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Article

Use of the Value Chain in the Process of Generating a Sustainable Business Strategy on the Example of Manufacturing and Industrial Enterprises in the Czech Republic

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Abstract: This paper presents a method of generating a business strategy using value chain analysis. There were 186 manufacturing and industrial enterprises from the Czech Republic. The analysis was carried out using mathematical–statistical methods (dimensional reduction, logit regression and its transformation in order to objectify the opinion level of the managers) and with a neural network in terms of validation of the results of the mathematical–statistical methods. The aim was to determine the significance of different parts of the value chain in terms of their impact on the profitability of an enterprise and to demonstrate its important role in the process of generating business strategy. The significance for the profitability of the enterprises was statistically proven in the area of scientific and technological development, input logistics and human resource management. These parts were identified by the authors as the golden triangle of manufacturing and industry. Purchasing and output logistics were identified as the parts with a negative impact to the profitability of the enterprises. Strong underestimation of scientific and technological development by the top managers of the manufacturing and industrial enterprises is seen as a very negative finding. Neural networks showed higher statistical sensitivity compared to the mathematical–statistical methods (dimensional reduction and logit regression). They defined the value sector chain with the following structure (ranked from the highest degree of positive impact on the profitability of the enterprise): human resource management, scientific and technological development, production, input logistics, purchasing, material management, output logistics, enterprise infrastructure, marketing and sales, service and other supporting services. In conclusion, it is stated that the sector value chain of manufacturing and industrial enterprises will be further decomposed into value chain models of specific industries of the production and industry, such as engineering and construction, intended for direct use in different business entities to generate their unique value chains and corporate strategies.

Keywords: value chain; business strategy; profitability; competitiveness; sustainability; competitive advantage

1. Introduction

The impact of a new paradigm related to the introduction of new information technologies, innovation, and digitization processes taking place in the internal environment of enterprises is increasingly reflected in business practice [1–3]. Such changes, however, are not followed by appropriate changes taken by the enterprises in the enterprise architecture, including the generation of corporate strategies. Scientific institutions, including universities, need to play a crucial role in addressing this limiting issue in terms of sustainability of enterprises.

The current state of scientific knowledge in the field of corporate strategy creation, its structure, form and implementation, together with its decomposition into partial strategies including the methods of its implementation, is described as inconsistent and difficult to use in business practice.

The authors of this paper were directly confronted with such a negative and worsening situation in the framework of cooperation with business practice, in particular with top business managers. A similar situation arises in the educational field at universities, where the requirements of enterprises for knowledge and skills competences of university graduates in a number of areas, especially in the field of strategic management and decision making of companies, differ considerably from the content and form of teaching of courses related to business strategy. These facts have become the main accelerator and motivation to start our research activities and write this paper. This paper focuses on one of the possible approaches to creating a business strategy, using a value chain, with the aim of contributing to the above-mentioned paradigm in business management.

2. Literature Review

Demir et al. [4] and Dagnino et al. [5] notice an increased pace of change in the current business environment disrupting established industry practices, stating that increasing the speed and intensity of process changes might have a profound impact on business strategy. The gradual digitization of the strategy is mentioned by Wirtz, Pistoia and Ullrich [2], and digitizing business models are also mentioned [2,3,6]. Major changes are also taking place in the world and the European market ring, including the internationalization of trade [7,8], ending globalization and beginning glocalization, together with geographic changes in terms of economic world centers [9,10]. What is important, however, is that these changes disrupt the existing competitive advantage of enterprises [11]. Borshchevska [12] states that, like any complex phenomenon, competitiveness is factor-based or rather factor-dependent. For this reason, there are a myriad of ways to define competitiveness depending on the factors preferred [12].

The resources and concepts of building a competitive advantage have been analyzed and discussed in detail for many years and other new exploitation strategies are proposed, some of which, for example, Adamik and Nowicki [13], are more accurate, others less, confusing the enterprises in relation to the strategic steps the organization should follow. Strategy itself has been studied as an implicit management concept since the 1950s and has always been primarily aimed at gaining a competitive advantage, which may be one of the keys to corporate sustainability [14]. The pressure on enterprises to operate sustainably will gradually increase, requiring enterprises to adopt a systemic approach that integrates all dimensions of sustainability, creating value not only for the customer but for all stakeholders (including the society or the environment) [15,16].

For the projection of corporate strategy, enterprises use strategic situational analysis (SSA) of varying degrees. The internal and external business environment is analyzed and evaluated through the use of the internal and external strategic analyses and the output is a basis for the formulation of corporate strategy. Wang [17] states that the enterprises mostly do not process strategic analyzes themselves because of their time-consuming nature, using rather the services of external organizations, which, however, tend to be very costly. Downey [18] describes that all analytical tools rely on historical, backward data extrapolating future assumptions, and he points out that caution is important when interpreting their results, as the results may be affected by prejudices and pressures within the enterprise. Frost [19] and Knott [20], on the other hand, argue that strategic analysis tools and techniques support the strategic thinking of managers, reduce the risk associated with their decision-making and are the starting point for strategic management activities. According to an internal survey by the authors, strategic analysis tools are used by about a quarter of the enterprises in the Czech business environment, compared to more than 50% of enterprises [21] globally, by the survey of Gunn and Williams [22].

Many authors (including the authors of this paper) believe that generating a corporate strategy based on a number of internal and external analytical tools is starting to fail in the corporate sector [21,23–27]. The authors agree that this traditional approach (the use of SSA) provides only a retrospective view of the competitive position of the enterprise and shows above all the financial nature of the performance. Kennerley and Neely [27] note that the shortcomings of traditional approaches have revolutionized corporate strategy generation.

Porter's scientific work marked a turning point in the perception of corporate strategy generation [28–30]. M. Porter speaks of corporate strategy as a competitive strategy and describes a different procedure for generating it. It underlines the strong importance, role and role of the model of five competitive forces and the value chain, defined as a powerful tool to break down a business into strategically important activities that result in higher prices or lower costs [31]. The value chain analysis is a tool for understanding the activities that create the business value. It helps the enterprises identify their position and analyze value chain activities, and to eliminate the activities that do not add value to the product or service [32]. Porter's value chain assumes that an enterprise is a system of inputs, transformation processes, and outputs. Each activity in the system involves the acquisition and consumption of resources. The way an organization performs value chain activities determines the costs and profits [33,34]. The value chains of the enterprises in different industries are different, and also different value chains are created by the enterprises in the same sector. Such structure depends on the strategy of the enterprise and corporate traditions [35]. The value chain approach is a method of decomposing an enterprise into strategically important activities, while the overall logic of creating a value chain with generic categories of the activities is valid in all industries [28,36].

The concept of the value chain was also discussed by many other authors, such as Hill and Jones [37], Robbins and Coulter [38], Mallya [39], Feller et al. [40] and Bedeley et al. [41]. McGuffog and Wadsley [42] notice that the profitability of enterprises depends both on the structure of the industry, and on the value that the enterprise creates over its competitors. Understanding whether an enterprise has the potential to create added value and whether it can use it in the future is an essential step in diagnosing its potential [43]. Feller et al. [40] describe that by implementing primary and secondary activities, the business entity creates a value that customers are willing to pay for, and if that value exceeds the costs incurred for all activities carried out, the business entity becomes profitable.

McPhee and Wheeler [44] discussed the value development and noted that in the context of economic globalization and concepts such as offshoring, outsourcing, brand marketing and the knowledge economy, the rankings of values have changed dramatically in last twenty years. They consider the name and reputation of the business entity and its skills and abilities (goodwill) to be the new sources of value added. Both Porter and Magretta [31] take a different view, disagreeing with the managers who talk about how skills and competences create value. According to them, it is the activities that completely decide whether a business entity has a competitive advantage or not. The experience of famous companies in terms of value chain theory resulted in these organizations being often subject to radical restructuring in both primary and ancillary activities, causing high volatility and a challenge for market competition, and significant changes in supply chain structure [45,46].

The authors respect and do not trivialize the importance of strategic situational analysis. However, they are in favor of M. Porter's view and consider the value chain analysis, including the analysis of the internal structure of the sector, as the primary approach in developing a competitive business strategy. Only the business strategy, generated in this way, ensures the required competitiveness and sustainability for an enterprise in the new geographic and economic–economic context of the world, Europe, region and municipality.

Two research hypotheses are formulated in the research:

Hypotheses (H1): *The sector value chain is the first step in generating a sustainable business strategy.*

Hypotheses (H2): *Dimensional reduction method and logit regression including the use of neural networks are suitable methods for value chain analysis with production and economically sustainable outputs.*

3. Material and Methods

Research dealing with the issue of strategy management and decision making, strategic situational analysis and the use of its most common analytical tools to generate corporate strategy in Czech enterprises started in 2016.

It was carried out through an extensive questionnaire survey, where the target group consisted of the top managers of the enterprises. Before starting the field survey, the questionnaire was assessed by the representatives of the business community and representatives of the scientific community of the relevant field. In order to ensure the quality of the research, the interviewer team was set up and trained, and the research was conducted both on the basis of direct personal questioning and electronically. The trained interviewing team comprised 21 interviewers. A total of 70% of the enterprises completed the answers using a contact questionnaire and 30% were done electronically. More than 15% of the questionnaires were discarded due to incorrect and incomplete answers. The research was carried out in the period of economic growth, so that the profitable enterprises are the most common in the sample.

The sub-sample of 186 industrial enterprises used in the research is a part of the total sample of more than 550 business entities for the sectors of production and services from the whole Czech Republic. Its size and sectoral categorization corresponds to the structure of enterprises in the Czech Republic with a significant prevalence of the SMEs.

The methods of dimensionality reduction [47,48], regression analysis (general linear model) [49] and its transformation were used to test the significance of individual components of the value chain and for the objectification of the responses of the top managers of the sample enterprises. Neural networks were used to validate the results obtained from dimensional reduction calculations.

3.1. Dimensionality Reduction

This method estimates the dimension and central subspace of the general linear model. That is, to find the p x d dimensional matrix B of the minimum value of d such that

$$F(y\,|\,x) = F(y\,|\,B'x), \qquad (1)$$

The calculation of dimensionality reduction is based on the inverse distribution of $F\ (x \mid y)$. The statistical software "R" was used for the calculation and the calculation method of dimensional reduction known as slice inverse regression (SIR) was used. This method uses information from the inverse regression curve to produce a weighted analysis of the major parts to identify the effective directions of the dimensional reduction.

3.2. Generalized Linear Model

GLM expresses the relation between the explained variable and the set of explanatory variables (regressors) using a regression function, which is a linear function of unknown estimated parameters. This function is usually called the link function. Using the Statistica software, a logit model was used where the explained variable has either a binomial distribution, known as a logistic regression, or a multinomial distribution, known as a multinomial logit model.

$$\mathrm{X}\beta = \ln\left(\frac{\mu}{1-\mu}\right) \qquad (2)$$

with:

The **X matrix** of the independent variables (regressors, covariates) is $n \times \mathrm{p}$. Its j^{th} column is labelled as $\mathbf{X}_{\mathrm{J}}$.
$\boldsymbol{\beta} = [\beta_1, \ldots \beta_p]^T$ is the vector of the parameters.
The response is the column vector of the random variables, type $n \times 1$, means $\boldsymbol{y} = [y_1, y_2 \ldots y_n]^T$.

The random part of the model is of a vector of the expected value $E(Y) = \mu$ type $n \times 1$ and the covariance matrix of $cov(Y)$.

Linear predictor **η** is the system part of the linear model, as follows:

$$\eta = \sum_{j=0}^{p} x_j \beta_j, \tag{3}$$

with $\mathbf{x_j}$ as the j^{th} column of **X matrix,** i.e., the vector $n \times 1$.

3.3. Transformation Model

In order to compare the data reported by top managers and the results of a logit model that is optimal against profit maximization, estimates of the model's regression parameters were transformed into the scale used by the top managers in their responses.

The value chain was transformed in the following way:

$$\widetilde{\beta_j} = (\beta_j - \min_{i=l,\dots p} \beta_i) / (\max_{i=l,\dots p} \beta_i - \min_{i=l,\dots p} \beta_i),\ j = 1, \dots, p, \tag{4}$$

The values of transformed estimates have the same range as the values reported by the managers. By comparing the average of the values given by the managers and the transformed value chain estimate, the percentage difference between reality and the optimal model was obtained.

3.4. Neural Networks

The calculation used Statistica software, version 12, from DELL, using the neural network datamining tool in particular. The "automated neural networks" tool was used for the calculation. The dependent variable was the profit and the independent variable was the HRZ—value chain. The data was divided into three groups:

1. Training: 70%,
2. Testing: 15%,
3. Validation: 15%.

The random seed value was set to be 1000.

Sub-sampling was random. Multilayer perceptron networks (MLP) and radial basic function neural networks (RBF) were used to determine the appropriate classification neural structure. In the case of multilayer perceptron networks, the minimum number of hidden neurons in the hidden layer was set to two and the maximum number of hidden neurons to 25. For RBF, at least four neurons were used in the hidden layer. The maximum number was not set.

Both the hidden layer and the output layer of the neural structure were determined as activation functions:

1. Identity:

$$f(x) = ld\ x, \tag{5}$$

2. Logistic function:

$$f(x) = \frac{L}{1 + e^{-k(x - x_e)}}, \tag{6}$$

3. Hyperbolic tangens:

$$S(t) = \frac{1 - e^{-t}}{1 + e^{-t}}, \tag{7}$$

4. Exponential function:

$$f(x) = b^x + c, \tag{8}$$

5. Sinus:

$$f(x) = sinx, \tag{9}$$

In the model, 10,000 neuron structures were generated and five of them with the best characteristics were used. The error was measured by the sum of the least squares and by entropy. If each other trained network did not show a significant improvement, the training was terminated. Other settings were default. Finally, a correction was made using the VNS tool [50].

If the network performance was high in all three samples (test, training and validation), i.e., higher than 0.7, the top managers behaved in their decisions quite rationally. If the performance ranged from 0.5 to 0.7, the managers behaved mostly rationally. However, if network performance was less than 0.5, the managers acted irrationally.

4. Results

The results from dimensional reduction in terms of significance of value chain value factors are as follows. The following equation was used for the calculation:

$$\begin{aligned} Dr(formula = \quad & HV \sim VSTUPLOG + VYROBA + VYSTUPLOG + MARK + SERVIS \\ & + NAKUP + VTR + RLZ + PINF,\ data = MS,\ MVP,\ method = \text{"sir"}) \end{aligned}$$

Variables of the value chain:

VSTUPLOG—input logistics, VYROBA—production, VYSTUPLOG—output logistics, MARK—marketing and sales, SERVIS—repair and other services, NAKUP—purchase/material management, VTR—scientific and technical development, RLZ—human resource management, PINF—enterprise infrastructure, MVP—production and industry, HV—profit/loss.

Using the method of dimensional reduction, a positive impact on the profitability of business entities was found for scientific and technological development and input logistics, and for human resource management to a lesser extent. These factors are considered to be dominant in terms of value-added creation.

However, another issue is related to their real use in business practice. Scientific and technological development is generally considered to be an accelerator of the national economy; a statistically significant result for this part of the value chain is considered as rather favorable and a theoretically positive finding.

Similarly, two related indicated parts of the value chain are characterized this way, as the importance of input logistics for the manufacturing and industry sector is unquestionable (it is dominant for many business entities, especially for complex, demanding and highly innovative products) in generating the added value.

Such positively important parts are summed up into the golden triangle of the manufacturing and industry sectors in the current market environment. The golden triangle is not fixed and its validity is limited by the developmental stages of the economy and the interaction of competitive factors in the competitive ring of the industry. It can be said that it is a basic prerequisite for generating unique value-creating processes in an enterprise and its competitiveness.

Purchases and partly also output logistics were found to be negative parts affecting the profitability. Purchasing results are explained by price volatility in the area of raw materials resources and the creation of new raw materials centers in Europe and in the world, and also by the increasing market competition for production inputs in some industries such as engineering, plastics, chemicals and the food industry.

Output logistics in this sector is currently focused mainly on strengthening final inspection due to the ever-increasing demands of customers on product quality.

Environmental issues are also at the forefront, i.e., ensuring production that will not endanger different parts of the environment. In the future, operations related to the storage and shipping of finished products will continue to be subject to automation and robotization processes to streamline output logistics within the enterprise. Based on the above-mentioned, it is possible to expect strengthening and refurbishment of output logistics and its even closer connection with input logistics in the long term. In this sector, the differences between input and output logistics will be eliminated gradually and business logistics will be ensured as one process component in two access levels.

In the following part of the research, the calculation was performed using the general linear model and its transformation. The following equation was used to calculate the optimal model:

$$\begin{aligned} glm(formula &= ZISK \sim VSTUPLOGF + VYROBA + VYSTUPLOG + MARK + SERVIS \\ &+ NAKUP + VTR + RLZ + PINF + VELPOD,\ family \\ &= binominal(link = \text{“logit”}),\ data = MVP \end{aligned}$$

Variables of the value chain:

VSTUPLOG—input logistics, VYROBA—production, VYSTUPLOG—output logistics, MARK—marketing and sales, SERVIS—repair and other services, NAKUP—purchase / material management, VTR—scientific and technical development, RLZ—human resource management, PINF—enterprise infrastructure, MVP—production and industry

By comparing the results in Tables 1 and 2 (dimensional reduction of the value production potential of the enterprises and its optimal model), it sees three parts of the value chain in terms of positive significance in input logistics and scientific and technological development and negative significance in purchasing. In this case, the commentary on the results of Table 1 is fully valid. As noticed before, the research took place in a period of strong economic growth, and it is assumed that such economic reality significantly affects the dominance and weakness of the different components of the value chain. This is particularly noticeable in the optimal model, which has precisely defined time validity. In the growth period, the importance of input logistics as an organizational tool and scientific and technological development as an innovative tool is increasing naturally. A further comparison of the above tables shows that the human resource management component contained in Table 1 is not represented in the optimal value chain model.

Table 1. From the dimensional reduction in terms of the significance of the value-creating factors of the value chain.

Value Chain Activities	Dir1 Manufacturing and Industry
Input logistics	0.46983
Production	0.12189
Output logistics	−0.21121
Marketing and sales	0.02312
Repair and other services	−0.05822
Purchase	−0.41119
Scientific and technological development	0.62247
Human resource management	0.37053
Enterprise infrastructure	0.14844
Input logistics	0.46983

Source: authors.

Table 2. Value chain model.

	Estimate	Std. Error	Value	Pr(>|z|)
(Intercept)	0.66333	0.53480	1.240	0.2148
Input logistics	0.78793	0.42570	1.851	0.0642 *
Production	0.34257	0.44925	0.763	0.4457
Output logistics	−0.17256	0.42135	−0.410	0.6821
Marketing and sales	0.15658	0.36556	0.428	0.6684
Repair and other services	−0.03553	0.39430	−0.090	0.9282
Purchase	−0.72805	0.38936	−1.870	0.0615 *
Scientific and technological development	1.62826	0.79296	2.053	0.0400 **
Human resource management	0.62573	0.51448	1.126	0.2239
Enterprise infrastructure	0.22014	0.56030	0.393	0.6944
Size of enterprise: micro	−0.60972	0.59206	−1.030	0.3031
Size of enterprise: middle-sized	−0.36661	0.45623	−0.804	0.4216
Size of enterprise: large	−0.29715	0.53138	−0.559	0.5760

Signif.codes: 0.01 ‘**’ 0.05 ‘*’ 0.1 ‘ ’ 1; Source: authors.

The identified output fully confirms the previous statement that when the value of the company, production and efficiency grows, human resources are increasingly involved until they are exhausted and become the limit of the existence and sustainability of the enterprise. This situation occurs both in the Czech and in other European economies.

The results (Table 3) show a strong underestimation of scientific and technological development, which is a general trend in the entire Czech national economy.

Table 3. Transformed optimal value chain—-“error rate” of the managers.

Value Chain Activities	Transformed VC Values	“Error Rate” of Managers
Input logistics	0.6433694	0.2240146
Production	0.4543599	−0.3735971
Output logistics	0.2357435	−0.2266221
Marketing and sales	0.3754306	−0.08693502
Repair and other services	0.2938995	−0.02330477
Purchase	0.0000000	−0.3548387
Scientific and technological development	1.0000000	0.8655914
Human resource management	0.5745327	0.3487262
Enterprise infrastructure	0.4024020	0.2411117

Source: authors.

Despite the ever-increasing financial and material investment in science and research by both the government and the private sector, the transfer of actionable outputs to business practice is not significantly increased and the Czech enterprise are lagging behind in this respect (with some generalization). Objectively, it should be stated that 2019, and especially the following years, might become a turning point in such a negative situation. When arranging the research projects and grants to research organizations and the Academy of Sciences, business practice requirements are increasingly respected and directly formulated by them, reporting a fundamentally different approach from the previous period.

Such a negative business experience has contributed to the emergence of a negative attitude of managers towards research organizations in the past. The outputs also show that to a lesser extent, human resources, closely related to scientific and technological development, are underestimated and both components are mutually dependent. The human resources are previously discussed in Tables 1 and 2; in addition to the above comments, another aspect is emphasized, namely their quality, where the professional and uniform skills of the managers, including their competencies, grow significantly in line with the growing technological and innovative maturity of the enterprises.

Neural networks were used to validate the results of the dimensional reduction, optimal model and its transformation. Furthermore, the results of the statistical methods were compared. In case of agreement of the results and slight deviations the results are considered credible.

Considering 10,000 neural networks, five best multilayer perceptron networks were kept (Table 4). The performance of the training, testing, and validation datasets is above 70. All networks were created using the Quasi-Newton (BFGS) algorithm. Entropy is used as an error function for networks 1, 2, 3, and 5; and the sum of squares for network 4. Considering the activation in the hidden layer of neurons, the exponential function is used in the first and fourth networks, the logistic function in networks 2 and 5 and the hyperbolic tangent in network 3. Softmax was used to activate the output neurons for networks 1, 2, 3 and 5. For network 4, it is a logistic function.

Table 4. Chain active networks.

Overview of Active Networks (Data—Current State Calculation 2)								
	Name of network	Training perform.	Test perform.	Valid. per.	Training algorithm	Error function	Activation of hidden layer	Output activation fce
1	MLP 18-24-3	71.96970	74.07407	70.37037	BFGS (Quasi-Newton) 6	Entropy	Exponential	Softmax
2	MLP 18-16-3	75.75758	74.07407	74.07407	BFGS (Quasi-Newton) 13	Entropy	Logistic	Softmax
3	MLP 18-19-3	75.75758	77.77778	77.77778	BFGS (Quasi-Newton) 14	Entropy	Tang	Softmax
4	MLP 18-15-3	73.48485	74.07407	74.07407	BFGS (Quasi-Newton) 17	Sum.sq.	Exponential	Logistic
5	MLP 18-16-3	76.51515	74.07407	74.07407	BFGS (Quasi-Newton) 15	Entropy	Logistic	Softmax

Source: authors.

Table 5 shows that none of the networks can predict the correct negative economic result (loss). With some differences, networks can predict zero and positive economic results (profit). The best estimate of future zero earnings are revealed by network MLP 18-19-3 in 13% of cases; network 5 MLP 18-16-3 correctly estimates zero profit in 11% of cases. A detailed view of the results is given in Table 6.

Table 5. Chain substitution matrix.

Prediction	6HVSoucC (Substitution Matrix) (Data—-Current State Calculation 2)		
Category	**Samples: Training, Testing, Validation**		
	HVSoucC–1	**HVSoucC-0**	**HVSoucC-1**
1. MLP 18-24-3–1	0	0	0
1. MLP 18-24-3-0	0	4	5
1. MLP 18-24-3-1	9	38	130
2. MLP 18-16-3–1	0	0	0
2. MLP 18-16-3-0	0	10	5
2. MLP 18-16-3-1	9	32	130
3. MLP 18-19-3–1	0	0	1
3. MLP 18-19-3-0	1	13	5
3. MLP 18-19-3-1	8	29	129
4. MLP 18-15-3–1	0	0	0
4. MLP 18-15-3-0	0	10	8
4. MLP 18-15-3-1	9	32	127
5. MLP 18-16-3–1	0	0	0
5. MLP 18-16-3-0	0	11	5
5. MLP 18-16-3-1	9	31	130

Source: authors

Table 6. Chain summary of classifications.

		HVSoucC (Summary of Classifications) (Data—-Current State Calculation 2)			
		Samples: Training. Testing. Validation			
		HVSoucC–1	**HVSoucC-0**	**HVSoucC-1**	**HVSoucC-Total**
1. MLP 18-24-3	Total	9.0000	42.00000	135.0000	186.0000
	Correct	0.0000	4.00000	130.0000	134.0000
	Incorrect	9.0000	38.00000	5.0000	52.0000
	Correct (%)	0.0000	9.52381	96.2963	72.0430
	Incorrect (%)	100.0000	90.47619	3.7037	27.9570

Table 6. *Cont.*

		HVSoucC (Summary of Classifications) (Data—-Current State Calculation 2)			
		Samples: Training. Testing. Validation			
		HVSoucC–1	HVSoucC-0	HVSoucC-1	HVSoucC-Total
2. MLP 18-16-3	Total	9.0000	42.00000	135.0000	186.0000
	Correct	0.0000	10.00000	130.0000	140.0000
	Incorrect	9.0000	32.00000	5.0000	46.0000
	Correct (%)	0.0000	23.80952	96.2963	75.2688
	Incorrect (%)	100.0000	76.19048	3.7037	24.7312
3. MLP 18-19-3	Total	9.0000	42.00000	135.0000	186.0000
	Correct	0.0000	13.00000	129.0000	142.0000
	Incorrect	9.0000	29.00000	6.0000	44.0000
	Correct (%)	0.0000	30.95238	95.5556	76.3441
	Incorrect (%)	100.0000	69.04762	4.4444	23.6559
4. MLP 18-15-3	Total	9.0000	42.00000	135.0000	186.0000
	Correct	0.0000	10.00000	127.0000	137.0000
	Incorrect	9.0000	32.00000	8.0000	49.0000
	Correct (%)	0.0000	23.80952	94.0741	73.6559
	Incorrect (%)	100.0000	76.19048	5.9259	26.3441
5. MLP 18-16-3	Total	9.0000	42.00000	135.0000	186.0000
	Correct	0.0000	11.00000	130.0000	141.0000
	Incorrect	9.0000	31.00000	5.0000	45.0000
	Correct (%)	0.0000	26.19048	96.2963	75.8065
	Incorrect (%)	100.0000	73.80952	3.7037	24.1935

Source: authors.

Explanatory notes:

HVSoucC—1 negative results (loss)
HVSoucC-0 balanced results
HVSoucC-1 positive results (profit)

As revealed by Table 6, network 3 correctly estimates 30.95% of cases for zero profit and 95.56% of cases for positive profit. MLP 18-16-3 network correctly estimates 26.19% of cases with zero profit and 96.30% of cases with positive profit. In practice, network 3 is applicable. Table 6 is followed by the results of the sensitivity analysis (Tables 7 and 8).

Table 7. Value chain: summary of classifications.

Network	Sensitivity Analysis (Data—-Current State Calculation 2)						
	Samples: Training. Testing. Validation						
	RLZ	VTR	VYROBA	VSTUP LOG	NAKUP	VYSTUP LOG	PINF
1. MLP 18-24-3	1.049400	1.243114	1.048622	1.081940	1.029558	1.016740	1.039805
2. MLP 18-16-3	1.783906	1.572670	1.245523	1.351343	1.359443	1.408332	1.425715
3. MLP 18-19-3	1.702912	1.803558	1.396182	1.298427	1.261572	1.232405	1.321617
4. MLP 18-15-3	1.477925	1.406646	1.342680	1.287669	1.228830	1.150128	1.032551
5. MLP 18-16-3	1.589430	1.481737	1.414520	1.397936	1.402258	1.367124	1.277908
Average	1.520715	1.501545	1.289505	1.283463	1.256332	1.234946	1.219519

Source: authors.

Table 8. Value chain: sensitivity analysis (second part).

Network	Sensitivity Analysis (Data—Current State Calculation 2)	
	Samples: Training. Testing. Validation	
	MARK	SERVIS
1. MLP 18-24-3	1.032285	1.003745
2. MLP 18-16-3	1.277958	1.083770
3. MLP 18-19-3	1.300687	1.134536
4. MLP 18-15-3	1.172191	1.111847
5. MLP 18-16-3	1.240417	1.087514
Average	1.204708	1.084282

Source: authors.

Explanatory notes:

VSTUPLOG—input logistics, VYROBA—production, VYSTUPLOG—output logistics, MARK—marketing and sales, SERVIS—repair and other services, NAKUP—purchase / material management, VTR—scientific and technical development, RLZ—human resource management, PINF—enterprise infrastructure.

Sensitivity analysis using neural networks showed significant agreement with the results of dimensional reduction, and partly with the regression analysis as performed, in the following parts: scientific and technological development, input logistics and human resources. Table 7a,b show that the first position of predictors affecting profit/loss is the human resource management, followed by the scientific and technological development, production, input logistics, purchasing, material management, output logistics, enterprise infrastructure, marketing and sales. Repair and other services were ranked as the least important. At the same time, the agreement in the outputs also indicates the suitability of the methods used for the analysis of the value chain.

5. Discussion

The results presented in this paper are aimed at verifying scientific hypotheses. These were based on the scientific direction which the authors of the paper fully respected in their scientific work, namely from Porter's scientific approach of creating competitiveness and value in the enterprise. There are many followers of such approach such as Hill and Jones [37], Robbins and Coulter [38], Magretta [31], Zhang [32], and Nagy et al. [35]. In general, it says that a business strategy is a competitive strategy. It also emphasizes the irreplaceability of the five competitive forces model and the value chain [51,52]. In order to test the first hypothesis, claiming that the value chain is the first step in generating a sustainable business strategy, the answer needs to be divided into two levels. It was confirmed in accordance with the research direction that it is possible to test the activities of the value chain for their impact on the profitability of the enterprise. It is possible to differentiate such activities, their dimension and the direction of their impact in terms of corporate sustainability.

The authors are aware that the outputs might be limited by the sectoral testing level. In further research, the authors consider it necessary, following the findings of the analysis of the value chain, to descend from the sectoral level to the level of different industries where several value chain models can be defined. Based on general industry-specific models, an enterprise can create a unique value chain that would provide the enterprise with a long-term sustainable competitive advantage and profitability. Here too, the theory of the irreplaceability of the sectoral level in generating a highly competitive business strategy ensuring the financial and economic sustainability of the enterprise and its stability is confirmed. The hypothesis is considered confirmed together with the scientific direction of its definition.

Regarding the second hypothesis concerning the suitability of the use of mathematical and statistical methods and neural networks for the analysis of the value chain with production and economically sustainable outputs, its confirmation by the following outputs is proved.

The methods used are suitable for testing the value chain and demonstrate the agreement of the results and corresponding level of sensitivity. The neural networks show higher sensitivity. The researchers assume the use of methods verified at this first sectoral level and also at the industry level. The requirements for outputs from the sectoral analysis of the value chain are given by the requirements of the business sphere itself, meaning their direct usability in generating the corporate strategy. In particular, the authors of the paper consider the refinement of the input information requirements together with the process of the analysis for the industry level. Within this hypothesis, it is proved that these methods are suitable for testing the enterprise production flows.

6. Conclusions

This paper presents a new approach designed to generate sustainable corporate strategies. Traditional approaches that use situational analysis methods fail in current business practice. This approach cannot be rejected in principle, however it is considered outdated and its methods are seen as the diagnostic, signaling and pre-analysis stages of the analysis of value-creating business processes itself.

A competitive advantage, and a competitive position generating lower costs than a competitor and higher selling price with higher margin is fulfilled and realized within the value chain activities. Achieving competitive advantage and long-term corporate profitability and prosperity means being original and unique both in the product portfolio and at the same time in the management of the corporate value and the material flow, only possible within the value-generating business components and processes.

The customer is the most important part, and their decision is essential for the following production process as they see the offer by the prism of its value (price, quality and attractiveness), however it must be unique as well as the way of its realization in the business subject.

The results as discussed in the paper at the sectoral level can be perceived as method and methodological verification and pre-accession stage before the industry analyses.

The results of the research are summarized in the following way:

- Possibility and appropriateness of the value chain analysis based on Porter's definition of the competitive forces proves to be a perspective analytical method in strategic management and decision-making, in particular in generating sustainable corporate strategies.
- The analyzed agreement in the outputs indicates the suitability and applicability of the tested analytical methods (dimensional reduction, regression analysis and neural networks).
- The nature and form of the results, although at the sectoral level, make it possible to express an opinion on their possible use directly in the practice, provided the methodological procedure is simplified and the relevant user software for the industry level is created.
- Neural network sensitivity analysis showed significant agreement with the outcomes of mathematical–statistical methods (dimensional reduction and regression analysis), considered to be a positive promise for similar analyzes in specific industries.
- In the current market environment of industrial enterprises, the dominant value creation activities using dimensional reduction are related to the scientific and technological development, input logistics and human resource management. These factors are defined by the authors as a sectoral golden triangle, which is not fixed and its validity is limited by the developmental stages of the economy and the interaction of the competitive factors in the competitive ring of the relevant sector and the industry with the assumption of its long-term stability in general.
- Regarding the neural networks in terms of their higher degree of sensitivity, a value-generating sectoral chain with a structure is defined (ranked from the highest degree of positive impact on the

profitability): human resource management, scientific and technological development, production, input logistics, purchasing, material management, output logistics, enterprise infrastructure, marketing and sales, and repair and other activities.
- Negative parts of the value chain (intersection of the dimensional reduction and the neural networks) include purchase (price volatility in the area of raw materials resources, emergence of new economic centers, intensified market competition) and output logistics resulting from increased output control due to increasing customer demand for product quality and increasing emphasis on the environmental issues related to the production process and its sustainability.
- The underestimation of the scientific and technological development was proved, as the long-term negative situation in this area in the Czech Republic was confirmed. This finding is in line with real business practice; however it is in a complete contradiction with the declared government policy in the field of transfer of scientific knowledge to the business sphere and with the new innovation strategy of the Czech Republic 2019–2030.

Regarding the results, the following recommendations are produced for the next research period:

- Use the same analytical method at the industry level and choose the appropriate sample of enterprises;
- Develop the detailed methodology for collecting and adjusting input information in accordance with the requirements of the analytical methods;
- Set precise assessment criteria for each part of the value chain;
- Develop a unified methodology for the presentation of the results of the value chain analysis;
- Ensure the same share of profitable and non-profitable enterprises in the sample;
- Know the parameters of the corporate environment in all its parts (micro, mezzo, and macro) to generate a sustainable strategy.

The authors of the paper continue to test the creation of the competitiveness of the enterprises using the analysis of value-generating flows. Under the conditions of the Czech Republic, and also some other EU countries, the authors are not aware of scientific work focusing on the research of generating a sustainable corporate strategy using the value chain. The necessity and urgency of the issue arises from the increasingly intense competitive environment both within the European and world economic competition area.

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