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ADDED VALUE IN THE TRANSPORT SECTOR AT THE TIME BEFORE COVID-19 PANDEMIC: A COMPARISON OF THE EU COUNTRIES

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Abstract. The COVID-19 pandemic has had a significant impact on the generation of added value within national economies. Generation of added value in the transport sector is an important factor in manufacturing products and providing services in the environment of the national economies. The globalisation of production has made the transport sector one of the main sectors enabling and accelerating the process of generating added value in all other sectors. The objective of the contribution is to determine which EU-28 countries made the most effective investments in research and development (R&D) in order to achieve the highest possible value added of the state within the transport sector in the years 2012-2017. For the purposes of the analysis, regression model and the method of artificial neural networks were used. Our research identified a high differentiation in terms of the volume of investments in R&D participating in the creation of added value in the transport sector. The results of the analysis identified the EU-28 member states which achieved the optimal share of investments made in R&D and generated added value in the monitored period. Since each country has its priorities related to its goals and geographical location, the determined optimum is only indicative value of investment for a specific country but not a recommended value for all other states.

Keywords: added value; investments in research and development; transport sector; COVID-19

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1. Introduction

Globalisation of production and services has broken the value chain between several countries or even continents (Foundation Robert Schuman, 2016). The European continent is still a patchwork of national transport systems which aim to overcome the differences to ensure the competitiveness of European countries (Purwanto et al, 2017). The transport infrastructure in all 28 countries in the European Union (EU28; EU 27 since the year 2020) has shown rapid development in the last decade, and the impact of transport on sustainability, development, and economic growth has become an interesting issue for policy-makers as well as economists or entrepreneurs (Cigu et al, 2019). The dynamics of the economic development is very diverse (Yun & Won & Park, 2018) and the growth and development strategies are becoming more sophisticated, economically transforming them-selves to creating products and services with a higher added value. This goal is achieved through R&D related activities, which increase innovation growth and positively influence the productivity, thus providing a platform for sustainable development (Daniieviciene & Lace, 2017) which is an important prerequisite for growth and development (Yun & Yigitcanlar, 2017).

The transport sector is a backbone of the economy (Gherghina et al, 2018) which includes a complex network of ca. 1.2 million private and public companies within the EU and ensures the supply of goods and services to EU citizens and companies. Transport is a strategic sector of the EU economy, which directly influences the everyday life of EU citizens and ensures their mobility, thus contributing to the free movement of persons within the internal European market (AndSoft, 2018). Road transport in the EU is not characterized by mobility only; there is also a factor of business competitiveness (Foundation Robert Schuman, 2016), since the availability, price, and quality of transport services have a significant effect on production processes and selection of business partners (AndSoft, 2018).

Global competition is a benefit for European supply chains (Bentyn, 2019). An example is a dominance and relative competitiveness of carriers in new developing EU countries (Poland, Bulgaria, Croatia, and Romania) caused by their high share (80 %) of the overall cross-border trade within Europe. On the other hand, it seems that carriers from the developed countries, such as Sweden, France, Italy, Belgium, and Denmark are less competitive and show a relatively low market share in terms of export and import within their own economies (AndSoft, 2018). This is caused by economic factors which are reflected in different costs of labour within the EU member countries. Experts point to the fact that the entities in the transport sector participating in the global value chain (GVC) are not individual countries but individual companies (Vrh, 2018).

In addition to its advantages, globalization of the transport sector has also several shortcomings. When the European Union realized the impacts and threats the rapid development of road transport poses for the environment, a new principle of "modal shift" was accepted in the White Paper on the future development of the common approach (Foundation Robert Schuman, 2016). The above principle is considered the main challenge in the European transport strategy, and besides mitigating the environmental impacts, it ensures increasing competitiveness of the EU countries by means of creating a system supporting the European economic progress and providing high-quality services within the mobility while effectively using the resources (Purwanto et al, 2017).

To meet the challenge in the White Paper, another priority of the EU is to create the conditions for effective innovations essential for the logistics industry (Gong at al, 2019). Innovations in logistics represent significant advantages for enterprises, such as accelerating the purchasing process, reduction of storage or transportation costs, timely delivery of goods or material, reduction of the workforce, improvement of safety and precision (Tabatabaie & Nik, 2016). The sup-port of innovations by means of investments in the transport infrastructure accounts ap-prox. for 25 % of the EU public investments (Dijkstra & Poelman & Ackermans, 2018), which makes the given sector the most expensive and important within the European supply chain (Gavric & Miloloza, 2017).

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Another priority of the European Commissions is to close the investment gap in Europe, e.g. by means of launching new investment projects in the transport sector (Raczkowski & Schneider & Laroche, 2017).

The COVID-19 crisis has shown that everything in today´s world is interconnected, as confirmed by the fast spread of the virus, and that it is interconnected also in terms of delivering products. This interconnection in logistics as a part of the transport sector is expected to grow in the future (Liu et al, 2020). Trading in raw materials is thus dependent on the ability to manage the logistics chain between various production plants according to fluctuating prices. This explains why trades increasingly more often invest in transport and warehouse infrastructures in order to adapt their logistic strategies to real-time logistics (Foundation Robert Schuman, 2016). In the near future, by the year 2028, global logistic organizations will be pushed to "innovate or die" and instead of vertical growth, they will focus on creating goods using spin-off technology (Suberg, 2018). Industry 4.0 should initiate significant changes in technologies, business, and enterprises, where logistics as an entrepreneurial activity is not an exception (Čámská & Klečka, 2015).

The value chain of companies influences and is influenced many societal issues (Yun & Yigitcanlar, 2017). The common European market needs competitive transport systems to structure the value chain, which can be achieved by applying innovative solutions (Eremina & Lace & Bistrova, 2019). The modernization of all modes of transport needs to be focused, without any exception, on competitiveness and creating innovative ecosystems, modernization, optimization, and maintenance of the existing systems rather than on extending the existing networks.

However, as it is not possible to implement only a single solution across Europe (Foundation Robert Schuman, 2016), the objective of the contribution is to determine to which extent the investment in research and development participate in the creation of the added value within the transport sector in all EU28 countries in the years 2013 - 2017.

2. Theoretical background

In the transport sector, there is an obvious reason for its slow development, which is insufficient investment in innovations. The individual European countries at the regional and national level and EU level try to contribute to R&D by means of new innovations as well as improving the control of effectiveness of investments in realized or current pro-jects. Researchers from all over the world participate in verifying the existing and searching for new statistical methods applicable for verifying how investments in a specific sec-tor have contributed to creating competitiveness and generating added value for the given sector.

Purwanto et al (2017) examined the relationship between investments in transport infrastructure and their wide economic effect on competitiveness and economic growth using the cost-benefit analysis (CBA). Based on the research results, the authors concluded that in terms of the relationship between transport and the target market, in the case of the target market non-competitiveness, the EU project will have only a negative impact on the efficiency of the given market.

Stawicki (2018) compared the investment made in the transport infrastructure with the support of the EU structural funds in selected countries (Latvia, Lithuania, Poland) in the years 2007 - 2013. Using a descriptive method of relative and absolute ratios, the author concluded that in the monitored period, the most financial resources from the EU funds were drawn by Poland (approx. 30 billion EUR), while the overall value of all projects supporting transport infrastructure in Latvia and Lithuania were very similar (1,7 billion EUR). By the number of inhabitants, Latvia made the most investments (865 thousand EUR per capita). Based on other results, the author points out that the support of the EU structural funds intended for the development of the transport infrastructure enabled to increase the territorial cohesion of the EU in the analysed region.

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Gherghina et al (2018) examined the relationship between the main modes of transport, related investment, and sustainable economic growth in the territory of the EU28 in the years 1990 - 2016. According to the Granger causality test with the error correction model, the research has shown a short-term one-way link of the volume of goods transported by air and gross domestic product per capita (GDPC). In terms of the investments in transport, the authors identified the relationship of a short-term development caused by the investments in the road transport infrastructure and inland waterways and GDP.

Melecký (2018) investigated the effectiveness of financing the infrastructure in the EU countries between 2007 and 2013 using efficiency analysis. The results show that most countries with a lower volume of investments show higher efficiency, especially the coun-tries in the group of the so-called “old member states” (EU-15).
Vlahinic Lenz et al (2019) empirically examined the impact of transport infrastructure on the economic growth of Central and Eastern European EU Member States (CEMS) in the years 1995 - 2016 using panel analysis. The results of their research indicate a long-term non-efficient and obsolete railway infrastructure. Railway infrastructure is an ecologic solution, as railway transport is the eco-friendlies mode of transporting goods in terms of increasing competitive advantage and economic growth in the CEMS.

Some studies were focused on comparing the investments made in the transport sec-tor in terms of the comparison of the public and private sectors. According to the results of the study realized by PwC in 2016, the public sector made low investments in start-ups. Between 2011 and 2015, private companies invested approximately 30 million USD annually in digital logistic start-ups, while the public logistic sector invested less than 2 mil-lion USD annually in logistic start-ups (Suberg, 2018). Rokicki et al (2021) also examined the impact of regional investments in the infrastructure on the example of Poland using the application of the TERM model. The results of their research point to the big difference between the regions with the high share of investments made by private investors and the regions that rely fully on public funding.

When analysing the studies focused on comparing investments made in the private and public sector, it can be seen that the public transport companies do not invest in innovations as much as other industries for many different reasons, such as inadequate belief in centuries-old traditions and obsolete economic principles.

Andersson & Forslund (2018) aimed to find and interpret possible determinants of logistic innovations and explain innovative activities of a company in the sectors of road transport and logistics in comparison with other industries in the Czech Republic be-tween 2008 and 2014. The given period includes the period of the economic crisis in 2008. The authors pointed out that the Czech Republic, for its geographical location in the centre of the European Union, is a strategic option for multinational companies also due to the fact that compared to highly developed countries, such as Germany or Austria, it has lower staff costs or rent expenses. The results of their research indicate the existence of a negative relationship between innovation decisions and industry in road transport or logistics. For the purposes of the research, the authors developed an indicator for measuring sustainable logistic innovation (SLI), which identifies innovative ratios and provides a method for their measurement with the dimensions of sustainability and logistic activities. During the period under review, the only statistically significant positive determinant of logistic innovation was in the case of foreign ownership.

Cigu et al (2019) examined the relationship between the transport infrastructure and economic performance of the EU28 countries between 2000 and 2014. Using the panel analysis of data, the authors examined the impact of transport infrastructure on economic growth as well as on the role of policy-makers within the EU explaining the differences between the EU member states. The results show that the improvement of transport conditions in the EU countries plays an important role in sustaining the economic growth of the national economies.

Studies that examined investments in the transport sector focused on the impact of the given industry on the competitiveness and sustainable economic growth of countries using the cost-benefit analysis (CBA) (Purwanto et al, 2017). Granger causality (Gherghina et al, 2018) and panel analysis (Cigu et al, 2019; Vlahinić-Lenz & Pavlić-Skender & Mirković-Adelajda, 2019). Other studies compared the investments in the transport sector made by private, public (Suberg, 2018), and regional sectors using the application of the TERM model (Rokicki et al, 2021). In terms of the explanation of the innovative activities and interpretation of the possible determinants of logistic innovations, the authors developed an SLI indicator (Andersson & Forslund, 2018). Other authors dealt with determining the effectiveness of funding infrastructure in the EU countries by means of efficiency analysis (Melecký, 2018). Other researchers compared investments made in the transport infrastructure with the support of EU structural funds using the descriptive method of relative and absolute indicators (Stawicki, 2018).

The issue of the effectiveness of investments made is a frequently researched topic; however, none of the studies has focused on determining the impact of investments made in R&D on the added value of a specific state and the EU as a whole. Within the given contribution, one research question is formulated: What is the optimal ratio between the added value and investments? By answering this question, it is possible to determine which EU28 countries use investments in R&D most effectively to achieve the highest possible added value of the state in terms of transport.

3. Research objective and methodology

The objective of the contribution is to use the analysis of added value and investments made in research and development to determine to which extent the investments in research and development participated in the creation of added value in the transport sector in all EU28 countries between 2013 and 2017. Using the research question, we will determine the ideal ratio between the added value and investments. The analysis is per-formed using the regression model, which enables avoiding extreme values. For the analysis, the statistical data on investments made in research and development in the transport sector of the 28 countries of the EU and the data on generating added value in these countries on the basis of the European Commission´s statistics in the years 2013 - 2017:

1) Data on the investments in research and development within the transport sector of the EU28 countries were obtained from the publicly available Eurostat data (Eurostat, 2020).

2) Data on the added value within the EU countries were obtained from the Euro-stat-OECD entrepreneurship indicator programme (OECD-Eurostat, 2020).

The research dataset includes a total of 57,967 enterprises (of all size categories) operating in the transport sector from the whole European Union. For the statistical calculations, the Statistica software, version 13.0 is used. The relationship of added value and in-vestments in R&D is analysed using a selected tool – the method of artificial neural net-works. The given method is used for prediction and controlling the processes, and adaptation of linear and non-linear functions (Didych et al, 2018). The method of artificial neural networks consists of a set of neurons (Russell & Norvig, 2020) interconnected by means of weights (Ledesma et al, 2020). The input data for the training of the neural networks will be the data on investments in R&D in the transport sector within the EU28 countries. In the training, the weights are adjusted so that each input is assigned an output with the closest possible output value (Masters, 2019) after training. In our case, basic multilayer perceptron networks are used (hereinafter referred to as MLP), which represent the basic type of neural networks, and radial basis function networks (RBF) based on the logic phases. The output of the training of these networks is predictive data on investments made in R&D in the transport sector.

The analysis of the input data in the Statistica software used the tool of Data mining – neural networks, specifically General Regression. When selecting the data, the investments made in R&D are an independent variable, while the added value is a dependent variable. The above data are divided in the ratio 85:15, which is the ratio between the training and validation datasets. The more data are used for training, the more precise the calculation will be. The analysis performed provides the basic characteristics of the input data, i.e. the statistical information on investments made in research and development and the added value, which are presented in Table 1 below.

Table 1. Basic statistics of input data

Statistics	**VA Total transport**	**Investment transport**
Minimum (Train	405.9	4.54
Maximum (Train)	111423.2	58493.50
Statistics	**VA Total transport**	**Investment transport**
Mean (Train)	20019.5	4215.71
Standard deviation (Train)	28734.3	10218.04
Minimum (Test)	767.3	11.56
Maximum (Test)	103634.0	53359.10
Mean (Test)	22476.3	5401.50
Standard deviation (Test)	31488.0	12431.13
Minimum (Overall)	405.9	4.54
Maximum (Overall)	111423.2	58493.50
Mean (Overall)	20388.0	4393.58
Standard deviation (Overall)	29037.7	10529.60

Source: Authors

The results of the research obtained on the basis of the analysis performed are graphically represented using the scatter plot, where the states which have achieved the optimal level of investments made in R&D are marked.

Results and discussion

In accordance with the above-mentioned procedure on the training dataset, the neural networks that best describe the relationship between the independent and dependent variable were found. Out of the 10,000 generated neural structures, 5 with the best performance were retained. The hidden layer of the MLP networks contained 2-20 neurons, in the case of RBF networks, it was 11-30 neurons. For the activation of the internal neural network, the Logistic, Gaussian, Tanh functions were considered; the output layer of the neurons was activated using the functions of Identity and Sine. Using regression analysis, the Statistica programme randomly selected 5 neural networks out of 1000 neural networks depending on their performance, as seen in Table 2 below.

Table 2. Most successful neural networks

Index	**Network title**	**Trainin g perf.**	**Test perf .**	**Training error**	**Test error**	**Training algorithm**	**Error function**	**Hidden activation**	**Output activation**
1	MLP 1-2-1	0,9	1,0	43863395	19208022	BFGS 54	SOS	Logistic	Identity
2	RBF 1-22-1	1,0	1,0	35552131	22488084	RBFT	SOS	Gaussian	Identity
3	MLP 1-2-1	0,9	1,0	40804082	23231403	BFGS 71	SOS	Logistic	Identity
4	RBF 1-20-1	1,0	1,0	34898010	22406600	RBFT	SOS	Gaussian	Identity
5	MLP 1-6-1	1,0	1,0	39464654	23580903	BFGS 83	SOS	Tanh	Sine

Source: Authors

In these selected neural networks, the programme calculated the basic statistics of the prediction, as seen in Table 3.

Table 3. Basic statistics of investment predictions

Statistics	Predictions statistics. Target: Investment				
	1.MLP 1-2-1	**2.RBF 1-22-1**	**3.MLP 1-2-1**	**4.RBF 1-20-1**	**5.MLP 1-6-1**
Minimum prediction (Train)	5861.7	1043.8	4109.4	228.3	3810.9
Maximum prediction (Train)	98694.7	111008.7	101681.8	108734.4	100236.6
Minimum prediction (Test)	5868.4	1155.6	4130.9	724.9	3846.8
Maximum prediction (Test)	98694.7	107144.7	101681.8	105036.0	100050.2
Minimum residual (Train)	-21912.8	-22563.7	-18066.4	-23665.3	-22009.9
Maximum residual (Train)	28823.8	29371.3	27182.3	27091.8	26225.6
Minimum residual (Test)	-7372.2	-14266.7	-8157.1	-7395.0	-7297.7
Maximum residual (Test)	19175.6	14938.3	20792.8	19147.4	20963.4
Minimum standard residual (Train)	-3.3	-3.8	-2.8	-4.0	-3.5
Maximum standard residual (Train)	4.4	4.9	4.3	4.6	4.2
Minimum standard residual (Test)	**-1.7**	**-3.0**	**-1.7**	**-1.6**	**-1.5**
Maximum standard residual (Test)	4.4	3.2	4.3	4.0	4.3

Source: Authors

The relationship between the PH and the basic statistics of investment predictions for R&D based on Table 3 is presented in Figure 1. The selected neural networks (MLP and RBF) in the Figure indicate the point where the individual EU28 member states are located in the prediction of the optimal level of investments in R&D in the transport sector.

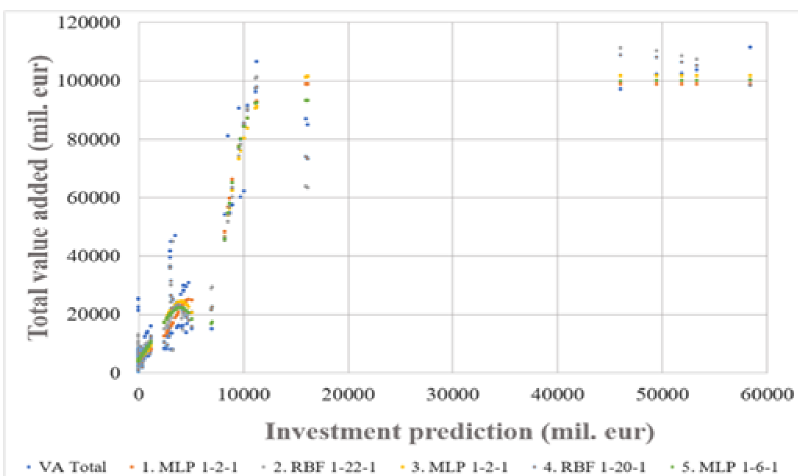

Figure 1. Relationship of VA and investments in R&D

Source: Authors

The neural networks in Figure 1 selected by the Statistica programme were divided and graphically represented in Figures 2 – 6 separately for better understanding according to each neural network. The actual values of the ratio between the investments and added value achieved by the EU states in the monitored period are marked blue in the Figures, while the predicted values calculated by the Statistica programme are marked orange. All data are given in EUR million.

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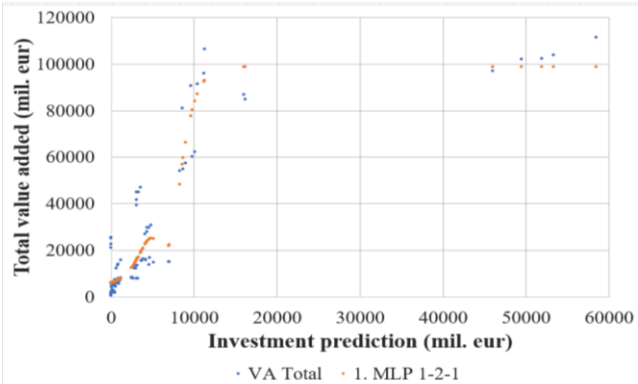

Figure 2. Neural network № 1. MLP 1-2-1

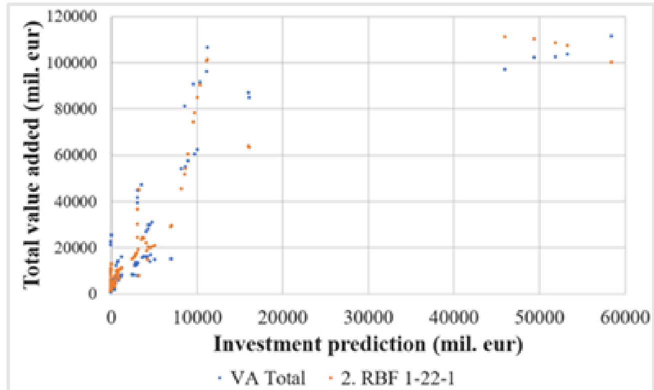

Figure 3. Neural network №2. RBF 1-22-1

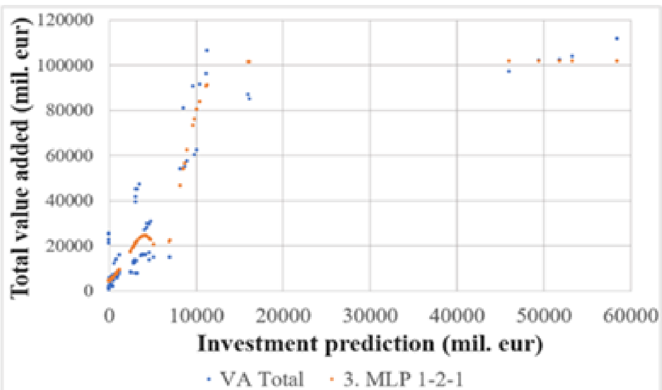

Figure 4. Neural network № 3. MLP 1-2-1

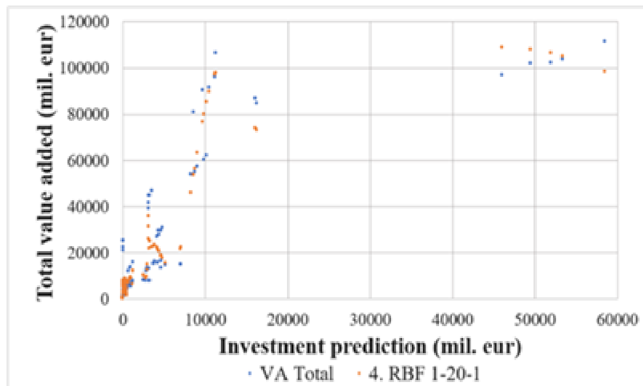

Figure 5. Neural network № 4. RBF 1-20-1

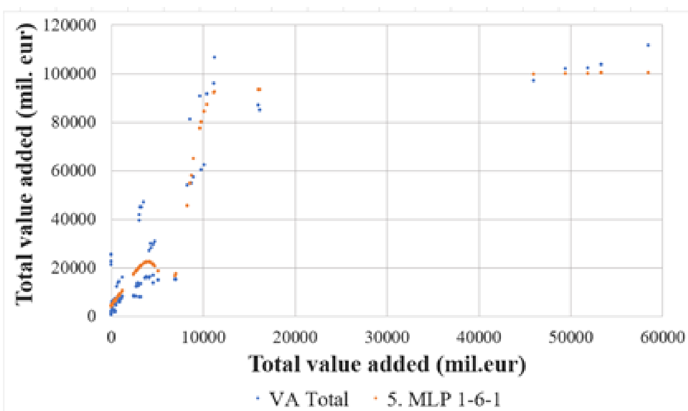

Figure 6. Neural network № 5. MLP 1-6-1

Source: Authors

Subsequently, the suitability of the selected method (regression analysis using neural networks) were verified and the most successful neural network, which provides the most accurate description of the given method logic, was selected. The aforementioned neural networks with the best performance according to the Statistica programme and presented in Figures 2-6 confirm the basic function of training using regression analysis of the neural

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networks, confirm the suitability of the method, and provide evidence that the tested network does not suffer from overfitting. This means that there was no underfitting of the model, where the statistical training model is not able to capture the basic corresponding data structure.

Furthermore, when comparing the predictive statistics with the real data provided by the five neural networks, we are searching for the model of neural network which will be the most efficient, i.e. where the actual and predicted values overlap.

The searched points on the axes (x, y) are the highest residual values closest to (0, max) on the graph. These are the points where the lowest waste of investments in R&D in the selected sector.

Based on the analysis performed, neural network №2 was selected, which is considered to be the most successful (see Figure 7 below). The names of the EU member states are in accordance with the international classification of states (Intrast EU, 2019).

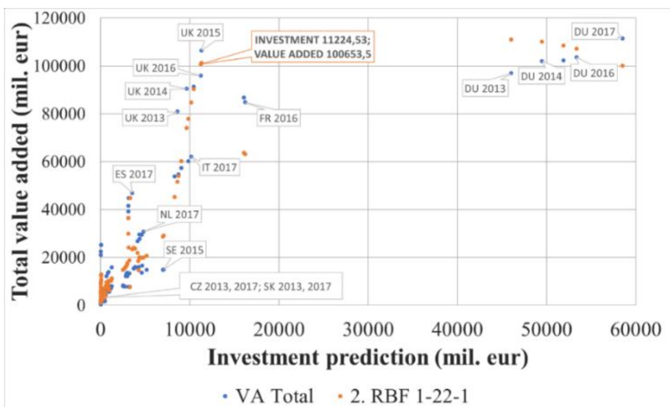

Figure 7. Selected neural network №2. RBF 1-22-1

Source: Authors

In the analysis of the most successful neural network №2, it was found that the most efficient ratio of investments in research and development in the transport sector is achieved at the level of investments of 12,000 mils. EUR. In terms of the efficiency of the investments made, it was the United Kingdom that achieved the optimal values in the year 2015.

On the basis of the results obtained, it was possible to answer the research question: What is the optimal ratio between the added value and investments in the transport sector of the EU28 countries?

The optimal ratio of investments in research and development in the transport sector was achieved at the level of investments of 12,000 mils. EUR. The country closest to the given optimum was the United Kingdom, whose investments in R&D in 2015 achieved 11,299.81 mils. EUR, while the generated value added achieved 106,374.4 mils. EUR. The values predicted by the Statistica programme were as follows: the level of investments in R&D was 11,224.53 mils. EUR, the related value added generated was 100,653.5 mils. EUR. Brexit (the United Kingdom leaving the EU) in 2020 meant that the European Union lost one of its member states as well as the second-largest value-creator in the European trade.

According to the analysed data, another country that has managed to get closer to the optimum is France, geographically situated close to the United Kingdom, which operates regular ferry service to the British Islands.

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In terms of the transport sector, Germany is the country which generates the highest added value; however, compared to the UK, it invests 4 times more money while achieving only 9% higher added value. Higher investments in the given state are connected with advanced technological development but also with high wage and tax costs. Nevertheless, despite the highest achieved value added, the level of investments in Germany is 4 times less optimal than in the case of the UK.

All EU member states can be divided into three groups according to the generated value added in the transport sector within the monitored period (2013 – 2017): states with low added value (0 – 4 000 mils. EUR), medium added value (4 000 – 8 000 mils. EUR) and high added value (8 000 – 12 000 mils. EUR).

In the monitored period, the Czech Republic increased the generated added value from 5702.4 to 7061.3 mils. EUR; in the Slovak Republic, it was the increase from 2508.6 to 2760.0 mils. EUR. These insignificant improvements rank the Czech Republic and Slovakia among the countries with a low generation of added value.
The comparison of the EU28 countries showed big differences in generating added value in the member states. As part of the research, it was possible to determine to what extent the generated added value of the given state is dependent on the size of enterprises. Large enterprises created the most added value for their state in all EU28 countries under review.

This research builds on the previous research (Kostiuk & Korená, 2020), where the authors compared the impact of investments in R&D on the added value of the EU28 in the sectors of construction and manufacturing. The results of their research indicate that in the construction sec-tor, the optimum was achieved by Great Britain by investing 11.3 billion EUR, while in the manufacturing sector, it was France with the level of investments of 11.42 billion EUR.

The method of regression analysis using neural networks corresponds with the pro-posed model; it was able to make a precise prediction of the given values (the share of in-vestment and added value) in the future. Since no computer technology is able to precisely predict a possible financial, ecological, or health crisis, even the method of neural net-works is not able to make predictions with 100% accuracy.

Therefore, a question arose in the research on the accuracy with which the method of regression analysis is able to predict the development of added value e.g. during the COVID-19 pandemic and in the period after the pandemic. By answering the research question, it would be possible to verify the accuracy of predictions made by the Statistica programme for periods of crisis.

Conclusions

Mobility is a basic principle of the European transport policy. Transport services ac-count for up to 4.3 % of the added value in the EU (European Commission, 2019).

Evaluation of the objective achieved. The objective of the contribution was to deter-mine to which extent the investment in research and development participated in generating the added value of the EU28 countries in the transport sector between 2013 and 2017. The objective formulated was achieved using the method of regression analysis of neural networks. The selected method enabled us to find the optimal value in the share of the investments made and generated value added of the EU countries. Based on the results of the method used, it was concluded that the optimal share of the investments in research and development in the transport sector was achieved at the level of investments of 12,000 mils. EUR. The best results in terms of the effective use of investments were achieved by the United Kingdom in the year 2015, when investing 11,299.81 mils. EUR generated the value added of 1299.81 mils. EUR.

Limitations of the research. When trying to achieve the objective formulated, we encountered the problem of missing statistics of some countries as well as delayed publishing of the Eurostat data. It is assumed that the EU countries use the same methods for calculating the statistical data on the investments in R&D and added value. The limitation of the applicability of the results can be the fact that each country has different priorities in terms of transport, which is related to its objectives and geographical location; the optimum found is thus an indicative optimum for investments in a specific country, not a general recommendation for all other states.

Applicability in practice. In practice, the results of this research will be beneficial for the individual states in terms of comparing their competitiveness in the global market with the generated value added. The outputs of the research will be applicable also in in-vestment budgeting of companies in R&D in the transport sector in order to ensure the model of sustainable mobility of the European transport sector. The given research will also help researchers dealing with the field of transport, R&D investments, and added value of the EU states.

Further research. The potential of the given topic for further research is confirmed also by the fact that the verified method of regression analysis using neural networks is able to predict the future development of the added value of the countries with relatively high accuracy. Further research in this field could verify the accuracy of the predictions made using this method concerning the development of added value in times of crisis (e.g. in the case of financial or health crisis caused by the COVID-19 pandemic and in the aftermath of the pandemic). The transport sector, in relation to the closure of the economy, restricted movement and travelling of persons during the pandemic crisis, is assumed to be one of the sectors both negatively and positively affected by the pandemic. The transport sector as one of the main economic sectors will need a major restructuring and a cash injection in order to ensure its efficiency, usability, and eco-friendliness, i.e. the transport sector needs to prepare for the humanitarian and environmental crisis, which is expected in the globalized European and global society after the pandemic.

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