10.	0,25	0,25	0,25	1	1	0
Σ	16	21	3	34	22	16
c	12	12	12			

Spearman's rank correlation coefficient

- SOM – WSM.: $r_s = 1 - \frac{6.16}{10.\left(10^2 - 1\right) - 12} = 0{,}9018$
- SOM – PM: $r_s = 1 - \frac{6.21}{10.\left(10^2 - 1\right) - 12} = 0{,}8712$
- SOM –SVM: $r_s = 1 - \frac{6.3}{10.\left(10^2 - 1\right) - 12} = 0{,}9816$
- WSM –PM: $r_s = 1 - \frac{6.34}{10.\left(10^2 - 1\right)} = 0{,}7939$
- WSM- SVM: $r_s = 1 - \frac{6.22}{10.\left(10^2 - 1\right)} = 0{,}8667$
- PM – SVM: $r_s = 1 - \frac{6.16}{10.\left(10^2 - 1\right)} = 0{,}9030$

Kendall's coefficient of concordance confirmed the high concordance in the ranking.

$$r_K = \frac{12\left(6044 - \frac{4^2 10(10+1)^2}{4}\right)}{4\left(4.10.\left(10^2 - 1\right) - 12\right)} = 0{,}9149 .$$

Conclusion

Selected financial indicators for the 10 companies were compared using the above methods. On the basis of these methods the order of the objects is compiled. The methods result in similar orders of the objects. Compliance was verified by serial order coefficients. The values of these coefficients indicate a high order compliance. Such a comparison will serve companies for the purpose of company development planning.

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QUALITY OF SERVICE AND CONDITIONS OF CUSTOMER SATISFACTION MEASUREMENT

Renata Winkler
Cracow University of Economics, Faculty of Management, Department of Organizational Behaviours, ul. Rakowicka 27, 31-510 Cracow, Poland, renata.winkler@uek.krakow.pl
Marta Moczulska
University of Zielona Gora, Faculty of Economics And Management, Department of Human Resources Management in Organisations, ul. Podgórna 50, 64-246 Zielona Góra, Poland, m.moczulska@wez.u.zgora.pl

Keywords: *quality of service, customer satisfaction*
Abstract: The starting point for the considerations made in the article is to compare such categories as product quality and service quality. An essential part of analysis is devoted to the relation of quality of service and satisfaction with the service. In the article discusses the grounds of designing and preparing customer satisfaction survey of services.

1 Introduction

Quality is perceived as a strategic tool by leading service providers. It should be stressed that in today's economy a customer is a major "engine" of the operating companies. The customer determines whether the operators will remain on the market and/or will develop. Thereby ensuring an appropriate level of quality requires conducting the evaluation of customer satisfaction and monitoring changes in this level. The more that the satisfied customer manifests not only a higher willingness to re-use the services (and therefore it is characterized by a higher rate of loyalty to the service provider), but also to recommend these services to other customers [4].

2 Quality of service and satisfaction with services

The quality of material products (of specific goods) is usually determined in reference to the standard size of the technical parameters established for a particular category of articles. The class of product quality is determined depending on the nature and level of identified deficiencies. However, in the case of services it is extremely rarely possible to refer to a set of specific parameters. This stems mainly from the specificity of provision, which is a service. Cody and Hope [1] pay attention to three characteristics of services, which contribute to the fact that service quality is difficult to delimit and to measure. These are: service intangibility, performance heterogeneity, and customer-producer inseparability.

In the case of the service - justification is therefore not so much discussing the objective quality of service, but rather the perceived quality. According to the classical recognition of Grönroos [2], [8] the service quality assessment carried out by the customer in each case depends on such factors as:

- Technical quality („*what*?") – and thus the quality of the outcome of the provision that was the subject of the service, which is perceived by the customer as a result of its interaction with the service provider.
- Functional quality („*how*?") – i.e. the evaluation of the implementation process of this provision.
- Customer expectations with regard to both these dimensions formulated before the initiation of the implementation process of the service ("*Imagine*").

The perceived quality of service becomes therefore dependent on: the final result of the provision, the manner of this provision implementation, as well as on the degree of discrepancy between the assessment of the outcome and the method of the service implementation made by the customer, and the expectations, which in relation to the result and the way of the service realization the service recipient formulated. Thus, the category of quality for services should be associated with customer satisfaction with the service (figure 1). And it is connected with satisfaction, identified with the subjective, emotional condition appreciably by the individual due to the comparison of the real process of completion of the service with the expectations held by the individual in terms of this service [3]. Hence, in this article, it was decided to focus attention on the issue of the measurement of customer satisfaction in relation to logistics services.

3 Measures of customer satisfaction

According to the argument presented above, satisfaction with the services should be regarded as the result of[1] [10]:

[1]Of course, in the literature there is a variety of other service quality models. For instance: *Attribute service quality model* (Haywood-Farmer), *Synthesized model of service quality* (Brogowicz, Delene and Lyth), *Performance Only model* (Cronin and Taylor), *Ideal value model of service quality* (Mattsson), *Evaluated performance and normed*

- customer needs,
- the whole experience related to the use of a particular type of product / service,
- customer expectations, which (apart from the personal experience) will be influenced by, firstly, the image of the provision (which the client uses or intends to use) created by the service provider by marketing through the media, secondly, the opinions of other customers that are transferred.

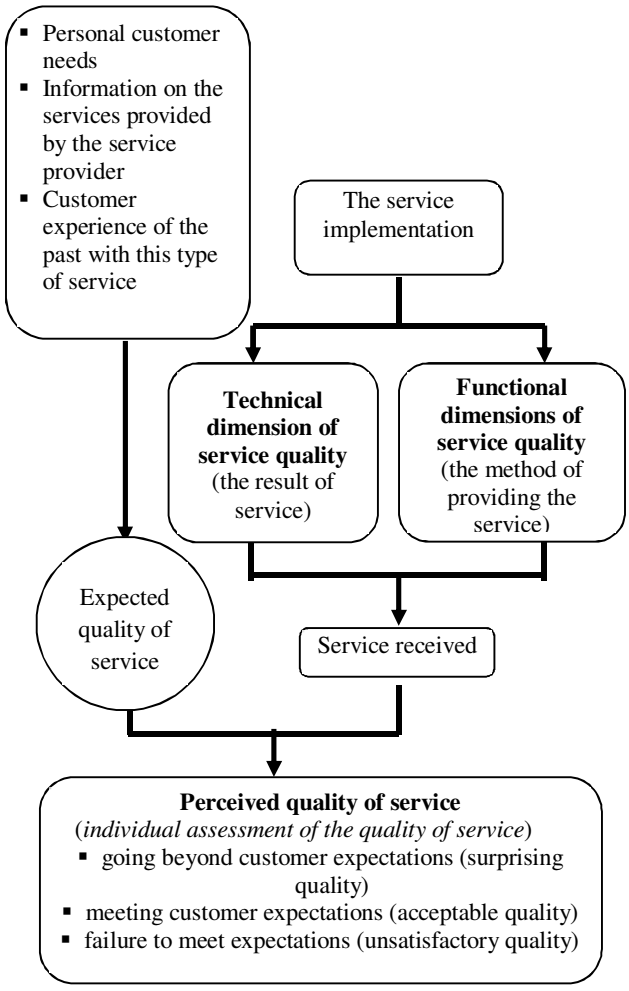

Figure 1 Perceived quality of service [7]

Thus, in the customer assessment service quality deficiencies (so called "quality gaps"), which are responsible for the formation of the perceived level of satisfaction, can arise due to [6]:

- providing the customer adulterated (idealized) image of the standard of services, on the basis of which the level of expectations is formulated,
- incorrect identification (wrong diagnosis) of customer needs and expectations by the service provider, and thus the implementation of activities that do not meet these needs and expectations,
- defective, in relation to customer expectations assessment, quality of service specification - which is synonymous with the appointment of defective quality standards in relation to the implemented provision (as it is the case when the activities carried out in the course of providing services are focused on satisfying insignificant customer expectations, as a result the service can meet the needs of the client, but in a way that does not meet his expectations),
- failure to meet quality standards by the provider of the service (negligence in the implementation of the provision of services by the service contractor).

Hence, it is advisable that the study aimed to measure customer satisfaction with the services, includes:
identifying the needs of customers, their expectations and requirements, both in terms of the expected effect of the service, as well as the way of its implementation (or verifying that previously made assessment is correct in this regard),
gathering customer feedback regarding the outcome and the method to implement the service,
the analysis of the degree of discrepancy between the assessment of the outcome and the method to implement the service made by the customer, and the expectations, which in relation to the result and the way of the service provision was formulated.
The low level of divergence of expectations in relation to the perception of the service received will prove an appropriate level of quality and a high level of customer satisfaction. However, unless, in the case of fully satisfied significant expectations, it is especially necessary to recommend the actions aimed to monitor the level of customer satisfaction, for the purpose of maintaining the quality provided, then in the case of minor expectations it is possible to talk about determining the areas of the service, from the provider's point of view, in which giving up certain activities, the company can seek cost savings. On the other hand, in a situation in which a high degree of discrepancy will be diagnosed between the level of customer expectations and the quality of services they perceive – in the case when these expectations are not relevant, the organization does not require, or does not recommend any action. If, however, the expectations are attributed to the high level of significance by the customers, then in relation to these particular elements / dimensions / aspects of the service it is necessary to look for the opportunities to improve quality of service. For a clear recognition of the above conclusions a matrix of

quality model (Teas), *Attribute and overall affect model* (Dabholkar), *Model of perceived service quality and satisfaction* (Spreng and Mackoy), *PCP attribute model* (Philip and Hazlett), *Retail service quality and perceived value model* (Sweeney, Soutar and Johnson), *Service quality, customer value and customer satisfaction model* (Oh), *Antecedents and mediator model* (Dabholkar, Shepherd and Thorpe), *Internal service quality model* (Frost and Kumar), *Internal service quality DEA model* (Soteriou and Stavrinides) [9].

satisfaction was constructed[2], within which a declared significance level of the individual elements/dimensions/ aspects of the service by customers was included, as well as the degree of the expressed in relation to them satisfaction from customers (Table 1).

Table 1 Matrix of satisfaction

High level of quality perceived by customer	*(insignificant elements, high satisfaction)* **NEEDLESS SURPLUS:** area of searching savings	*(significant elements, high satisfaction)* **ADVANTAGE** the area to take measures aimed at monitoring the quality and its maintenance
Low level of quality perceived by customer	*(insignificant elements, low satisfaction)* **STROKE OF LUCK** lack of action area	*(significant elements, low satisfaction)* **ACHILLES HEEL** area to seek opportunities to improve the quality
	The low level of significance for the customer	**The high level of significance for the customer**

The use of the above matrix for examining satisfaction allows for recommending appropriate courses of pro-quality activities aimed at increasing customer satisfaction.

In the respect to what exactly must be examined - due to the fact that the phenomenon of satisfaction is a largely subjective category and dependent on individual perception of the entity - the specification of all indicators of satisfaction and the strength of their impact in the study is not possible. According to Lisińska-Kuśnierz and Gajewska in the study of satisfaction with logistics services it is necessary to take into account such aspects as [5]: timeliness of deliveries, completeness of deliveries, promptness of deliveries, accuracy of deliveries, flexibility of deliveries, keeping the commitment, transportations conditions, terminal conditions, accuracy of invoice, complexity of services. The specificity of the nature of logistics services leads to the further analysis that should consider such factors as: the level of prices for services, methods of payment, payment terms, ability to obtain a discount, organization of work in the terminal, the overall quality of the rolling stock (purity, labelling, compliance with environmental standards), availability of information about the company, the clarity of the information included in the company's offer, staff appearance, staff helpfulness, ability to respond in emergencies and responding to complaints.

Conclusion

The discussed demands or the principles of conducting the studies on service satisfaction by no means exhaust the complexity of the issues, nor constitute a recipe for the solution to all problems associated with this type of research. In addition, a detailed consideration is required by issues such as:

- *When* (how often) *to study customer satisfaction?*
- *Who to entrust the study?*
- *Who should take the study?* (carrying out the exhaustive study or based on the selected sample?)
- *What tools should be used?* (standardized or individualized?).

Regardless of the decision taken, it is advisable that the customers, who were included in the study, were fairly and timely informed of the purpose and objectives of the study. As the practice proves (in terms of reliability and quality of the collected data) a strategic point of the study can turn out to be the way to resolve the issue of ensuring its participants an appropriate level of anonymity, as well as the confidentiality of the data obtained through them. The solutions adopted in this regard must be – for the surveyed customers - not only fully legible but also supremely reliable and respected by them. It is also advisable to recognize the margin of tolerance of customers in a range of examined dimensions (in other words, the definition of what constitutes an ideal, and what is an acceptable level of quality in relation to the service). Nevertheless, due to the nature of this kind of research, the discussed conditions and proposed postulates can serve to carry out such studies, which in a thoughtful and knowledgeable way take into account the type and nature of the specific service.

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