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Chasing up the value-added by implementing newest trends of Industry 4.0 – Evidence from Slovak automotive industry

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Abstract

The main purpose of the paper is the identification of Industry 4.0 (I4) in a selected sector of the Slovak economy with emphasis on a single case study in the company PSA, which is a key player in the market in the analysed automotive sector.. In the paper, three research questions are determined together with the methods through which the analysis is carried out, mainly the method of exploration, explanation and description using the secondary data, financial and annual reports published by the PSA and Slovak authorities. The crucial finding of the paper is the presentation of opportunities for value-added growth and a specific case study of PSA Group Slovakia and its application of the Industry 4.0 concept as a driving force for value-added growth in car exports. Based on the research outputs, the proposals and recommendations are proposed as a series of steps and recommendations for the Slovak Republic with the intention of becoming an innovative country.

Keywords: Industry 4.0, globalization, value-added, global value chain, digitization, innovation, export, automotive industry.

Introduction

In January 2003, the Government of the Slovak Republic accepted the investment plan of the French automobile concern PSA Group (at that time the second-largest automobile producer in Europe) to build a new production plant in the Slovak Republic. According to PSA Group's strategic expansionist considerations, it was most advantageous to build a factory near new core markets closer to the centres of Central and Eastern Europe (CEE; as a fast-growing region with huge sales potential). At the time of the investment, the investors and experts analysed and presented the following circumstances leading to the decision to build a new production plant within CEE in Trnava, Slovakia (Tab. 1).

Tab. 1: Criteria for deciding on a new PSA Group site in CEE

Localization criteria officially published by the investor:	**Other factors** of the investor's decision-making - according to analysts:
• position in central Europe • building land with an area of 190 hectares, which is easily accessible by rail, highway, and navigable river • the possibility of creating a supply park near the plant • the industrial tradition of the region, and available workforce with a good level of education • proximity to important markets in which the PSA Group is expanding rapidly	• political stability • reform and integration-oriented government • government activity and involvement in the project • established and potential subcontracting base • quick access to the airport • proximity to Vienna, where the children of French managers can study in their mother tongue schools • plans of the Slovak school system to open French schools in Trnava as well • openness of universities in Trnava and Bratislava for cooperation with the investor • the potential to efficiently install and use the technical equipment of the plant • the potential to increase the added value of own car manufacturer

Source: Authors.

The Government of the Slovak Republic naturally agreed with this investment plan and provided several investment incentives. The rationale for supporting this project was primarily the benefit for public finances (taxes, levies, reduction of social expenditures), the growth of the volume of industrial production in the Slovak Republic, and the increase in overall economic growth (Stock et al., 2018). After the start of the operation, the volume of production was estimated at 100 billion SKK per year (approximately €3.32 billion). The value-added realized by the new investor was estimated for 2006 by government advisers at the level of 10 billion SKK (approximately €332 million) represented up to 1% of Slovak GDP at that time. Thanks to this investment and the creation of value-added within the new plant, Slovak GDP would grow by 1% in the future. The government's ambition was to increase the share of domestic suppliers to increase added value in exported cars. Another positive impact was employment growth (and a decrease in high unemployment at the time) and a positive impact of investment for the trade balance (export growth and a promising decline in imports due to greater involvement of Slovak suppliers).

This study aims to identify the available technological components and their potential use in the company PSA, which over time can bring the required increase in added value.

Based on the above mentioned and following the main aim of the paper, three research questions were formulated:

RQ1: Can the application of the Internet of things (IoT) and other components significantly change the nature of production and increase the quality of products, which will increase the required added value of the entire company?

RQ2: Is the application of these technological components necessary to maintain the current market position of the company?

RQ3: Do the technological components of Industry 4.0 affect the production and the added value of the products?

The paper is divided as follows: The first part of the paper presents a literature review, the content of which are the most relevant sources for the topics of the fourth-generation industry and added value. The next part depicts data and methods through which the analysis is carried out. The last section is devoted to the proposals and recommendations and contains a series of steps and recommendations for the Slovak Republic with the intention of becoming an innovative country.

Literature Research

There are currently many ways how to improve added value in any industry. This paper focuses mainly on the automotive industry, especially in Slovakia and in PSA Group SVK. At present, this sector is the strongest in Slovakia and brings the highest profit to the whole country. To properly understand the issue, it is necessary to state the basic theoretical background of these topics. As early as 1985, Mr. Porter characterized the basis for knowing value, understanding it as the amount the buyer pays for what goods or services a particular company provides. The term "global value chain" (GVC), has also been used this year. It has continued its research, essentially to the present day. Its main solution area focuses on the competitive position of companies and their mutual struggle for primacy. GVC means a set of activities that are gradually added to society and in which the value of products or services is gradually created (Porter, 1993). Slovak group of authors Balaz et al. (2020) emphasize the need and essentiality of scientific progress, which they consider to be one of the most important accelerators of the growth dynamics of international trade. Through the development of relevant technologies, the value chain can be virtualized, which will significantly reduce market entry barriers for more marginal service providers, in short outsourcing and offshoring (Martinez-Noya and Garcia-Canal, 2014). Zabojnik (2015) points to the history of globalization and presents two dimensions of its development as striking. These are, above all, tangible changes in the world of technology and a diversity of forms of social and economic understanding. Already in connection with Industry 4.0, Marcon (2016) describe all previous industrial revolutions and also mention their significant impact on globalization as such. The term Industry 4.0 was first used in the German city of Hanover in 2011 by Professor Kagermann and his team. It was used in conjunction with the strategic program for the development of advanced production systems. The goal was to increase the productivity and efficiency of the national industry (Kagermann and Wahlster, 2013). The fourth industrial revolution was launched based on the beginning of the use of the Internet in all available areas of industrial production, which allows different types of real-time communications such as machine-machine, man-machine and their combination. The driving force behind Industry 4.0 is the Internet and self-configurable networks, which can operate fully autonomously (Clayton and Kral, 2021). He also introduces the fourth industrial revolution as Internet technologies that are integrated into various branches of

industrial production. Hermann, Pentek and Otto (2015) point to the need for interconnection through information from both worlds, virtual and physical. The concept of digitization is a striking part of Industry 4.0, and it is used for horizontally integrated processes, which are indicated within values and their flow. This is the production and application of Industry 4.0 components, this interconnection means the term "digitization." According to Rüttimann and Stöckli (2016), it is important to present a significant increase in the need to implement technologies that are interconnected and thus achieve full connectivity. Durana, Perkins and Valaskova (2021) understands Industry 4.0 comprehensively, i.e., it takes into account the entire industry and its efforts to adapt to this phenomenon. Koderova (2016) presents Industry 4.0 as a transformation of production to fully automated. This is achieved by creating complex global networks, the essence of which is the interconnection of production facilities into cyber-physical systems CPS (Cyber-Physical Systems). Such systems are the basis for creating "smart factories" (Mehmann and Teuteberg, 2016). He also lists the potential positives and negatives of a given phenomenon, where the positive effects significantly predominate and its onset is necessary. The Ministry of Economy of the Slovak Republic also points to significant changes in the social spheres of society, especially in the ability to use the Internet correctly. Dalenogare et al. (2018) talk about the ability of data to create value and also points out the originality and important roles of individual technologies. They also point out the importance of developing the role of man in intelligent work. Digitization can also increase the efficiency of the value chain by reducing costs and creating more collaboration and innovation (Hoffmann, 2019). Hoffmann (2019) joins several authors, arguing that the rise of Industry 4.0 will not be a path of revolution, but of evolution. Minarik, Zabojnik and Pasztorova (2022) present Industry 4.0 on the concept of automation as a technological advance. Its flexibility will depend on the intent of politics, companies, education and a quality workforce in the field of innovation. Zavadska and Zavadsky (2020) emphasize the important role of corporate management in planning a business strategy in connection with digitization. Global developments in terms of Industry 4.0 can bring about a marked development of national economies and thus move the imaginary bar of innovation of these countries forward. The potential for the implication of Industry 4.0 in the Slovak Republic is measured through the DESI index, which is authored by the European Commission (2021). According to Said et al. (2021), industry 4.0 is largely dependent on the Internet of Things and smart sensors. Zhong et al. (2021) present a wide range of possibilities for quantification and processing of data in real-time through mathematical-optimization models, which are based on multicorrelation dependencies. In the current threat of the COVID-19 pandemic, Belhadi et al. (2021) cite cooperation between supply chain stakeholders as essential. It can then significantly overcome potential challenges and also speed up the use of digital technologies. The conclusions of the issue of digitization predict the importance of investing in the right measures to adapt to the overall digital revolution.

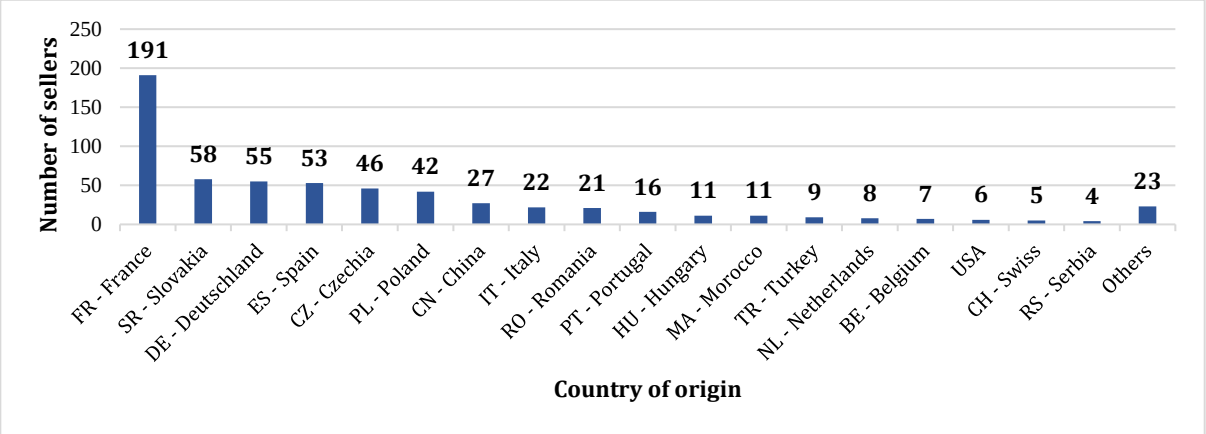
Methods and Data

To be able to meet the main aim of the paper and answer the research questions, the method of exploration, explanation and description using the secondary data, financial and annual reports published by the PSA and Slovak authorities was applied. Secondary analysis is the practice of using secondary data in research. As a research method, it saves both time and money and avoids unnecessary duplication of research effort. As stated by Hinds, Vogel and Clarke-Steffen (1997), secondary analysis is based on a usage of existing data (financial and annual reports in case of our study), collected for the purpose of a prior study in order to pursue a research interest which is distinct from the original work, setting different research questions and alternative perspectives.

Describing the data used in this analysis, there is a need to present the basic information about the company and slightly also about the Slovak automotive industry, applying the methods of collecting secondary data (collecting information available on the internet, using sources of commercial information, and public sources and libraries). The carmaker based in Trnava is a leader in producing small vehicles in the B-mainstream segment. It currently produces the extremely popular Citroën C3 and Peugeot 208 models. In July 2020, the carmaker had already produced 3.5 million vehicles. Serial production at the carmaker plant began in 2006, and its products are aimed at satisfied customers on almost every continent. At a production cadence of 62 vehicles/h, it produces approximately 1,395 vehicles per day (PSA, 2022). Trnava carmaker directly generates almost 4,400 jobs. In addition, it employs almost 20,000 people through its subcontractors located in Slovakia. In 2019, the carmaker in Trnava ranked 4th among the largest non-financial companies in Slovakia. It also has a dominant position in the foreign trade of the Slovak Republic. In 2019, it became the third-largest exporter within Slovakia. It currently ranks fourth. In 2020, it produced 338,050 vehicles. In the seventh consecutive year of year-on-year growth, production at the Trnava production centre increased by 5.1% compared to the previous year, 2019. Of the total number of vehicles produced, 33,334 were electric, with the e-208 monogram. Last year, the "battery-factory" completed 35,922 battery packs. The establishment in Slovakia of the parent company made and still makes sense; the production is situated in the middle of the automotive cluster within the V4 region. The cumulative value of the Group's foreign direct investment in Slovakia has already exceeded € 1.2 billion (PSA, 2022). The main objective of this case study is to analyse PSA's attitude toward the Fourth Industrial Revolution, innovation, electromobility and use particular examples from production management to identify how this trend significantly affects and helps more efficient and error-free production, which in turn generates also increased value-added in car exports and at the same time point out sufficient resp. insufficient state support in the parameters of the business environment. The right business environment and conditions for innovation activity can be seen as a major incentive for Slovak suppliers to participate more in subcontracting for PSA Group and thus increase the rate of the value-added generated in the Slovak Republic (and thus maximize the positive effects of FDIs for the

host economy). To characterize and answer these questions, the case study identifies the primary areas where it is possible to define the innovation potential of this company, also based on the supply structure to identify potential gaps and analyse the attitude to environmental policy (since decarbonization policy has seriously impacted the European industries).

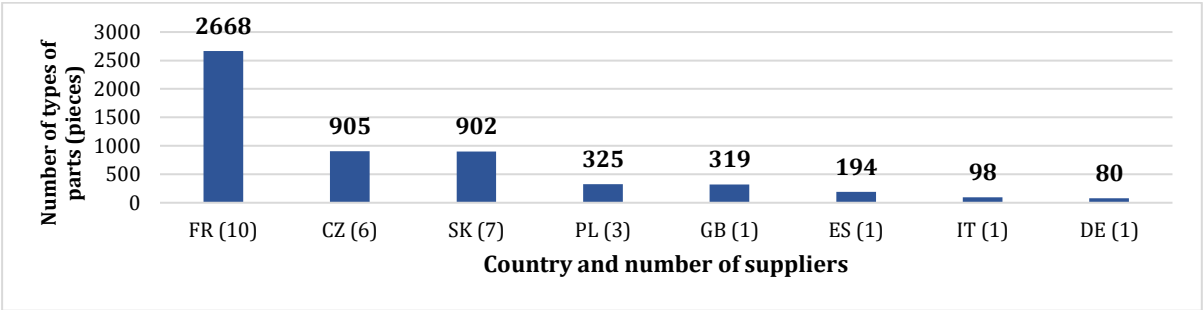
Figure 1: PSA Group SVK supply structure by supplier's home country



Source: Authors.

Figure 1 represents all suppliers based on the country of origin (categories – specific and joint suppliers) in 2020. The figure represents the international supply chain, the number of suppliers has increased to 615 compared to other years, and in the international context, their structure is more fragmented. The first, most robust suppliers are suppliers from France with 191 companies (approximately 31%); this country, therefore, represents a particular supplier leader, which the registered office of the parent company could be assumed. The second is the Slovak Republic with 58 suppliers (approx. 9.43%), and the third place is represented by Germany (55 – approx. 9%). In the analysis of previous years, it can be identified that in each year the number of suppliers was dominated by France. It also directly creates the highest value-added, as it is a French carmaker, which is dominant on the so-called "smile curve" (the highest value-added). The influence of suppliers from the Slovak Republic is less significant: it represents the second place in terms of the number of suppliers (Figure 2).

Figure 2: Suppliers of PSA Group SVK by part types in pieces (2019)



Source: Authors.

Looking at PSA Group's suppliers by type of parts (Fig. 2), France is the first to import about 2,700 types of parts to the carmaker (10 companies – 2,668 types of parts). Import from the Czech Republic follows; PSA Group Slovakia imported 905 types of parts from six Czech companies. The third place belongs to the Slovak Republic – domestic supplies (7 companies – 902 types of parts). When the French carmaker was established in the Slovak Republic, the share of domestic suppliers was naturally high; Slovak companies carried out 90% of construction works during the plant's construction. Unfortunately, Slovak subcontractors, who would participate in creating value-added intended for export (serial production activities), do not have such a significant role in the production of cars. The leading suppliers related to production in Slovakia are Faurecia, Lear Corporation Seating Slovakia, Plastic Omnium, Visteon Electronics, Eurostyle Systems, Slovakian Door Company, Bourbon Automotive Plastic. Approximately 54% of the company's revenues come from Central and Eastern Europe (V4 + Romania), 21% of turnover from Slovakia (Tab. 2).

Tab. 2: The most important Slovak suppliers of PSA Group SVK by number of imported types of parts (2019)

Order	Seller	Town (Region)	Products	Parts (pcs)
1.	Faurecia Automotive SVK s.r.o.	Trnava (TN)	Car seats	279
2.	Adhex Technologies	Senec (BA)	Foam parts	158
3.	Lear Corporation Seating SVK	Presov (PO)	Seating systems	119
4.	Eurostyle Systems s.r.o.	BnB (TR)	Plastic parts	95
5.	SMRC Automotive Solutions	Nitra (NR)	Modules, cockpits	92

Source: Authors.

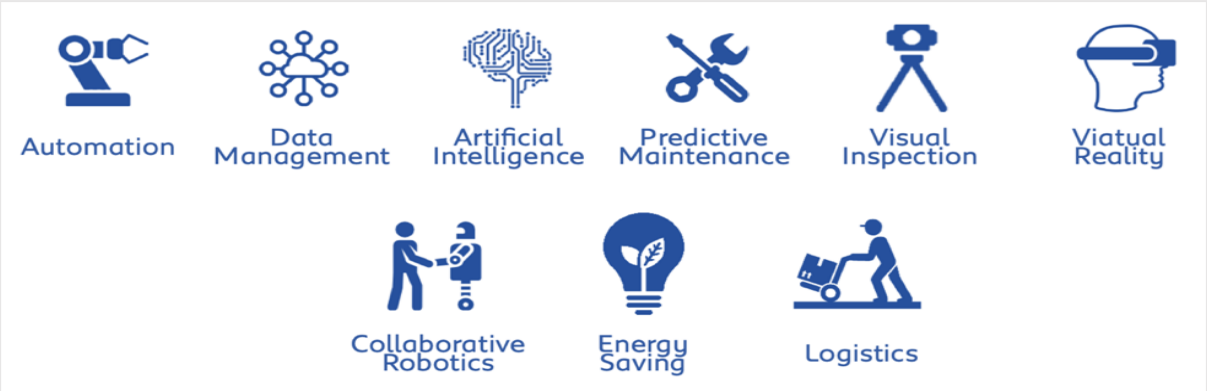
The priority intention of the French management was to produce at lower costs in the Slovak Republic and subsequently export to other European countries using the barrier-free single market of the EU, which is also confirmed by current export statistics. From the point of view of the territorial structure of PSA exports, most exports are to the EU (80%) and other countries, such as Japan, New Zealand, or Egypt. The transport of vehicles to customers is provided by the subsidiary GEFCO (60% of the vehicles produced in PSA Group SVK reach customers by rail, others by truck). Faurecia Automotive Slovakia s.r.o. is the most critical Slovak supplier for PSA TT. Based in Trnava, which manufactures car seats, and exhaust systems and deals with innovations in these areas. It dominates by importing 279 kinds of parts. The second company is Adhex Technologies (158 foam parts), and the third is Lear Corporation Seating Slovakia, based in Presov. Its main area consists of seating systems, which it imports with 119 parts. The Slovak Republic contributes to the production of cars (the year 2020) by sourcing materials and components approximately 9.43%, with the number of 58 suppliers. However, these are mainly plastic components with a lower rate of value-added. The cars are manufactured in Slovakia; they are mainly engaged in domestic assembly. Insufficient expenditures and a weak focus on research and development in the automotive industry (concept I4) represent the lower value-added in subsequent exports. Quality education and innovative

activity of employees within subcontracting companies are also important. Employees´ training and development play a crucial role in the perspective creation of the value-added. In 2020, the costs of training employees amounted to €178 000, 63 567 hours, including training for both regular and agency staff. The training with the most funds was: technical training in industrial automation and robotics (Boost school project), legislative training, and English language training. The training with the most significant number of realized hours included the primary activities of the operation – assembly, initial training of newly hired employees, technical training of industrial automation, and robotics (Rogers and Zvarikova, 2021). Education helps to meet the company's main goals and, of course, also to meet legislative requirements, especially in the field of environment, safety standards, and fire protection, which is also one of the company's main goals. In the dual education system in 2020, there were 43 pupils in the teaching and study fields: Car-repair worker – electrician, mechanic – electrician, and mechanic – mechatronic. As a part of dual education, the Trnava car company cooperates with three secondary vocational schools (SOS automobilova Trnava, SOS technicka Galanta and SOS elektrotechnicka Trnava). In 2020, 6 new students passed the selection procedure for dual education. For each new employee who joins group PSA Slovakia, the education department will prepare a training plan related to his / her job classification and socio-professional category (Hopkins and Siekelova, 2021). This plan aims to prepare the best possible employee to acquire the competencies necessary for the performance of their job position. The negative impact of car production on the environment cannot be eliminated, but the company is trying to minimize it. The paint shop is the most critical production process in terms of environmental impact and falls under the law on integrated pollution prevention and control. It is a significant source of volatile organic compound (VOC) emissions to air, wastewater, and hazardous waste (Galbraith and Podhorska, 2021). In order to limit these effects, the Trnava carmaker uses water-based primarily paints. The paint shop also includes a physicochemical wastewater treatment plant, which treats wastewater from the surface and painting processes. Heavy metals from these waters are precipitated here in the form of sludge. The biological wastewater treatment plant, which is located on the premises of the production centre, treats sewage and industrial wastewater. Sewage sludge is further recovered (Lăzăroiu and Harrison, 2021). At the beginning of March 2020, due to the COVID-19 risk, it was decided to stop production unprecedentedly in all European PSA plants. The production line in Trnava did not run for 55 days since March 19. As a result of the shutdown of the production line, more than 72,000 vehicles lost production. At the first production change, the gradual start of production began on May 12. Since Saturday, June 6, as the first carmaker in Slovakia, Trnava returned to production at total capacity (Burke and Zvarikova, 2021). A significant milestone in PSA's development activities was establishing the InoLab team in 2020. The main task of InoLab is to connect the traditional production plant with the world of intelligent technologies and the university environment. The main activities of InoLab include (Figure 3): development of automation solutions for the production and logistics process, digital business transformation, building cooperation with universities, technology companies,

and state institutions, management of EU grants, contributions, and funds, cooperation with students of Slovak and French universities (PSA, 2022).

Trnava carmaker does not carry out activities in product research and development (Lawrence and Durana, 2021). This is one of the fundamental problems of creating higher value-added in the long run. Shortly, the application of research will be an essential part of the carmaker's innovation activities to remain competitive (Klingenber, Borges and Antunes, 2019). The carmaker's priorities will be indicators of client quality, economic efficiency, and operational performance. In addition to continuing the transformation project "Future in our hands" to increase efficiency from its resources, the priority is the carmaker's partnership with the Slovak government and improving the external business environment in Slovakia. The good news came at the beginning of 2021: the merger of the Fiat Chrysler Automobiles FCA Group and the Groupe PSA Group, of which the Trnava carmaker is a part, created a new company, Stellantis, on 16 January 2021. This is good news for the future of the carmaker. In addition to the new identity, the company in Trnava is gaining new opportunities from the new global potential. The merger of two world car players and the emergence of Stellantis, which is the fourth largest carmaker in the world, is not caused by the crisis. It connects the potential of two healthy groups. The goal is not to be big but strong in products and services and thus better prepared for the industry's challenges – compliance with demanding CO2 limits and meeting customer demand for new and innovative types of mobility (PSA, 2022).

Figure 3: Main areas of InoLab in PSA Group SVK



Source: Authors.

Results

The following part was prepared based on a structured interview, which was prepared with the employees of the Industry 4.0 department and the digitalization of the company's production at the beginning of 2022. This interview was conducted with approximately 40 experts in various fields for Industry 4.0. Following all the results of these interviews, a follow-up analysis was performed. It can be listed and characterized through the answers to a comprehensive questionnaire and identified key conclusions

that this interview and subsequent synthesis of conclusions brought. The first goal of the interview was to find out the knowledge of the employees of the selected company about the Industry 4.0 concept. The second goal was to determine the readiness of PSA Group SVK for the transition to a digital company as a tool for technological – product, and process innovations in the company and thus increase value-added in the company. The prerequisite was the establishment of innovative approaches based on the transformation (upgrade) of GVCs at the level of process upgrades and/or product upgrades for value-added growth. Through an organized interview, the respondents confirmed the key role of Industry 4.0 in the Slovak Republic, especially in the future. It is Important to implement this concept and address it at the national level, as innovation and investment in research and development can move the Slovak economy and industry forward. Due to the dominance of the automotive industry in the Slovak Republic and thus the technical industry, the Industry 4.0 concept is of significant importance. By applying the Internet of Things link, the machines will be able to communicate with each other faster and more efficiently. The whole race will cooperate and communicate with each other, which will make the race intelligent. With Cloud and Big Data applications, it will be able to synchronize and receive various requests, data and "order," in real-time. The digitization process eliminates excess paper consumption and also enables faster communication. This results in reduced product error rates, greater control and a smoother production process.

PSA Group understands digitization as a better, more comprehensive and faster interconnection of products, suppliers, customers and car manufacturers themselves. It is a digital supply chain. In production, the communication of line and machine workers is currently being digitized (it has replaced paper production). The fact is that everything cannot be digitized yet, it is a very difficult and lengthy process, but significant changes will be seen in the near future. Staff training, various training, retraining and the like are also key. Automation in PSA Group SVK takes place mainly in the "core" areas, i.e., in the main activities, such as assembly lines with robots (675 robots). With the advent of the Peugeot 208, laser welding, with and without consumables, “Full Kitting”" was introduced, which is a way of supplying the edge of the line in operation (3.5 million parts distributed daily) or laser geometry control. The following chart shows the areas where PSA Group SVK currently focuses most on automation elements.

From the Figure 4, we can observe the dominance of automation in production, which is about 55%. This mainly concerns robotic processing (675 robots) and laser solutions. Logistics follows this with a 20% share, and maintenance and services with a 10% share. 95% are automated core solutions, and the remaining 5% are other activities. Investment activity of the company in new technologies, machines, and equipment for the last five years was rich.

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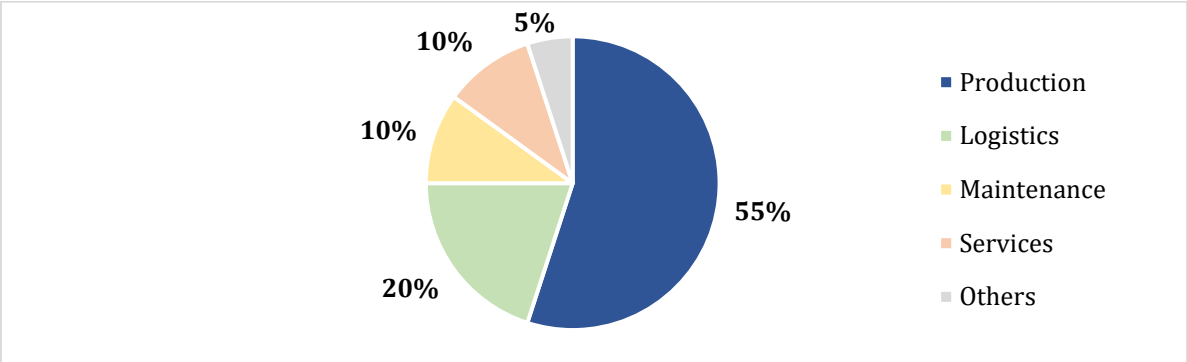
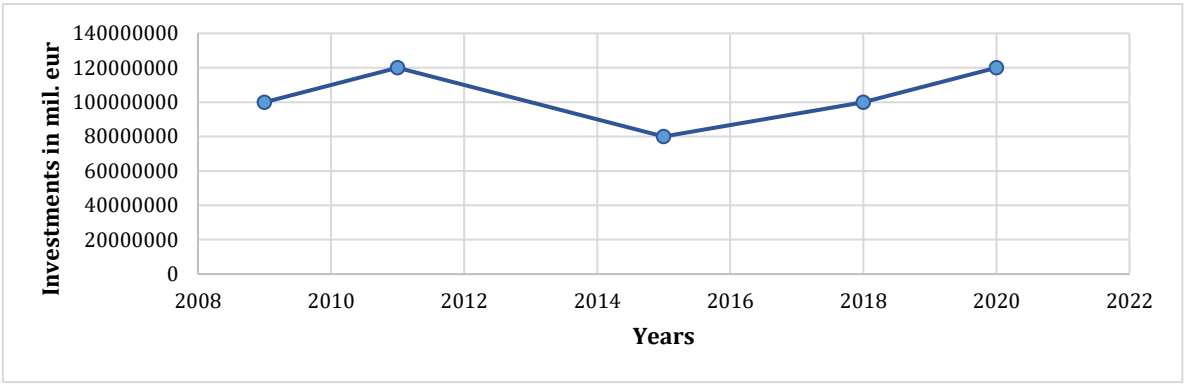
Fig. 4: Areas of automation in PSA Group SVK



Source: Authors.

Selected investments by years: investment in the construction and start of production of the 1st Peugeot 207 model: €700 million, investment in the start of production of the Citroën C3 Picasso: €100 million, investment to start production of the Peugeot 208: €120 million per year (2011), investment to start production of the new Citroën C3: €80 million (2015), investment to start production of the new generation Peugeot 208 and e-208: €100 million (2018). The total amount of the group's investments in Slovakia: more than 1.2 billion € (Fig.5).

Fig. 5: The most interesting investments of PSA Group SVK



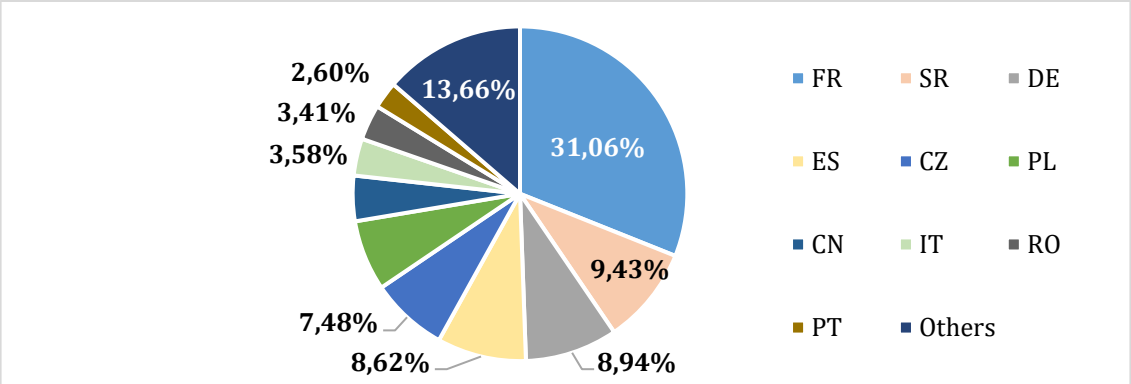
Source: Authors.

The company currently invests heavily in electromobility (battery production) and the environment (over 20% compared to last year), also develops the projects and technologies in laser solutions, automated logistics systems, and the like. Electromobility is currently the driving force of the company. Of the complete package of manufactured vehicles, 33,334 were electric, with the e-208 monogram. Last year, the battery factory completed 35,922 battery packs. The investment to start the new generation Peugeot 208 and e-208 amounted to 100 mil. € (2018). The first battery assembly plant was also exhibited and applied in Trnava. Currently, from the perspective of Industry 4.0, PSA Group SVK has received an investment in a new segment B production program at its production centre in Trnava (2021). The gradual start of production of the new production program of segment B is planned for 2023. In order to significantly contribute to increasing carbon neutrality, a large part of the production program will also be represented by fully electric motors. Industrial

investment in the new production program will also mean a significant mobilization of activities related to innovation, further application of Industry 4.0 technologies, reduction of energy intensity, and environmental protection (Kovacova and Lewis, 2021). According to experts, I4 certainly brings more positives, such as higher competitiveness, cost minimization, lower stocks, higher production efficiency, etc. Respondents included the possible loss of some job positions as negatives/threats. They also confirm the need to apply this concept in its entirety and shortly, mainly due to higher competition from neighbouring countries. The Industry 4.0 concept positively affects the car company's exports. It can transform it into an intelligent, digital enterprise in which all parts of production, machines, and people are connected in real-time, which enables higher production efficiency, lower error rates, and production costs. As a result, the company can dominate with a higher number of quality goods with a quality supply network. These segments will also positively affect its subsequent export and contact with customers (PSA, 2022).

Based on the analysis of available company data for the years 2020-2021, we found that the percentage of value-added for C3 and 208 vehicles consists of several countries; the parent country of the company creates the highest value, i.e., FR (31.06%), followed by Slovakia with almost 9.5% share, it is mainly assembly work. FR dominates only thanks to the fact that it is a French carmaker; the vehicles were invented right here, and the most modern technologies were applied for their design, design, etc. The Slovak Republic will probably not reach the same level of value-added as FR, as it is not the parent country of the company, but the Slovak goal must be to maximize the share of value-added of Slovakia in the production process and increase this share every year (Fig. 6).

Fig. 6: Percentage of value added by country for C3 and 208 vehicles (2020-2021)



Source: Authors.

By applying innovations and essential research and development, with which the company does not yet dominate in Slovakia, the products will achieve higher value-added. However, it is questionable when and how the Slovak government and overall legislation will be able to respond to this trend in order to support companies with innovative policies, better conditions, and laws. In particular, two parties, the company and the state are needed to make the innovative concept a reality. Respondents consider this to be a weak point of the Industry 4.0 concept in the territory of the Slovak Republic. Legislative conditions are currently insufficient and, in some places, chaotic compared to the outside world. When companies

have the necessary capacities for their research and development, only then will the path of the Slovak Republic grow exponentially in terms of added value.

Discussion

There is a strong need to spread the idea of Industry 4.0 across all sectors so that these industries understand and benefit from it (Tab. 3). The vision and one of the most important goals of the Slovak industry is to combine research and development activities, together with innovation, including broad-based application, which will enable the contribution of all relevant technologies, knowledge, and skills from industry and enterprises in various sectors to society and quality of life in Slovakia (European Commission, 2021; Stock et al., 2018).

Comprehensive analyses must achieve all this, and it is necessary to create a so-called "Slovakia's Intelligent Industry Platform". We can understand this Platform as the leading and managing body of Industry 4.0, consisting of a group of experts, which will consist of key actors and government bodies. The right step would be to appoint ambassadors for each sector, with the aim of continuous improvement and support for implementing expert recommendations.

Tab. 3: Comprehensive table of recommendations

Areas	Recommendations
Awareness raising and cooperation	1. Information campaign
	2. Support for IoT experimentation
	3. I4 Implementation Manual
	4. Better promotion
Industry Research 4.0	1. Support for applied research
	2. Research agenda for Industry 4.0
	3. Sector-oriented consortia
	4. Efforts to reduce the amount of rest. costs and R&D
Smart Factory	1. Support for the introduction of new technologies and materials
	2. Standardization (reference architecture)
	3. New models and their entry into supply chains
	4. Use of Big Data
Financing	1. Better funding mechanisms
	2. Address the needs of the research agenda
	3. Innovative public procurement
	4. Implementation of pilot projects
Labour market and education	1. Analysis of the main requirements of the present
	2. Creating predictive curricula
	3. Providing more specialized skills
	4. Following the European agenda (new skills)
Legislation and E-Government	1. Continuous development of skills in the public sector
	2. Commercial use of data (Big Data)
	3. Active participation of the government in supporting the implementation of I4
	4. Proposal of a transparent VS digitization plan

Source: Authors.

The main document of this Platform would be an "action plan" that would be specifically designed for a specific area. This plan would bind the platform and set long-term goals in the field of various strategies of energy, materials, nanotechnology, robotics. Environmental policy, which is also essential in matters of progress, must also be remembered and addressed. Recommendations for EP:

1. The Slovak government needs to create favourable conditions for businesses to become green, which is in its interest to attract foreign investment.
2. Businesses in Slovakia must press the government to create the proper regulatory framework for greening.
3. The car headquarters needs to work with its suppliers in Slovakia to help them adapt to new technologies and production processes through retraining staff.
4. Retraining and improving the quality of staff to meet the job requirements of the emerging e-mobility sub-sectors requires new training programs and cross-cutting cooperation between the public and private sectors and academia.

Conclusion

Based on the answers from a comprehensive questionnaire, it is possible to characterize a high level of knowledge about the latest trends in PSA Group Slovakia and a quality workforce that is ready for the challenges of this concept. The conclusions of the questionnaire confirm the significant impact of I4 on the company's product portfolio growth with value-added growth and point to insufficient state support, especially in the areas of education, financing (”R&D”), and legislation. This confirmed the first research question, but it should be noted that the EU will only run into the already established phenomenon of Industry 4.0, so it will not be a pioneer in this regard. The last part of the study is the proposals and recommendations of the authors. The content of this section contains two concepts of recommendations, the first in terms of the implication of Industry 4.0 for Slovak industry, in six areas/steps that follow the need of Slovakia to innovate, apply the latest available technologies, change educational programs and thus achieve high value-added in the industry and subsequent exports of the goods and services through the Action Plan. The second concept is devoted to the environmental policy of the Slovak industry, its importance, and its impact. Based on implementing these proposals and recommendations, the Slovak Republic can acquire the proactive character of an innovative country, otherwise, it will remains as an "assembly country."

However, despite the detailed intent of the analysis, the study has several limitations. It should be noted that this is a study that was conducted in one country and in one company. However, it must be said that the socio-economic environment or culture and especially the legislative environment are significant in Industry 4.0, so this shortcoming can also be considered a meaning and a positive feature. Our next challenge is to analyse and compare I4 and its implementation in the automotive sector as well as in other sectors for which it could be essential. It is also a challenge to compare the V4 countries or Central Europe.

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