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Foreword

It gives us a great pleasure to welcome the readers of the Journal on behalf of the LIM Editorial Board.

The Journal aims to provide publication opportunity for the experts of three dynamically emerging scientific disciplines.

The importance of logistics in world economic processes is unquestionable. The globalisation, the purchasers' demands, the appropriate product range for perceptions, the undisturbed fulfilment of service processes show the indispensability of logistics. A vast number of important researches are being performed in this field, and in Hungary several groups have contributed with valuable results. Our journal aims to present these results, and furthermore provide an opportunity for young researchers to gain visibility.

Information technology is another field that has an exceptionally important role in economic development. Even just a couple of decades ago it was unimaginable that we could not live without computers, mobile devices, and applications. Social networks intertwine the world, and became an integral part of young people's life. At the same time major changes occurred in the industry and services as well due to IT developments. In our journal we would like to give floor to topics about this subject with an open mind. Given the background of the founding Institute we have special interest in the results of IT science researches that are connected to economic or financial processes.

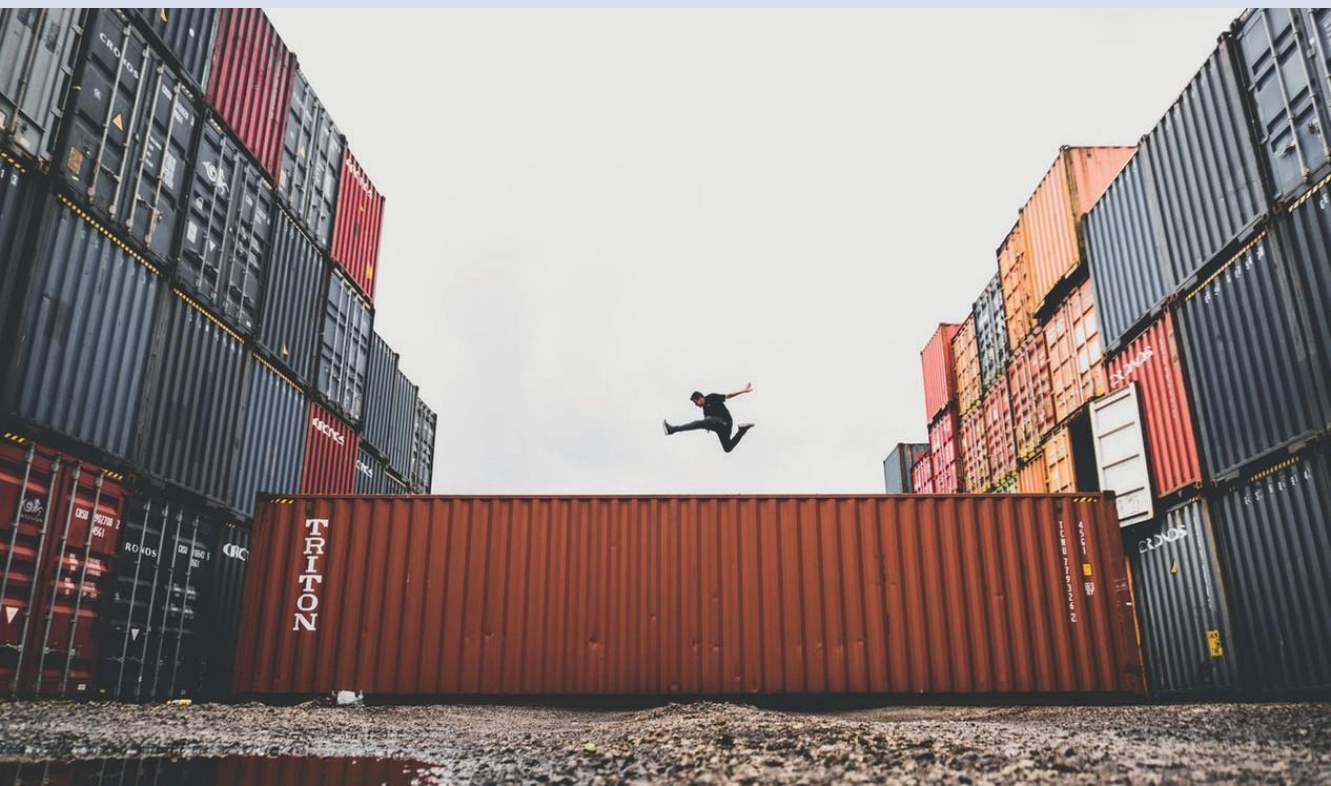
The third pillar of the Journal highlights the field of management. The state-of-art management, the production, the service provision, and the complete fulfilment of purchasers' demand cannot be executed without efficient management scheme. We have to react to present and future challenges with constantly renewing mind-set, novel solutions and toolkits. Management is indeed an inevitable supporter of the two aforementioned scientific disciplines. This justifies our interest in publishing the results of this field in our journal, and introducing the colleagues that work in this field.

I hope the Reader finds thought provoking and gap filling articles while reading our Journal.

Dr. Miklós Gubán

Chief Editor

BGE Gazdálkodási Kar Zalaegerszeg



Augmented Reality in Order-picking processes – Advantages and Disadvantages

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Abstract

The efficiency of warehouses is one of the crucial factors concerning the efficiency of overall supply chains. As order-picking accounts for 55% to 65% of cost of warehousing operations, it is important to continuously improve the efficiency of it. It is necessary to apply new technologies to order-picking and thus improve results and reduce costs. The purpose of this paper is to explore present-day researches and knowledge about the usage of AR for pick-by-vision. The study is based on literature review and the goal is to explain advantages of this picking method, but also to point out problems that occur during picking, especially concerning comfort of pickers.

Keywords:

augmented rality, warehouses, supply chains

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1. Introduction

Within a logistics chain, products need to be physically moved from one location to another, from manufacturers to end users. During this process, they may be buffered or stored at certain places for a certain period of time. Many activities are carried out in a warehouse. Among them, order picking - the process of retrieving products from storage in response to a specific customer request - is the most critical one. It has long been identified as a very labor-intensive operation in manual systems, and a very capital-intensive operation in automated systems. The cost of order picking is estimated to be as much as 65% of the total distribution center operating expense. For these reasons, logistics professionals consider order picking as the highest priority activity for productivity improvements [1,2,4].

A material handling or logistic engineer will analyse slotting - where and how product is stored, and its volumes and speeds - in order to gather information on how well warehouse is laid out. This process begins with

an ABC analysis, which will determine the articles that move the fastest (A articles), those that are intermediate movers (B articles), and items that are the slowest (C articles).

Once an engineer performs his analysis, distribution center may require a reconfiguration to optimize product storage prior to picking. Also need to rearrange storage infrastructure, including racking and shelving. The process of reconfiguring locations is commonly called reslotting.

Designing a successful order picking system requires asking the right questions, analysing the right data, and applying the right expertise.

Probably one of the best methods of improving an order picking productivity involves the implementation and maintenance of a slotting plan to properly locate product in the distribution centre. Proper slotting can result in labour productivity savings by shortening picker travel distances, depending on the slotting rules employed. Slot articles with similar handling characteristics in the same storage resource - full case together, partial case together, refrigerated items together. For similarly packaged, they should be dispersed in the slotting to avoid picking errors. For efficiency and ergonomic reasons, slot fastest moving articles in the middle of carton flow rack shelf height, the so-called golden zone. Golden zone usual between 0,6 and 1,9 meters from the floor, depending on pick resource design. In this minimizes the bend and reach/search activities of the

order picker and also locate heavy/bulky items on the lower shelves to minimize the strain in lifting/lowering them. Heavy articles should be slotted at the beginning of the pick, to form a stable base for pallet and to avoid crushing lighter articles [3,5,6,7].

There are five most frequently applied technologies in the order picking systems: paper picking, pick-by-light, pick-by-vision, pick-to-voice and radio frequency identification. Finding the correct solution or combination of technologies is the most important factor in creating an efficient picking system [8,9].

The term pick-by-vision means an innovative concept in logistics enabled by the use of smart glasses, which, through WLAN technology, allow the transfer of information from the server directly into the field of view of the picker. Smart glasses belong to the class of AR devices. The real world that the user sees when they are worn is linked to the virtual versions displayed in the field of view. This is possible thanks to the screens, cameras and microphones they are equipped with. Through a bar code scanner, when a picker picks up a product, his glasses will turn green if the item is good or red if it is the wrong item, Figure 1.



Fig. 1. Pick by vision picking technology

The main advantage over existing pick-by-voice and pick-by-light systems is the display of all necessary information (position, item, quantity) in the field of view of the picker, which means faster information transfer. Smart glasses can also be used to determine the position of the picker in storage. Based on this, they can be used to manage virtual storage using graphical symbols (arrows, guidelines) that lead the employee to a specific location, Figure 2.

Augmented reality (AR) is a term that describes user's vision of the world enhanced by computer generated text, image and sound. With AR, digital information is set over the existing physical world. Even more, AR is not only a displaying technology, it represents a real-time friendly user interface for interactions between humans and objects. The first appearance of the AR

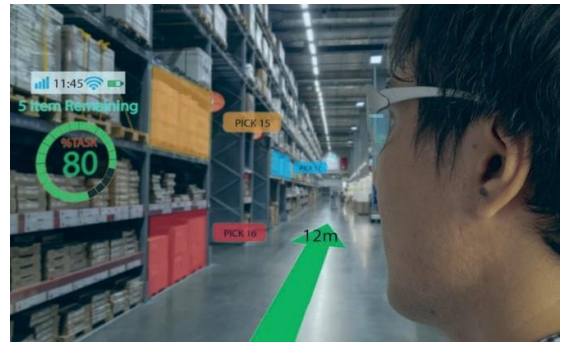


Fig. 2. View the field of view of the picker

was back in 1950s, but it was not seriously considered until the 1990s when it was used for military purposes. With the development of the internet and smart devices, the usage of AR was spread to various industrial systems. One of the areas where AR set good grounds is logistics. AR users can gain insight into information at anytime, anywhere, enabling accurate planning and quality execution of specific tasks which is vital for providing higher levels of customer service. There are several categories in logistics where AR can be implemented: warehousing operations, transportation optimization, last-mile delivery and enhanced value-added services. So far, AR is showing best results when used for warehousing operations. These operations are responsible for 20% of all logistics costs and order-picking accounts for 55% to 65% of overall cost of warehousing operations. By applying AR to order-picking and improving pick-by-vision techniques, there is a vast potential for cost reductions. AR mobile systems are consisted of head-mounted displays (HMD), cameras, wearable PCs and battery packs. The software used for AR vision picking provide real-time object recognition, barcode reading, navigation in the warehouse and continuous information flow between warehouse management system (WMS) and the picker. The main improvement for order-picking is the freedom of picker's hands and digital support during picking operations [10,11,12,13,14,15].

2. Opportunities and barriers concerning AR used for order-picking

In [16] possibilities and limitations of augmented reality applications in warehouse management were explored. Augmented reality is said to be viewed as one of the technologies that could lead to the next big wave of change in the industry. For this reason, two studies were conducted. The first involves interviews with experts in the field of logistics and augmented reality aimed at gaining insight into the current situation and

Operation	Potential use
Receipt of goods	Displays the unloading terminal to the driver of the incoming truck.
	Checking the goods received according to the shipment.
	Shows where goods should be left in the waiting area.
Warehousing	Notify the operator of the newly assigned assignment.
	View the location of the warehouse for incoming goods.
	View the image and details of the item to be stored.
	Show route to storage location.
	View the current status of the picker and the next step.
Order-picking	Checking locations that require replenishment during storage.
	Notify the commissioner of a newly assigned assignment.
	View the picture and details of the item to be selected.
	View the storage location of the item being commissioned.
	Display the selection route.
	A physical location tag with the required item.
	Information on errors and disorders.
	Bar code scan to see more information.
Mark where each item should be placed.	
Shipping of goods	Provides information to prevent congestion on passageways.
	Oversees the condition and performance of the picker.
	Display of used packaging.
	Showing the best way to store selected items.
	View the location of the shipping pallet.
	Display the order of each order by order type, destination.
	Display the appropriate loading area.
	Checking truck loading order.

Table 1. Potential use of augmented reality in storage operations [16]

future of technology. Other research involves a set of experiments using an augmented reality application, developed by the authors, with the aim of gathering user and examiner feedback based on hands-on experience. In Table 1. authors give a list of the potential use of augmented reality in four key warehousing operations. During the interview with twelve experts, there were seven characteristics that respondents identified as very important for the future adoption and application of augmented reality. Table 2. summarizes these characteristics and shows how many times each has been referred to by experts. In general, the vast majority of respondents saw good potential for augmented reality applications in warehouses, especially due to the fact

Function	Description	Number of mentioning
The user interface	It requires no special knowledge to use, easy to use and minimal interaction required.	8
Ergonomics	The device is comfortable to carry (balance, weight, etc.) and does not interfere with the user's view.	6
Scanning	It should be done quickly and with great accuracy using a high-precision autofocus camera, bar code or QR code reader.	5
The screen	Large enough to read information, wide view, in the natural field of view.	3
Battery	No extra device is needed to carry the battery.	3
Robustness	The device can be used in an industrial environment (ie they are dust resistant, can be dropped without breaking, etc.).	2
Programming	Simple programming, using a well-established programming language.	2

Table 2. Functional requirements from experts [16]

that there are a number of options and areas where it could be used. Through experimental testing, the authors concluded that the use of augmented reality in storage using wearable technologies such as goggles depends significantly on hardware and results can vary greatly between devices with different specifications. Table 3 presents the possible benefits of using this technology in warehouse operations.

The authors conclude that, although augmented reality



Fig. 3. Monocular and binocular HWD

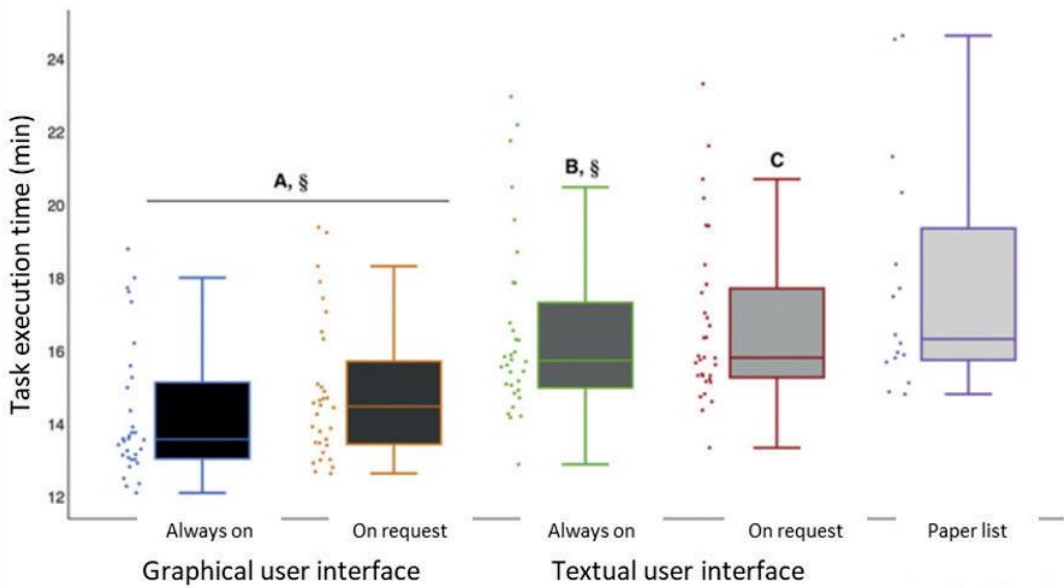


Table 4. Barriers to augmented reality use in warehouse operations [16]

Type of benefit	Justification
Reducing the number of errors	There is no need to remember the order of exclusion of goods.
	Display the image of the product in the field of view.
	Ability to view the following steps.
	An automatic double check can easily be done.
Greater flexibility	If the operator is disturbed, his next steps are unaffected.
	The unit has hands-free capability when the item / package is large in size.
	Information can be displayed anytime, anywhere in the warehouse.
Improved reliability	If the operator is confused, there is no need to walk to the station to check.
	Opportunity to share a video or photo of an error or contact an out-of-place manager.
Increased speed	Less concentration required.
	Reduces error rate, no re-work required.
	Avoids unnecessary travel to access fixed computers, carry scanners, etc.
Flexibility	For certain operations, such as routing, it helps predict moves and result in faster movements (especially for seasonal workers).
	It does not require a special environment while the user is carrying it.
Security	It may be suitable for disabled people, especially with regard to the use of hands.
	If the work is hands-free, it can be safer for the operator.
New technology	The device may provide feedback and information for security purposes or an alert for imminent danger.
	Brings enthusiasm to many young operators.
	From a marketing point of view, it shows that the company is adapting to the latest innovations.

Table 3. Expected benefits of augmented reality in warehouse operations [16]

Type of barrier	Justification
Hardware Restriction	Commercial scanners and smartphone cameras provide a faster and more reliable solution for scanning bar and QR codes.
	The battery cannot cover the entire working day. Alternative solutions with extra batteries carried by operators can be cumbersome.
	Processors overheat and slow down after prolonged use.
	Many of the available AR devices are not designed for continuous long-term use, which can cause comfort problems: headaches can occur, some users may need to wear glasses due to poor vision, central vision creates eye fatigue, a heavy-duty device, etc.
Software Challenges	With head-mounted devices, certain operations can be very slow compared to handheld devices (eg checking multiple incoming items).
	Programming languages are not standardized, making it difficult for developers to experiment with devices, develop their own applications, and connect devices to existing systems.
	Acceptance of the user interface is very important, simple and intuitive ways of interacting with the device are needed to avoid confusion.
User Acceptance	The screen does not adjust to automatic light changes (eg movement inside and outside the subject).
	Some users are reluctant to wear the device with their camera and microphone at all times for privacy.
The price	Confidentiality issues stem from the fact that AR devices can capture photos or videos with user data.
	The overall cost is high, especially if each user is considered to have their glasses (for hygienic reasons).
	Alternative IT solutions for warehouse management can be significantly cheaper.

Table 4. Barriers to augmented reality use in warehouse operations [16]

Model	Battery	Navigation light	Additional device required	Weight	Field of view	The price	The system
Epson Moverio BT-300	6 h with external battery	Yes	Yes	69 g	23°	850€	Android
Google Glass	1 h	Yes	Yes	42 g	14°	1500€	Android
Meta 2	Is powered by a cable	No	Yes	500 g	90°	1700€	Windows
Microsoft HoloLens	4 h	No	No	580 g	35°	5000€	Windows
Smart-Eyeglass SED-EI	2.5 h	Yes	Yes	77 g	20°	800€	Android
Vuzix M300	2 h	Yes	Yes	110 g	15°	1700€	Android

Table 5. Comparison of Augmented Reality Glasses [18]

is not considered a new technological development, its use in logistics operations is far behind compared to other industries. Some of the obstacles to why this is the case have been identified.

Table 4 lists the barriers to augmented reality use in warehouse operations, according to the authors. With the development of new technologies and the improvement of existing ones, augmented reality can soon be seen in many industrial processes.

3. Influences of augmented reality head-worn display type

In [17] the use of head-worn display (HWD) was investigated. This study explored how different display technologies (monocular and binocular HWD, Figure 3) and ways of presenting visual information affect gait performance.

The screen in front of one (monocular HWD) or both eyes (binocular HWD) causes practical problems, such as distraction and reduced situational awareness. From a workplace safety perspective, the author's findings confirm that caution should be exercised when engaging HWDs in work processes that require the worker to walk around. The use of HWD affects walking performance in terms of risk of slippage or falls.

In [18] an experiment was performed on the Augmented Reality concept using Microsoft HoloLens glasses. As there are several different AR glasses available that differ in many ways, the authors give a comparison of some of the latest glasses in Table 5.

Many interviewees said the experiment was fun. Most respondents complained that the glasses were too heavy and uncomfortable to wear. Also adjusting the glasses is difficult. Many subjects had trouble placing their glasses because they could not see the entire field of view completely, and the glasses slid downwards. Another technical problem, which was very common during the experiment, was that the glasses regularly lost their orientation. It has often been the case that respondents have to take a few steps away so that they can identify objects that are in front of them or are not directly in the center of the field of view. Due to the limited field of view, simple navigation showing arrows in the user's field of vision could be enhanced. The positive is that users have noticed that after very short, five-minute instructions, they can do their job very well. At the beginning of the experiment, people were skeptical about the new technology. Potential participants heard about the cybernetic problem and therefore avoided participating in the experiment. Only after some detailed explanations and reports from the first respondents did they agree to participate in the experiment. This

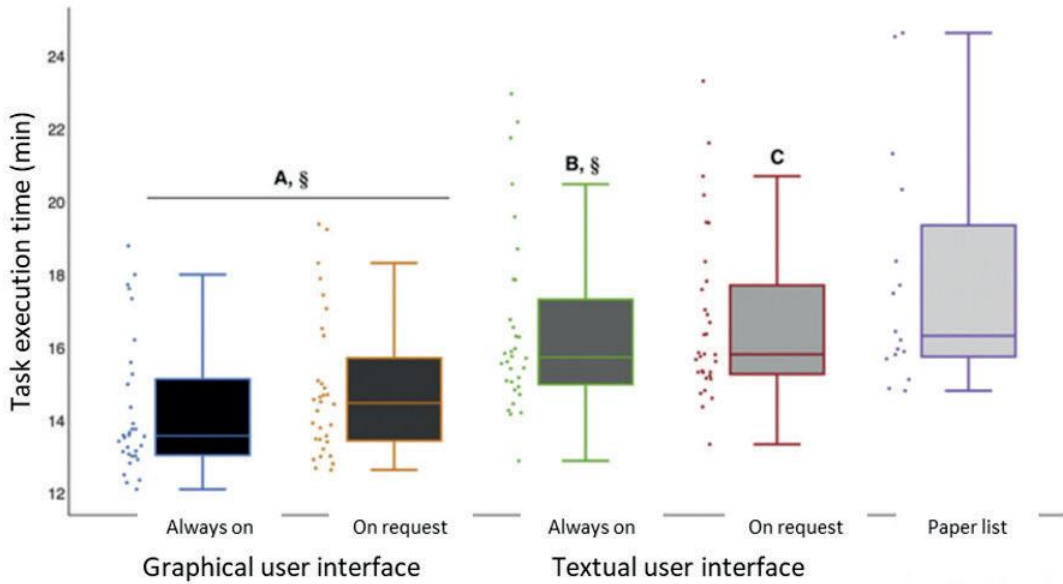


Fig. 4. Effect of information availability on order-picking time

study showed that AR has the potential to facilitate the commissioning process. However, this technology still requires further development, especially with regard to the comfort of wearing glasses.

In [19] effects of different types of HWD and user interface design (i.e. mode and availability of information) on job performance, workload, usability, and visual discomfort in a simulated warehouse environment were examined. Graphical user interface design reduced job completion time by 13% and error rate by 59% compared to textual user interface design, Figure 4.

In addition, the use of a user interface with a constant display of information versus an interface where the information is obtained at the request of the picker has resulted in a 4% reduction in the picking time, Figure 4 and Figure 5.

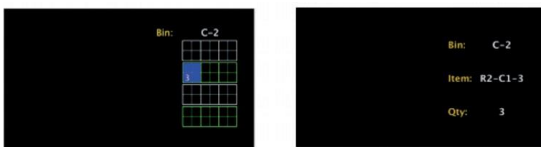


Fig. 5. Graphical (left) and textual (right) views of the user interface

This study examined how different HWD types and UI designs differ and how they may affect warehouse workers. User feedback suggested that neither monocular nor binocular HWDs fully meet the design requirements (eg device weight and display quality). The results of the experiment, however, support the professional use of HWD technology, while emphasizing

the importance of user interface design in reaching this potential.

4. Evaluation of AR order-picking

In [20] the use of augmented reality on pick by vision picking technology was explored. Participants in the experiment wear a HWD-Head-worn display that visually displays all the information required for commissioning directly in the field of view of the commissioner. One of the most important things for this system is the graphical representation of the user interface, as virtual information must be displayed at the right time and in the right place, Figure 6.

The authors conducted an order series experiment comparing pick by vision picking technology with a common sheet of paper. Each of the 16 participants in the experiment had to make 14 orders using both techniques. Orders are selected in the same order for each technique. This means that each participant started with task 1 and finished with task 14. The results show that there is a slight difference between the mean values of the commissioning time, Figure 7. With pick by vision equipment, the respondents were about 4% faster than with the paper list.

The technique by which the subjects had to start the experiment was chosen at random. So, eight participants started with a pick-by-vision technique and eight with a list of papers. The authors noted an interesting effect. Participants were noticeably faster with pick-by-vision technology by 19%, but when they exempted orders from the paper list previously, Figure 8. The explanation



Fig. 6. System used in the experiment and possible visualization

for this effect is that subjects are more confident with pick-by-vision technique and are familiar with storage and flow work so that they can rely on AR technology. In this experiment, the error rate for a sheet of paper is seven times higher than for pick-by-vision technology, Figure 9. With pick-by-vision, only one mistake was made from the 1904 item selected.

The authors' results highlight the potential of pick by vision technology. They show that users are faster, make fewer mistakes, and that customer acceptance is high, but that there are still some problems. The biggest obstacle to transferring such systems from the exploration phase to practical applications is the hardware components, especially the wearable head unit (HWD) and the monitoring system. But there is a continued further development of these components as the gaming

industry is slowly discovering AR and HWD will soon be part of everyday life within mobile multimedia applications. Therefore, HWDs will be used in industrial applications over the next five years.

In [21] different ways of visualizing work instructions based on augmented reality technology in the order-picking process using a wearable head-mounted display (HWD) were analyzed. The authors conducted three experiments to develop and refine the information display system. A total of 64 subjects were collected (18 in test 1, 34 in test 2, 14 in test 3) and a total of 5080 items were collected (1620 in test 1, 1940 in test 2, 1512 in test 3) from different boxes in storage. In the first experiment, the impact of visualization modes (1D, 2D, or 3D) on finding the commissary path is

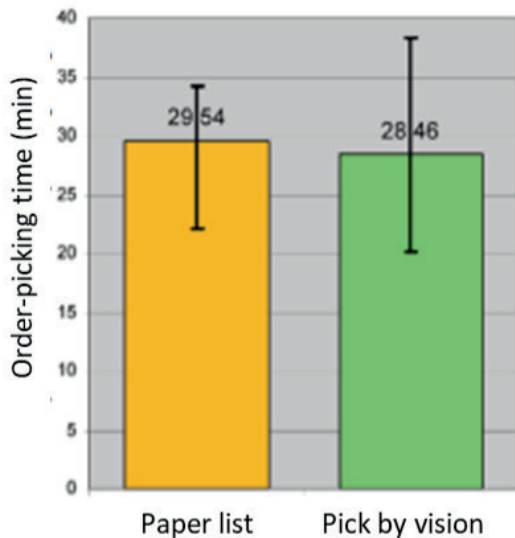


Fig. 7. Order-picking time

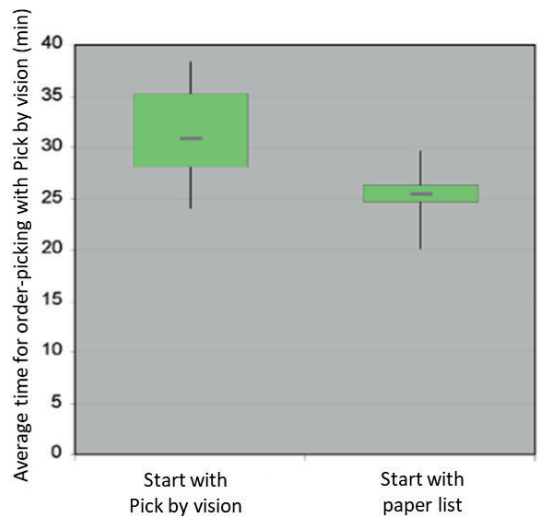


Fig. 8. The difference in picking time based on the choice of initial technique

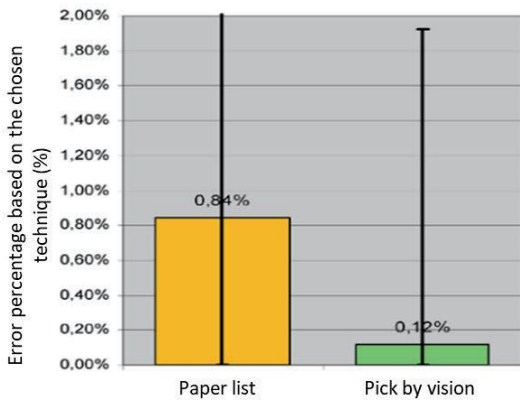


Fig. 9. Error rate depending on the choice of order-picking technique

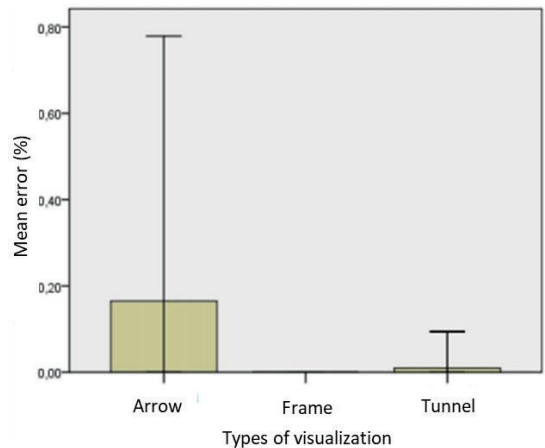


Fig. 11. Mean error for all three visualization modes

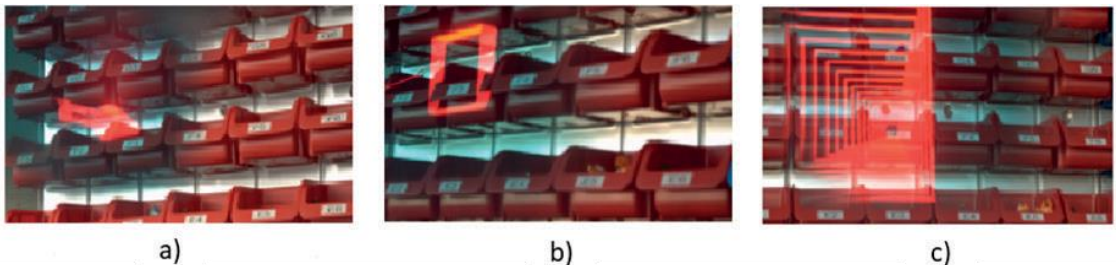


Fig. 10. Different ways to visualize work instructions

checked. The results show no significant difference in time between 1D and 2D visualization, while 3D visualization was a few seconds slower than them. As many as 10 times more object selection errors occurred with 3D visualization than with 1D and 2D visualization. In most cases, the exclusion item is too high or too low, indicating depth of perception using augmented reality. This means that the AR-based system has a lower box size limit. Below this limit, the identification of the box becomes ambiguous. In another experiment performed by the authors, they reduced the size of the boxes from which objects had to be selected by 3D visualization. Three ways of visualizing the operating instructions were developed and compared, Figure 10. Under a) an arrow is shown, under b) a rectangular frame and under c) a tunnel.

Participants were asked to stand in front of a shelf and select items. It was not possible for them to see the entire shelf while standing in front, so participants had to move their heads to see the boxes to select. For all three visualization methods, they used the same orders, which was not obvious to the participants. The order in which respondents were required to use visualizations was permuted to offset the learning effect. Respondents had to start each exemption with their backs to the

shelf. At the starting signal, they turned and performed the test. When they said „I chose!” They moved on to the next visualization at the touch of a button. At that moment, the system recorded the time and a simple harmonic sound indicated a change in the mode of visualization. When analyzing test results, errors when selecting boxes mostly occur with the arrow. The tunnel gave much better results, but people still made mistakes while the frame worked without error, Figure 11.

Analyzing the exclusion time, the following results were obtained for the excluded subject: 4,341 seconds for the arrow, 3,581 seconds for the rectangular frame, and 4,096 seconds for the tunnel, as shown in Figure 12.

Based on the experience of the previous experiments in the last, third experiment, the authors optimize the display mode from the second experiment. They use four modes of visualizing work instructions: the Square Tunnel, the Transparent Square Tunnel, the Square Tunnel Arrow, and the Round Tunnel, Figure 13.

The results show that during the experiment in which 1512 items were excluded; no participants chose the item wrong. Regarding the average time required to exclude an object, the following results were obtained: 6,602 seconds for the opaque S-tunnel, 6,265 seconds for the semitransparent S-tunnel, 6,038 seconds for

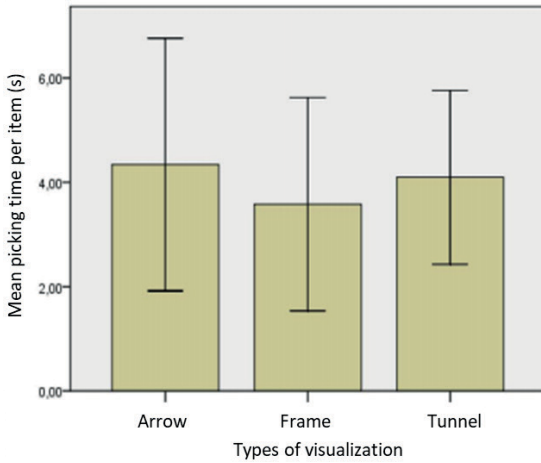


Fig. 12. Mean picking time per item

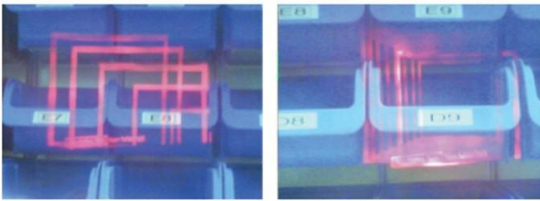


Fig. 13. Different forms of semi-transparent operating instructions display modes

the square tunnel arrow, and 6,039 seconds for the semi-transparent R-tunnel, as shown Figure 14.

The average median time to pick an item in the third experiment is two seconds longer than in the second experiment. The results show that both ways of visualizing work instructions are suitable for small warehouses, where people do not have to move much.

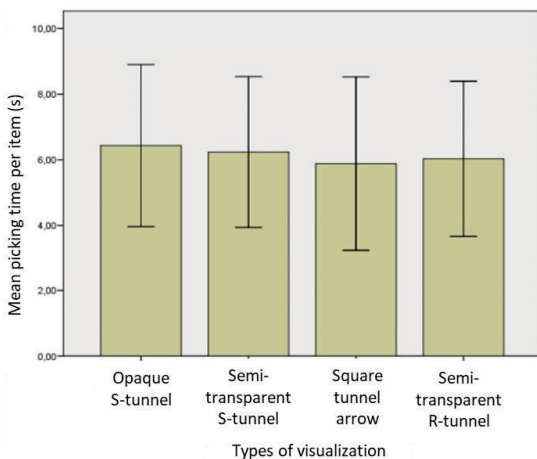


Figure 14. Mean picking time per item

4. Conclusion

The first appearance of the AR was back in 1950s, but it was not seriously considered until the 1990s when it was used for military purposes. With the development of the internet and smart devices, the usage of AR was spread to various industrial systems. One of the areas where AR set good grounds is logistics. AR users can gain insight into information at anytime, anywhere, enabling accurate planning and quality execution of specific tasks which is vital for providing higher levels of customer service. There are several categories in logistics where AR can be implemented: warehousing operations, transportation optimization, last-mile delivery and enhanced value-added services. So far, AR is showing best results when used for warehousing operations. These operations are responsible for 20% of all logistics costs and order-picking accounts for 55% to 65% of overall cost of warehousing operations. By applying AR to order-picking and improving pick-by-vision techniques, there is a vast potential for cost reductions. AR mobile systems are consisted of head-mounted displays (HMD), cameras, wearable PCs and battery packs. The software used for AR vision picking provide real-time object recognition, barcode reading, navigation in the warehouse and continuous information flow between warehouse management system (WMS) and the picker. The main improvement for order-picking is the freedom of picker's hands and digital support during picking operations. The present-day researches about the usage of AR for pick-by-vision were explored in this paper. The study showed advantages of this picking method, but also underlined common problems that appear during order-picking operations using AR technology, especially those one concerning comfort of pickers.

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The relationship between the national culture, Facebook use and smartphone use of students in Serbia

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Abstract

The paper presents the results of research into the influence of the GLOBE national culture dimensions on Facebook and smartphone use items for students in Serbia. The moderating effect of the four variables; the respondents' gender, year of study, success in studies and the possession of finance to open up one's own company was examined on the observed relationships. The survey was conducted by means of a student survey at seven faculties. 488 valid questionnaires were collected. The main conclusions of the research are: 1. The impact of the dimensions of national culture on the observed Facebook and smartphone use items is not strongly expressed, and occurs as statistically significant in individual cases. For example, the dimension of uncertainty avoidance statistically significantly and positively affects the items of frequency of Facebook usage and daily time use, but can also be expressed by avoiding uploading images on Facebook. The number of groups item is under the influence of two dimensions: power distance and humane orientation. Total daily smartphone usage is influenced by two dimensions: collectivism 1 (collective) and collectivism 2 (in group). The dimensions of future oriented and performance orientation slightly negatively affect certain individual items. 2. The most significant impact is achieved by the dimension collectivism 2 (in group), while the items under the greatest influence of the dimensions of national culture are number of groups, total daily smartphone usage and use of smartphones to access Facebook. 3. None of the four analyzed moderators showed a strong moderating effect on the observed relationships.

Keywords:

National culture, Facebook use, smartphone use, students, Serbia

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1. Introduction

Facebook implies communication: through this social network people exchange words, messages, pictures, and videos. The daily frequency of Facebook usage, the number of hours spent on Facebook, the number of friends on Facebook, the number of photos posted, and the number of different groups represent categories which vary greatly from person to person. All of these Facebook usage parameters depend on the user's personal characteristics and the purpose for which Facebook is used (Hew, 2011; Skues, Williams, & Wise, 2012). Some people have a dominant desire for self-represen-

tation, while others have the need to satisfy their desire to belong (Nadkarni & Hofmann, 2012). The gender of users and their year of study also affect the way Facebook is used (Sanches, Cortijo, & Javed, 2014). Facebook can also be accessed via smartphones. Numerous studies focus on the factors which influence the way smartphones are used, and one of the most expressive factors is the users' gender (Sanches-Martinez & Otero, 2009; Bisen & Deshpande, 2016).

Facebook is a global social network through which people communicate both within their national cultures and across cultures. Communication, both on-line and offline, also depends on culture. „What, where

and how we should talk (or communicate with others) is regulated by culture” (Chen, 1995, p.85). Numerous papers point to the importance of this topic and confirm the diversity of the use of Facebook and smartphones depending on the characteristics of national culture (Caporael & Xie, 2003; Campbell, 2008).

National culture is a very complex term and „no part of our lives is exempt from culture’s influence” (Hofstede, 1991, p. 170). However, culture is not the only factor that affects people’s behaviour. Although the dimensions of culture can be established at the national level, this does not necessarily mean that as such they will inevitably be reflected in the behaviour of each individual member of that culture (Hofstede, 1991). In other words, the analysis of the dimensions and characteristics of national culture reflects the basic traits of the country from which such a culture originates, but does not foresee (in full) individual behaviour. However, a significant number of the values of a national community are common to all its individuals, which is why it is called national culture. It represents an important factor which determines the profile of individual values.

One of the characteristics of national culture is certainly individualism or collectivism (Hofstede, 1980; House et al., 1999, 2002, 2004) and it is known that western cultures are individualistic, while the national cultures of the east are collectivist. This feature of national culture greatly influences how individuals within their cultures use Facebook and smartphones (Van Belleghem 2010; Campbell, 2008; Janoff-Bulman & Leggatt, 2002; Caporael & Xie, 2003), and the prevailing opinion is that the use of Social Network Services (SNS) in national cultures that are collectivist (Nadkarni and Hofmann, 2012) has not been sufficiently researched. Also, „Current research on SNS has been primarily developed in North American or European cultural contexts, and this may be problematic in that it inadequately explains

the communication behavior of non-western populations.” (Zhang & Leung, 2015, p. 1019).

Bearing in mind the aforementioned, the main goal of this paper is to make a modest contribution to the knowledge of the influence of collectivist national culture in Serbia on Facebook and smartphone use. This goal was realized through the establishment of a link between the dimensions of national culture according to the GLOBE project (House et al., 1999, 2002, 2004) and the Facebook and smartphone use items. It is particularly important to note that the research covered all of the dimensions of national culture according to the GLOBE project, and the GLOBE dimensions have not been greatly explored within the context of Facebook and smartphone use. In addition, the moderating effect of the four variables: the respondents’ gender, year of study, success in studies and the possession of finance to open up one’s own company, were examined on the observed relationships. The survey was conducted by means of student surveys at seven faculties in Serbia. The results and their discussion are given below.

2. Theory and research questions

2.1 National culture

Due to globalization and increased dependence among nations, there is a growing interest in understanding national culture (House, Javidan, & Dorfman, 2001). The importance of national culture and its impact on communication are highlighted by numerous researchers dedicated to this ever-present issue, while Hall (1976) and Hofstede (1991) are certainly among the most important. According to Hofstede (1980, 2001), culture is revealed by symbols, heroes, rituals, values and national culture is an important factor in determining the profile of individual values (Hofstede 1980, 2001; Trompenaars & Hampden-Turner, 1997).

In this paper, the level of the dimensions of national culture among students in Serbia according to the GLOBE project (House et al., 1999, 2002, 2004) is determined. GLOBE is a significant and globally accepted project, which included 160 researchers from 62 different cultures. However, the impression is that the dimensions of the GLOBE project are not used frequently enough in researching the impact of national culture on Facebook and smartphone use. Researching the available literature, we found

Names of dimensions and items	Abbr.	N	Min	Max	Mean	Std. Deviation	α
Uncertainty Avoidance	NC1	488	1.00	5.75	3.43	.93668	.731
Future Oriented	NC2	488	1.00	6.80	3.10	1.07890	.777
Power Distance	NC3	488	1.60	7.00	5.13	1.16449	.823
Collectivism 1 (institutional)	NC4	488	1.75	7.00	3.86	.83133	.791
Humane Orientation	NC5	488	1.00	6.40	3.37	.94696	.881
Performance Orientation	NC6	488	1.00	6.00	3.33	1.04190	.711
Collectivism 2 (in-group)	NC7	488	1.50	7.00	4.80	.93882	.855
Gender Egalitarianism	NC8	488	1.00	6.20	3.42	.86158	.722
Assertiveness	NC9	488	1.00	6.50	3.38	1.02901	.893
Frequency of Facebook usage (daily use)	FB1	488	0	6	3.0369	1.77325	
Daily time use (hours)	FB2	488	0	24	2.8279	4.22483	
Number of friends	FB3	488	0	5000	685	761.107	
Number of photos	FB4	488	0	6433	211.76	598.7386	
Number of groups	FB5	488	0	2000	22.1281	117.128	
Total daily smart phone use (hours)	SP1	488	0	24	7.7951	6.76101	
Use of the smart phone to access Facebook (minutes per day)	SP2	488	0	1000	36.6848	78.13496	
Success in studying	SUC	488	1.00	5.00	3.70	.828	
Possession of finance	FIN	488	1.00	5.00	2.13	1.073	

Table 1. Descriptive statistics

that the cultural dimensions defined by the GLOBE project were used by Reed, Spiro and Butts (2015) to determine the relationship between national culture and self-disclosure behaviour on Facebook for 200,000 users from different cultures around the world. The authors of this paper point to the fact that they were the first to use the dimensions of the GLOBE project to examine the impact of national culture on self-disclosure behaviour on Facebook (Reed et al., 2015). Similarly, in this paper the influences of the GLOBE dimensions of national culture on basic Facebook and smartphone use were researched for the first time.

The dimensions of the GLOBE project show that the characterization of a national culture may be complex and involves ongoing practice and behaviour (state as is) and the values or firm beliefs of what a given culture should be (Waldman et al., 2006). The dimensions of culture (national and organizational) according to the GLOBE project are: (Javidan, House, & Dorfman, 2004: 30; House et al., 1999)

- NC1 - Uncertainty Avoidance is the degree to which the members of an organization or society tend to avoid uncertainty relying on established social norms, rituals and bureaucratic practices.
- NC2 - Future Oriented is the degree to which the individuals in organizations or society are involved in future-oriented behaviour, such as planning, investing in the future and postponing individual or collective gratification.
- NC3 - Power Distance is the degree to which the members of an organization or society expect and agree that power should be stratified and concentrated at higher levels of an organization or state.
- NC4 - Collectivism 1 (institutional) is the degree to which organizational and social institutional practice is encouraged and rewarded by the collective contribution of resources and collective action.
- NC5 - Humane Orientation is the degree to which the individuals in organizations or society are encouraged and rewarded for being fair, altruistic, friendly, generous, caring and kind to others.
- NC6 - Performance Orientation is the degree to which an organization or society encourages and rewards the members of a group for improvement of performance and excellence.
- NC7 - Collectivism 2 (in-group) is the degree to which individuals express pride, loyalty and cohesion within an organization or family.
- NC8 - Gender Egalitarianism is the degree to which an organization or society reduces gender differences while promoting gender equality.
- NC9 - Assertiveness is the degree to which the individuals in organizations or society are asser-

tive, confrontational, and aggressive in social relationships.

2 Facebook use and smartphone use

Facebook is a social network that allows people to establish relationships and connect to each other (Skues et al., 2012). It can be used in different ways. Basic Facebook use is related to the frequency of daily use of Facebook, the number of hours spent on Facebook (time spent on Facebook, daily time use), the number of friends on Facebook, the number of photos posted, the number of different groups, the reasons for Facebook use and the preferred functions of Facebook (Ross et al., 2009).

Research suggests that basic Facebook use and ways of using Facebook vary across cultures. For example, for Hispanic students from South America and the US it is most important to keep in touch with friends and to share photos, while in Greece, Italy, France, the UK and the US, students have other priorities on Facebook (Albarran & Hutton, 2010). The number of friends reported by users of this social network also differs across cultures: 29 in Japan, 63 in China, 95 in France, 200 in the US, and 360 in Brazil (Van Belleghem, 2010). Huang and Park (2013) state that the average number of friends in East Asia is 349.6 and in the United States 362.0.

Smartphones are an irreplaceable part of everyday life and are used to „call, text, e-mail, video conference, micro-blog, interact on social networks, surf the Internet, watch and share videos and pictures, play video games and utilize a tremendous array of software driven applications” (Lepp, Barkley, & Karpinski, 2014, p. 343). How and for what purposes an individual will use a smartphone depends on many factors. One of the factors which influences the use of smartphones is whether the individual belongs to an individualist or collectivist national culture. In collectivist cultures (Japan, China) the use of mobile phones is different to that in individualist cultures (Anglos, Sweden, Hawaii), which can be seen in the references (Campbell, 2008; Janoff-Bulman & Leggatt, 2002; Caporael & Xie, 2003). For example, while in individualist national cultures it is perfectly reasonable to use a mobile phone on the street and in a public place, in collectivist national cultures such behaviour is often not socially acceptable. On the other hand, in collectivist national cultures, the employer can call his employees outside working hours, and in individualistic national cultures this is not common practice. Based on previous considerations, in this paper, the following research questions can be posed:

- RQ1: Is there a statistically significant influence of the national culture dimensions on the Facebook use and smartphone use items among students in Serbia?
- RQ2: Is there a statistically significant predictive effect of the national culture dimensions on the Facebook use and smartphone use items among students in Serbia?
- RQ3: Is there a moderating effect of the four variables (the respondents' gender, year of study, success in studies and the possession of finance to open up one's own company) in the relations between the influence of the national culture dimensions on the Facebook use and smartphone use items among students in Serbia?

3. Method

3.1 Survey instruments (measures)

National culture. National culture will be examined by means of the GLOBE instrument for measuring national and organizational culture (House et al., 1999, 2002, 2004). The first part of the beta questionnaire, which examines national culture, refers to the state of „as is”. The respondents value the questions on a scale from 1 to 7, and the completed questionnaires are processed according to GLOBE Syntax. The questionnaire consists of 39 questions, classified into nine dimensions of national culture: 1. Uncertainty Avoidance, 2. Future Oriented, 3. Power Distance, 4. Collectivism 1 (institutional), 5. Humane Orientation, 6. Performance Orientation, 7. Collectivism 2 (in-group), 8. Gender Egalitarianism, 9. Assertiveness.

The Facebook questionnaire. This questionnaire consists of 5 items. Item FB1 - Frequency of Facebook usage was constructed according to the reference (Sanchez et al., 2014). The respondents assign grades from 1 to 6 depending on how many times a day they use Facebook, where larger numbers denote greater daily use of Facebook. For items FB2 - Daily time use (according to Skues, Williams, & Wise, 2012; Kuo & Tang, 2014), FB3 - Number of friends (according to Skues et al., 2012; Sanchez et al., 2014; Kuo et al., 2014), FB4 - Number of photos (according to Kuo & Tang, 2014) and FB5 - Number of groups (according to Skues et al., 2012; Kuo et al., 2014), the respondents directly entered the corresponding numerical values.

The Smartphone questionnaire (Lepp et al., 2014). This instrument comprises two items: SP1 - Total daily smartphone use and SP2 - Use of smartphones to access Facebook. The respondents enter how many hours a day they use a smartphone and how many minutes a

day they use a smartphone to access Facebook.

3.2 Participants and data collection

The respondents were students at seven faculties in Serbia. The students who participated in the research are studying at technical and economic faculties. The survey was conducted by means of a survey. The students completed the questionnaires anonymously either during or after classes. A total of 488 valid questionnaires were collected. Out of this number, there were 337 (69.1%) female students and 151 (30.9%) male students. The respondents are between 18 and 32 years of age, with the average age of the respondents 21.38 years (standard deviation 1.962). The research included students from undergraduate and masters studies, from the first to the fifth year of study. The sample comprised 157 (32.17%) first year students, 88 (18.03%) second year students, 122 (25.00%) third year students, 70 (14.34%) fourth year students and 51 (10.45%) students in their fifth year.

4. Results

4.1 Descriptive statistics

The descriptive statistics for the national culture dimensions and the Facebook and smartphone use items are shown in Table 1. The table shows the dimensions and items, abbreviations, mean values, and standard deviation for each dimension and item, as well as Cronbach's alpha for each dimension. The values of Cronbach's alpha range from $\alpha = 0.711$ to $\alpha = 0.893$. Relevant data were also given for the moderating variables of success in studies and possession of finance.

For most of the Facebook and smartphone use items (with the exception of FB1 - Frequency of Facebook usage) open questions were used where the students showed the real values of these items. Table 1 shows the min, max, mean, and standard deviation for these real numeric values which the students assigned. However, in order to be able to carry out further analyses: correlation, regression and analysis of any moderating effects, the categorization of the responses into five categories was done for each item separately. This was done for all the Facebook and smartphone use items except for item FB1 - Frequency of Facebook usage. Category 5 comprises those respondents who assigned very high marks for the observed item, category 4 those respondents who assigned high marks for the observed item, category 3 the respondents who gave average grades for the observed item, category 2 the respondents who gave

low marks for the observed item, and category 1 those respondents who assigned very low grades for the observed item.

FB1 - Frequency of Facebook usage (daily use) among students in Serbia ($M = 3.03688$, $SD = 1.77325$) corresponds to the real value of 6 to 10 times of Facebook usage a day. This value is similar to the result obtained in the reference (Sanches et al., 2014), and slightly higher than the value of 4.81 times a day, which was obtained by Skues et al. (2012). When it comes to FB2 - Daily time use (hours), globally speaking, students spend a daily average of between 10 and 75 minutes using Facebook (Joinson, 2008; Christofides, Muise, & Desmarais, 2009; Ross et al., 2009; Pempek, Yermolayeva, & Calvert, 2009; Orr et al., 2009; Valenzuela, Park, & Kee, 2009; Kuo & Tang, 2014), while in Serbia, students use Facebook for an average of 2.8279 hours a day ($M = 2.8279$, $SD = 4.22483$). The average value of FB3 - Number of friends among students in Serbia is 685 ($M = 685$, $SD = 761.107$), which is significantly higher than the average number of friends in other surveys, where the number of Facebook friends ranges from 100 to 400 (Elison, Steinfield, & Lampe, 2007; Sheldon, 2008; Tong, van der Heide, Langwell, & Walther, 2008; Lewis & West, 2009; Van Belleghem, 2010; Skues et al., 2012; Huang & Park, 2013; Kuo & Tang, 2014). The average value of FB4 – the number of photos students in Serbia have on their Facebook profiles is $M = 211.76$ with $SD = 598.7386$. The average value of FB5 – the number of groups ($M = 22.1281$, $SD = 117.128$) students access in Serbia, is both much higher than the 7 groups gained in the survey (Kuo & Tang 2014), and much lower than the total of 66.10 groups gained in the study (Skues et al., 2012).

SP1 - Total daily smartphone usage in Serbia is an average of 7.7951 hours a day ($M = 7.7951$, $SD = 6.76101$), which is significantly more than the total of 4.83 hours obtained in the study (Lepp et al., 2014). SP2 - The use of smartphones to access Facebook is 36.6848 minutes per day ($M = 36.6848$, $SD = 78.13496$), which is significantly less than 147 minutes per day obtained in the study (Lepp et al., 2014).

4 Correlation analysis

The correlation coefficients between the national culture dimensions and the Facebook and smartphone use

items are provided in Table 2. Pearson's correlation was used, and all statistically significant correlations are indicated: * $p < 0.05$; ** $p < 0.01$.

4 Regression analysis

The predictive effect of the national culture dimensions (independent variables) on the Facebook and smartphone use items (dependent variables) was examined using multiple regression analysis. The results of the regression analysis are given in Table 3.

4 Analysis of the moderating effects

	FB1	FB2	FB3	FB4	FB5	SP1	SP2
NC1	.114*	.089*	.025	-.085	.011	.084	.005
NC2	-.008	.031	.005	-.064	-.043	.046	-.029
NC3	.035	-.033	.059	.063	.144**	.034	.135**
NC4	-.018	.050	-.028	-.043	.032	.114*	-.011
NC5	-.029	.014	.082	.015	.131**	-.054	-.034
NC6	-.017	-.033	-.031	-.033	-.040	.022	-.040
NC7	.089*	.035	.031	.072	.095*	.112*	.149**
NC8	.051	-.027	.042	-.014	-.069	.039	-.042
NC9	-.020	-.020	.043	.014	.051	.009	-.030

* $p < 0.05$; ** $p < 0.01$.

Table 2. Correlation coefficients between the national culture dimensions and the Facebook and smartphone use items

The paper examines the moderating effects of four variables (the respondents' gender, year of study, success in studies and the possession of finance to open up one's own company), in the relations between the influence of the national culture dimensions on the Facebook and smartphone use items. In doing so, hierarchical regres-

Dep.	Independent									R ²	F	Sig.
	NC1	NC2	NC3	NC4	NC5	NC6	NC7	NC8	NC9			
FB1	.164	-.024	.004	-.039	-.052	-.077	.081	.077	-.019	.034	1.883	.052
FB2	.116	.019	-.065	.048	.035	-.111	.043	-.020	-.057	.023	1.232	.273
FB3	.045	-.006	.054	-.040	.078	-.069	.006	.035	.031	.017	.917	.510
FB4	-.091	-.037	.032	-.039	.022	.015	.071	-.010	.044	.020	1.057	.393
FB5	.020	-.044	.121	.020	.158	-.049	.029	-.090	.036	.054	3.021	.002
SP1	.067	.033	.009	.095	-.106	-.030	.101	.056	-.005	.037	2.037	.034
SP2	.017	.019	.093	-.028	-.035	-.008	.128	-.027	-.011	.035	1.901	.050

Table 3. Regression analysis (independent variables: the national culture dimensions; dependent variables: the Facebook and smartphone use items)

sion analysis was used. The results of these analyses are given in Table 4. Table 4 shows those pairs where there is a moderating effect, the values of R squared change and F-change in those cases, as well as the correlations of the observed pairs for both relevant groups (groups

depending on the respective moderator).

For the year of study variable, the sample of N = 488 respondents was divided into younger students (students in the first and second year) and older students (students in the third, fourth and fifth year). The first group (younger students) comprises 245 (50.20%) respondents, while the second group (older students) consists of 243 (49.80%) respondents. In the case of the success in studies variable, the sample of N = 488 respondents was divided into those who assigned this variable grades 1, 2 and 3 (those who claimed to have relatively poor success in studies - Low SUC) and those who assigned this variable grades 4 and 5 (those who declared themselves to

have relatively high success in their studies - High SUC). In the first group (Low SUC) there are 185 (37.91%) respondents, while in the second group (High SUC) there are 303 (62.09%) respondents. For the possession of finance to open up one's own company variable, the sample

of N = 488 respondents was divided into those who rated this variable 1, 2, and 3 (those who claimed to have relatively low finance) and those who assigned this variable grades 4 and 5 (those who declared themselves to have relatively significant finance - High FIN). The first group (Low FIN) comprises 396 (81.15%) respondents, while the second group (High FIN) consists of 92 (18.85%) respondents.

5. Discussion

5.1 Discussion of the results of the correlation analysis (answering RQ1)

Table 2 shows that for the main part the dimensions of national culture do not have a statistically significant impact on the observed Facebook and smartphone use items. Statistically significant impacts exist in individual cases (between the individual dimensions of national culture and the individual Facebook and smartphone

use items), and they are always positive. This general conclusion is also the answer to RQ1. Below are some comments on the statistically significant relations.

The dimension NC1 - Uncertainty avoidance statistically significantly affects items FB1 - Frequency of Facebook usage and FB2 - Daily time use. This result can be understood in the following way: people who are trying to avoid uncertainty sometimes do this by accessing Facebook more often and thus spend more time on Facebook. In this way, probably unconsciously, they escape from reality and avoid facing real life problems and challenges. At times when a challenge or a change has to be faced, requiring the acceptance of uncertainty

and a certain level of engagement, some people retire to a secure place, and Facebook can be such a carefree oasis, or at least it may seem so. Interestingly, avoiding uncertainty has a negative link with item FB4 - Number of photos. Although this correlation is not statistically significant, it points to the

emergence of a habit whereby people who avoid uncertainty also avoid posting a large number of images on social networks. The reason probably lies in the fact that they do not want to risk posting images that might not be accepted for a number of reasons, or because of concerns about how they look in such pictures.

The dimension NC3 - Power distance has a statistically significant effect on items FB5 - Number of groups and SP2 - Use of smartphones to access Facebook. A possible explanation should be sought, first of all, in the high average value of NC3 - Power distance (M = 5.13, Table 1). There is a strong power distance in Serbia and it is possible that those respondents who feel the distance of power join a larger number of groups, consciously or unconsciously seeking in those groups what they lack: a low distance of power, equality and respect within social groups. If the predominant influence of certain individuals is manifested in the group, then the user enters new groups, striving to join groups where no such individuals are present. The impact of power distance

Moderator	Independent	Dependent	R square change	F-change	Correlations	
Gender	NC7	SP2	0.013	6.567	Male .316**	Female .076
Year of study	NC1	FB2	0.011	5.234	Younger .201**	Older -.029
		FB4	0.009	4.353	-.029	-.142**
	NC5	FB1	0.009	4.543	0.045	-.130*
		FB4	0.010	4.760	-.086	.110
Success in studies	NC5	FB1	0.015	7.584	Low SUC -.184**	High SUC .062
		FB4	0.018	8.754	-.113	.090
The possession of finance	NC2	FB1	0.010	4.736	Low FIN -.028	High FIN .074
		SP1	0.012	5.958	.031	.152
		SP2	0.008	3.977	-.007	-.167
	NC3	FB1	0.014	6.944	.053	-.056
		FB3	0.010	4.778	.092	-.166
		FB4	0.013	6.363	.088	-.104

*p<0.05; **p<0.01.

Table 4. Results of the research into the moderating effects of the four observed moderators(those cases where there is a moderating effect)

on item SP2 - Use of smartphones to access Facebook is particularly interesting. This item relates to accessing Facebook by means of a smartphone, therefore, in conditions that are generally not at home. It is outside the home where the power distance is felt the most acutely, making the respondents most likely to approach Facebook at that time so as to reduce the power distance (and since they are out of the house, they have to do it on their smartphones).

The dimension NC4 - Collectivism 1 (institutional) has a statistically significant impact on item SP1 - Total daily smartphone use. As the dimension of institutional collectivism relates to values such as collective loyalty, collective interest, collective acceptance, and cohesion within the collective, it is clear that this implies a significant degree of interaction and communication between the members of groups and collectives. Mobile phones are available at all times, and thus represent a significant means of meeting the needs, but also the obligations, of collective connectivity.

The dimension NC5 - Humane orientation has a statistically significant effect on item FB5 - Number of groups. Among other things, the humane orientation dimension implies consideration for others, a sense of others and friendliness, and membership in groups can easily meet these needs and create behaviour in accordance with this cultural dimension.

As might have been expected, the dimension NC7 - Collectivism 2 (in group) has the strongest impact on the Facebook and smartphone use items. Specifically, statistically significant influences exist on items FB1 - Frequency of Facebook usage, FB5 - Number of groups, SP1 - Total daily smartphone use and SP2 - Use of the smartphones to access Facebook, therefore, on most of the observed items. As with power distance, it should be noted that the NC7 - Collectivism 2 dimension has a high average value ($M = 4.80$, Table 1), the highest after power distance. This points to the collectivist culture in Serbia. Group and family connections are easily realized, satisfied, and demonstrated through activities on social networks and the use of smartphones.

In Table 2 it should be noted that the dimensions NC2 - Future oriented and NC6 - Performance orientation negatively affect certain individual items. Although these influences are not statistically significant, there is an interesting tendency for the respondents who highly perceive orientation towards the future and performance to use Facebook and smartphones less. It is possible that the respondents who have such a perception of the given dimensions (and perhaps themselves have a higher orientation towards the future and performance) realize that a person needs to constantly work, progress, plan and improve, all of which involve involvement in

activities which do not leave as much space for the use of social networks and smartphones for the purpose of having fun and spending time without any specific goal.

2 Discussion of the results of the regression analysis (answering RQ2)

The regression analysis (Table 3) shows that the statistically significant predictive effect of the independent variables (the dimensions of national culture) on the dependent variables (the Facebook and smartphone use items) is not strongly expressed, is predominantly positive, and occurs mainly in the cases described in the discussion of the results of the correlation analysis. This statement may be considered a response to RQ2.

The results of the regression analysis may be said, to a large extent, to be consistent with those of the correlation analysis, as discussed earlier. However, two statistically significant and negative standardized beta coefficients should be noted as differing from the results of the correlation analysis. One appears as the negative predictive effect of NC6 - Performance orientation on item FB2 - Daily time use. In addition, the predictive effect of NC5 - Humane orientation on item SP1 - Total daily smartphone usage was also statistically significant and negative. This result can be explained by the fact that increased consideration for others, a sense for others and friendliness are all likely to encourage individuals to become more involved in live communication and interaction rather than through telephone conversations and messages. Also, more direct socializing means less playing games, watching movies via smartphones, and similar. Therefore, it should be noted that institutional and group collectivism intensifies the use of smartphones, while human orientation decreases it. According to Table 3, the corrected determination indexes R^2 have very low values, ranging from 0.017 to 0.054. However, the values of the determination indexes R^2 are statistically significant for three items: FB5 - Number of groups, SP1 - Total daily smartphone use and SP2 - Use of smartphones to access Facebook. Observed along with the results of the correlation analysis, it can be generally said that from the observed items these three are most influenced by the dimensions of national culture.

3 Discussion of the moderating effects (answering RQ3)

The analysis of the moderating effects of four variables (the respondents' gender, year of study, success in studies and the possession of finance to open up one's own company), shown in Table 4, show that the mode-

rating effects in the relations between the influence of the national culture dimensions on the Facebook and smartphone use items are very weak and only occur in rare cases. This can be considered a response to RQ3. The discussion of the cases where moderating effects occur is given below.

The moderating effect of the students' gender variable in the relations between the influence of the national culture dimensions on the Facebook and smartphone use items proved to be very weak: there is only one pair: NC7 - Collectivism 2 (in-group) and SP2 - Use of the smartphones to access Facebook. This relationship is otherwise strong and positive (correlation in Table 2), but it can now be seen that it is actually very strong for men (correlation in Table 4). Practically, the perceived collectivism in the group specifically directs men to access Facebook via a smartphone. This phenomenon is not easy to explain. The dimension NC7 - Collectivism 2 consists of the following items: In this society, children take pride in the individual accomplishments of their parents; In this society, parents take pride in the individual achievements of their children; In this society, aging parents generally live at home with their children; In this society, children generally live at home with their parents until they get married. Particular attention should be paid to the last two items. Life with parents in later years is a common phenomenon in Serbia, and is often due to poor finances and the consequent inability to purchase an apartment. Male students are especially affected by this circumstance because in the years when they plan to establish their own family, it is desirable to have their own apartment or house. This can cause anxiety and more frequent stays away from home. Therefore, accessing Facebook via smartphones is more common. It is possible that male residents, away from home and accessing Facebook via their smartphones, are actually escaping reality and unconsciously seeking a solution to this situation.

The moderating effect of the year of study variable in the relations between the influence of the national culture dimensions on the Facebook and smartphone use items is also very poor, but nevertheless somewhat stronger than for gender. The moderating effect of year of study is present in the relation between NC1 - Uncertainty avoidance and FB2 - Daily time use and FB4 - Number of photos. For younger students there is a statistically significant correlation between NC1 - Uncertainty avoidance and FB2 - Daily time use. Young students' perceived uncertainty diminishes with their presence on Facebook, thus making it easier to cope with. On the other hand, the correlation NC1 - Uncertainty avoidance and FB4 - Number of photos is statistically significant and negative for older students. This

is what was indicated in the discussion of the results of the correlation analysis. Older students are more cautious about posting images because such images may reveal certain details about them, so avoiding posting them is actually a way of reducing uncertainty.

We should immediately notice here that the situation is reversed by the impact of the NC9 - Assertiveness dimension on the same item: FB4 - Number of photos. Namely, older students perceive assertiveness as one of society's challenges, and accordingly post more images on Facebook. Older students are safer and more persistent, and this results in the posting of a larger number of photos. There is an interesting situation here with older students: on the one hand perceived avoidance of uncertainty serves to reduce the number of images on Facebook, while on the other, perceived assertiveness encourages the uploading of images on Facebook. In other words, maturity requires them to be careful when images are in question, and security and self-confidence encourage them to post images. Given the average ratings of item FB4 - Number of photos for younger students (FB4mean, $y = 2.38$) and older students (FB4mean, $o = 2.63$), as well as the fact that the t-test showed a statistically significant difference in these values, for older students assertiveness prevails over uncertainty avoidance, at least when it comes to item FB4 - Number of photos.

The moderating effect of year of study is present in the relation between NC5 - Humane orientation and FB1 - Frequency of Facebook usage, as this relation becomes statistically significantly negative for older students. If students perceive the environment as less humane, more intolerant, and with no feeling or consideration for others, then frequent use of Facebook may serve as some kind of compensation for such circumstances. This is especially true for older students who think more about this condition, they find it more difficult to cope with and it affects them more. On the other hand, the perception of high humane orientation, feelings for others and companionship, may reduce the need for access to Facebook, with older students especially striving for live contact.

The moderating effect of the success in studies variable in the relations between the influence of the national culture dimensions on the Facebook and smartphone use items is very weak and occurs between NC5 - Humane orientation and FB1 - Frequency of Facebook usage and FB4 - Number of photos. These relationships are not statistically significant (Table 2), but they now become extremely negative (for FB1 - Frequency of Facebook usage and statistically significant) for less successful students. This phenomenon can be explained in the following way: if a student perceives society as

having low humane orientation and he is a bad student, he then tries to find a place for himself in such an environment. This encourages frequent visits to Facebook, where he expects „to find something”, as well as posting a large number of images hoping that „something will happen”. Conversely, if a student perceives society as humane oriented, and he is a bad student and therefore unsuccessful in his work, this may cause envy, insecurity and a decreased desire to appear on Facebook.

Although the moderating effect of the possession of finance to open up one’s own company variable in the relations between the influence of the national culture dimensions on the Facebook and smartphone use items is poor, it is still stronger than the previous moderators. More specifically, the moderating effect focuses on two dimensions of national culture: NC2 - Future oriented and NC3 - Power distance. The NC2 - Future oriented dimension has the lowest average rating of all the national culture dimensions (Table 1). Logically, it should be assumed that most students perceive future oriented as low. If a student perceives low future orientation, and is relatively well off, such circumstances may result in a certain degree of relaxation and a reduced need to seek something through frequent entries on Facebook and long conversations via a smartphone. The situation is reversed when it comes to the impact of the NC2-Future oriented dimension on the SP2 - Use of smartphones to access Facebook item: relaxation in these conditions may lead to time outside the home being spent on Facebook via a smartphone. Conversely, a student who has money and perceives high future orientation may develop the feeling that people in the environment are involved in activities and making plans, so when he already has money this encourages him to do something and to be more proactive. This may be partly manifested through accessing Facebook and getting involved in long discussions. This does not apply to item SP2 - Use of smartphones to access Facebook because these more proactive students use their time outside the home more effectively, without the need to use Facebook.

The moderating effect of the possession of finance variable is expressed in the NC3 - Power distance dimension where a negative impact on the power distance of certain items related to Facebook is present for students with access to finance. Note that NC3 - Power distance has the highest average rating of all the national culture dimensions (Table 1). Hence, in Serbia, there is a high power distance which has a stronger effect on those students who do not have their own money. Conversely, in high power distance conditions, students with access to their own funds feel more secure, and have greater opportunities for other kinds of entertainment. Practically, students who perceive high power distance

and have access to their own funds are more confident, and have less need to access Facebook, search for friends or upload images on Facebook. They may even avoid this so as not to provoke the majority because they have money and they may not want someone to accept them because of certain hidden expectations.

6. Conclusion

The influence of the dimensions of national culture on the observed Facebook and smartphone use items is not strongly expressed, and is statistically significant for certain individual dimensions of national culture and Facebook and smartphone use items. The NC1 - Uncertainty avoidance dimension statistically significantly and positively influences items FB1 - Frequency of Facebook usage and FB2 - Daily time use. Thus, accessing Facebook can create a subjective feeling of avoiding uncertainty and escaping problems. Also, avoiding uncertainty can also be manipulated by avoiding uploading images on Facebook. Item FB5 - Number of groups is under the influence of two dimensions: NC3 - Power distance and NC5 - Humane orientation. The respondents are encouraged to gain the support and attention of others through group membership, and through equality within such groups they find a place where they are able to avoid the power distance which is high in Serbia. Item SP1 - Total daily smartphone use is also influenced by two dimensions: NC4 - Collectivism 1 (institutional) and NC7 - Collectivism 2 (in group). Mobile phones simply and efficiently serve to meet the needs, but also the obligations, of collective and family connections. NC2 - Future oriented and NC6 - Performance orientation negatively affect individual items. Although these impacts may not be as strong, they still suggest that planning and focusing on results reduce the space for using Facebook and smartphones.

By combining the results of the correlation and regression analysis, it can be concluded that the total strongest impact is achieved by the dimension NC7 - Collectivism 2 (in group), while items FB5 - Number of groups, SP1 - Total daily smartphone use and SP2 - Use of smartphones to access Facebook are under the greatest influence of the national culture dimensions. The paper examines the moderating effects of four moderators: the respondents’ gender, year of study, success in studies and the possession of finance to open up one’s own company. However, none of them demonstrated a strong moderating effect in the observed relationships. In general, the effects of national culture on the Facebook and smartphone use items are not statistically significant in the majority of cases, just like the moderating effects, but some interesting relationships and tendenci-

es have been noticed. The results would probably have been more pronounced if the research had included all social networks at the same time. This and the fact that the results of the research apply to the conditions in Serbia may be considered as the main limitations of the research. Therefore, the proposal for further research is to repeat a similar study where the respondents would evaluate their own parameters for all social networks together. In any case, the results of the research presented here have theoretical and practical significance. The theoretical significance is that the observed impacts have not been examined with the GLOBE dimensions of national culture so far, while the practical significance is that the results may contribute to a better understanding and guidance of students when it comes to the use of Facebook and smartphones.

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Corporate Social Responsibility Disclosure in Banking Sector of Pakistan: Evidence from Commercial Banks

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Abstract

This paper determines the current status of Corporate Social Responsibility (CSR) in Pakistan especially in the banking sector. The annual reports of listed commercial banks are analyzed from the year 2008 to 2018, regarding CSR practices. Nine different dimensions of CSR were inspected through content analysis. The results of the study show that the concept of CSR in Pakistan is not fully developed and is in transition stage. However, the participation of commercial banks in social responsible activities and its disclosure has been increased in last decade. In present scenario, Pakistan is confronting some serious socio-economic and environmental risks and the banks might contribute to reduce environmental issues by adopting sustainable banking practices. The study suggests that the banks in Pakistan should incorporate policies concerning supplier and environmental aspects of CSR in their business operation as the disclosure performance of the banks with respect to the study dimensions is below average.

Keywords:

Corporate Social Responsibility, Banking Sector, Content Analysis, Philanthropy, Environment

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1. Introduction

The concept of Corporate Social Responsibility (CSR) in Pakistan is relatively new and underdeveloped as compared to developed nations, where CSR is considered as key element for long-term success. In Pakistan the definition of CSR is confused with philanthropic activities of the firm and labour rights (Waheed, 2005; Khan, 2012). According to the definition of Industry Canada (2005, p.1), “the way firms integrate social, economic and environmental concerns into their values, culture, decision making, strategy and operations in a transparent and accountable manner and thereby establish better practices within the firm, create wealth and improve society”. In developing world, the issues of corruption, pollution, labour working hours and overtime, due to the failure of companies to comply with national laws and regulations against the said dilemmas, discourage firms to go beyond the existing legal obligations (Lund-Thomsen, 2008).

In Pakistan, there are no specific laws and regulations

outlining CSR obligations of business organizations to ensure their social and environmental compliance, and CSR in the country is completely on voluntary basis (Waheed, 2005). However, certain laws are comparatively associated with firms’ CSR responsibilities, such as labour laws, environmental laws and some of the constitutional provisions. The Provincial Employees Social Security Ordinance 1965 bonds the companies regarding the provision of Health and safety measures, sick leave, disabilities benefits, pension and death grants (The Provincial Employees Social Security Ordinance, 1965). The Article (9a) of the constitution covers the areas concerning environmental and consumers rights protection, Article (11 and 17) of the constitution restrict companies to practice forced and child labour and also intimidate the sexual discrimination (The Constitution of Pakistan, 1973). The Environmental protection Act 1997, ensures control for pollution and deforestation and improvement of biodiversity (Alam, 2008). In 2013, the Security Exchange Commission of Pakistan (SECP) issued CSR guidelines, aimed to enhance the awareness in companies to design CSR policies, and adopt social responsible practices concern-

ning reporting and disclosure of their CSR

activities, accountability and transparency, community support and environment (SECP, 2013). Likewise, certain non-governmental organizations and research institutes are working for the promotion of CSR in Pakistan. Some of these organizations are: Corporate Social Responsibility Center Pakistan, National Forum for Environment and Health, and Responsible Business Initiative Pakistan. These organizations encourage the businesses towards CSR initiatives through seminars, trainings, policy guidelines and stakeholders' dialogues.

According to Awan et al., (2018) asserted that in small and medium enterprises, the more focused dimensions of CSR are environment, legal and economic perspectives. Whereas, philanthropy is widely considered as an ethical and social priority in this sector. This study explores the actual practices concerning CSR undertaken by commercial banks in Pakistan and the level of its disclosure. Different dimensions of CSR were thoroughly analyzed, in order to know the nature and involvement of banking sector in CSR activities, and their contribution towards social, economic and environmental benefits to the employees, suppliers, competitors and society in large. After brief introduction of CSR in Pakistan, this paper is organized as follows: section 2 addresses the CSR in banking sector of Pakistan; section 3 briefly describes the methodology. Section 4 and 5 illustrates the results and discussion of content analysis and conclusion of the study respectively.

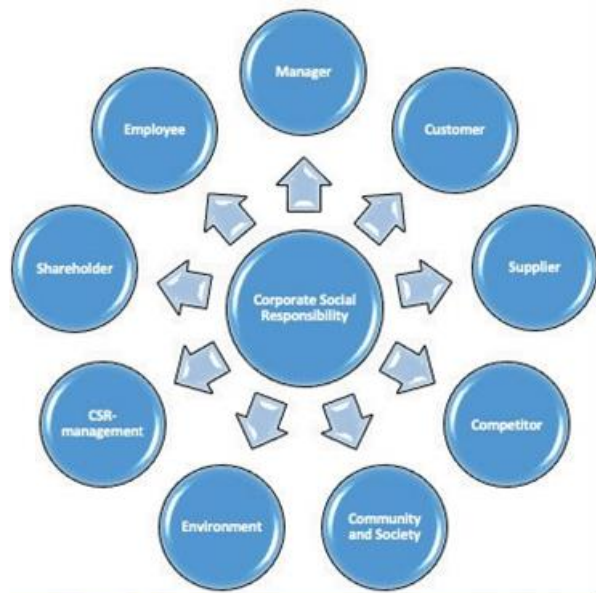


Figure 1. CSR stakeholder theory
Source: own edition

2. Corporate Social Responsibility in Banking Sector of Pakistan

Banking sector is one of the important economic pillars of any country and contributes in its growth and prosperity, by providing financial assistance to both private and governmental organizations. McKinnon (1973) determined that the increase in the financial activities of banking sector is positively associated with the growth of the region. The financial sector of Pakistan operates under the supervision of State Bank of Pakistan (SBP) and is divided into three major divisions; regular banks, micro finance banks and non-banking financial firms. According to the State Bank of Pakistan, 33 schedule banks, having 13692 branches altogether, are providing their services across the nation (SBP, 2018).

Social accountability and social responsibility are the prompt areas of CSR in Pakistan based companies, and the companies are struggling to extend their CSR practices by incorporating environmental accountability and human rights in their operations (Awan et al., 2010). The CSR awareness in local companies in Pakistan is lagging behind and the environment, human rights and anticorruption aspects of CSR are almost ignored in these companies. As compared to local firms, the multinational firms operating in Pakistan show more commitment while practicing and disclosing CSR (Naem and Welford, 2009).

Yamak and Suer (2005) pointed that a number of stakeholders such as shareholders, employees, managers, depositors, borrowers and regulating bodies are connected to the banking sector. Banking sector as compared to other sectors, adopted CSR principles and reacted relatively late to the CSR-related global issues. Keeping in consideration the importance and seriousness of CSR in business operations, banks also incorporated CSR policies and initiated CSR programs including educational, sports, cultural and environmental programs (Polyshronidou et al., 2014).

Years											
Banks	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Allied Bank	0.6479	0.6479	0.6338	0.6338	0.7183	0.6901	0.7606	0.7465	0.7606	0.7887	0.7887
Bank Alfalah	0.5915	0.5775	0.6197	0.6338	0.6197	0.6761	0.6901	0.6901	0.7042	0.7042	0.7042
Bank Alhabib	0.5775	0.5915	0.6761	0.662	0.6479	0.662	0.6901	0.7042	0.7183	0.7465	0.7183
Askari Bank	0.5915	0.5915	0.6338	0.6056	0.6338	0.6338	0.662	0.662	0.6761	0.662	0.6761
Bank Islami	0.5493	0.5493	0.6056	0.6197	0.662	0.662	0.662	0.662	0.6761	0.6901	0.7324
Bank of Khyber	0.5211	0.5211	0.5352	0.5915	0.5915	0.5915	0.6479	0.6338	0.6761	0.7183	0.7183
Bank of Punjab	0.493	0.493	0.507	0.5211	0.5634	0.6338	0.6901	0.7183	0.7183	0.7183	0.662
Faysal Bank	0.5634	0.5915	0.5915	0.6056	0.6197	0.6197	0.6479	0.6338	0.6479	0.7042	0.7183
Habib Metropolitan	0.6197	0.6197	0.662	0.6338	0.662	0.662	0.662	0.662	0.662	0.6761	0.6761
Habib Bank	0.5915	0.6197	0.662	0.6761	0.6901	0.7042	0.7042	0.6479	0.7324	0.7465	0.7324
JS Bank	0.5634	0.507	0.6056	0.5915	0.6056	0.662	0.6761	0.6761	0.7042	0.7465	0.7042
Muslim Commercial Bank	0.5634	0.6479	0.7183	0.7324	0.7183	0.7465	0.7606	0.7324	0.7887	0.7887	0.7887
Meezan Bank	0.5775	0.6056	0.6197	0.6056	0.6901	0.6761	0.6901	0.6901	0.7042	0.7465	0.7465
National Bank of Pakistan	0.662	0.6901	0.662	0.6761	0.7042	0.6901	0.7042	0.7183	0.7324	0.7606	0.7606
Samba Bank	0.4648	0.4507	0.4789	0.4648	0.4789	0.493	0.507	0.507	0.5211	0.6056	0.662
Standard Chartered Bank	0.662	0.6901	0.7183	0.6761	0.6761	0.6901	0.7042	0.7183	0.7606	0.7887	0.7746
Silk Bank	0.493	0.507	0.5634	0.5775	0.6197	0.6338	0.6479	0.6338	0.6479	0.6479	0.662
Soneri Bank	0.4789	0.4789	0.493	0.5352	0.5775	0.6197	0.6761	0.6761	0.7042	0.7183	0.662
Summit Bank	0.4789	0.4789	0.4789	0.493	0.5352	0.5493	0.5775	0.5634	0.6197	0.6338	0.6338
United Bank	0.6056	0.6338	0.662	0.662	0.6901	0.662	0.7324	0.7042	0.6901	0.7324	0.6901
Yearly Averages of CSRI of all Bank	0.5648	0.5746	0.6063	0.6099	0.6352	0.6475	0.6675	0.6690	0.6923	0.7162	0.7106
Overall CSR Disclosure (2008-2018)	-	-	-	-	-	0.6449	-	-	-	-	-

Table 1. CSR Disclosure Index (Score) of Listed Commercial Banks 2008-2018 (year wise)

Banks having transparent policies concerning CSR have high organizational reputation and attract more investors and borrowers, which results in profitability (Ross, 2010).

Mohsan et al., (2011) reckoned that the banking sector in Pakistan is experiencing an intense competition, to survive in this competitive environment, banks are expanding their services by initiating online and mobile banking. Most of the banks have adopted CSR as strategic marketing tool, to increase the customers' attractions and to achieve the competitive edge (Porter and Kramer, 2006). Khan et al., (2015) asserted that banking customers in Pakistan perceive CSR as provision of quality services, trust and the healthy professional behavior of employees with their customers. Safi and Ramay (2013) brought that the knowledge and awareness of banking customers have developed overtime regarding CSR activities and consider the environmental protection and sustainable development of the community as a core responsibility of the banks.

Sharif and Kashif (2014) concluded that the CSR disclosure performance of commercial Banks in Pakistan is high and positively influences the financial performance of the firm. Habib Bank Limited (HBL) incorporated the concept of CSR in their vision statement. The bank has donated more than Rs. 144 million (PKR) to different governmental institutions and NGO's, to support the health, education and community building programs (HBL, 2016). Allied Bank Limited (ABL)

engaged in employee training and development, sports sponsorships, environmental protection, education and healthcare programs. The bank has donated Rs. 10 million (PKR) to Prime Minister's Earthquake Relief Fund, to assist and compensate the affected people of Baluchistan (ABL, 2018). Askari Bank has initiated "Plant a tree, Make Pakistan green", under this project the bank will plant 3000 trees in collaboration with Metropolitan Corporation Islamabad (Askari Bank, 2019). The National Bank of Pakistan (NBP), integrated the CSR in its corporate policy and a separate division is dedicated to supervise the CSR initiatives of the bank. The primary focused areas of NBP are: health and education, employees' welfare, natural disaster relief and improvement of living standards of people living in poverty (NBP, 2018).

Dimensions	Disclosure Percentages (%)
Shareholder	82.88
Employee	70.46
Manager	92.82
Customer	65.62
Supplier	40.53
Competitor	68.64
Community and Society	68.64
Environment	40.04
CSR-management	79.32

Table 2. Average Disclosure Percentages of Each Dimension from 2008-2018
Source: own edition

3. Methodology and Data

The CSR data of 20 listed commercial banks were obtained from their annual reports for the year 2008 to 2018, downloaded from their respective official websites. These annual reports were analyzed in accordance with CSR-dimensions based on stakeholders theory (Appendix I); Shareholder, Employee, Manager, Customer, Supplier, Competitor, Community and Society, Environment and CSR-management (Scholten, 2009; Gao, 2011; Sharif and Kashif, 2014; Deutsch and Éva, 2018), through content analysis.

For the purpose 0 and 1 were assigned to each item, depends on the disclosure of each item in the annual report of respective bank. 1 mean the bank have disclosed the CSR item and vice versa. The total disclosure index for a particular bank is as follow:

$$CSRI_j = \frac{\sum_i^n x_{ij}}{n_j}$$

Whereas

$CSRI_j$ = Corporate social responsibility index of jth bank

n_j = total number of CSR items for jth bank, $n=71$

$x_{ij} = 1$ if "ith" item is disclosed by "jth" bank annual reports and 0 if the item is not disclosed in annual reports/websites.

4. Results and Discussion

The results provided in table I, portray that the average overall CSR disclosure of all listed commercial banks in Pakistan from 2008-2018 was 0.6449, highlighting that in the said time period, these banks disclosed 64.49 percent of information regarding their CSR activities. The results of the content analysis indicate that the level of CSR disclosure in commercial banks in Pakistan is moderate. However, an increase has been noticed over the years as compared to 2008. The

overall CSR score of these banks in 2008 was 0.5648, whereas in 2018 it increased to 0.7106. Muslim Commercial Bank (MCB) has maximum disclosure score among all other banks in the study. In 2008 the average disclosure score of MCB was 0.5915, which increased to 0.7465 in 2018. The second highest overall average CSR disclosure score was 0.7145 of Standard Chartered Bank (SCB), followed by Allied Bank Limited with an average of 0.7106. The average disclosure score (0.5122) of Samba Bank was very poor and is the lowest among all other commercial banks under-study. However, the disclosure performance of Samba Bank also increased over the time period 2008-2018. In 2008 the CSR disclosure score of Samba Bank was 0.4648, increase to 0.668 in 2018. The average score of summit bank (0.549) and Soneri Bank (0.6018), below average as compared to other banks in the sample.

Table II, shows the average disclosure score with respect to each dimension during 2008-2018. The finding of the study determines that 92.82 percent information was disclosed in Manager/Governance dimension of CSR followed by Shareholder 82.88 percent and CSR-management 79.32 percent respectively. The minimum amount of information by commercial banks in Pakistan was disclosed in environmental aspects of CSR, which was 40.04 percent, followed by supplier with 40.53 percent respectively.

5. Conclusion

The main objective of this study is to investigate the level of corporate social responsibility practices and its disclosure in listed commercial banks of Pakistan. Content analysis was utilized to analyze the annual reports of listed commercial banks of Pakistan regarding the disclosure of shareholder, employee, manager, customer, supplier, competitor, community, CSR-management and environmental aspects of CSR. The analysis shows that the overall disclosure of CSR practice has been improved, as in 2008 the average CSR disclosure of all listed commercial banks was 56.48% while in 2018 it was 71.1%. The increase in overall CSR disclosure from 2008-2018 is 14.62%. All the banks under study showed satisfactory disclosure performance in all dimensions except suppliers and environment. The reason is that banks do not focus enough on environmental issues, most of the banks do not have policies or guidelines concerning environment, none of the bank

in the sample disclosed information in order to follow the World Bank and OECD environmental guidelines. Very few banks have environment protection programs. On other hand, the main focused areas of CSR for these banks were shareholders, employees, customers and the provision of financial assistance to different institutions, working for the development of the community; contributing in health, education, natural disaster reliefs and sports. The finding of the study indicated that the level of CSR in banking sector of Pakistan is moderate. The study suggests that the banks in Pakistan should incorporate policies concerning supplier and environmental aspects of CSR in their business operation as it will benefit the bank in a number of ways such as: increasing level of employees' motivation and retention, reducing costs and increasing operational efficiency via paperless environment and energy efficiency, improving the reputation and credibility of the banks in business environment.

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Appendix 1.

Categ	Shareholder	Categ	Employee
S. No	Items	S. No	Items
1	Investor relation Management	1	Gender diversity
2	Common Forum for dialogue	2	Employee education & Training
3	Flexible policies for shareholders and investors	3	Employee benefits
4	Appreciating shareholders	4	Employee safety & Hygiene
5	Information disclosure for share holders	5	Equal opportunity
		6	
		7	Minorities (discrimination Policy)
		8	Employee motivation
			Number of employees
Categ	Manager	Categ	Customer
S. No	Items	S. No	Items
1	Board of Directors (Names, qualification & position)	1	Marketing Practices (responsible, ethical)
2	Independent Directors	2	Customer satisfaction
3	Board effectiveness (Governance structure)	3	Customer Awareness
4	Relation between all stakeholders	4	Social Responsible Investment
		5	Social Responsible Saving
Categ	Supplier	Categ	Competitor
S.No.	Items	S. No	Items
1	Equal opportunity to suppliers	1	Relationship with Competitors
2	Provision of info to suppliers	2	Collaboration with competitors
3		3	Fair selling practice
4	Fair negotiation with supplier		(No negative advertisement)
	Support, caring, protection and advances		
Categ	Community and Society	Categ	Environment
S. No	Items	S. No	Items
1	Charitable Initiatives/zakat	1	Environmental programs
2	Health and education	2	ISO 14000/14001
3		3	Environmental Guidelines
4	Employment opportunities	4	Pollution Control
5	Eradication of Poverty	6	
7	Sports and Culture	7	Recycling
8	response to natural disasters	8	Energy efficiency
9	Community welfare Program	9	
10	Human rights	10	Investment in agriculture sector
		11	World bank Guidelines
	Disable Person		OECD Guidelines
Categ	CSR-Management		
S. No	Items		
1	Code of Conducts/ethic		
2	Sustainability report		
3	Anti-bribery		
4	Transparency (Internal, external audit)		

Packaging 4.0 – Questions and dilemmas

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Abstract

Stepping into a new decade of the 21st century, we have heard and will hear much about the changes caused by Industry 4.0. The continuously appearing technical innovations revolutionize our lives, redefine the processes of production and services. Among other fields, the packaging industry has also seen new developments. Smart packaging, so-called packaging 4.0 is one type of the mentioned innovations. What does this concept mean? How unified is the interpretation of smart packaging today? What are the technological innovations driving the packaging industry? Which functions of the packaging are the most affected? What is the difference between active and intelligent packaging? What characterizes the spread of smart packaging? How can we distinguish between packaging forms providing real added functionality and solutions that sometimes seem unnecessary, almost luxurious? What can we expect in the future? Answering the raised questions is not always straightforward. There are a number of dilemmas about packaging 4.0. The questions and problems mentioned above will be discussed in this paper.

Keywords:

Smart packaging, Industry 4.0., active packaging, intelligent packaging

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1. Introduction

Stepping into a new decade of the 21st century, we have heard and will hear much about the changes caused by Industry 4.0. The continuously appearing technical innovations revolutionize our lives, redefine the processes of production and services. Among other fields, the packaging industry has also seen new developments. Smart packaging, so-called packaging 4.0 is one type of the mentioned innovations. What does this concept mean? How unified is the interpretation of smart packaging today? What are the technological innovations driving the packaging industry? Which functions of the packaging are the most affected? What is the difference between active and intelligent packaging? What characterizes the spread of smart packaging? How can we distinguish between packaging forms providing real added functionality and solutions that sometimes seem unnecessary, almost luxurious? What can we expect in the future? Answering the raised questions is not always straightforward. There are a number of dilemmas about packaging 4.0. The questions and problems mentioned above will be discussed in this paper.

Industry 4.0 is transforming our lives. Smart devices, digital technologies and artificial intelligence-based solutions are gaining ground. These changes are so profound and so rapid that we could not have imagined before. There is no difference in the field of the

packaging industry either. As Thomas L. Schneider, the president of The World Packaging Organization (WPO) said „New technologies bring unexpected situations, winners can become losers, and losers can become winners - all in a very short time.” (Source: <https://docplayer.hu/18198287-Csomagolasi-innovaciok-a-biztonsagert-es-a-fenntarthatosagert-budapest-2016-majus-26-nemzetkozi-csomagolasi-konferencia.html>)

2. Packaging in general

Next to the basis logistics processes – loading, transport, storage – there is a need for additional processes such packaging, order picking, unit load training too. Packaging can mean the process of wrapping to be conveyed consumption goods and also the wrapping itself. This is needed because nowadays most products are not consumed at the production place. In many cases the product travels thousands of kilometres before reaching the final consumer. From the expectations for packaging it can be highlighted that: “It should ensure that the final product is delivered to the consumer in the most economical way without reducing the value of the finished product, ie. by preserving its quantity and quality... The task of packaging usually begins at the end of the manufacturing process and lasts during the total spatial distribution from production through transportation, wholesale and retail, to its delivery to the consumer,

and possibly even exists beyond. „ (Source: Tiefbrunner; Anna 2010/15)

Dörnyei (2019/13), referring to Rockstroh (1979), mentions that packaging can be interpreted as a physical product and also as an activity. „Packaging as a physical product is an element group that forms a complex but temporary cover around the product.” Dörnyei (2019/13). Packaging as an activity is „a set of operations preparing the product for shipment, distribution, storage, commerce and end use.” (Source: Dörnyei; 2019/13)

Packaging must guarantee long shelf life, food safety and quality, plus it should encourage consumers to buy the product itself. Our main expectations for packaging are the following:

- Maintaining the value of the product,
- Delivering the product in intact condition from the manufacturer through the distributor to the consumer
- Unopened, original packaging to be delivered to the consumer,
- For units with larger quantities, resealability should be solved,
- Ensure child-proof seal - for chemicals, paints and medicines
- Prevention of spillage in case of hazardous substances
- Being environmentally friendly, based on sustainable materials and technologies
- Providing information,
- Ensure traceability.

Ideal packaging ensures maximal product protection, marketability, customer friendliness and complies with packaging rules, regulations, and asset protection requirements at minimal cost.

Packaging can also provide added value, for example in the case of aroma sealing, or we can mention the value-adding effect of the optionality to consume/use the product directly from the packaging. The value-adding feature of packaging is particularly true for some smart packaging solutions, which we will return to later.

Most frequently four functions of packaging¹ are highlighted in the literature related to the aforementioned requirements.² One is the protection function, where packaging protects the product from environmental influences and vice versa, it protects the environment from the goods. In this function, packaging helps to prevent quantitative and qualitative losses during loading, transportation, storage, and protects the product from mechanical, chemical, biological or even weather conditions, effects and pollution. Secondly, the

rationa- lization function can be stated, packaging facilitates the handling of goods - for example through proper sealing, often resealability. This supports the easy loading of goods, stacking optionality and secure fixing for load-ing and transport. It is important that packaging should be easily removable and it should be ensured that its' materials can be collected and recycled for environmen- tal and sustainability reasons. We can also highlight the marketing function of packaging, playing a big role in the sale of goods primarily in the field of awareness raising and advertising. Aesthetic packaging is impor- tant for attracting customers, as this also encourages potential buyers to realize the purchase. Communication function of the packaging can be mentioned as the fourth function, closely linked to the marketing functi- on. In this context, the packaging is a „mediation tool „ between the product and the environment, provides information, identifies the product and supports easier choice. It also describes the product, provides directions for use and informs customers of the product's usability and warranty.

There are three basic forms of packaging³, which are the followings:

1. Consumer packaging: is in direct contact with the final consumer, contains goods in smaller volume and quantity.
2. Multipack: consists of a defined number of consumer packages. It always contains the same type and number of consumer packages.
3. Shipping packaging: is used to make shipping easier and more efficient. There are two forms existing:
 - a. individual transport packaging, which is usually used for the transportation of high value, higher volume goods eg. household appliances.
 - b. unit cargo, which optimizes space utilization in warehouses, transport vehicles and facilitates the automation of material handling and storage.

We note here that most of the aforementioned packaging functions are provided by consumer packaging (based on Tiefbrunner 2010/17. page)The literature mentions the model of optimal packag- ing (OP) (based on Medvéne 2006/17. page). The opti- mal packaging model is directly linked to the previously mentioned requirements and functions of packaging. According to the model, the packaging must also meet the requirements of product protection, suitability for distribution, transport, storage, consumer information, and customer-friendliness.

Based on the above, it can be stated that there are many requirements for packaging, causing challenges for the

manufacturers, designers and also for the whole packaging industry.

Packaging requires:

- Packaging materials (paper, plastic, textiles, ...)
- Packaging equipments (box, canned glass,...)
- Packaging accessories (label, adhesive,...).

Packaging materials are primarily related to the subject of this study, the history of packaging is not detailed within this paper. We only mention that our ancestors worked with different types of packaging materials, equipments and accessories in each historical period in accordance with the technical, technological, economic and social conditions of that time.⁴⁵⁶ Nowadays, we have come to a point, where we can realize that packaging materials used in the past are still present in the packaging industry in modern versions (glass, wood, paper, plastics, metal, textiles,...) and next to them new packaging materials and solutions are constantly appearing. These can be connected to the category of Packaging 4.0.

3. The types of smart packaging and the technical solutions behind it

Various definitions of smart packaging can be found in the literature. Two of them are quoted below: “Smart packaging is more than just using traditional packaging with fine print, possibly with bar code. Smart packaging is a system that can carry intelligent functions (signalling, sensing tasks), helps to increase shelf life, improves safety, quality, and warns consumers about potential problems and dangers.” (Source: Chakravarthi AVPS <https://anzdoc.com/csomagolasi-innovaciok-a-biztonsagert-es-a-fenntarthatosager.html>) Based on a different description: “They not only preserve the value of the packaged goods, but they also contribute to quality preservation, usage and product safety by improving a functional feature.” (Source: Anna Tiefbrunner, 2010/133)

Smart packaging can be split basically into two major groups. One is active packaging, which protects the product from environmental impacts and prolongs the quality of the product. Thus, for example, the active packaging ensures the „breathing” of vegetables and fruits. This type of packaging gives greater functionality to the product. Its’ special type is the indicator packaging, which shows, for example with a colour change the various transformations (temperature, pH, carbon dioxide, etc.) within the package. It is mainly used for frozen products. The advantage of this solution is that consumers will not dispose the product simply

because its estimated warranty period has expired by 1-2 days. This is particularly important in an age where nearly 80 million tonnes of food are getting wasted in Europe within 1 year.⁷ Another type of smart packaging is intelligent packaging, which is able to communicate with the buyer about the status of the content, product, and give feedback to the seller after purchase. When we examine these intelligent features, we see that they are related to the marketing function of the packaging, and are therefore essential. Here we demonstrate the smart solutions by some examples. Firstly, we bring examples of the additional functions, these became common practices. These include modern medicine packaging solutions making counterfeiting impossible, providing the elderly with easier box opening, protecting against environmental damage (moisture, chemicals, light, etc.) with a built-in barrier layer, allowing child-proof sealing or providing information for visually impaired consumers by Braille writing. Special packaging materials for cosmetics may also be mentioned, where the packaging protects the product for example from ultraviolet radiation.

There are types of packaging that provide experiences based on today’s consumer trends. Such a solution can be a video embedded in the package, which briefly describes the product. We can find examples of perfumes illuminated by LED lights (more on Bedó, 2017/31), vodka-glass lighting dependent on the volume level of the music giving special experience to partying young people, lipstick cases with mirrors and lights easing the application in a dark bathroom. The above examples are based on the idea that light, sound and motion picture, together with packaging, evoke emotions in consumers.

Today we come across packaging solutions that provide additional information about the product, its potential uses, or about the consumer. An example of the latter is the use of the Near Field Communication (NFC) code, which „tests” on the phone whether the right person is opening the (drink) bottle by confirming the age. We can face with solutions where we get consumption suggestions and recipes for the product after scanning the QR code. For example in the case of vodka: “The label contains visual recognition technology that is matched with the application during use. Scanning the tag through Shazam app allows users to access free-brand content, including cocktail trends, recipes and social media, to create more interactions with the product.” (Source: <https://www.trendhunter.com/trends/warhol-absolut-vodka>)

Let’s take a look at the technology behind smart packaging! Many technical solutions support smart packaging. Below we mention the most important ones. One of them is the use of the RFID (Radio

Frequency Identification) tags, which can continuously track the path of a product, which not only causes difficulties for thieves, but can also automate inventory management. The application of the previously mentioned NFC technology offers many possibilities ranging from extending security solutions to multimedia communication of product information. Major beverage manufacturers already provide their premium category products with an encoded NFC chip that contains all the important details of the product and, above all, verifies that the drink was actually made by them, stating it is not a counterfeit. Customers with an "NFC phone" can scan this information in a snap while holding their cell phone over the bottle in the shop. The TTI (time-temperature-indicator) labelling solution is useful for foods, for example through continuous temperature measure of refrigerated products. If it notices that the product has been in a warmer environment for a long time than the set temperature, the label will become discoloured, turn red, and it can be read clearly that the food is not recommended for consumption. Using LED light on the packaging can help you to sell your products in the perspectives of marketing (such as the LED-lighted perfume mentioned earlier.) Augmented Reality (AR) allows us to get extra information about the product with the help of the smartphone. In the case of printed electronics and microsensors, the circuitry is being printed by innovative printing machines, which then starts to operate using either body, product heat or human energy and provide information to the consumer. The use of QR code is useful for product identification and protection against counterfeiting. Special cases of smart packaging solutions include special materials (such as bioplastics) that eliminate the use of environmentally harmful plastic, extend the shelf life of the product, and may include a sensor that informs the customer if the product is unsuitable for consumption. Smart solutions include blockchain technology⁸, which can be used in tracking as well.

4. Questions and dilemmas

What questions do smart packaging solutions raise? There are many benefits of smart packaging. As we have already shown above, the product's warranty can be indicated showing the real condition, it retains the aroma, provides additional product information, can be eye-catching, and so on. But the question is: Do the smart packaging solutions above only have positive effects? Let's start by examining the question below.

„Packaging must excel in three dimensions: sustainability, profitability and environmental protection.” (CSA-OSZ Yearbook 2016/53)⁹ Among smart solutions, there are many cases where we may

feel that the packaging is redundant, exaggerated or luxurious, thus harming the sustainability dimension. For example, perfumes illuminated by LEDs. We can find packages with significant costs. In all cases, it is necessary to weigh the marketing benefits and costs of smart solutions in order to determine the economy of packaging. Comparing the two pages can provide valuable information. Analysing environmental considerations, we can start from the often-heard statement that „The most environmentally friendly packaging is if there is no packaging at all.” It is not easy to comply with this principle, but minimizing the use of packaging materials is already a good solution, or to use simple, reusable materials, avoid materials that are harmful to the health and the environment, or avoid over-packaging. If we look at the above, we can see that there are some elements that are definitely damaged in smart packaging. For example, some smart packaging solutions can be exaggerated. Because of marketing, there are often items on the package which is considered luxurious (such as video on the box). At the same time, it is visible that companies can win consumers with unique, innovative packaging. These packages are attractive especially for younger generations.

The future consumer - the future of smart packaging
With regard to smart packaging, in the future the emphasis should be placed on packaging that offers truly added functionality, rather than on the redundant, sometimes seemingly luxury solutions. Corporate responsibility plays a major role in this. It can be mentioned that the decision on the individual smart packaging forms can be controversial within a given manufacturing company as marketing, logistics, finance as functional areas may even take opposite view on smart packaging. Particular attention should be paid in the future to recycled materials, biodegradable plastics or even edible packaging (such as seaweed edible plastic). When it comes to smart packaging, we cannot continue without looking at the future consumer. „The consumer of the future is today's Digital Native,” said Dave Rodgers, Microsoft's retail manager. Source: <https://www.packworld.com/home/article/13371893/pac-to-the-future-customization-connection-community> It is becoming increasingly common that, due to the young generations, we have to deal with 5 "I" instead of 4P's of products. These are:

- Instrumental – everybody owns a smartphone
- Interconnected – connection with technology, community
- Informed – they know more than anyone else about the product they want to buy
- In place – they actually make purchases with their

- phones while in the store
- Immediate – they want to buy now, they want to get the product now

Young people are receptive to smart technologies and value their use also in the field of packaging.

In the early 2010s, “Ipsos conducted a survey in connection to consumer expectations towards packaging in 26 countries. In particular, they were interested in the additional services of food packaging for what the public is willing to pay higher prices. According to the general opinions of the countries “keeping the food fresh” and “environmentally-friendly” functions are the ones, for which people are ready to pay more (the distribution of responses was the same for these two functions). The „reusable” and the „easier to use” aroused significantly less interest. The least important aspects were the „avoid spillage of food”, „keep food at the right temperature” and „easy-to-eat”. ., (Source: Nagy (2013/17)) By 2020, in my opinion, we have come to realise even greater expectations for packaging. In the future, it will be even more important to increase consumer safety and the opportunity for greater consumer interaction through packaging. The former can lead to an increase in the role of active packaging and the latter to the role of smart packaging. The green approach, the increased focus on sustainability aspects, and the „limited” nature of the Earth’s carrying capacity implies the need to minimize food waste, which not only directly affects consumption, but also the quality of packaging and the amount of packaging material. The importance of using recyclable materials and environmentally friendly packaging technology will increase in the future. With the spread of sustainability, there is a growing need to getting rid of the disposable packaging and minimize the burden on the environment created by the use of disposable packaging materials. Return and multi-path packaging may come to the forefront.

The demand for safe food products with minimal processing and reduced additives is emerging as a trend. (Source: Singh et. al; 2011/258) This may also boost future demand for active packaging. As time goes on, the customer-friendly nature of packaging continues to be present and becomes even more significant. Consumers want to buy packages that provide more detailed information about the „history” of the product, about the food quality (Robertson, 2006). Customer-friendliness in packaging means hygienic, easy to open and close, and low weight solutions. For the 21st century’s consumer design is an important aspect besides being provided with real information on the product.¹⁰ When applying smart solutions, you need to consider carefully-ly how much more expensive this product type is and how these costs can be “passed”

on to the consumer. Aday et. al. (2015) conducted a questionnaire survey that mapped consumer perceptions of smart packaging. Most customers would accept a 10 percent price increase for smart packaging solutions after seeing the positive effects of innovative packaging.

5. Summary

Increasing consumer income through age and socio-economic changes contribute to new food demands (based on Jensen, 2006). In addition, changes in retail operations (market globalization) and lifestyle (spending less time shopping and cooking) have also created new requirements for food packaging (based on Restuccia et al., 2010). Therefore, consumers express increasing preferences for fresh, comfortable and natural products (without preservatives) and healthy foods with longer shelf life (Zink, 1997). We can expect that the use of new technologies and new materials in packaging will continue and even accelerate in the future. We can count on the diffusion of smart packaging not only for food, but also for other products. At the same time, we see that the adoption of smart solutions is particularly high by the food sector.

Today we know, that Packaging 4.0 is an added value option. According to the research by Smithers Pira: “The combined market¹¹ is expected to grow at an annual average of 5.9%, reaching \$7.56 billion by 2023.”¹² What can be expected in the future? On one hand, there is a continuing trend to fit the packaging exactly to the size of the product, thereby reducing both waste and costs. It is important to eliminate large, heavy, unnecessary packaging in the field of packaging design. On the other hand, smart packaging seems to be spreading in the future. It is particularly important that smart solutions should meet with the requirements of sustainability and environmental friendliness. It should also be noted that not all „smart appearing” solutions meet with all the conditions. That is why it is important to carefully estimate and calculate every level, before introducing new packaging solutions

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[12.] Source: <https://www.smitherspira.com/industry-market-reports/packaging/active-intelligent-packaging-to-2023>

Jegyzetek

[1.] Based on Tiefbrunner 2010/17-18. page

[2.] It is mentioned here that we even meet the economic function that clarifies „packing is a profitable cost factor”. (Dörnyei (2019/13)

[3.] Based on Tiefbrunner 2010/17-18. page

[4.] Information on this area can be found at the following pages: <http://hamzhang.blogspot.com/2009/03/packaging-history.html>
https://www.google.hu/search?q=csomagol%C3%A1s+t%C3%B6rt%C3%A9net&client=firefox-b&source=lnms&tbm=isch&sa=X&ved=0ahUKEwj_g9Kczf3SAhUEM5oKHZX-8BWUQ_AUICcB&biw=1280&bih=643#imgrc=BwiUn8c83b6IFM

[5.] <https://hu.lush.com/article/csomagolas-tortenete>

[6.] <https://www.cimkeplaza.hu/blog/csomagoloanyagok-tortenete-ahogy-kezdozott/>

[7.] Source: based on https://ec.europa.eu/commission/presscorner/detail/hu/MEMO_16_3989

[8.] The implementation of blockchain technology has a big future ahead, for example, „it allows a more reliable blockchain-based forwarding, foreign trade transactions and lower transaction costs.” <http://bertazsolt.com/mire-jo-blockchain-technologia/>

[9.] Dudás (2012/ 180-194) also investigates this issue.

[10.] It is noted that the role of „on the go” packaging is increasing. „A busy lifestyle reduces the size of packaging in the FMCG market, but the growth in single-person households, aging populations (lighter packaging, pharmaceuticals and dietary supplements) and even growing populations in developing societies also contribute to single-dose packaging ...” Source: https://issuu.com/termekmixmag/docs/termekmix_2017_junius

Az új ellátási lánc koncepciók gazdasági hatásai - a rugalmasság, mint sikertényező

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Absztrakt

Napjainkban a növekvő globális verseny, az egyre egyedibb és gyorsan változó vevői igények következtében jelentős változások következtek be a gyártási szektorban és az ellátási láncok kialakításánál is. Az eltérő vevői igények következtében egyre összetettebb és egyedibb, magasabb minőségű, testreszabható és rövidebb életciklusú késztermékek gyártására van szükség, amely innovatív és rugalmas gyártási technológiákat igényel. Az alkalmazott gyártási koncepciók meghatározzák az ellátási láncok jellemzőit. Így a különböző jellegű vevői igények kielégítésére három új ellátási lánc koncepció jött létre: 1.) a Lean, 2.) az Agilis és 3.) a Hibrid ellátási láncok. A különböző ellátási lánc koncepciók pedig eltérő gyártási rendszereket alkalmaznak. A cikkben bemutatásra és összehasonlításra kerülnek a Push és a Pull termelési filozófiák, az új típusú ellátási lánc koncepciók, valamint a láncokhoz kapcsolódó gyártási rendszerek is. Ezen gyártási rendszereknek 3 típusa van: 1.) a dedikált gyártási rendszer, 2.) a rugalmas gyártási rendszer és 3.) az újrakonfigurálható gyártási rendszer. Továbbá elemezzük a változó vevői és piaci igényekhez való rugalmas alkalmazkodási képesség tartalmát, amely az ellátási láncok és azok tagvállalatainak is a kulcs-sikertényezője.

Keywords:

Ellátási lánc koncepciók, gyártási rendszer, rugalmasság

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1. Globális tendenciák a gyártási szektorban és az ellátási láncok kialakításánál

A globalizáció, a gyorsan változó gazdasági környezet, a növekvő piaci verseny, az egyre nagyobb méretű ellátási láncok és a gyorsan változó vevői igények következtében a termelő és a szolgáltató vállalatok egyre nagyobb hangsúlyt fektetnek hatékonyságuk növelésére, költségeik csökkentésére és tevékenységeik optimalizálására versenyképességük megőrzése és növelése érdekében [1].

A fent említett változások következtében a gyártási szektorban is jelentős változások következtek be. A gyártási filozófiák pedig alapvetően meghatározzák a globális ellátási láncok kialakítását és jellemzőit [2-4]. Ezen változások közül a legfontosabbak a következők:

- A vevők igényei egyre egyedibbé váltak, magas minőségű, testreszabható és kedvező költségű késztermékeket igényelnek.
- A globális piaci versenynek, valamint az egyre gyorsan

sabban változó és egyre egyedibb vevői igényeknek köszönhetően a „Nyomó” („Push” – „készletre gyártás”) termelési filozófiát felváltotta a sokkal gazdaságosabb és hatékonyabb „Húzó” („Pull” – „vevői rendelésre gyártás”) termelési filozófia. A „Pull elvű” gyártás előnye, hogy a termelés csak akkor kezdődik el, amikor a konkrét vevői igények részletes késztermék-specifikációval megjelennek, így nem keletkeznek eladhatatlan készletek. Napjainkban pedig már az Ipar 4.0 koncepció elemei is bevezetésre kerültek számos vállalatnál.

- A termelési filozófiák hatással vannak az ellátási láncok kialakítására is. A fenti változások eredményeként az értékteremtő láncok globalizálódtak, a globális ellátási láncok egyre nagyobb méretű és egyre komplexebb hálózatokká váltak, a vállalatok közötti együttműködés dinamizálódott.
- A globális ellátási láncok versenyképességének feltétele a vevői követelmények megértése, és minél magasabb színvonalon való kielégítése, valamint a piaci igények várható változásához való alkalmazkodási képesség javítása. Az ellátási láncok kialakí-

tásánál fontos szemponttá válik a minél kisebb számú, azonban stratégiai partnerekből álló beszállítói hálózat kialakítása.

- Az egyes láncok versenyképessége a partnerek kompetenciáinak minél jobb kihasználásából és szinergiájából adódik. A globális piacon azonban az ellátási láncok is versenyeznek egymással a vevői igények minél magasabb színvonalú kielégítése érdekében.
- A vevők a késztermékek megvásárlásával egyben a terméket előállító ellátási láncok közül is választanak számos szempont alapján. A legfőbb döntési szempontok a következők: a termék költsége, átfutási ideje, minősége, testreszabhatósága, valamint a termékhez kapcsolódó szolgáltatások színvonala.
- Nem csak az egyes ellátási lánc tagvállalatainál, hanem a teljes globális ellátási láncban is csökkenteni kell a készleteket, mivel ez költségmegtakarítást eredményez.
- Az ellátási láncok és azok vállalatai versenyképességének megőrzése érdekében – a hagyományos ellátási láncok mellett – új típusú ellátási lánc koncepciók kerültek bevezetésre a különböző jellegű vevői igények kielégítésére: 1.) a Lean (Karc sú), 2.) az Agilis (Agile) és ezek kombinációja a 3.) Hibrid (Leagile) ellátási láncok.
- A vállalatok között új szervezeti és együttműködési formák alakultak ki. A hagyományos és a Lean ellátási láncokkal ellentétben az Agilis ellátási lánc

tagjai az együttműködés dinamikus formájában, a Virtuális Vállalat (VV), mint speciális ellátási lánc hálózat keretében működnek együtt.

- A gyártásban az erőforrások (gépek, eszközök, emberek, nyersanyagok, energia, stb.) korlátozottak. Azonban a népesség és a lakossági fogyasztás is folyamatosan nő, továbbá a környezetkárosítás is globális problémává vált. Ezért az erőforrások felhasználásának jelenlegi gyakorlata nem fenntartható.
- A gyártó vállalatoknak költséghatékony és magas minőségű termékeket kell gyártaniuk, amely csak az erőforrások maximális kihasználásával és minimalizált gyártási költséggel valósítható meg.
- A gyártó rendszereknek egyre komplexebbeknek és rugalmasabbaknak kell lenniük azért, hogy eredményesen tudjanak reagálni az egyre gyorsabban változó vevői igényekre és gazdasági környezetre.
- Napjainkra a környezetszennyezés és a fenntarthatóság is globális problémává vált. Ezért a vállalatoknak nem csak a költséghatékony és profitábilis működésüket, hanem egyúttal a környezetbarát és hosszútávon fenntartható gyártási rendszert is biztosítaniuk kell.
- A termelő vállalatoknak – a fenti okok miatt – egyrészt nagy hangsúlyt kell fektetni hatékonyságuk javítására, költségeik csökkentésére, energia- és anyaghatékony késztermékek előállítására versenyképességük megőrzése érdekében.
- Másrészt a vállalatoknak a megújuló erőforrások

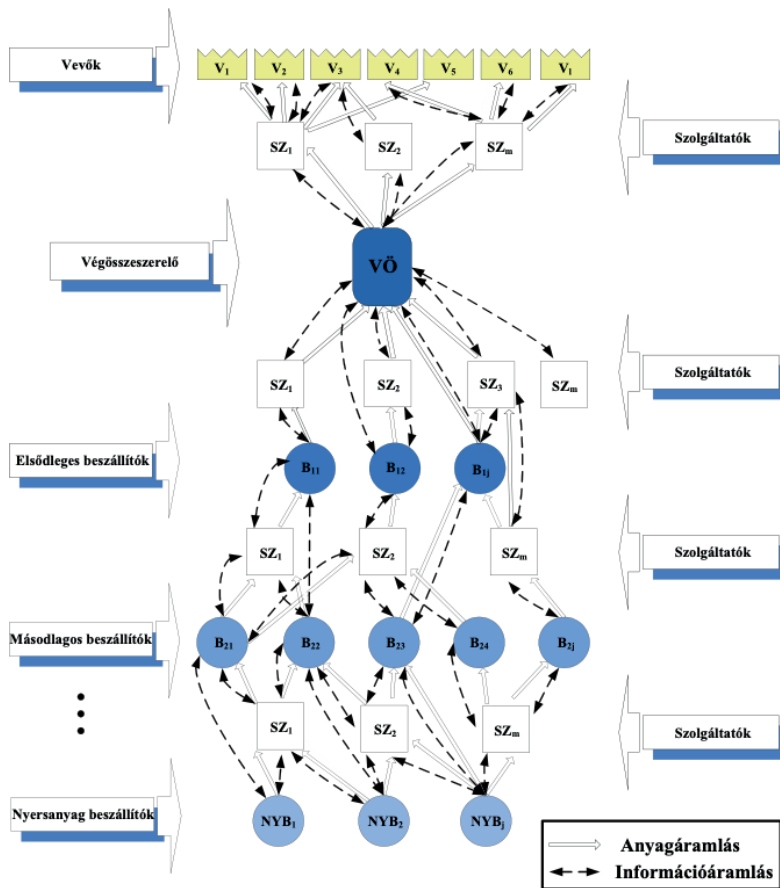
PUSH FILOZÓFIA

- ▶ Nagy készletek halmozódnak fel.
- ▶ A készletek költsége jelentős.
- ▶ Hosszú a teljes átfutási idő.
- ▶ A veszteségek rejtve maradnak a nagy készletek miatt.
- ▶ A veszteség helyek nem beazonosíthatók.
- ▶ Nincs motiváció a javításra, fejlődésre.
- ▶ Szériaváltásnál nagy műveletközi készletek vannak, amik kezelése is jelentős költséget és időt igényel.
- ▶ A termeléshez és egyéb tevékenységekhez nagyobb alapterület szükséges.
- ▶ Az erőforrások kihasználtsága alacsony.
- ▶ A gyártási folyamat nem működtethető költséghatékonyan.

PULL FILOZÓFIA

- ▶ Kiseb b készletek halmozódnak fel.
- ▶ A készletek költsége minimalizálható.
- ▶ Rövid a teljes átfutási idő.
- ▶ A folyamatokban a veszteségek könnyen fellelhetők a kisebb készleteknek köszönhetően.
- ▶ Motiváció van a javításra és a fejlődésre, mivel a változtatások hatása azonnal tapasztalható.
- ▶ A szériaváltás gyorsan megvalósítható.
- ▶ A termeléshez és egyéb tevékenységekhez kisebb alapterület szükséges.
- ▶ Az erőforrások kihasználtsága kedvezőbb.
- ▶ Produktív és költséghatékony termelés valósítható meg.

1. táblázat. A Push és a Pull filozófiák jellemzőinek összehasonlítása
Forrás: [saját]



1. ábra. A globális ellátási lánc tagvállalatai. Forrás: [saját]

egyre nagyobb mértékű felhasználásával, innovatív, környezetbarát technológiák és hatékonyságjavító módszerek alkalmazásával, valamint a globális ellátási láncok optimális és fenntartható működtetésével biztosítani kell a fenntartható gyártást is.

2. A termelési filozófiákban bekövetkezett változások

A vevői igények alapvetően meghatározzák az alkalmazott termelési filozófiát, amelyek pedig az ellátási láncok kialakítására vannak hatással.

A gyorsan változó piaci környezetnek, a globalizációnak és az egyre gyorsabban változó vevői igényeknek köszönhetően új termelési filozófiák alkalmazása vált szükségessé. A hagyományos tömegtermelést, a „Nyomó” („Push”-„készletre gyártás”) elvű termelési filozófiát felváltotta a sokkal gazdaságosabb „Húzó” („Pull”-„vevői rendelésre gyártás”) elvű termelési filozófia [1].

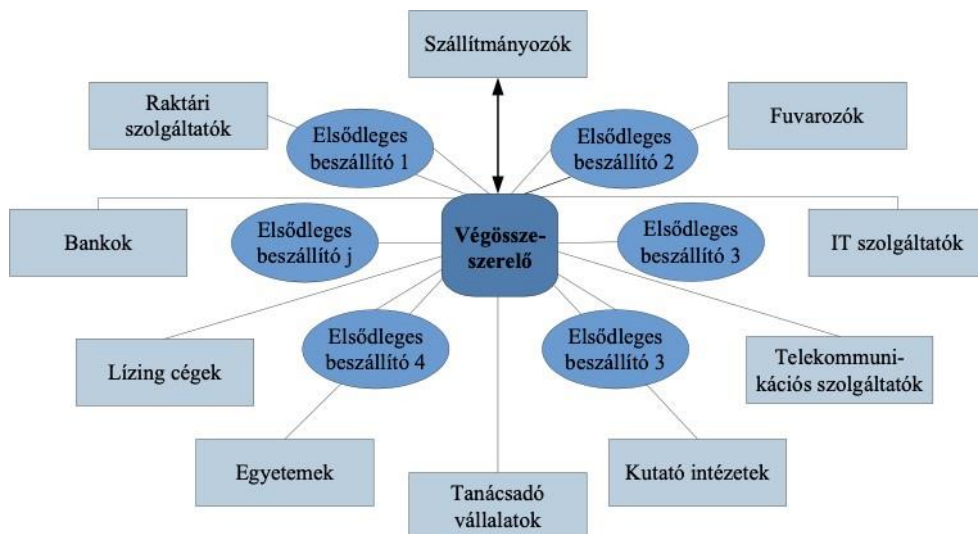
2.1 A Push filozófia jellemzői és gazdasági hatásai

A Push filozófia esetén prognosztizált adatok (nem va-

lós vevői igények) alapján történik a gyártás tervezése, így a gyártás eredményeként nagy és sokszor eladhatatlan készletek, veszteségek keletkeznek.

Sok termék esetén a jövőbeni vevői igények pontosan nem határozhatók meg, így a termelés tervezése csak a vevői előrejelzésekre alapozható. Ilyen esetekben az előrejelzett megrendelések és a prognosztizált adatok alapján értékesítési terv készül. Az értékesítési előrejelzések alapján – figyelembe véve a meglévő készleteket – megrendelésre kerül a termeléshez szükséges nyersanyag, alapanyag és alkatrész. Az alapanyag beérkezésétől függően – figyelembe véve az értékesítési tervet – történik meg az alkatrészgyártás. A vásárolt alkatrészek beérkezésétől, illetve a legyártott alkatrészek elkészülésétől függően pedig sor kerül a végösszeszerelésre. A szerelést követően a késztermék a készáru-raktárba kerül, onnan pedig az értékesítési helyekre szállítják ki a termékeket, ahol a vevők megvásárolhatják azokat.

Alapvetően tehát az alapanyag- és alkatrészkészletek alulról nyomják fölfelé a termelési folyamatot. Ezen filozófia alapján történik – többek között – napjainkban is az élelmiszerek többségének gyártása, valamint a kisértékű kereskedelmi és ipari termékek (pl. vasaló, hajszárító, DVD, stb.) előállítás is.



2. ábra. Az ellátási lánc lehetséges szolgáltató tagvállalatai Forrás: [saját]

2 A Pull filozófia jellemzői és gazdasági hatásai

A Pull elvű gyártás esetén a termelés csak akkor kezdődik el, amikor a konkrét vevői igény részletes késztermék-specifikációval megjelenik. Csak ekkor indulnak el a tényleges gyártási vagy beszerzési folyamatok. Ez azt jelenti, hogy a termelési tevékenységek beindítását (beszállítás, gyártás) mindig a jelentkező konkrét vevői igény váltja ki, a vevő mintegy „húzza” maga után az előtte lévő folyamatot. Így ez a termelési koncepció sokkal hatékonyabb és gazdaságosabb, mint a Push elvű gyártás.

Ezen filozófia alapján történik jellemzően a nagyértékű vagy az egyedi termékek gyártása (pl. a nagyértékű elektronikai termékek, személygépkocsi, hajó, stb.).

3. Az új típusú ellátási lánc koncepciók és gazdasági hatásai

3.1 A globális ellátási láncok általános jellemzői

Az ellátási lánc a lánc tagjainak (a termelő vállalatok: a végösszeszerelő és a beszállítók; a szolgáltatók és a vevők) hálózata, továbbá különböző alapanyagokból késztermékek előállításának és ezen késztermékeknek a vevőkhöz való eljuttatásának a folyamata. Az ellátási láncban folyamatos anyag- és információáramlás valósul meg, a tagok értékteremtő tevékenységeket folytatnak versenyképességük növelése és a maximális vevői elégedettség elérése érdekében.

A globális ellátási lánc olyan lánc, amelynek tagja különböző országok területén található.

Az ellátási lánc menedzsment feladata az ellátási lánc elemeinek integrálása annak érdekében, hogy minimalizálja a teljes ellátási lánc, mint rendszer teljes költségét az elvárt gyártási és szolgáltatási színvonal fenntartása mellett.

A globális ellátási lánc tagjai (1. ábra):

1. a gyártó vállalatok:
 - a. a végösszeszerelő és
 - b. a beszállítók (elsődleges, másodlagos, stb.),
2. a szolgáltatók:
 - a. a szállítványozók, a fuvarozók;
 - b. a bérraktározók;
 - c. az IT szolgáltatók, a telekommunikációs szolgáltatók;
 - d. a K+F szolgáltatók (tanácsadók, kutató intézetek, egyetemek) és
 - e. a pénzügyi szolgáltatók (bankok, lízing cégek, stb.) (2. ábra).

3.2 Az új típusú ellátási láncok gazdasági jellemzői

A logisztika legfőbb feladata a maximális vevői elégedettség elérése. Napjainkban a vevői igények egyre gyorsabban változnak, és egyre egyedibbnek lesznek. A különböző típusú ellátási láncok más-más jellegű vevői igényeket elégítenek ki [5-6].

Az ellátási láncok és azok vállalatai versenyképességének megőrzése érdekében új ellátási lánc koncepciók kerültek bevezetésre [7, 8]: 1.) a Lean, 2.) az Agilis, illetve ezek kombinációja a 3.) Hibrid ellátási láncok.

1.) A LEAN ELLÁTÁSI LÁNC (Lean Supply Chain)

A Lean vagy Karcsú ellátási lánc alkalmazásának el-

	Lean Ellátási Lánc	Agilis Ellátási Lánc	Hibrid Ellátási Lánc
Célja:	<ul style="list-style-type: none"> Veszteségek és a nem értékteremtő tevékenységek kiküszöbölése. Költségek csökkentése. A folyamatok állandó javítása. 	<ul style="list-style-type: none"> Rugalmas és gyors alkalmazkodás a változó vevői és piaci igényekhez. 	<ul style="list-style-type: none"> A gyártás során a Lean filozófiát alkalmazza. Azonban a lánc tagjai Virtuális Vállalat keretében működnek együtt.
Késztermékek jellemzői:	<ul style="list-style-type: none"> általános használati termékek kis termékválaszték nagy volumenben viszonylag hosszú termék-életciklus (több, mint 1-2 év) 	<ul style="list-style-type: none"> innovatív, egyedi vagy szezonális termékek (informatikai, elektronikai, divatcikkek) nagyobb termék-variáció kis volumenben rövid termék-élet-ciklus (max. 1 év) 	<ul style="list-style-type: none"> innovatív, még egyedibb termékek még testreszabottabb termék-portfólió kis volumenben rövid termék-életciklus (max. 1 év)
A tagok együttműködési formája:	<ul style="list-style-type: none"> hagyományos hálózati szervezeti formában 	<ul style="list-style-type: none"> Virtuális Vállalat keretében 	<ul style="list-style-type: none"> Virtuális Vállalat keretében
Vevői igények:	<ul style="list-style-type: none"> előrejelezhető 	<ul style="list-style-type: none"> változékony 	<ul style="list-style-type: none"> változékony, nem előrejelezhető
Vevői kereslet fő szempontja:	<ul style="list-style-type: none"> alacsony költség 	<ul style="list-style-type: none"> rövid átfutási idő 	<ul style="list-style-type: none"> magas szolgáltatási színvonal
Profit:	<ul style="list-style-type: none"> alacsony 	<ul style="list-style-type: none"> magas 	<ul style="list-style-type: none"> közepes
Fő költség:	<ul style="list-style-type: none"> anyagáramlási költség 	<ul style="list-style-type: none"> marketing költség 	<ul style="list-style-type: none"> anyagáramlási és marketing költség
Veszteségek kiküszöbölése	<ul style="list-style-type: none"> elengedhetetlen 	<ul style="list-style-type: none"> ajánlott 	<ul style="list-style-type: none"> tetszőleges
Gyors alkalmazkodás	<ul style="list-style-type: none"> ajánlott 	<ul style="list-style-type: none"> elengedhetetlen 	<ul style="list-style-type: none"> elengedhetetlen

2. táblázat. Lean, Agilis és Hibrid ellátási láncok összehasonlítása Forrás: [saját]

sődleges célja a veszteségek csökkentése az egyes tagvállalatoknál és a teljes ellátási láncban, vagyis a nem értékteremtő folyamatok kiküszöbölése, továbbá a folyamatok állandó javítása és optimalítása. A Lean ellátási lánc szereplőinek többsége a Lean termelési filozófiát alkalmazza.

- A Lean ellátási láncok alkalmazásával a hagyományos ellátási láncokhoz képest kisebb volumenű, egyedibb, gazdaságosabb gyártás valósítható meg.
- Ezen stratégia jellemzője, hogy főként a relatív hosszú élettartamú (1-2 évnél hosszabb) termékek előállításánál alkalmazható.
- A lánc szereplői – ellentétben az Agilis ellátási láncal – hagyományos hálózatszerűen működő szervezeti formában – nem Virtuális Vállalatként – működnek együtt. Jelenleg a vállalatok egyre nagyobb része használja ezt a gyártási koncepciót.

2.) AZ AGILIS ELLÁTÁSI LÁNC (Agile Supply Chain)

Az agilitás („mozgékonyosság”) a késztermék-előállító vállalat és a vevői piac közötti kapcsolatra vonatkozik, vagyis hogy a vevői igények változására mennyire rugal-

masan tud válaszolni az ellátási lánc. Az Agilis ellátási lánc versenyképességét és profitját a lánc piaci kihívásokra való minél gyorsabb reagálási képessége jelenti.

- A gyártott termékek egyre inkább a vevői igényekre testreszabottak, vagyis egyre egyedibbek, mely egyedi termékeket egyre kisebb darabszámban, egyre rövidebb átfutási idővel és egyre kisebb költséggel kell gyártani.
- Ezen stratégia jellemzője, hogy jellemzően a rövid életciklusú (maximum 1 év) innovatív termékek előállításánál alkalmazzák.
- A hagyományos és a Lean ellátási láncokhoz képest az Agilis ellátási lánc szereplői az együttműködés dinamikus formájában, a Virtuális Vállalati (VV) hálózatok keretében működnek együtt, mely a dinamikus változó vevői igények minél gyorsabb kielégítését szolgálja. Tehát a VV az Agilis ellátási láncok jellegzetes szervezeti formája. [9, 10]
- A VV fogalmára számos definíció létezik. Ezek közül az egyik legpontosabb meghatározás a következő: a Virtuális Vállalat olyan jogilag független vállalatok rövid időintervallumra kötött ideiglenes együttműködése piaci termékek fejlesztése és

gyártása érdekében, melyben a VV tagvállalatai megosztják szaktudásukat, fő kompetenciáikat, erőforrásait az új üzleti lehetőségekre való minél gyorsabb és sikeresebb reagálás érdekében. Ugyanakkor a VV tagjai a kockázatokat és a veszteségeket is megosztják tevékenységük során. A partnerek együttműködése számítógépes hálózaton, információs és kommunikációs technológián (ICT) alapul.

3.) A HIBRID ELLÁTÁSI LÁNC (Hibryd/Leagile Supply Chain)

A Hibrid (Leagile) ellátási lánc a Lean és az Agilis ellátási láncok kombinációja, amely ötvözi a fent említett két koncepció előnyeit. Ugyanis ezen stratégia jellemzője, hogy a lánc termelő vállalatai a gyártás során a Lean módszereket alkalmazzák, azonban a vállalatok a dinamikusan változó vevői igények kielégítése érdekében Virtuális Vállalati formában működnek együtt.

- Ez a stratégia jellemzően a „rendelésre összeszerelt” termékek gyártása esetén alkalmazott, ahol a vevői előrejelzések már viszonylag pontosak, és innovatív alkatrészek alkalmazásával a késztermékek egyedisége és színvonala növelhető.
- A Hibrid ellátási lánc alkalmazása egy széles, testreszabott késztermék-portfólió megvalósítását teszi lehetővé.

3 A Lean, az Agilis és a Hibrid ellátási láncok jellemzőinek összehasonlítása

A 2. táblázat a Lean, az Agilis és a Hibrid ellátási láncok jellemzőinek összehasonlítását mutatja be.

4. A rugalmasság, mint az ellátási láncok és a gyártórendszerek kulcsjellemzője a szakirodalomban

A rugalmasság a változó vevői igényekhez és a változó piaci körülményekhez való rugalmas alkalmazkodási képességet jelenti. A globális ellátási láncok és a gyártó vállalatok sikerének kulcsa a piaci igények változásaihoz való minél gyorsabb alkalmazkodási képesség, amely biztosítja a láncok és a vállalatok versenyképességét.

Az egyes ellátási lánc koncepciók eltérő rugalmassággal rendelkeznek. A vállalatok reagálási képessége és rugalmassága kulcsfontosságú jellemzővé vált a profitabilitásuk szempontjából. Az ellátási láncok alkalmazkodási képessége a gyorsan változó piaci igényekhez elengedhetetlen a versenyképességük fenntartásához vagy növeléséhez.

A rugalmasság/érzékenység általában úgy határozható meg, hogy a teljes ellátási lánc tagvállalatainál alkalma-

zott gyártási rendszer milyen mértékben képes alkalmazkodni a vevői igények ingadozásaihoz, mint például a gyártási volumen vagy a késztermék-variációk számának változásaihoz. A rugalmasság átalakíthatóságot és átméretezhetőséget is jelent. Ez egy olyan mérőszám, amely különféle típusú rendszerekre egyaránt alkalmazható, és azt mutatja, hogy a rendszer hogyan képes reagálni a változásokra [11, 12]. Ha egy rendszer rugalmassági mutatója nagyobb, ez azt jelenti, hogy sokkal könnyebben reagál a környezeti változásokra.

A rugalmassági feltételek tartalmára vonatkozóan a szakirodalomban különböző értelmezések találhatók. Oke például négy fő mutatót definiált, amelyek a gyártási volumen, a gyártási rendszer, a termékvariációk és a kiszállítás rugalmassági mutatói [13]. Vokurka és O’Leary-Kelly a gyártás rugalmassági paramétereinek 15 dimenzióját határozták meg [14]. Chan és szerzőtársai [12] a következő rugalmassági mutatókat fogalmazták meg: gyártási rugalmasság, stratégiai rugalmasság, erőforrás rugalmasság, koordinációs rugalmasság, termékválaszték rugalmasság és reagálási rugalmasság. Néhány szerző számos további rugalmasságot is definiált, például Naim [11] vizsgálta a szállítási rugalmasságot, Zhang [15] pedig a logisztikai rugalmasságot is, mint a vevői elégedettség egyik szintén fontos tényezőjét.

Naim az egyik olyan szerző, aki talán a legrészletesebben foglalkozott a rugalmasság tartalmával. Naim a rugalmasság két fő kategóriáját definiálta: a belső és a külső rugalmasságot. A belső rugalmasság leírja a rendszer viselkedését, míg a külső rugalmasság befolyásolja a vállalat teljesítményét. Naim szerint a gép és a folyamat rugalmassága azt a képességet jelenti, hogy a termelés változtatása mennyire nehézkes. A működési rugalmasság pedig az a képesség, hogy miként lehet gyártási szekvenciákat kialakítani a termelésben. A szerző szerint a kapacitás rugalmassága azt jelenti, hogy milyen gyorsan tud a vállalat reagálni a termelési kapacitás változására. A gyártási sorrend rugalmassága pedig a termelési folyamat azon képessége, hogy sztochasztikus üzemzavarok-

Ellátási lánc koncepció	Alkalmazott gyártórendszerek
1.) Hagyományos ellátási láncok	dedikált gyártórendszerek
2.) Lean ellátási láncok	dedikált gyártórendszerek / rugalmas gyártórendszerek
3.) Agilis ellátási láncok	rugalmas gyártórendszerek
4.) Hibrid ellátási láncok	újrakonfigurálható gyártórendszerek

3. táblázat. Az ellátási láncok főbb típusai és a jellemzően alkalmazott gyártórendszerek

ra miként tud reagálni a rendszer [11]. Purvis a cikkében összefoglalta a leggyakrabban publikált rugalmassági paramétereket és azok csoportjait is. Továbbá Purvis a rugalmassági paraméterek kategorizálására egy új struktúrát is javasolt, mely szerint a

rugalmassági mutatók a következő két csoportba sorolhatók: a beszállítói és a beszerzési rugalmasságba [16]. A beszállítói rugalmasság hasonló a Naim által definiált belső rugalmassághoz, de magában foglalja még a raktározás és a szállítás rugalmasságát is. Purvis a beszerzési rugalmasságot külső tulajdonságként értelmezte, amely magában foglalja az ellátási hálózat rugalmasságát is.

5. A különböző ellátási lánc koncepciók és a gyártórendszerek közötti kapcsolat

A digitalizáció és a digitális vállalati technológiák elterjedésének köszönhetően napjainkban már lehetőség nyílik új gyártási rendszerek létrehozására vagy a már meglévő gyártási rendszerek fejlesztésére és optimalizálására is a vevői igények minél szélesebb körű kielégítése és a termelési logisztikai célok még hatékonyabb megvalósítása érdekében. Ezek a változások egyre inkább lehetővé teszik az egyedi vevői igények kielégítését, valamint az átfutási idők, a készletek és a költségek csökkentését is a gyártási folyamatokban.

A gyártórendszerek három fő kategóriába sorolhatók: 1.) a hagyományos dedikált gyártórendszerek, 2.) a rugalmas gyártórendszerek és 3.) az újrakonfigurálható gyártórendszerek [17-19].

Azok a vállalatok, amelyek hagyományos dedikált gyártórendszereket alkalmaznak, nem tudják kielégíteni a gyorsan változó vevői igényeket. Ez a rugalmas alkalmazkodási képesség növelése iránti igény ösztönözte a vállalatokat új gyártási technológiák kifejlesztésére. Ennek a folyamatnak az eredményeként új gyártási rendszerek kerültek kifejlesztésre és alkalmazásra. Ezen új rendszerek a rugalmas gyártórendszerek és az újrakonfigurálható gyártórendszerek. Ezek az új rendszerek sokkal jobban és gyorsabban tudnak reagálni az ellátási láncokban bekövetkező változásokra, illetve az esetlegesen előforduló problémákra.

Az ellátási láncok és az alkalmazott gyártórendszerek között szoros kapcsolat van. Az egyes ellátási lánc koncepciók esetén jellemzően alkalmazott gyártórendszereket a 3. táblázat foglalja össze.

Az ellátási láncok és az alkalmazott gyártórendszerek között tehát szoros kapcsolat van. A gyártórendszerek három fő kategóriájának jellemzői a következők:

- A dedikált gyártórendszereket (Dedicated Manufacturing Lines – DML) elsősorban a hagyományos tömegtermelés esetén a hagyományos ellátási láncokban alkalmazzák, ahol kis késztermék-variációt nagy volumenben kell előállítani.
- A rugalmas gyártórendszereket (Flexible Manufacturing Systems – FMS) közepes sorozatnagyságú termékportfólió gyártása esetén alkalmazzák, ahol

a késztermék-variáció ugyan már nagyobb, viszont a gyártási volumen kisebb, mint a dedikált gyártórendszereknél. A rugalmas gyártórendszer egyes gépei többféle és összetettebb műveletek elvégzésére alkalmasak, mint a dedikált gyártórendszer gépei. A dedikált gyártórendszereket általában a Lean elvű gyártásban alkalmazzák, míg a rugalmas gyártórendszereket többnyire az agilis ellátási láncokban.

- Az újrakonfigurálható gyártórendszer (Reconfigurable Manufacturing Systems – RMS) koncepciója egyesíti a dedikált gyártórendszerek és a rugalmas gyártórendszerek előnyeit. Az újrakonfigurálható gyártási rendszer legfontosabb jellemzője a nagyfokú rugalmasság és a rövid gyártási átfutási idő alacsony készletszint fenntartása mellett. Az újrakonfigurálható gyártórendszerek képesek gyorsan, egyszerűen és költséghatékonyan átállni új terméktípusok gyártására. Ez a gyártási rendszer a kis sorozatszámú egyedi gyártás megvalósítására a leginkább alkalmas, mely gyártási rendszert elsősorban a hibrid ellátási láncokban alkalmazzák.

6. Összefoglalás

A cikkben áttekintést adtunk a globalizáció, a növekvő piaci verseny és a gyorsan változó vevői igények hatására a gyártási szektorban és az ellátási láncok kialakításában bekövetkezett változásokról és globális tendenciákról. Mivel az alkalmazott gyártási koncepciók meghatározzák az ellátási láncok jellemzőit, bemutatásra és összehasonlításra kerültek – a Push és a Pull termelési filozófiák mellett – a különböző és egyre egyedibb vevői igények kielégítése érdekében létrejött új típusú ellátási lánc koncepciók (Lean, Agilis, Hibrid) is. Megállapítható, hogy napjainkban a vevők egyre inkább jó minőségű, még egyedibb és testreszabhatóbb késztermékeket igényelnek, ezért új, innovatív és rugalmas gyártási technológiákra van szükség. A különböző ellátási lánc koncepciók pedig eltérő gyártórendszereket (1.) a dedikált gyártórendszer, 2.) a rugalmas gyártórendszer és 3.) az újrakonfigurálható gyártórendszer] alkalmaznak, amelyek jellemzői szintén ismertetve lettek. Összegezhető, hogy az ellátási láncok és tagvállalataik versenyképessége és profitabilitása nagymértékben függ a változó vevői és piaci igényekhez való gyors és rugalmas alkalmazkodási képességtől, amely sokrétű kompetenciák meglétét igényli a vállalatok részéről.

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Nyomonkövetés és azonosítás a gyártási folyamatokban -esettanulmány

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Absztrakt

A nyomonkövetésnek és azonosításnak a logisztikában kiemelt szerepe van, hisz ez az alapja, hogy az anyag- és információáramlás meg tudjon valósulni. Ennek nem csak az ellátási lánc tagjai között van jelentősége, hanem a vállalat belső folyamataiban is. Jelen esettanulmányban egy egyedi gépgyártó vállalat belső folyamatait vizsgáltuk meg a nyomonkövethetőség szempontjából.

Keywords:

nyomonkövetés, azonosítás, gyártás, minőség

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1. Bevezetés

A vállalatok számára is kiemelt fontosságú a nyomonkövetés és azonosítás kérdése egyfelől a partnerekkel való együttműködés miatt, másfelől a belső folyamatok kialakítása végett. Ebben az esettanulmányban egy egyedi gépgyártó vállalat belső folyamatait és annak megoldási lehetőségeit vizsgáltuk fókuszban a nyomonkövetéssel, folyamat alapú megközelítéssel, figyelembe véve a minőségügyi rendszer követelményeit is. Meghatározásra kerültek az azonosítás illetve jelölés módjai és végrehajtói, a szükséges dokumentumok és a jelölések mikéntjei.

Tisztában vagyunk azzal, hogy az értékteremtő folyamatok és ezen belül a logisztikai működés és vállalati szükséglettervezés támogatását szolgáló információs rendszerek felépítése jól tükrözi a logisztikai folyamatok alapvető feladatstruktúráját. [1] Ugyanakkor az esettanulmány keretein belül a vállalat által alkalmazott információs rendszerrel külön nem foglalkozunk.

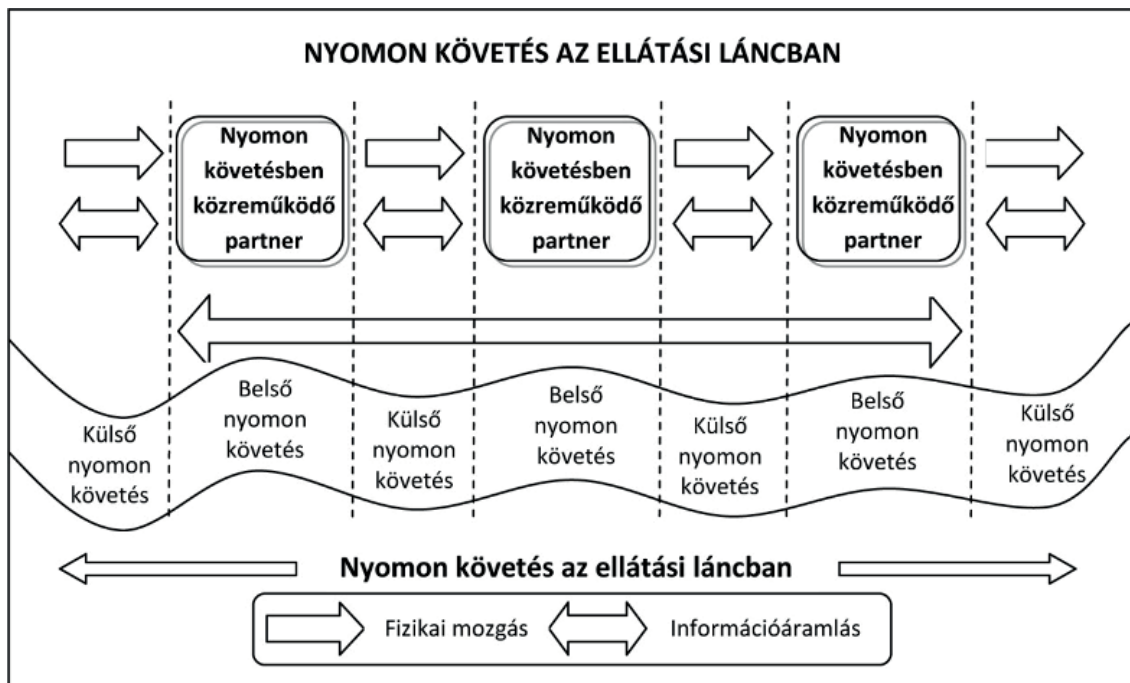
2. Az azonosítás és nyomonkövetés szerepe

Az ellátási láncban a nyomonkövethetőségnek a kezelése az információáramlás és a nyomon követhető áruk fizikai mozgásának összekapcsolását foglalja magába, mindenkinek a nyomonkövethetőség kezelésének alapvető,

közösen elfogadott lépéseit kell követnie. Ahhoz, hogy az ellátási láncban az áru nyomon követhető legyen, minden félnek belső és külső nyomon követhetőséggel kell rendelkeznie. [4] Kiemelten fontos az erőforrások nyomon követése és rögzítése: pontos és naprakész információk az ügyfelek megrendeléséről, emberekről, anyagról, felszerelésről, szerszámokról stb. [6]

Az információs folyamatok az anyagi folyamatokat kísérve biztosítják a tevékenységek lebonyolítását. Az információs folyamatok esetében egyfelől az anyagáramlással egy irányban is azonosíthatunk információáramlást, amely a már lezajlott vagy a jelenleg zajló tevékenységekre és azok következményeire vonatkozik, másfelől a fogyasztó irányából visszafelé haladva, például ilyenek a keresletre vonatkozó információk [7], ez utóbbival most mi nem foglalkozunk. A termelési logisztika keretében az egyik fő feladat az információáramlás megtervezése, ha ez megfelelő az segíti az anyagáramlási folyamatok lebonyolítását is. [3]

A mi esetünkben azt is figyelembe kellett venni, hogy a vizsgált vállalatnál műhelyszerű termelésről beszélhetünk, hiszen nagyon sokféle, általában testre szabott terméket állítanak elő kisebb, vagy esetleg egy termékből álló sorozatban. [5] Ebből kifolyólag a termékek és a műveletek állandóan változnak, sok esetben ritkán vagy csak egyszer gyártott sokféle termékről beszélhetünk, a feladatokat folyamatspecifikusan kell megközelíteni. [8] A műhelyrendszerben az azonos műveleteket végző



1. ábra: Nyomonkövetés az ellátási láncban [4]

gépeket egy műhelyben helyezik el. A termék az egyes műhelyek között, össze-vissza áramlik, ahogy a gyártás menete ezt megkívánja. [2] E gépelvű elrendezés miatt is kiemelten fontos az azonosítás és nyomonkövetés megfelelő kialakítása.

3. Nyomonkövethetőség a vállalatnál

A vállalat esetében is definiálnunk kell, hogy mit értünk nyomonkövetés alatt: azt a lehetőséget, hogy a regisztrált adatok alapján valamely termék, tevékenység stb. előtörténete, alkalmazása, helyzete kideríthető, valamint a korábban elvégzett műveletek, vizsgálatok, ellenőrzése és azok eredménye megállapítható.

3.1 A dokumentumok jelölése

A folyamatok szerint az alábbi dokumentumokat különböztetjük meg:

A fejlesztés dokumentumai

A gyártmányfejlesztés dokumentumainak jelölését a Műszaki osztály dolgozza ki és a műszaki igazgató hagyja jóvá. A dokumentumok jelölése a rajzszámmal és annak időszerű változási számával történik.

A kereskedelem dokumentumai

Az ajánlatkészítés, a megrendelések feldolgozási folyamatának, és a kiszállítás dokumentumainak jelölését a Kereskedelmi osztály dolgozza ki, és a kereskedelmi igazgató hagyja jóvá. A csomagolás dokumentumai-

nak jelölését a témafelelős üzem végzi. A Kereskedelmi osztály minden vevőt vevőszámmal lát el. A vevőszám illetve a szerződésszám alapján történik a rendelések feldolgozása. A vevőszám és a szerződésszám összerendelt. Az anyaggazdálkodás dokumentumai

A körülmények figyelembevételével biztosítani kell, hogy a beszállító a termékét azonosító jelzéssel lássa el. Ha ez nem lehetséges, az idegenáruellenőrzés folyamatában történjen meg az azonosító jelzéssel való ellátás. Ezt az anyag dokumentumain is fel kell tüntetni. A szállítók azonosítására a szállító neve és a Kereskedelmi osztályon meghatározott vevőszáma szolgál.

A beszerzési dokumentumok azonosítása az anyag nyilvántartási száma és a szállító száma, valamint a gyártási tételszám alapján történik. Raktározásra, felhasználásra beszállított termék dokumentált azonosító jelzés nélkül nem kerülhet.

A műszaki gyártáselőkészítés dokumentumai

A gyártóeszköz szerkesztésének folyamatában az eszközzel készítendő termék rajzszámát és az eszköz nyilvántartási számát együtt alkalmazzák. Az azonosító számokat a Rajzszámos gyártóeszköz nyilvántartáson, és a gyártóeszközön is feltüntetik.

A gyártás dokumentumai

Jellemző gyártási dokumentációk: darabjegyzékek; jellegrajzok, összeállítási rajzok, részletrajzok, alkatrészrajzok; műveleti, technológiai és vizsgálati utasítások; szükségleti jegyzékek (pl.: készülék); anyagutalványok.

A gyártás számára szükséges dokumentumok jelölése az alábbiak szerint történik:

Alkalmazási terület	A jelölés módjának meghatározója	A jelölés végrehajtója
Fejlesztés	műszaki igazgató	Műszaki osztály
Kereskedelem	kereskedelmi osztályv.	Kereskedelmi osztály
Anyaggazdálkodás	kereskedelmi osztályv.	Kereskedelmi osztály
Anyagbeszerzés/Raktározás	gazdasági igazgató	Gazdasági osztály
Értékesítés	kereskedelmi osztályv.	Kereskedelmi osztály
Termelés	termelési igazgató	Témafelelős üzem
Minőségügy	minőségügyi vezető	Minőségügyi osztály Témafelelős üzem

1. táblázat: A dokumentumok jelölése

- a dokumentum megnevezése
- érvényességi ideje
- az előállítás ideje
- a munkautasítás gyártási tételszáma
- munkaszám
- szériaszám.

Munkaszámot a Kereskedelmi osztály, szériaszámot a témafelelős üzem ad kidolgozott eljárási rend alapján. A gyártás során a fő dokumentum a Gyártáskísérő lap, amely a gyártási fázisnak, az ellenőrzés megtörténtének, az ellenőrzés eredményének azonosítására szolgál. A művezetők biztosítani kötelesek, hogy adott munkafázisokban az előírt jelölés és a Gyártáskísérő lapon történő dokumentálás megtörténjen, továbbá nemmegfelelőség jelzése esetén a termék a következő megmunkálási fázisba ne jusson.

A minőségügy dokumentumai

A minőségügy dokumentumainak jelölése az alábbiakat tartalmazza:

- a dokumentum megnevezése,
- előállítási ideje.

Egy termékhez az anyag hozzárendelése az anyagjelzés alapján történik. Az alkatrészek és részegységek azonosításának a rajzsám és a technológus által megadott gyártási tételszám az alapja. A gyártásközi és a végellenőrzés időpontját, eredményét és az ellenőrzést végző személy nevét a Gyártáskísérő lapon fel kell tüntetni. A késztermék raktározása, kiszállítása csak pozitív eredménnyel járt, bizonylatolt, jelöléssel ellátott végellenőrzést követően történhet meg.

2 Termékjelölés

Itt az alábbi folyamatokat különíthetjük el:
Termékjelölés a fejlesztés területén

A termékek azonosítása a rajzsám és a technológus által megadott gyártási tételszám szerint történik.

Termékjelölés az anyagátvétel területén

Átvételkor a szállító jelölését meg kell tartani. A raktár anyagszámot ad, melyet a műszaki ellenőrzés után adott esetben az anyag függőcímkéjére is felvezet. A követelményeknek nem megfelelő anyagot — lehetőleg sárga színt alkalmazva — „ZÁROLVA” jelöléssel kell ellátni.

Termékjelölés az idegenáru-ellenőrzés során

Az anyagok csak az idegenáru-ellenőrzés által megfelelőnek tartott mérési eredmény alapján kerülhetnek raktározásra. A követelményektől eltérő jellemzőkkel rendelkező anyagokat — lehetőleg sárga színt alkalmazva — „ZÁROLVA” jelöléssel kell ellátni.

Idegenáru-ellenőrzés során az alábbi állapotok fordulhatnak elő: piros megjelölés: selejt; fehér megjelölés: vizsgált állapotot takar; jelöletlen anyag: vizsgálatra vár. Termékjelölés a gyártás folyamán

A gyártás során felhasználható anyagok anyagszámmal vannak ellátva. Az anyagszám alapján az anyagok jellemző tulajdonságai kikereshetők. A munkadarabok — amennyiben a megrendelőtől eltérően nem rendelkezik — a gyártás alapjául szolgáló rajzsámok, valamint a technológus által megadott gyártási tételszám szerint kerülnek megjelölésre. A megrendelő előírása esetén az általa igényelt jelölést kell alkalmazni. A termékek gyártása során a Gyártáskísérő lap biztosítja a munkadarabok nyomonkövethetőségét, amely az elvégzett munkafázisok, az ellenőrzések, az észlelt eltérések dokumentálását lehetővé teszi. A technológiai és ellenőrzési utasításoknak megfelelően az előírt munkafázisokban, üzemközi és üzemek közötti mozgás esetén a vizsgálati állapotot a terméken és a Gyártáskísérő lapon jelölni kell. A gyártás során a nem megfelelőnek ítélt munkadarabokat — lehetőleg sárga színt alkalmazva — „ZÁROLVA” jelöléssel kell ellátni. A selejtnek nyilvánított terméket piros, az utómunkálással megfelelővé alakítható munkadarabot sárga színű jelöléssel kell ellátni.

Alkalmazási terület	A jelölés módjának meghatározója	A jelölés végrehajtója
Fejlesztés	műszaki igazgató	Műszaki osztály Témafelelős üzem
Anyagbeszerzés/Raktározás	logisztikai vezető gazdasági vezető	Logisztika Gazdasági osztály
Idegenáru-ellenőrzés	minőségügyi vezető	Minőségügyi osztály
Termelés	termelési igazgató	Témafelelős üzem
Értékesítés	kereskedelmi osztályv.	Kereskedelmi osztály
Minőségvizsgálat	minőségügyi vezető	Minőségügyi osztály
Reklamáció-fogadás	minőségügyi vezető	Minőségügyi osztály

2. táblázat: A termékek jelölése

Termékjelölés a végáru-ellenőrzés során

A gyártás befejezése, a termék végáruellenőrzésre történő felajánlása után a végáruellenőrzési eljárások során megfelelőnek tartott termékeket tartalmazó gyűjtőcsomagolás zöld jelölést kap, mely a termék raktározását vagy kiszállítását lehetővé tevő jelzéseként kerül alkalmazásra. Amennyiben a Szerződés kiter a végáruellenőrzés jelzésére is, akkor a szerződésben foglaltaknak megfelelően kell eljárni.

Termékjelölés a raktározás folyamán

Minden késztermék vagy gyűjtőcsomagolás a raktározás folyamán az előző fázisban kapott jelölést viseli.

Termékjelölés a reklamációfogadás során

A vevők által visszaküldött vagy át nem vett termékek sárga jelölést kapnak, amely a vevő nevét, az anyag visszaküldésének (visszautasításának) okát, sorszámát, időpontját tartalmazza.

4. Összegzés

A nyomonkövetés és azonosítás kérdése a logisztika, így a termelési logisztika területén is kiemelt jelentőségű. Napjainkban az a vállalat amelyik meg akar felelni a vevői elvárásoknak és a piaci partnereknek, ezen a területen folyamatosan fejleszt. Ezek az elvárások a vállalatok belső folyamataira is igazak. Esettanulmányunkban egy egyedi gépgyártó vállalat nyomonkövethetőségi folyamatait vizsgáltuk meg, fókuszálva a vállalati anyag- és információáramlás fő kérdéseire.

A tanulmány az EFOP-3.6.1-16-2016-00015: A Pannon Egyetem átfogó intézményfejlesztése az intelligens szakosodás elősegítése érdekében pályázat keretében valósul meg.

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