

# STRATEGIC MANAGEMENT AND PERFORMANCE OF ENTERPRISES EVALUATED USING CHAID DECISION TREE ANALYSIS

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**Abstract:** *The proposed paper deals with the relation of strategic planning and economic performance of Czech and Slovak industrial enterprises based on questionnaire research results processed by CHAID decision tree model. The relations between the selected parameters were focused and statistically tested on a sample of 254 industrial enterprises active in the Czech and Slovak Republic in the years 2009-2011. The hypothesis was formulated and evaluated with the goal of clarifying the mutual relation between the strategic planning and performance of the examined enterprises. The chi-square analysis was used as the primary statistical method. The findings show that the “successful branch” of the decision tree based on the parameter “annual turnover” leads through “written strategic document”. We can also find the implementation of ISO 9001 quality management system on the “successful branch”. The results can be interpreted as empiric ex-post confirmation of reasonability of thorough strategic planning and continuous improvement. These management branches are crucially underestimated especially in micro and SMEs. The findings confirm our previous research publications on this topic as well as other studies.*

**Keywords:** *Strategic Management, Business Performance, Enterprises, Chi-square, Decision Tree.*

**JEL Classification:** *D22, L2*

## Introduction

This paper presents mainly the interconnection between a strategic document form and turnover as the parameter of economic performance and some related phenomena. The primary motivation is to emphasise the necessity of managerial education and application of this knowledge in enterprises (micro and SMEs) to increase competitiveness. The specific goal of the paper is to prove the correlation of strategic planning and economic performance by CHAID decision tree method. The paper is organized as follows: First literature review emphasizing the influence of strategic planning and strategic document on overall business performance is presented. Then the methodology used, including data collection and analyses, and formulation of hypothesis are introduced. The results and discussion include graphical decision tree scheme and its interpretation, derived data tables and the most important conclusions are deduced and discussed.

## 1 Literature review and theory

The theoretical review focuses on scientific literature concerning strategy, formulated strategic document, and related management tools and their influence on business performance. Later, the concepts of different levels of strategic document are explained.

## 1.1 Strategic planning and enterprises performance

This chapter deals with the analysis of the scientific literature related to strategic planning and strategic document and their impact on business performance. The most important synthetic information is provided in Tab. 1. The focus is put on strategic management, strategic documents, and tools related to strategical analyses (SMART, PESTLE, five forces according to Porter, SWOT, and BCG matrix).

**Tab. 1: Literature sources – strategy, strategic document (SD), and performance of enterprises**

#	Author, year	Finding, causality
1	Analoui, 2003	SD increases the readiness of an enterprise for market conditions.
2	Andersen, 2000	SD is an important tool for the performance of an enterprise.
3	Anthony, p. 36, 2012	Reengineering of core capabilities → mastering of strategic innovation.
4	Brkic et al. 2011	Clear strategy, long-term planning → best quality management practice.
5	Drucker, 2008	SD is an absolute necessity and primary success condition of any business.
6	Dyer et al. 2011	Long-time strategic work → success in significant or disruptive innovation.
7	Ettlie et al. 2005	Strategy → predictor of adoption performance.
8	Frost, 2003	Approach to strategic management differs according to enterprise size. Bigger enterprises have often better and more elaborate written SD.
9	Hartz, 1998	Long term goals, management tools and frequent updating → core of SD. Bigger enterprises have a written SD more often.
10	Hussey, 1997	Small enterprise usually utilizes max. 2-3 strategic management techniques.
11	Johnson, 2006	Strategic document (SD) → specific competitive advantages.
12	Laforet 2008	Bigger enterprises → resources and infrastructure, Smaller enterprises → individuality and flexibility.
13	Lichtenthaler 2008	Strategic technology planning → firm performance in a knowledge-based economy.
14	Rudd, 2008	SD has to be actualized frequently to bring positive impact on enterprise performance.
15	Rumelt, p. 77, 2011	SD = diagnosis, guiding policy and actions.
16	Song, 2011	SD leads to better performance of enterprises, but planning process has to be sophisticated.
17	Stonehouse, 2002	Big enterprises → focus on strategic management tools. SD of a small firm is usually only an operational plan. SWOT analysis is the strategic tool with dominant occurrence.
18	Tapinos, 2005	SD → engine driving the enterprise towards its visions.
19	Temtime, 2003	Size → resources, investments, knowledge → strategic planning.

*Source: own processing by authors.*

Analoui and Karami describe some benefits of the implementation of strategic management in SMEs in the following points (Analoui, 2003): It helps to understand the current situation in which the business is located. It provides a clear insight into the vision and mission of the enterprise. It determines strengths and weaknesses, with emphasis on those strategically important for business activity. It contributes to identifying the right business objectives.

Andersen's study provides empirical evidence that strategic planning (where the emphasis is on conventional elements of the strategic management) is associated with higher performance in all the studied industrial environments. The resulting effect on the performance of strategic planning between the different sectors of activity did not

differ significantly. Therefore, strategic planning is an important performance tool in all areas of economic activity, which increases both economic performance and innovation and business development (Andersen, 2001). Existing enterprises that want to master strategic innovation have to carefully borrow some core capabilities, thoughtfully forget others and systematically learn some completely new skills – Vijay Govindarajan (Anthony, p. 36, 2012).

It can be inferred that the best quality management (integrating continuous improvement philosophy) practice is found in enterprises having clearly defined analysing strategy relying upon cost-based leadership with smaller-scale (continuous) innovations and good analytical capabilities, where managers are proactive, plan long-term and motivate employees, who are also proactive, having good personal relations, spirit of fellowship, and cooperation (Brkic et al. 2011). The current environment where enterprises of various sizes and sectors operate together is often described in literature as more dynamic, turbulent, and unpredictable. Especially in these defined terms, the existence of basic long-term development goals and guidelines appears to be an absolute necessity, a condition for the success of any business. We are talking about a strategic document, strategic planning, and strategic tools. Without the acceptance of this requirement, the enterprise is only responding to the incentives, instead of actively creating (Drucker 2008). Success in significant or disruptive innovation requires long-time strategic work and outlook in deep vision. Innovation advantage can translate into a premium in your enterprise's stock price – an innovation premium – that is possible only by building the code for innovation right into your organization's people, processes, and guiding philosophies (Dyer et al. 2011).

In many industries, external technology commercialization is critical for gaining and sustaining a competitive advantage. Opening up strategic technology planning therefore contributes to firm performance in a knowledge-based economy (Lichtenthaler 2008). While large enterprises have realized the importance of formal writing formulated, long-term planning, smaller enterprises do not necessarily point intentions and activities to the same depth and put the same emphasis on understanding and applying strategic management (Frost, 2003; Zakrzewska-Bielawska, 2005).

The key aspects of the strategic document are the long-term organizational goals, strategic use of management tools, and frequent updates. As Hartz and Kanji emphasize, smaller enterprises have the flexibility regarding the implementation of a new management philosophy and approach and this process does not take so much time. This leads to the fact that there is a direct relationship between enterprise size and existence of a strategic document in writing. Smaller enterprises are placing greater emphasis on operational planning, intuitive or informal planning activities, and short-term goals. They also pay little or no attention to improving the environment (Hartz, 1998). The number of strategic management methods, tools, and systems used by management in small businesses is very low. Hussey has identified nearly sixty different management strategic tools, methods, and techniques. The empirical data show that small enterprises use only two or three strategic managerial techniques in practice (Hussey, 1997).

While larger firms have the advantage of the availability of resources and systems, small businesses have the advantage of individuality. Also, decision-making processes are easier in smaller enterprises than in larger (Laforet 2008, Kraus, 2006). To place a positive impact on business performance, a certain flexibility in deciding changes in

strategic matters, such as products and services and their production and financial issues - capital and fixed assets (equipment), is needed (Rudd, 2008). For this reason, frequent updates of the strategic document are important. According to R. P. Rumelt, one of the most influential thinkers on strategy and management, the core of a strategy contains three elements (Rumelt, p. 77, 2011):

- A diagnosis that defines or explains the nature of the challenge. A good diagnosis simplifies the often overwhelming complexity of reality by identifying certain aspects of the situation as critical.
- A guiding policy for dealing with the challenge. This is an overall approach chosen to cope with or overcome the obstacles identified in the diagnosis.
- A set of coherent actions that are designed to carry out guiding policy. These are steps that coordinated with one another to work together in accomplishing the guiding policy.

Song's empirical research shows that more strategic planning and more new product development lead to better business performance. That is why strategic planning is a way of predicting turbulent business environment, a logical sequential process that is often described in the literature as really affecting the performance of the business (Song, 2011). Academics have a huge amount of models, methods, tools, techniques, and approaches that are available to support the processes of strategic management. However, almost all of these theoretical approaches focus only on large enterprises. Scientific publications severely lack focus on strategic tools customized for the management of medium and small or micro-enterprises (Stonehouse, 2002).

The most widely used management tool among small firms is SWOT analysis. Next are the evaluative tools of financial analysis and budgeting. SWOT analysis is a tool used by most enterprises of any size. (Stonehouse, 2002; Vaněk, 2014). Strategic planning can be defined as a process that is performed by an organization in order to develop strategies that contribute to performance and drive the organization toward its vision for future (Tapinos, 2005 Volberda, 2010). These conclusions based on the literature reflect an important fact - the lack of strategic thinking among top managers of small businesses. All cited results agree that the effort devoted to strategic planning process is critically low in small enterprises. Temtime explains this phenomenon rationally; increasing the size of the business means an increase in resources, investment, and expertise, which have a direct impact on strategic planning and management of enterprises (Temtime, 2003). Lazar et al (2012) introduce the importance of careful costing in strategy creation as well as its realization.

## **1.2 The form of the strategic document**

In terms of business strategy development, we can divide enterprises (including both SMEs and large enterprises) into three categories:

1. Enterprises that have a well-planned and detailed written primary strategic document. This document deals with important areas of enterprise organization such as human resources, market analyses and marketing goals, product development and innovation, technologies of production and services, logistics, quality and environment, budgeting, financing and payback, time schedule, risk evaluation, etc. Detailed strategic document should use modern management methods and techniques such as PEST,

Porter's five forces, marketing mix, SWOT, and others. The strategic document covers the future period of at least three years and is often compared with real situation and updated (at least once a year).

2. Enterprises that have a strategic document drawn up in some written but concise form, with insufficient details in all the important chapters. Many enterprises briefly address just their mission and vision and some partial strategic issues, such as production, marketing, or finances; however, other important chapters stay unelaborated. Such document often serves as a business plan for obtaining subsidies or loans, but hardly satisfies the internal strategic function.

3. Enterprises that have no written strategic document. It is never clear if the strategy is kept in the mind of top management (e.g. alone self-employed entrepreneurs), is partially a subject of the enterprise culture or does not exist at all.

## **2 Research materials and methods**

This section describes the original questionnaire research that provided data and the research process. A hypothesis is introduced, and the methodology of analyses based mostly on CHAID decision tree is described. The method of questionnaire survey was formerly used, for example, by Zimmermannova (2015) for the purposes of the analysis of decision making of Czech electricity and heat producers within the EU ETS. The results show that the EU ETS had no impact on environmental investments planning in Czech enterprises in the period 2013-2014.

### **2.1 Data**

The research project called "Adaptability of entrepreneurship", which created the data background for the presented article was realized during the spring semester 2012. A total number of 722 enterprises active in the Czech Republic (89%, including 64% from Moravia-Silesian region) and Slovak Republic (11 %) between 2009 and 2011 were interviewed. The interview protocol included a controlled dialogue between a questioner and an enterprise owner, an executive manager, or a top manager, so the collected data have the character of an experts' guess opinion. The initial sample of 722 enterprises was filtered and reduced to 677 credible subjects. Further filtration was realized in order to obtain a data group in which the subjects could be considered as industrial enterprises. The filtration included exclusion of micro enterprises with gross annual turnover less than CZK 10 million, exclusion of enterprises with less than 10 employees and exclusion of self-employed entrepreneurs – natural persons. For the filtration, industrial enterprises were specified (with compliance with ČSO) as those with NACE 05 to 33, which resulted in a data group of 254 valid items. NACE 05 to 33 covers these economical activities: B – Mining and quarrying (5 to 9) and C – Manufacturing (10 to 33). Based on the findings of the theoretical research, we carried out the following research:

### **2.2 The research processes**

The research process comprised the following components: (A) Defining the need for the research and the solved problem. (B) Formulation of the research objectives and the plan. (C) Theoretical research – analysis of literature and available information. (D) Questionnaire-based survey - primary data collection. (E) Data processing and analysis.

(F) Interpretation of the results. (G) Conference publishing activities – expert feedback. (H) Further data analysis and interpretation. (I) Advanced publishing - indexed journals, monographs.

### 2.3 Hypothesis

The following hypothesis was formulated: H1: Strategic planning correlates to business performance of the enterprises examined based on CHAID decision tree analysis. H0: non H1

### 2.4 Methodology of analyses

A decision tree consists of a set of hierarchical decision rules. Like a real tree, we say that the decision tree grows, has branches and is pruned. A decision tree consists of a root, which represents the entire subject, and through the gradual progress of branching to other nodes, the tree grows. The nodes that are not further divided are referred to as terminal nodes or leaves. Trees are binary or non-binary, depending on whether they branch into two or more branches. Among one of the most famous and widely used algorithms of binary trees belongs CART. In the presented case of analytical procedure, our team used the method CHAID (Chi-squared Automatic Interaction Detector).

This method was developed in 1980 by G. V. Kass. CHAID tree is often used in commercial spheres, especially in marketing (for example, the selection of target customers). CHAID tree is non-binary type; nodes can therefore be divided into a larger number of nodes than two branches. As the name suggests, the statistical criterion for branching is the chi-square test. Chi-square test is used to determine the independence of the PivotTable, that is, a combination of categories of a dependent variable and a predictor. If  $X$  and  $Y$  independently have the test statistics of Pearson's Chi-square distribution with  $\nu = (r-1)(s-1)$  degrees of freedom, where  $r$  is the number of rows and  $s$  the number of columns in the pivot table, independence in the pivot table means that both variables affect each other. The hypothesis of independence phenomena here is the null hypothesis  $H_0$ . Pearson's Chi-square test is often referred to as a test of goodness of fit (Kass, 1980).

The CART algorithm only creates binary trees, meaning that only two branches are from one node. Binary trees are usually more accurate than non-binary. The Gini index is used as the branching criterion. Strengths: The CART has a good use in the case of many input fields. It can quickly estimate the classification model. It also offers a booster method to increase classification accuracy. In addition to other algorithms it can work with both discrete and continuous outputs. The CHAID test uses the  $\chi^2$  test to select the most appropriate branch attribute, which implies that the input variable must be only categorical. Strengths: CHAID can create non-binary trees, it means that nodes can have more than two branches when splitting. Trees therefore grow more in width than in binary trees (QUEST and CART). CHAID is better for larger data files.

The branching of decision tree occurs via the calculation of CHAID adjusted  $p$  values. Chi-square test selects a predictor with the smallest adjusted  $p$  value for each of the merged class predictors using the Bonferroni correction. This predictor of optimally merged categories is used to split the node. If a significant predictor cannot be found, the node has been further subdivided. A further division may not occur as a result of the small number of observed cases that have not been distributed.

When analysing our sample, the following rules has been determined due to file size and clarity of output:

- Maximum/Maximum Tree Depth: 3 levels of branching.
- Parent Node (it branches out further nodes) must contain at least 20 observations.
- Child Node (it is already more node than branch) must contain at least 10 observations.

Since the aim was to explain the success of enterprises that we measured using variable sales development during the last three years and their three categories (decline, stagnation, and growth), the development of the turnover variable has been chosen as the dependent variable. To evaluate the dependent variable, we used the method of decision tree branch with other (independent) categorical variables, which included a questionnaire. Executing the Decision Tree with the original 254 observations gradually branched out with the help of six variables summarized in the inputs and outputs described in Tab. 2.

**Tab. 2: Categories of data for cluster analysis**

Inputs – Independent Variable	Outputs – Dependant Variable
Form of strategic document	Turnover (sales) from products/services
Implementation of ISO 9001	Total costs
Change in production	Profit

*Source: own processing by authors.*

The data were analysed and processed using Microsoft Excel and IBM SPSS statistic 11.5 software.

### 3 Results

The following chapter presents the most important results regarding the application of a decision tree based on chi square on the introduced data sample of Czech and Slovak industrial enterprises. The original data are illustrated by the decision chart, CHAID tables, comments, and discussion.

#### 3.1 Basic characteristics of the data group

More than  $\frac{3}{4}$  of the examined enterprises fall into group C – Manufacturing and other (incl. agricultural engineering) and B – Mining and quarrying active firms. In terms of size, roughly 30-40% are small enterprises, 20-30% are medium-sized enterprises and 15-30% are large enterprises. According to the turnover criterion, the rest are micro-enterprises (~15%). The criterion of number of employees does not match very well with the criterion of annual turnover in our data group, which indicates a relatively low turnover per capita in the regions of interest.

#### 3.2 Construction of the decision tree and the results

The graphical representation in Fig. 1 confirms the expected findings of whether the success of enterprises (sales performance over the last three years) is related to the form of strategic document. The adjusted  $p$  value assumes a value of 0.005, which is significantly less than the threshold value of 0.05. The branching out shows that

enterprises that have a strategic document elaborated in details reach an almost 20% higher turnover growth (growth rate 58.8%) than in the case of enterprises that have a brief or less formalized written strategic document (growth rate 37.9%).

The next level of branching shows that profit growth in all enterprises correlates with an increase in turnover, which is quite understandable. More interesting is the fact that was revealed by the third level of tree branching. Enterprises that have a written and detailed strategic document achieve a growth of profit and sales more often if they implemented QMS ISO 9000 series in their activities.

### 3.3 Successful tree branch results

The above mentioned conclusions are supported, with relatively high accuracy, by the CHAID model that works with the change in turnover with error estimate less than 20%, accuracy of the model is more than 80% on the level of statistical deviation of 0.025.

The following tables 3 to 8 show the basic statistical parameters such as frequency, valid percent, cumulative percent, and chi square value in nodes 0 to 12 and 16 to 17 of the “successful branch of the decision tree”. The changes in turnover and profit were chosen as the measure of success.

**Tab. 3: Change in turnover – node 0**

	Frequency	Valid Percent	Cumulative Percent	Chi Square
Valid Fall	82	32.3	32.3	
Stagnation	59	23.2	55.5	
<b>Growth</b>	<b>113</b>	<b>44.5</b>	<b>100.0</b>	<b>9.187</b>
Total	254	100.0		

*Source: own processing by authors.*

Tab. 3 characterizes the situation of change in turnover in the researched enterprises. Nearly half of the respondent enterprises (44.5%) achieved a growth in sales over the last three years. Stagnating sales were recorded by 23.2% of the respondent enterprises and a fall in turnover by 32.3%. Roughly one-eighth of the respondent enterprises (12.2%) recorded a growth greater than 30%

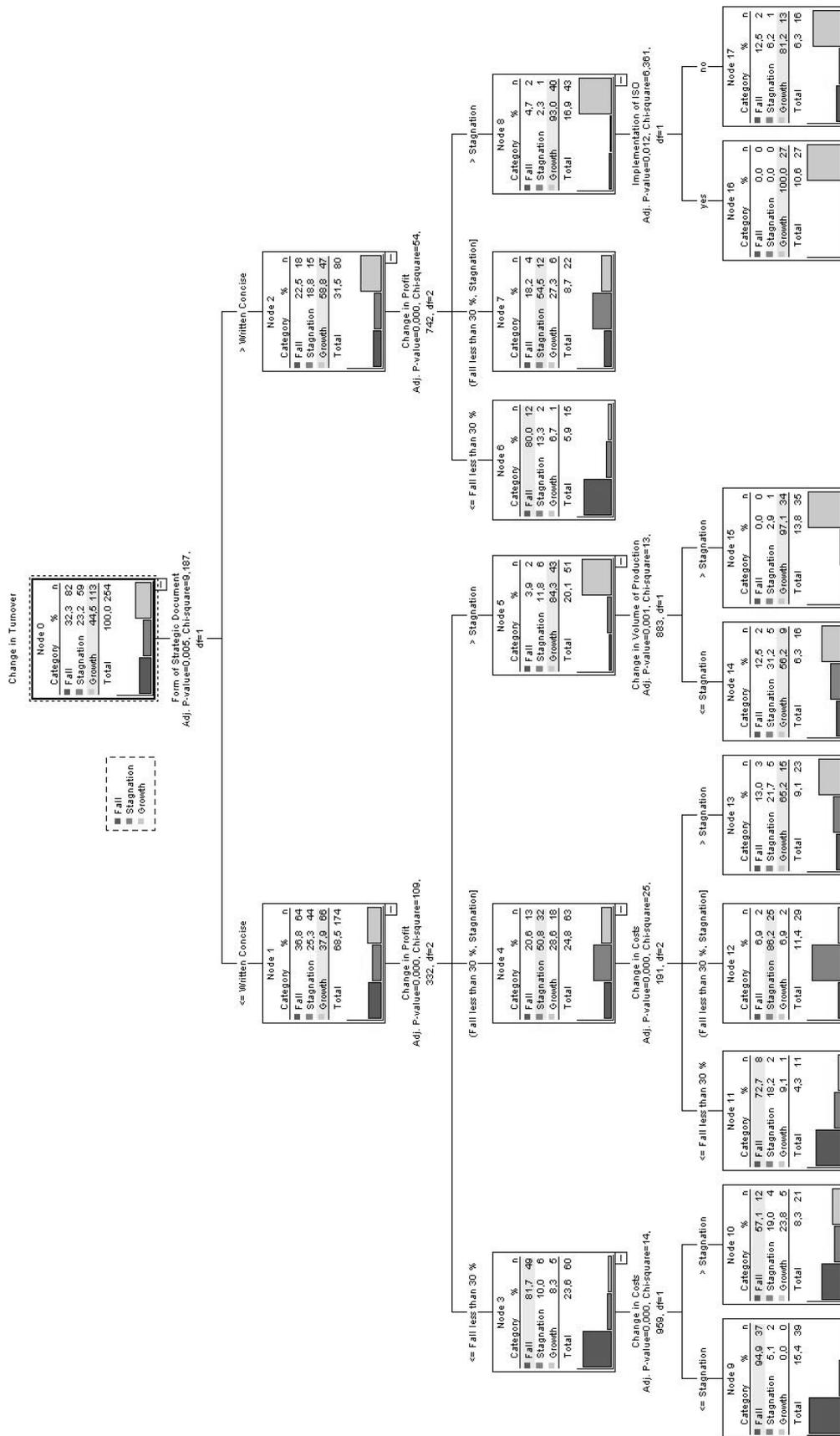
**Tab. 4: Form of strategic document – nodes 1, 2**

	Frequency	Valid Percent	Cumulative Percent	Chi Square
Valid Not written	52	20.5	20.5	
Written Concise	122	48.0	68.5	109.332
<b>Written Detailed</b>	<b>80</b>	<b>31.5</b>	<b>100.0</b>	<b>54.742</b>
Total	254	100.0		

*Source: own processing by authors.*

The impact of the form of the strategic document is apparent in Tab. 4. Almost half of the respondent enterprises (48%) work with strategic documents in written form, but only in brief, concise manner. Almost one-third of respondents/enterprises (31.5%) use a written, detailed strategic document. Chi square value suggests that written detailed form of strategic document leads more closely to enterprise success than other forms.

**Fig. 1: Decision tree, growing method: CHAID, dependable variable: change in turnover**



Source: own processing by authors.

**Tab. 5: Change in profit – nodes 3 to 8**

		Frequency	Valid Percent	Cumulative Percent	Chi Square
Valid	Fall >30%	18	7.1	7.1	14.959
	Fall less than 30%	57	22.4	29.5	
	Stagnation	85	33.5	63.0	
<b>Growth &lt;30%</b>		<b>65</b>	<b>25.6</b>	<b>88.6</b>	<b>13.883</b>
Growth >30%		29	11.4	100.0	
Total		254	100.0		

*Source: own processing by authors*

Tab. 5 confirms the expected relation between turnover and profit, where roughly ¼ of the researched respondent enterprises achieved growth up to 30%. Chi square value suggests that growth in turnover relates most to growth in profit up to 30%.

**Tab. 6: Implementation of ISO 9001 – nodes 16, 17**

		Frequency	Valid Percent	Cumulative Percent	Chi Square
Valid	No	106	41.7	41.7	6.361
	<b>Yes</b>	<b>148</b>	<b>58.3</b>	<b>100.0</b>	
Total		254	100.0		

*Source: own processing by authors.*

Tab. 6 presents the results concerning implementation of ISO 9001. The number of enterprises that implement the management standards ISO 9001 is slightly larger (58.3%) than the number of enterprises that are not administrated by ISO 9001 standards (41.7%). Chi square value suggests that ISO 9000 series implementation leads more closely to enterprise success than omitting it. The collected data show similar results as in the case of annual turnover and profit as well as in the case of trends of costs – see the following Tab. 7.

**Tab. 7: Change in costs – nodes 9 to 12**

		Frequency	Valid Percent	Cumulative Percent
Valid	Fall >30%	5	2.0	2.0
	Fall less than 30%	59	23.2	25.2
	Stagnation	72	28.3	53.5
<b>Growth &lt;30%</b>		<b>88</b>	<b>34.6</b>	<b>88.2</b>
Growth >30%		30	11.8	100.0
Total		254	100.0	

*Source: own processing by authors.*

## 4 Discussion

Discussions in theoretical literature of different geographical and economical origin show that proper strategic planning with the application of modern management tools clearly leads to better business performance in various forms. Our methodological approach allowed us to conduct ex-post research and analyses in Czech and Slovak enterprises. Our practical empirical research and analyses confirm the theoretical findings also in our native surrounding.

## Conclusion

To sum up, the objective of the study was to analyse and make more transparent the performance factors of business enterprises mostly in connection with strategic document from and turnover as the parameter of economic performance. The aim of the paper was to prove, by CHAID decision tree method, the connection between strategic planning and economic performance. The questionnaire contained many questions with categorical variable, and therefore it was decided that each pivot-table will be replaced in the output of the decision tree as a set of contingency tables converted into a graphical format output of decision tree analysis.

The hypothesis H1 was approved: strategic planning (specially structured and detailed) correlates to business performance of enterprises examined based on CHAID decision tree analysis as seen in Fig. 1 and Tab. 4. Nevertheless, there is no clear causality if strategic document influences enterprise performance or vice versa enterprise performance supports strategic planning. Even that their correlation is high, the causality is not proved by chosen method. The implementation of ISO 9001 supports better performance by reinforcing strategic planning. The main conclusion of the paper is that strategical planning as well as continuous improvement are very important factors close to business performance, however, the knowledge and utilisation of these methods still do not guarantee high performance, especially in SMEs. The novelty of the paper lies in the confirmation and specification of theoretical findings by the original data obtained in Czech and Slovak enterprises.

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