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ANITA BARBARA TOLNAY

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ANALYSIS AND MODELING OF THE COMPETITIVENESS OF SME DISTRIBUTORS IN THE HUNGARIAN LABORATORY ANALYTICAL MARKET

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ANITA BARBARA TOLNAY

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Doctoral school name:	Doctoral School of Economic and Regional Sciences
Discipline:	Management and Business Administration Studies
Head:	Prof. Dr. H.c. József Popp professor, correspondent member of the MTA Hungarian University of Agriculture and Life Sciences Institute of Economics
Supervisors:	**Dr Attila Lajos PhD** associate professor, PhD Hungarian University of Agriculture and Life Sciences Institute for Business Regulation and Information Management **Dr Nándor Komáromi, PhD** associate professor, PhD Hungarian University of Agriculture and Life Sciences Institute of Economics

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Approval of Head of Department

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Approval of Supervisor	Approval of Supervisor

Content

1. ANTECEDENTS AND OBJECTIVES OF THE WORK

1.1. Introduction, objectives

My research topic is a special, scientific, narrow segment market, the laboratory instrument and instrument market, the importance of which is given by analytical laboratory instruments supporting research and development and innovation, which greatly contributing the country's economic sustainability. My research's field is to examine the medium- and long-term competitive market opportunities of Hungarian micro, small companies acting as distributors of the international laboratory instrument manufacturers, covering the Hungarian analytical chemical laboratory market, as well as to explore and identify the influencing factors for measuring their competitiveness.

The Hungarian laboratory instrument market can be characterized by a small number of companies with a basic population of only 100-110 relevant Hungarian distributor companies. However, in terms of annual turnover (net sales), the market worth of more than a hundred billion, which, given the small number of market participants, results in strong, intense competition. Focusing on the evolution of market roles, I analyze and describe the content of necessary and possible competitive strategies to increase their share in a turbulent segment that is rapidly evolving in terms of technological innovations. During my sampling, I tried to achieve the highest possible number of samples, which helped in the representative examination of the laboratory instrument market.

The implementation of my research was greatly inspired by the fact that I have been working in the Hungarian laboratory instrument market for almost 20 years, which greatly helped to turn my empirical research into theoretical models and synthesize the cooperation of the three main segments in the market. The relevance of my research topic is also represented by the fact that it supports the research and development (R&D) of high importance at the technological level of the laboratory instrument market contributing economic growth and development, environmental sustainability as well as social responsibility. The scientific research work of my dissertation was basically determined by the above factors.

My choice of topic fell on this scientific field because the analytical laboratory technology market is one of the little-studied research areas from an economic aspect. An in-depth analysis and detailed elaboration of this topic has not yet taken place, although its topicality is unquestionable in terms of the current and future situation of the laboratory sector and the expected further strengthening of market competition. After reviewing the available international and domestic scientific research literatures, it can be stated that my work is pioneer, which endeavoured to give a comprehensive picture of the market position of supply chain members (instrument distribution companies, laboratory customers and international instrument manufacturers) in order to assess competitiveness. The present scrutiny was mainly provided by primary research qualitative and quantitative data and methods.

I compiled the theoretical background of the corporate competitiveness measurement procedure based on the methods processed and applied in international as well as Hungarian scientific publications (STANKIEWICZ 2002; MOROZ 2003; LIARGOVAS és SKANDALIS 2010; LALINSKY 2013; FLAK et al. 2015; AKBEN-SELCUK 2016; MAURY 2017). I structured the theoretical conceptual model of Professor SZERB's research group (2014), updated by integrating the specifics of the laboratory instrument market. The

main goal of my dissertation is to set up a competitive business model valid for the laboratory market supporting R&D for the first time. In order to complete the competitiveness measurement, I analyze in detail the other two players in the laboratory instrument market, the international instrument manufacturers, and the laboratory clientele.

Objective 1.
Exploring and analyzing the variables influencing the Hungarian laboratory instrument distributors' SME sector as well as the international laboratory instrument manufacturers, measuring and comprehensively examining their sector-specific factor characteristics and operating conditions, modeling and optimizing their operation in order to increase their efficiency.

Question 1.: Which areas and factors determine and influence the competitiveness of the laboratory instruments market? What methods are the most effective ones for analysing the aboves?

Objective 2.
Identification of factors influencing the motivation and performance promotion of sales professionals in laboratory instrument distribution companies.

Question 2.: Which factors play an important role in motivating salespeople? And what characteristics affect their performance?

Objective 3.
Identification of factors influencing the motivation and performance promotion of sales professionals in laboratory instrument distribution companies.

Question 3.: Which marketing communication tools prove most successful in targeting lab customers?

Objective 4.
Domestic overview of the laboratory instrument market supporting research and development in the light of current R&Đ activities level of the country.

Question 4.: How much progress has been made since the change of regime in R&D and in the number of laboratory researchers broken down by sectors (academic, higher education, and entrepreneurship)?

Objective 5.
Exploring the operational differences of the laboratory client sectors (non-profit, for-profit sphere).. Enumeration of factors influencing the laboratory customer-side instrument procurement decision and evaluation of the decision process.

Question 5.: What are the factors to be examined that influence customer purchasing decisions and what statistical method can be used to analyze them?

1.2. Hypotheses

During my research the following hypotheses were set up in order to achieve the objectives:

Hypotheses 1. (H1)
A multivariate linear regression model can be fitted to the competitiveness of the laboratory instrument manufacturer and distributor market, companies that are at a higher level of competitiveness are able to achieve higher profitability leading to more efficient operations.

I attemt to fit a model to the competitiveness of international manufacturers and domestic distributors of the laboratory equipment and instruments market by involving the influencing factors.

Hypotheses 2. (H2)
In the laboratory instrument market, the most determining factor of competitiveness is partnership cooperation, both on the side of international manufacturers and domestic distributors, and within this, a special role can be attributed to an exclusive contractual relationship.

Based on a multiple analysis of variance and a multivariate linear regression competitiveness model, it can be shown that several factors with the same content play a relevant role in the manufacturing and distribution segment, but partnership cooperation proved to be the most relevant, within that, the exclusive distributor right.

Hypotheses 3. (H3)
The results of the competitiveness studies, operational features, problems, limitations and shortcomings of laboratory instrument distributors operating in the SME sector are the same as the results of professional publications analyzing the SME sector widely. However, geographical segmentation does not affect the profitability of instrument distributors.

The results of the extensive competitiveness survey conducted by SZERB et al. (2014) in the SME sector well represent the competitiveness of the laboratory equipment and instrumentation market. The only exception is the geographical segmentation, which has no effect on profitability in the laboratory market.

Hypotheses 4. (H4)
The motivation of sales people greatly influences the companies' competitiveness, furthermore salespeople's performance varies by gender, age, education, and experience.

The effectiveness of developing an individually tailored motivational incentive system is more effective than a standardized method commonly applied to all employees. By examining the second part of the hypothesis, I endeavour to highlight the differences among sales people.

Hypotheses 5. (H5)
There are differences in the use of marketing communication tools used by the surveyed companies, but the importance of customer visits is the most significant sales promotion tool for all distributors.

The laboratory equipment distributors prefer sector-specific marketing activities, such as customer added value, professional application consulting, workshop, professional conferences, scientific publications, research reference sites, qualified professional opinion leaders, etc.

Hypotheses 6. (H6)
The increase in the number of R&Đ laboratories since the regime change is mainly due to the continuous expansion of the laboratory for-profit sphere. The number of researchers in all sectors (academic, higher education and business) is positively correlated with the increase in the number of R&Đ labs.

Hypotheses 7. (H7)
In the laboratory customer (buyer) side segment, the instrumentation and tender support of the for-profit and non-profit spheres are different, and the more optimal capacity utilization of laboratory instruments results in a more competitive laboratory market.

Hypotheses 8. (H8)
In the laboratory customer (customer) side segment, the elements of equipment and instrument procurement of the two spheres examined (procurement structure; centre; demand level; and licensing amount limit) are very different, and customers of different ages have different marketing communication tools (product catalogue, website, customer visits) are preferred for sales promotion.

During segmentation, customer demographic factors (age) have a special effect on sales decisions, during customer targeting, it is worth differentiating the use of marketing tools not only according to the sector affiliation of customers, but also based on the individual characteristics of customers.

Overall, this can be considered as the starting point of the doctoral dissertation, with the examination of which I formulated comprehensive conclusions and future proposals in order to increase the competitiveness of the laboratory instrument market. In my opinion, the new scientific results of my research can serve as a guide for laboratory instrument distributors and can be well adapted for practical application.

2. MATERIAL AND METHODS

2.1. Research methodology

I divide the literary background of my research into two parts from different sources (existing, available, literature collected from secondary materials, as well as from publicly available accounting and financial data). Prior to my research, I reviewed a number of domestic and international literatures in order to draw appropriate conclusions from the results obtained during the research. Each element was included in the sample independently; the sampling procedure used was random sampling.

By extending the elaborated literature approaches to competitiveness and its measurement and deepening the theoretical foundations, I tried to take steps to adapt the acquired knowledge to the laboratory instrument market business. From a methodological point of view, my research is mainly based on survey-type empirical studies. In order to measure the competitiveness of the laboratory instrument market, I undertook to capture the "input" factors affecting performance, I obtained the key "soft" data through the provision of questionnaire data. When measuring the competitiveness of laboratory instrument distributors, I contrasted the "soft" data obtained on the input side with the output type results as a target result.

During the examination of my research topic, I utilize secondary (domestic and international publications, studies of research institutes, information from dissertations, collection, systematization, processing of statistical data) as well as primary (participation in international trade fairs, in-depth interviews, questionnaires) sources.

2.1.1. Qualitative research

In order to explore the competitiveness of the laboratory instrument market, so as to compile the questionnaires for my quantitative research, I utilized unstructured, exploratory qualitative method based on small sample. In the three segments of the laboratory instrument market (international manufacturers, domestic distributors and laboratory customers) I gained the most effective data collection for deeper knowledge (MALHOTA 2008) through in-depth interview technique with the owners, managers and managers of companies. Furthermore, I used a focus group procedure to improve the performance-enhancing motivation of the sales professionals of the domestic distributors, which has the effect of increasing competitiveness. I performed the technique in a small number of closed groups of 4-7 people (colleagues to each other) per distributor.

2.1.2. Quantitative research

In the framework of quantitative research, I chose the closed, structured questionnaire survey, which mostly consists of five-level Likert-scale, interval measurement-scale variables. To compile my questionnaire, first of all I studied the results of previous research literature in detail. I collected and compared the most important domestic (SZERB et al. 2014) and foreign (FLAK et al. 2015; STANKIEWICZ 2002; LIARGOVAS and SKANDALIS 2010; CENTINDAMAR and KILITCIOGLU 2013) research results related to the topic of my dissertation, and also gained market knowledge during independent qualitative research, in-depth interview techniques with company owners and managers. When compiling the indicators in the questionnaire, I paid special attention to avoiding the redundancy mentioned by SZILÁGYI (2008), which leads to multicollinearity.

The essential features of my questionnaires are that I examined the three relevant segments with questionnaires included slightly different components in which the content composition of the manufacturer's and distributor's questionnaire and their research orientation built on almost identical elements, factors - 'pillars' (cooperation, human resources, marketing, and product and innovation pillars). The analysis of their market position and competitiveness are based on similar logical analysis, but in many parts segment-specific differences can be detected.

I examined the comprehensive competitiveness analysis of Hungarian laboratory instrument distributors with two different methods, firstly I took as a basis of the conceptual competitiveness model of SZERB Professor (2014) research group presented in the literature review, compiled from the pillars of the areas defining corporate operations, and the related statistical methodological calculations, secondly I structured my own multivariate linear regression model composed of factors generated by principal component methodology of factor analysis, principal component analysis.

The uniqueness of my questionnaire surveys stems from the fact that it collects comprehensive and complete information on the relationships within the company, between companies, and between the company and its environment from all three segments of the laboratory instrument market. That allows the possibility for assessing the internal operational consistency of instrument distributors and their attitudes towards the environment in the light of the declared objectives and self-assessments.

The compiled questionnaires cover the examined topic, which is intended to answer the research questions I have set up, and also describes the statistical methods I have used (Table 1., 2.,).

Table 1. Structure of the questionnaire for international manufacturers and domestic distributors

RESEARCH PARTS	*INDICATORS OF DISTRIBUTORS*	*INDICATORS OF MANUFACTURERS*	*STATISTICAL METHODS*	*HYPOTHESIS*
Competitive market situation	11	7	descriptive statistics, multiple variance-analysis, covariance-analysis	H2, H3
Cooperation pillar	5	6	multiple linear regression	
Human resources pillar	16	6		
Product- and Innovation pillar	5	11		H1, H2, H3, H5
Marketing pillar	9	4		
Strategic-decision pillar	6	0		
Financial situation pillar	6	0		

Source: Own research 2018, 2019

Table 2: Laboratory customer questionnaire structure

RESEARCH PARTS	*INDICATORS*	*STATISTICAL METHODS*	*HYPOTHESIS*
General data of laboratory customers	4	Descriptive statistics	H8
Customer satisfaction	31	Descriptive statistics, Crosstabs-analysis	H8
Purchasing decisions	15		H7, H8

Source: Own research 2018

The information necessary to prove the following hypotheses was obtained from a data source other than the above questionnaires and from a query of a qualitative procedural technique:

- I examined the fourth hypothesis (H4) belonging to the study of domestic distributors in the framework of qualitative research.
- To prove my sixth hypothesis (H6) belonging to the laboratory customer segment, I obtained the necessary data from the publicly available statistical data tables of the Central Statistical Office (CSO).
- The second part of my seventh hypothesis (H7) is supported by the results of my targeted research on the capacity utilization of analytical instruments in two spheres of the laboratory customer segment (non-profit and for-profit).

2.2. Definition of the research database, background of the data source

Prior to compiling my questionnaire, I defined the range of companies involved in the study, the core population, for all three market segments.

Domestic instrument distributors

The basic population of distributors operating in the domestic laboratory market can be up to 100-110 companies. The composition of the sample and the acquisition of data were greatly hampered by the lack of publicly available Hungarian statistics on the Hungarian laboratory instrument distribution segment.

I sent my questionnaire to 100 distributors operating in the domestic market by e-mail as well as in person, from September 2019 to November 2020. Following multiple resubmissions, 79 completed questionnaires were returned (Table 3). The return rate was almost 80%, which was also outstanding in terms of representativeness.

Table 3: Number of distribution companies by headcount category

Staff categories (persons)	*Enterprises*	
	no.	**rate (%)**
1-10	50	64%
11-20	16	20%
21-50	9	11%
51-100	3	3,8%
101-	1	1,2%
Total	79	100%

Source: Own research 2020

International instrument manufacturers

The population of international manufacturers of laboratory instruments and consumables in the European market is approximately 1400-1800 companies (in the absence of accurate statistics), based on official information available on the websites of the most important international trade fairs (www.analytica.com; www.achema.de; www.medica-tradefair.com).
I have contacted a total of 350 international manufacturers worldwide in person at international exhibitions and by e-mail. I conducted the survey from spring 2018 to November 2020. 234 completed questionnaires (192 producers from developed and 42 developing countries) were returned during this period, representing a response rate of 67%. A sample of around 20% of the sample I examined examines the core population.

Laboratory customers

The narrowed area of my research is analytical chemistry laboratories, the basic population of which is approximately one thousand. I conducted the survey trough semi-structured in-depth interviews mostly in person, and to a lesser extent through on-line and telephone interviews from the fall of 2017 to the spring of 2020. In compiling the indicators of my customer questionnaire, it contents the market-specific information obtained from in-depth interviews with customers and distributors. I sent out my questionnaire to 800 laboratories, of which a total of 502 completed were returned, 246 from the non-profit (49%) and 256 from the for-profit sector (51%) from the summer of 2019 to October 2020.

2. 3. Statistical methods used to analyze the data

Data collected from primary and secondary sources were examined using statistical analyzes. During the evaluation of the quantitative data, I used the SPSS statistical software package, where there were different methods to help me, which are the following:

- Descriptive statistic
- Multiple analysis of variance
- Curve Estimation regression
- Covariance-analysis
- Correlation
- Factor analysis (principle components analysis)
- Multiple linear regression
- Two-sample t-test
- Crosstabs analysis

3. RESULTS AND DISCUSSION

Formulating my hypothesis, I set the goal of covering the most relevant sub-areas of the competitiveness of the laboratory instrument market in all three relevant segments, in order to verify my theses. In the course of my research, I tried to explore the characteristics and difficulties of the small domestic distribution companies operating in the SME sector of the laboratory instrument market in as much detail as possible and, through this, examining the dominance and relevance of their position and role in the supply chain.

Hypotheses 1. (H1)
A multivariate linear regression model can be fitted to the competitiveness of the laboratory instrument manufacturer and distributor market, companies that are at a higher level of competitiveness are able to achieve higher profitability leading to more efficient operations.

I fitted a multivariate linear regression model to the competitiveness of international manufacturers and domestic distributors in the laboratory instrument market by including the influencing factors that I considered relevant. The research consisted of two overlapping statistical methodological studies in both segments (manufacturers and distributors). I reduced the number of original variables grouped into the pillars (cooperation, human capital, marketing, product and innovation) in the questionnaires by principal component analysis, as a result of which I obtained the following factors (Table 4.)

Table 4: Principal component manufacturing factors

Pillar	No. of factors	Factors	Total amount of variance
Human resource	**3**	The uniqueness of human resources	34,488%
		Character of employees	57,717%
		Quality of employees (knowledge, knowledge, experience)	**77,75%**
Cooperation	**1**	Cooperation	**62,018%**
R&Đ&I	**1**	R&Đ&I	**71,027%**
Product		Products' features	54,9%
		Price strategy	**71,413%**
Marketing	**3**	Value-added services	30,5%
		Value creation	51,030%
		Discounts available	**70,488%**

Source: Own research 2020

Overall, based on the Kaiser criterion, the explanatory power of the factors are high, with an average value above 70% explaining the variance.

To explore the causal links of the relationships, I attempted to fit a multivariate linear regression model to the distribution competitiveness of the international manufacturing market, including the variables used to measure the competitiveness of companies (dependent variables) such as European market share as well as turnover, and those variables that I assume determine the effectiveness of companies 'competitiveness (independent variables).

In my research, I examined the effect of the following dependent and independent variables:

Dependent variables
European market share
European turnover (%)

Independent variables
Uniqueness of human resources (H_1)
Character of employees (H_2)
Quality of employees (H_3)
Partners' cooperation
Products' feature (T_1)
Price strategy (T_2)
R&Đ Innovation
Value-added services (M_1)
Value creation (M_2)
Discounts available (M_3)

Table 5: Regression values for international manufacturers

Independent variables												
Dependent variables	**Constant**	**'p'**	**Human 3**	**'p'**	**Cooperation**	**p**	**Product 1**	**'p'**	**R&Đ &I**	**'p'**	**Marketing 1**	**'p'**
Market share	26,795	0,000	2,376	0,030	7,316	0,000	8,206	0,001	5,202	0,030	4,119	0,007
Turnover	37,286	0,000	3,252	0,004	7,41	0,000	8,227	0,000	6,618	0,010	4,356	0,006

Source: Own research 2020

The principal component analysis classified the domestic distributor pillars into the following factors (Table 6):

Table 6: Principal Component Distributor Factors

Pillar	**Faktorok száma**	**Faktorok**	**Összesített varianciahányad**
Human resource	**2**	The uniqueness of human resources	37,387%
		Quality of employees (knowledge, character, motivation)	**71,552%**
Cooperation	**1**	Cooperation	**67,205%,**
Product and innovation	**2**	Products' feature, development	**70,708%**
Marketing	**1**	Marketing activities	**63,824%**
Strategy, decision		Strategy, decision	**61,27%**
Financial situation	**2**	Liquidity	44,762%
		Performance	**80,786%**

Source: Own research 2020

Overall, the explanatory power of the factors are high, with an average value of almost between 60%-70% or above.

I examined the effect of the following dependent and independent variables on the laboratory instrument distributor market:

Dependent variables	**Independent variables**
Sales revenue per capita	Strategy, decision
Profit after tax per capita	Cooperation
ROE	Uniqueness of human resources
ROA	Quality of human resources
ROS	Liquidity
	Performance
	Product, innovation
	Marketing

The variables included in the multivariate regression models of domestic distributors, which p value showing a statistically significant correlation, are shown in Table 7.

Table 6: Significant variables of distributors' multivariate regression models

	Independent variables															
Dependent variables	**Strategy, decision**	**'p'**	**Cooperation**	**'p'**	**Uniqueness of HR**	**'p'**	**Quality of HR**	**'p'**	**Liquidity**	**'p'**	**Performance**	**'p'**	**Product innovation**	**'p'**	**Marketing**	**'p'**
Sales revenue per capita					3,8E+09	0,001					2,9E+09	0,480	3,1E+09	0,360	4E+09	0,003
Profit after tax per capita					3,9E+07	0,045					2,8E+07	0,056	3E+07	0,043	4E+07	0,003
ROS	0,26	0,003					0,016	0,06	0,014	0,036					0,193	0,100
ROA	0,251	0,030					0,017	0,042	0,018	0,013			0,216	0,050		
ROE	0,219	0,076					0,018	0,09	0,016	0,037					0,221	0,081

Source: Own research 2021

In the light of the above studies, I consider my first hypothesis (H1) to be accepted from both the manufacturer and distributor side, according to which the competitiveness of international manufacturers and domestic distributors can be modeled by multivariate linear regression.

Hypotheses 2. (H2)
In the laboratory instrument market, the most determining factor of competitiveness is partnership cooperation, both on the side of international manufacturers and domestic distributors, and within this, a special role can be attributed to an exclusive contractual relationship.

I analyzed the effect of exclusive contractual cooperation as an independent variable on the achieved market share as a dependent variable in international manufacturers with a multiway ANOVA, which showed a significant value ($p = 0.021$). On the domestic distributor side, exclusivity does not show statistically significant correlation ($p = 0.744$) to the percentage change in the net sales of distributors in the last 5 years (2015-2019 sales base ratio), only to the number of represented manufacturers ($p = 0.000$). Based on the multivariate linear

regression competitiveness model, I also proved that the partnership cooperation showed a significant result only on the international manufacturer's side, while on the domestic distributor side it had no effect on the dependent variable.

Taken the above research result into consideration, I **reject the statement of my second hypothesis (H2).**

Hypotheses 3. (H3)
The results of the competitiveness studies, operational features, problems, limitations and shortcomings of laboratory instrument distributors operating in the SME sector are the same as the results of professional publications analyzing the SME sector widely. However, geographical segmentation does not affect the profitability of instrument distributors.

H3.1. In contrast to the conceptual model of SZERB et al. (2014) implemented in the survey of broad-based competitiveness in the SME sector, outstanding competitiveness points were obtained in the segment operating in the narrow, closed, scientific laboratory instrument distribution SME sector. The laboratory instrument market is generally homogeneous.

In comparison to the results of the large-scale competitiveness survey of SMEs by SERB et al. (2014), where the lowest competitiveness score was only 8% of the maximum score available, while the highest achieved three-quarters of the scores, it can be stated that the R&D segment has an outstanding resource and operational background, which is set as a condition by the requirements of its laboratory customer segment.

While SERB et al. (2014) identified several particularly problematic areas, such as low education, lack of language skills, high turnover rates, low levels of training and cooperation, and insufficient innovation, not to mention the lack of use of marketing communication tools, the laboratory instrument distribution segment has high levels of human resources, low fluctuations and a high level of technical innovation (essential requirements in the market), as well as informative websites detailing technical specifications. I would highlight as further difference that while according to SZERB (2014) research group's survey, 40% of companies in the SME sector do not have any incentive scheme, most of laboratory instrument distributors have at least one (43%), 37% operate two types, and only 2% of do not have an incentive scheme at all.

In the light of all these research results, it can be stated that the results of the extensive competitiveness survey conducted by SZERB et al. (2014) in the SME sector do not show any similarities with the competitiveness of the laboratory equipment and instruments market.

According to the results, **I reject the first part of the third hypothesis (H3)**, as several differences of magnitude can be detected between the two researches.

H3.2. Using a multiple analysis of variance, I examined the market position of distributors, upon the percentage change in net sales of the last 5 years (2015-2019 sales base ratio) as a dependent variable, through the simultaneous effect of the following three independent variables: ownership background (Hungarian, foreign) ; company headquarters (capital, county seat, city, municipality); product portfolio (instrument, consumables). The result confirms that the effect of two of the three factors, ownership and product portfolio, indicates significant value ($p=0.000$ and $p=0.000$) on profitability. However, the registered office of the company does not affect the change in sales revenue ($p = 0.740$).

In the course of the statistical analysis, it was confirmed that the registered headquarters of the companies do not show statistically significant correlation with the turnover, so the second part of my third hypothesis (H3) is accepted.

Hypotheses 4. (H4)
The motivation of sales people greatly influences the companies' competitiveness, furthermore salespeople's performance varies by gender, age, education, and experience.

H4.1. In the framework of qualitative research, I used in-depth interviews and focus group techniques with sales professionals to demonstrate that the effectiveness of developing a customized motivational incentive system is more effective than a standardized method commonly applied to all employees. The development of the performance appraisal and motivation system set as the research goal followed the individual goals as well as the individual needs. The results of the qualitative study supported the first part of my fourth hypothesis, that from competitiveness' the point of view, it is much more effective to assess motivational needs of selling individual and implement them in practice.

Based on the study, **I accept the first part of the fourth hypothesis (H4).**

H4.2. My goal is to explore the differences among distributors, by examining the second part of the hypothesis. I examined the factors influencing the performance of the sales team (gender, age, years of study and professional experience) by covariance analysis, based on 3 years of sales data for 310 samples. 220 male and 90 female salespeople participated in the study. Based on my research, it can be concluded that the presence of middle-aged, over 40-year-old, experienced, highly educated male salespeople is dominant in the laboratory instrument distributor market. In the covariance analysis, the dependent variable remained the turnover value, I marked the gender of the salesmen as a fixed variable, while the number of years of study, age and years of professional experience of the salesman were added to the covariance values. The model also examined the effect of factor levels on each other, using an interaction method. The aim of the study is to screen for the impact of professional experience within gender.

According to the results of the covariance analysis, there is a significant difference between the different ages ($p=0.000$), gender ($p=0.000$) and number of professional years ($p=0.002$) of the salespeople in the available performance, with the exception of the number of academic years, which does not affect significantly the volume of sales of the sellers. The study shows that professional experience has a different effect when it comes to performance for different genders. Figure 1 shows that the line is much steeper for men, suggesting that men perform better and better with age. The information is of high relevance to strategic decisions for the companies' management.

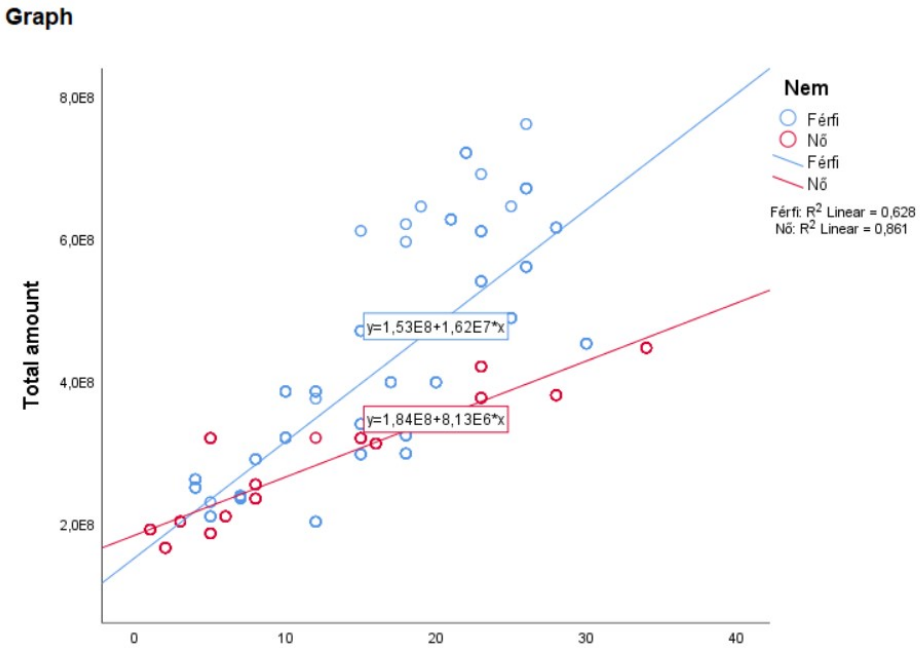

Figure 1: Sales experience of sales people by gender

Source: Own research 2019, SPSS Output

I accept the fourth hypothesis (H4) in the light of the two test results.

Hypotheses 5. (H5)
There are differences in the use of marketing communication tools used by the surveyed companies, but the importance of customer visits is the most significant sales promotion tool for all distributors.

The marketing communication tools used by distributors are shown in Figure 2. Customer visits were identified (22%) as the most effective marketing tool in the laboratory science market by the distributors taking part of the survey. 17-17% are followed by direct marketing (sending E-Blast) and internet marketing (displaying website promotions). PR activity (conferences, science days), as well as 1-2 weeks of non-mandatory testing of demonstration laboratory equipment are also a preferred tool. Advertising and sales promotion are not typical in the laboratory market due to the specialty of the devices. Cold calling is the least characteristic tool of the market. Scientific research and measurement instruments are sold on a trust basis with many years of experience as this segment requires special knowledge.

Based on the result shown in Figure 2, the fifth hypothesis (H5) is accepted that distributors consider customer visits to be the most effective sales promotion tool in the scientific market.

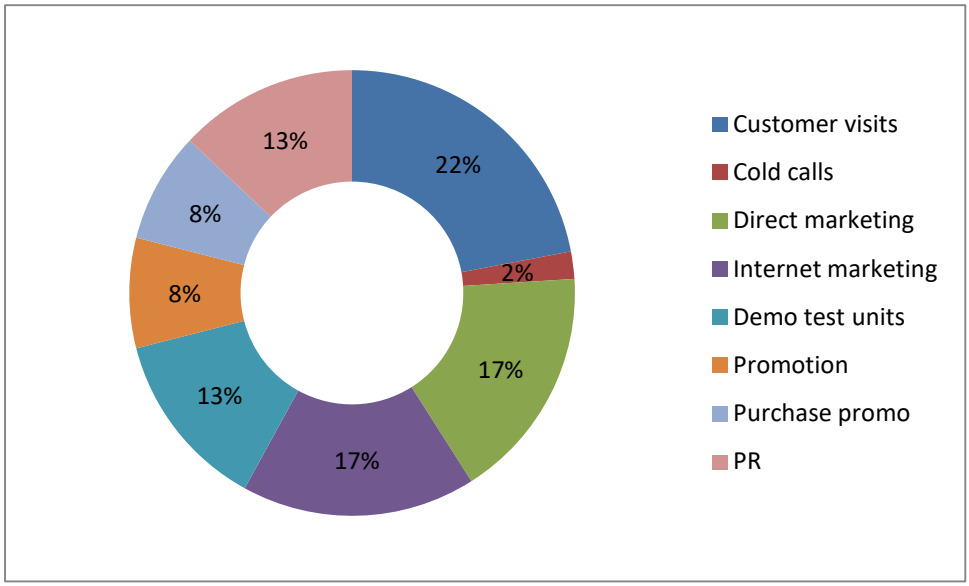

Figure 2: Marketing communication tools used by distributors

Source: Own research 2020

Hypotheses 6. (H6)
The increase in the number of R&Đ laboratories since the regime change is mainly due to the continuous expansion of the laboratory for-profit sphere. The number of researchers in all sectors (academic, higher education and business) is positively correlated with the increase in the number of R&Đ labs.

H6.1. The analysis assesses the general situation of domestic R&D by analyzing publicly available statistical data. I calculated the change of research and development places of the last three decades with a dynamic base ratio. Since the regime change, the number of research and development sites has tripled due to the drastic increase in the number of business R&D sites, more than tenfold. At the same time, the number of R&Đ institutes and other research sites, as well as higher education R&Đ sites, has stagnated since 1990. Figure 3 illustrates the trend line of the increase in the number of R&D sites. It can be seen that research sites have been growing overall since 1990, and a linear trend line with 92% accuracy can be fitted to this positive change. A similar direct function relationship can be detected at the enterprise R&Đ sites (R^2 = 0.938), however, the change in higher education research sites can be described by a polynomial function of the third degree. The figure also shows that the number of institutions ranged from 940 to 1331 during the period under review, and the number of R&Đ institutes has been stagnant since the change of regime. It can be stated that there is a close correlation between the total number of research and development sites and the number of private laboratories, higher education and research institutes do not influence the total number.

The study confirms **the validity of the first part of my sixth hypothesis (H6)**, according to which the number of Hungarian R&Đ sites has grown dynamically in the last three decades due to the laboratories of the for-profit sphere.

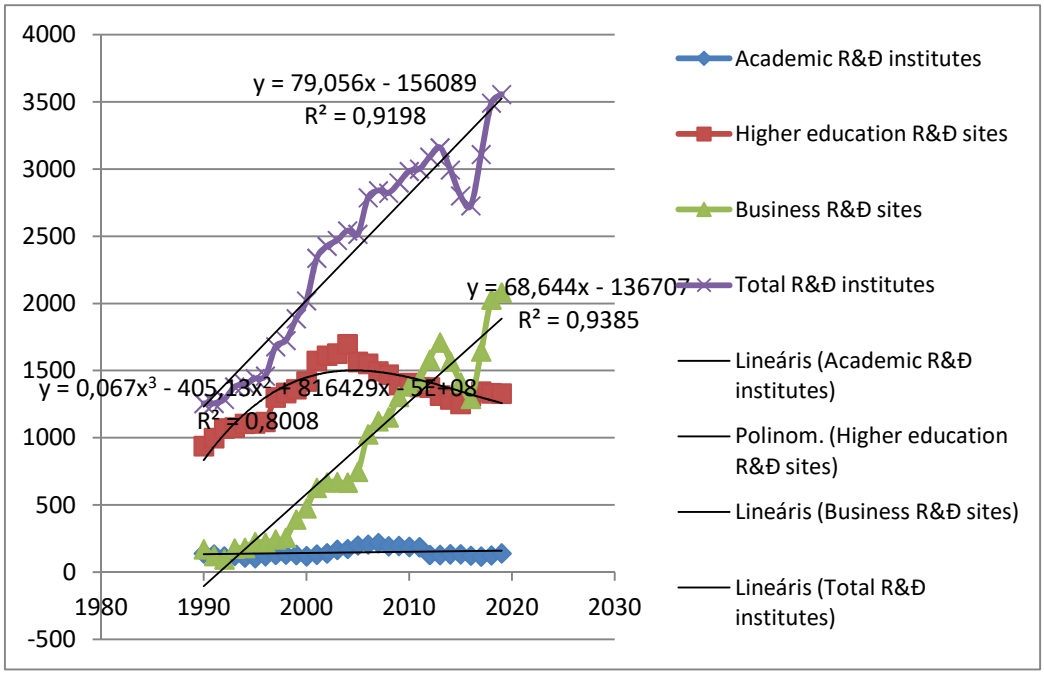

Figure 3: Development of the number of R&Đ sites by sectors

Source: Own research 2020

I assume a time series and regression relationship between the change of all R&D research sites as an independent variable and the development of the number of researchers as a dependent variable per sector and I examined this fit study with the Curve Estimation regression, which is summarized in Table 18 and illustrated graphically. In the corporate sector, the coefficient of determination (R^2 = 0.580) represents a stronger-than-average relationship value, so it can explain 58 percent of the total standard deviation, so the number of R&D institutions played a 58% role in the number of business researchers. In the case of the number of researchers in higher education, this proportion was very low, only 17.1 per cent, while in the case of researchers in academic laboratories it was 34.1 per cent. The F-test (38,727; 5,778; 14,509) showed statistically significant result for all three sectors (p = 0.000; 0.023; 0.001). The business sector has the greatest explanatory power, which also **supports the validity of the first part of my sixth hypothesis (H6)**, according to which the continuous increase in the number of R&Đ sites since 1990 is mainly due to the business, for-profit sector.

H6.2. Based on the Curve Estimation regression analysis, it can be concluded that while the number of business and higher education researchers is positively correlated with the number of R&D sites, in the academic sector this correlation is negative. In the light of the above results, the second part of my sixth hypothesis (H6) is only partially true, as the number of researchers in the business and higher education sectors is positively correlated with the total number of R&D positions, the same in the academic sector. **I reject the second part of my sixth sub-hypothesis (H6.2)**.

Hypotheses 7. (H7)
In the laboratory customer (buyer) side segment, the instrumentation and tender support of the for-profit and non-profit spheres are different, and the more optimal capacity utilization of laboratory instruments results in a more competitive laboratory market.

H7.1. I examined and compared the equipments of the laboratories and the European Union tender possibilities in the two spheres (NP and FP sectors). Firstly I conducted in-depth interview in the two sectors in order to explore the equipment of the surveyed laboratories as qualitative research, followed by structured questionnaire survey, which results summarized in Figure 4a. NP laboratories located on the outer circle, with poor laboratory equipment of 61% and a very low level well-equipped laboratories of a barely 3%, while in the for-profit sector, well-equipped laboratories are presented with 72%, and there is no poorly equipped laboratory among the survey ones in the FP sector. The spider web diagram on Figure 4.b. illustrates well the difference in device and instrumentation between the two spheres. The figure shows that the common section of the two spheres is the section of the axis representing the moderately equipped laboratories, followed by the 'poorly equipped' axis, while the for-profit sphere is represented exclusively by the 'well-equipped' axis.

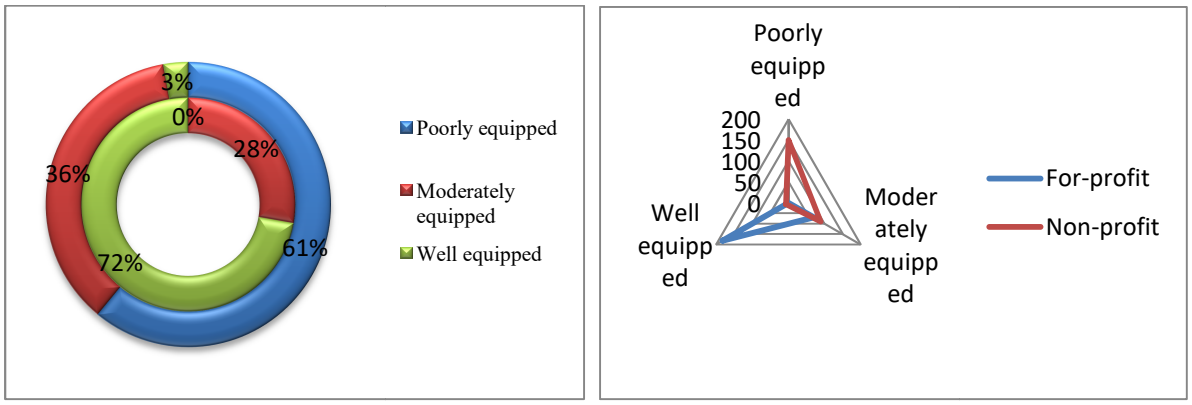

Figure 4: Pie chart (a.) and cobweb (b.) Diagrams of laboratory instrumentation

Source: Own research 2020

Nearly 80% of the surveyed laboratory customers had the opportunity to participate in public or European Union tenders, although to varying degrees, thus only 20% of the laboratories did not participate in any tenders in the period of 2013-2020. Four-fifths and almost 80% of the laboratories operating in the two spheres applied for Szechenyi 2020 Competitive Central Hungary Operational Program (VEKOP) and Human Resource Development Operational Program (EFOP) EU supports in the last 7-year cycle. NP, state-funded academic and higher education laboratories participated in the grant at a higher rate comparing to FP sector. Figure 5 illustrates the distribution of the laboratories' share of EU subsidies (EU (EIDHR, VEKOP and EFOP) and domestic resources (OTKA)).

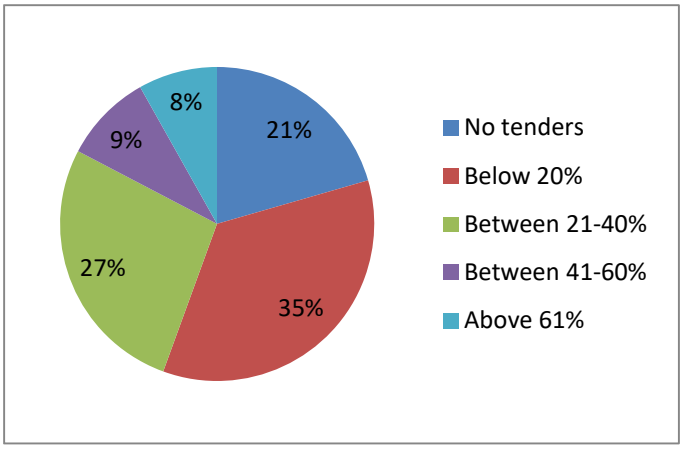

Figure 5: Proportion of EU and domestic grant grants in the laboratory sphere

Source: Own research 2020

Cross-tabulation analysis examined the statistical significance of the relationship between profit orientation and the two variables examined (instrument equipment and tender grants) using Pearson's Chi-square statistics. When examining the variable of laboratory equipment, it can be stated that the laboratories participating in the research as a whole to the following extent, 29.9% are weakly; 31.7% are moderately and 38.4% are well equipped. The results of the distribution of grant sources in the Pie Chart of Figure 5 are confirmed by the values obtained during the cross-tabulation analysis. According to the results of the study, the number of laboratories receiving grant support in the for-profit sector is much lower (0%: 19.1%; 1-20%: 42.6%; 21-40%: 32%; 41-60%: 6 .3%; above 60%: 0%) than in non-profit laboratories, where the application source used by laboratories in the four percentage categories is relatively evenly distributed (0%: 22.4%; 1-20%: 27 .2%; 21-40%: 22%; 41-60%: 11.4%; above 60%: 17.1%). State-funded laboratories are much more in need of external funding for their operations, which provides the background for their research activities.

In the light of the results of the above studies, it can be stated that **the first part of my seventh hypothesis (H7.1) was confirmed**, the laboratories have different instrumentation and tender support backgrounds in the two customer spheres.

H7.2. I presented the operational differences between the two main sectors, the non-profit and the profit sector, using a self-developed test method by measuring and evaluating the capacity utilization of a laboratory research instrument (chromatographic instrument) involving 40 laboratories (20 non-profit and 20 for-profit). The measurements were performed with the help of a questionnaire survey, using dead time indicators for a period of 12 months / year in 2018. During the analysis, I determined the laboratory time efficiency index of the instrument use by exploring the unused capacity and other time factors determining the possible spare capacity. 50% of the laboratories involved in the research are private, contract and pharmaceutical laboratories from the for-profit (FP) sector. *H7.2.* I presented the operational differences between the two main sectors, the non-profit and the profit sector, using a self-developed test method by measuring and evaluating the capacity utilization of a laboratory research instrument (chromatographic instrument) involving 40 laboratories (20 non-profit and 20 for-profit). The measurements were performed with the help of a questionnaire survey, using dead time indicators for a period of 12 months / year in 2018. During the analysis, I determined the laboratory time efficiency index of the instrument use by exploring the unused capacity and other time factors determining the possible spare capacity. 50% of the

laboratories involved in the research are private, contract and pharmaceutical laboratories from the for-profit (FP) sector. The other half were public (NP) spheres, mainly university laboratories. Most of the HPLC instruments involved in the research, mainly from laboratories belonging to central budget institutes, come from tender sources, while private laboratories usually procure their instruments from their own resources. I conducted my research in the form of a questionnaire and a personal interview with the laboratory managers to determine the productive and non-productive operating time of their HPLC instruments.

To measure the capacity utilization of the instruments, I used the individually modified formula below, developed by BÓNA et al. (2012) for the industrial production capacity utilization index (CUI - Capacity Utilization Index or η).

$$\mathrm{CUI_{lab}} = \frac{\mathrm{T_{productive}}}{\mathrm{T_{total}}} \cdot 100\ (\%) \quad \text{(Eq. 1.)}$$

Where CUI_{lab} is the capacity utilization index for an analytical laboratory instrument, T_{total} is the theoretical maximal annual working hours for the given HPLC instrument, $T_{productive}$ is for the practical measurement hours per year.

I examined measurement time, productive performance, and the capacity utilization index (CUI). I found significant differences in mean measurement times. To compare a laboratory measurement of the two sectors, I used a two-sample t-test. The result of the two-sample t-test ($t=7.468$, $df=38$, $p<0.001$) shows a significant difference in the mean value of the the average time of measurements between the two examined sectors. Much longer measurement time is detected in all laboratories operating in the NP sector, than in the FP. Based on the result of the F-test ($p <0.001$), the standard deviations are not identical.

Very similar results were obtained for unproductive times of the chromatography instruments compared to measure times. In case of NP organizations the unused time is quite high compared to FP's. The average time lost due to different reasons like instrument failures or lack of chemicals, in case of NP institutes was calculated for 772 hours but for FP companies only 171,8 hours, which is multiplied by four and a half times in favor of FP sector. The main reasons for the relatively high unproductive time were pointed out as well by the responders: the lack of order, the repair time of the instrument, the unfilled operator position, power outage and shortage of chemicals have caused mostly unwanted break in operation even for weeks. The result of the two-sample t-test ($t=10.309$, $df=38$, $p<0.001$; $F=4,373$) shows a significant difference in the mean value of the unproductive time between the two examined sectors. It can be determined that the average unproductive time for NP sector is almost four and a half time longer than for FP. The unproductive time (hours) is higher in NP sector than in FP sector in terms of operation.

The CU index (CUI) were calculated for each instrument according to Eq.1. The results are represented in Figure 6. The members of the for-profit sector have proved excellent CUI with average of 91,35%. In contrast the academic departments (NP's) average CUI was found only 39,15%.

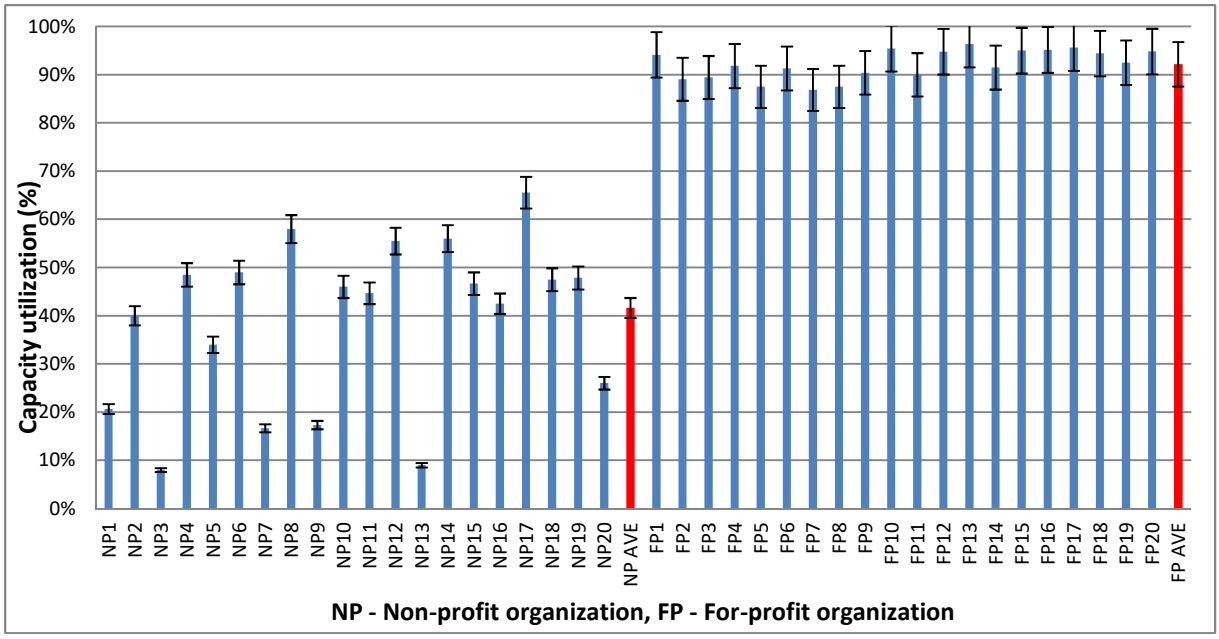

Figure 6. Calculated capacity utilization indexes for each organization

Source: Own research 2020

There are significant differences between the laboratories of NP institutes in terms of CUI results. The lowest result is 8%, while the highest is 65%. The result represents a deviation of 57%, which covers a high standard deviation. In contrast, the CU indexes of the FP companies are very close to each other at 90% of confidence level with the highest value of 96% comparing with the lowest of 87%, the gap is only 9% in total which means no significant difference have been found among them at significance level of 10%, (p=0,1). The result of the two-sample t-test (t=-12.83, df=38, p<0.001) shows a significant difference in the mean value of the CUI between the two examined sectors. Large fluctuations are observed in NP, while the value of FP's CUI can be said to be constant throughout.

Based on the test results, my second sub-hypothesis H7 was also proved, **so I accept my seventh hypothesis (H7)**.

Hypotheses 8. (H8)
In the laboratory customer (customer) side segment, the elements of equipment and instrument procurement of the two spheres examined (procurement structure; centre; demand level; and licensing amount limit) are very different, and customers of different ages have different marketing communication tools (product catalogue, website, customer visits) are preferred for sales promotion.

To prove Hypothesis Eight (H8), I examined the profit orientation affiliation variable of laboratory customers as well as the variables of the procurement elements (procurement structure, procurement center, procurement demand level, and procurement amount limit authorization) by cross-tabulation analysis. Using Pearson's $\chi 2$ (Chi-square) statistics, I

measured the statistical significance of the variable profit-making (non-profit and for-profit spheres) and the above variables.
H8.1. The value of Pearson's Chi-square is significant, based on which I assume that there is a significant correlation between the two variables in the four studies. The results of the study for each procurement element confirmed that the profit-orientation affiliation of the laboratories (non-profit, for-profit sphere) is related to the procurement factors (procurement structure, procurement center, initial level of procurement demand and licensing amount limit).
In the light of the above studies, it was found that **the first part of my eighth hypothesis (H8) was proved**, according to which the background of instrument procurement elements differs in the two customer spheres.

H8.2. I used a cross-tabulation analysis to examine the age difference of customers as well as the following marketing communication tools (presence of an informative website; printed product catalog and customer visit). The study results support that significant differences can be detected between age groups in the preference for the use of marketing communication tools. The second part of my last, eighth hypothesis (H8.2) has also been proved by presenting the above research results, segmentation can be done not only by considering different sectors (non- and for-profit), but also by making marketing communication tools even more effective by age.

In the light of the test results, **I accept my eighth hypothesis (H8)**.

During segmentation, customer demographic factors (age) have a special effect on sales decisions, during customer targeting, it is worth differentiating the use of marketing tools not only according to the sector affiliation of customers, but also based on the individual characteristics of customers.

The summary results of my hypothesis test presented are shown in Table 7.

Table 7. Summary system of hypotheses

OBJECTIVES	*HYPOTHESES*	*EVALUATION OF HYPOTHESES*
C1: Exploring and analyzing the variables influencing the Hungarian laboratory instrument distributors' SME sector as well as the international laboratory instrument manufacturers, measuring and comprehensively examining their sector-specific factor characteristics and operating conditions, modeling and optimizing their operation in order to increase their efficiency.	H1: A multivariate linear regression model can be fitted to the competitiveness of the laboratory instrument manufacturer and distributor market, companies that are at a higher level of competitiveness are able to achieve higher profitability leading to more efficient operations.	*H1 accepted*
	H2: In the laboratory instrument market, the most determining factor of competitiveness is partnership cooperation, both on the side of international manufacturers and domestic distributors, and within this, a special role can be attributed to an exclusive contractual relationship**.**	*H2 rejected*
	H3: The results of the competitiveness studies, operational features, problems, limitations and shortcomings of laboratory instrument distributors operating in the SME sector are the same as the results of professional publications analyzing the SME sector widely. However, geographical segmentation does not affect the profitability of instrument distributors.	*H3.1 rejected* *H3.2 accepted*
C2: Identification of factors influencing the motivation and performance promotion of sales professionals in laboratory instrument distribution companies.	H4: The motivation of sales people greatly influences the companies' competitiveness, furthermore salespeople's performance varies by gender, age, education, and experience.	*H4 accepted*
C3: Considering the most effective marketing communication tools of the laboratory market in terms of customer reach efficiency.	H5: There are differences in the use of marketing communication tools used by the surveyed companies, but the importance of customer visits is the most significant sales promotion tool for all distributors.	*H5 accepted*
C4: Domestic overview of the laboratory instrument market supporting research and development in the light of current R&Đ activities level of the country.	H6: The increase in the number of R&Đ laboratories since the regime change is mainly due to the continuous expansion of the laboratory for-profit sphere. The number of researchers in all sectors (academic, higher education and business) is positively correlated with the increase in the number of R&Đ labs.	*H6.1 accepted* *H6.2 rejected*
C5: Exploring the operational differences of the laboratory client sectors (non-profit, for-profit sphere).. Enumeration of factors influencing the laboratory customer-side instrument procurement decision and evaluation of the decision process.	H7: In the laboratory customer (buyer) side segment, the instrumentation and tender support of the for-profit and non-profit spheres are different, and the more optimal capacity utilization of laboratory instruments results in a more competitive laboratory market.	*H7 accepted*
	H8: In the laboratory customer (customer) side segment, the elements of equipment and instrument procurement of the two spheres examined (procurement structure; centre; demand level; and licensing amount limit) are very different, and customers of different ages have different marketing communication tools (product catalogue, website, customer visits) are preferred for sales promotion.	*H7 accepted*

Source: Own research 2021

4.CONCLUSIONS AND SUGGESTIONS

The topic of my dissertation is a very complex economic concept (competitiveness) without a uniform definition, which allows comparing companies, groups of companies, sectors, segments, markets and countries, national economies, along a certain goal defined by the researcher. Competitiveness can cover several sub-areas at the same time, with the help of which not only economic (eg. market characteristics, financial situation) but also sociological (eg. corporate culture) and human competence-based factors can be examined. Due to the complexity of competitiveness, it is able to measure several diverse disciplines (strategic, marketing, supply chain and human resource management) at the same time.

By narrowing down my topic, I had to focus on the SME sector as well as the R&Đ characteristics of the laboratory sector in order to draw the right conclusions and formulate future proposals. Since the market for laboratory instruments supporting R&Đ is not yet a commonly-studied area - the vast majority of the available literature examines the SME sector in general (eg. at national, regional or sectoral level).

The laboratory instrument distributors are located in the middle of the supply chain in terms of the examined segments, as an intermediary link, which due to their position presupposes some vulnerability, subordination and dependence in their relationship system, both towards the manufacturer and its customers, but also has many advantages. It is embodied in the knowledge of the local market and language in international manufacturer cooperation, which equips distributors with an irreplaceable toolbox. At the same time, distributors can provide support to customers and meet their needs during the transaction. The success of the sale, as well as its smooth execution, customer satisfaction all depend on the quality of service of the distributors. Manufacturers are fully represented in the local market with their local distributors creating a unified picture in the customer's mind of the two segments. In these respects, the responsibility and appropriateness of distributors in the laboratory market is unquestionable.

With the above findings in mind, I have attempted to assess the role of the two relevant segments solely from the aspect that affects the competitiveness of distributors. In light of this, I drew the following conclusions from an in-depth statistical and empirical study of the competitiveness of the laboratory instrument market, scoring points by area:

S_1: The most neuralgic point for small and medium-sized companies of Hungarian instrument distributors: the inadequate level of partnership cooperation. It is recommended, in particular, to make their cooperation with their supply chain members more effective and to strengthen trust with their partners, as well as more open communication and information sharing, in order to establish long-term partnerships based on joint evaluation and development of cooperation. The low level of trust is one of the biggest obstacles to increasing the efficiency of domestic laboratory instrument distributors. Distributors should strive in the future to improve the efficiency and closeness of their existing collaborative relationships through efficient information flow, open communication, and joint evaluation.

S_2: The changes in the turnover of companies have a statistically significant value in terms of corporate ownership and the width of the product portfolio, while the registered office has no effect on the development of sales revenue at all. Companies are able to achieve higher performance by marketing laboratory instruments from reputable, market-recognized foreign manufacturers with high technical specifications and references, as well as providing strong professional application advice to their customers with manufacturer support in the background. The operation of companies with foreign ownership is characterized by stable liquidity, a highly qualified sales team and continuous innovation product development. Companies with a Hungarian ownership background can compete with their foreign-owned competitors only by strengthening and deepening cooperation with their existing manufacturers, as well as by increasing the number of their represented manufacturers, and thus by expanding their instrument portfolio. The 'survival' strategy proposed by Hungarian-owned companies also carries a risk that could lead to market losses due to innovation-driven manufacturers' acquisitions and mergers.

S_3: Based on the analysis of competitiveness points and the correlation of pillars, the weaker correlation of the financial situation can be explained partly by external state burdens on companies (taxes, levies, etc.) and on the other hand of public budget bodies of low budget framework with weak payment morale, which causes liquidity problems for distributors that are difficult to bridge. Budgetary bodies should be increasingly involved in industrial projects, in which they could themselves generate the capital needed for their operation.
A solution could be to establish knowledge centers and technology parks, which are increasingly used abroad, where the researcher can cooperate, supporting each other with the practical specialist.

S_4: I considered as highly relevant to examine the motivation of the sales professionals responsible for the distributors' products as a group as well as an individual for the successful operation of the company. The joint evaluation of individuals from time to time, just like the evaluation of members of the supply chain, is of paramount importance in encouraging higher performance. The most effective motivation system can be realized by breaking down sales professionals by age group, where the management keeps in mind the different group and individual needs of different age groups and subordinates to it develops its own performance evaluation and motivation system.

S_5: Personal customer visit marketing communication tool, considered by distributors to be the most effective, is the least preferred by laboratory customers according to the survey results. It is recommended that distributors conduct market research and customer satisfaction surveys in the future in order to have more effective and competitive market presence among their customers, which would also lead to cost efficiency in the long run. In the light of the results, the best option is to choose 'customer-tailored' marketing communication tool (professional advice, demonstration device, free consumable support, workshop, etc.).

S_6: In the future, it would be worthwhile to place more emphasis on making non-profit (NP) laboratories more economical in Hungary by accessing higher tender resources, reforming the operation of the sectors and effectively involving them in business, and making the sector interested in joint industrial collaborations. In order to achieve better results, strong cooperation between private and public bodies would be needed, which would help the laboratories of the low-budget NP sector to operate more efficiently and thereby increase the utilization of instruments. Cooperation would also raise the level of R&D in the national economy.

S_7: The results of the study identified a number of difficulties in the non-profit sector, such as excessive administrative burdens, which result in unreasonably long administrative processes, thus hampering the instrument procurement, maintenance and servicing process, all of which hinder the proper development of R&D, furthermore many occasion the lack of professional knowledge of the decision-maker, who is responsible for the procurement of instruments, which is subject to a strict licensing amount. In addition, not only profit-oriented affiliation should be kept in mind when selecting the right marketing tools to be used (website, product catalogue or customer visit) when targeting customers, but also by differentiating the gender and age of customers as separate target groups.

S_8: Overall, in the non-profit laboratory clientele, supporting industrial collaborations, reducing wage developments, administrative burdens and the multi-stage procurement process, and entrusting decision-making power to experts would lead to a transformation of the current system, boosting R&D. The closest possible cooperation of the distributors with the customers, with the help of the international manufacturers to provide laboratory consumables and equipment support, placement of instruments for the jointly interested R&Đ, and in cooperation with the international manufacturers, to involve the customers in the product development through the distributors.

In setting up my research hypotheses, I tried to cover the competitiveness of the laboratory instrument market I studied as my research topic, but there were still untouched areas that I could not explore in my present research due to time and space constraints, so I aimed to investigate them in the future. I believe that the results of my research can be used both on a theoretical level and in a practical context, as I identified the grouping of variables influencing the competitiveness of the studied area, explored the weaknesses within the pillars, highlighted the strengths and the potential opportunities, which can serve as a guide in building the strategy of market participants.

In my opinion, small and medium-sized companies of Hungarian laboratory instrument distributors should make radical changes to their corporate strategy from the current isolation, which characterizes Hungarian SME sector companies in general, who still think mainly in their own corporate performance - an open, mutually cooperative, towards a partnership between manufacturers and customers within the supply chain, close, trusting partnerships with the right partners can be the keys to success for SME players. The new approach would mean more efficient, effective and competitive corporate operations in the laboratory instrument market, but this would require a change of approach, targeted training and a rethink of corporate strategy, in which a cross-corporate cooperative approach should play a prominent role.

Summarizing the above ideas, I would like to highlight the role of the scientific market in the field of research and development that stimulates innovation, so making it more efficient is in the common economic interest, considering that its importance cannot be

5. NEW SCIENTIFIC RESULTS

The new scientific background of my research is provided by the analysis of the competitiveness of a laboratory instrument and equipment market, an area that has never been scientifically studied from an economic point of view, supporting the R & D & I activity.

Although, my doctoral dissertation is related to and to some extent embedded in a number of frequently researched areas: the specially scientific, niche market I have chosen as my research goal can still be considered unique, because so far in this scientific field, a professional publication has been created exclusively from analytical measurements of laboratory instruments.

I examined my hypotheses formulated at the beginning of the research using quantitative and qualitative methods, thanks to which I set up new and novel scientific results.

R_1: I have proved that the competitiveness of the international instrument manufacturer and domestic instrument distributor segment can be modelled by segment.

I fitted a multivariate linear regression line to the two segments serving the laboratory instrument market (international manufacturers, domestic distributors) by measuring the variables I assumed that most influence competitiveness into pillars (cooperation, human resources, product and innovation, marketing). I performed a comparative multivariate regression analysis on the competitiveness of the two segments with the same explanatory variables as well as the same target variables (Market share, and percentage of turnover).

Table 8: Summary table of multivariate regression models for manufacturers and distributors

	Independent variables											
Dependent variables	**Constant**	**'p'**	**Cooperation**	**'p'**	**Uniqueness of HR**	**'p'**	**Quality of HR**	**'p'**	**Product, Innovation**	**'p'**	**Marketing**	**'p'**
Manufacturer market share	5,371	0,000	1,239	0,000			0,406	0,034	1,212 1,021	0,003 0,010	0,993	0,000
Manufacturer turnover	7,812	0,000	1,561	0,000			0,548	0,012	1,490 1,320	0,001 0,004	0,952	0,000
Distributor market share	18,191	0,000					3,373	0,038	3,942	0,016	39,45	0,097
Distributor turnover	4,5E+08	0,000			3,806E+09	0,045	1,6E+08	0,034	2E+08	0,010	3,806E+09	0,004

Source: Own research 2020

Table 8 summarizes the factors with the same content influencing competitiveness on the manufacturer and distributor side. The quality of human resources, product and innovation, and marketing activities on both sides show a statistically significant correlation with competitiveness, while the uniqueness of human resources compared to competitors has an impact on the achieved market turnover only on the distributor side. According to the model, the cooperation does not affect the successful operation of the distributor side at all, while on the manufacturer side it shows a statistically significant value in terms of the achieved market share and turnover.

R_2: The more efficient operation of international manufacturers in the case of both target variables (market share, turnover) is greatly influenced by their efficient cooperation with their distributors in the supply chain (p = 0.000; 0.000), while the joint cooperation shows no impact on the profitability (p = 0.609; Specific result p = 0.875; ROS: p = 0.137; ROA: p = 0.14; ROE: p = 0.113) for domestic distributors.

The share of international manufacturers in the European market is statistically significantly correlated with the presence in the number of European countries (p = 0.000), the manufacturer's instruments and the exclusivity of cooperation with their partners (p = 0.000), and the year of entry (p = 0.026) is. The longer a manufacturer is in the European market, the higher share they can achieve. The variance in the international manufacturers' market share is mainly explained by the number of their presence in European countries (partial eta square: 0.787), while exclusive cooperation (0.058) and the year of their entry to the European market (0.052) are only slightly around 5-6%. share.

R_3: In the examination of the exclusive representation of the international manufacturers' side in the supply chain, indicates a statistically significant correlation (p = 0.000) to the market share (p = 0.000), in the case of domestic distributors, this form of close cooperation does not show a significant effect on net sales, only the number of represented manufacturers indicates a statistically significant correlation (p = 0.000) for the achieved turnover.

R_4: The profitability of the distributor segment was statistically significantly indicated by the ownership of the company (p = 0.000) and the width of the distributed product portfolio (p = 0.000), however, unlike most corporate activities, the geographical segmentation of the market (p = 0.740) in sales is not a relevant factor in the distribution of laboratory instruments supporting R&D (p = 0.740).

The studies of R_3 and R_4 were performed by multi-aspect analysis of variance, involving several variables. On the international manufacturers' side, the number of presence in European countries, the development of the manufacturers' country of origin, the number of employees and exclusive contractual cooperation were included as independent variables. On the distributor side, the ownership background (Hungarian, foreign), the company's headquarters (capital, county seat, city, municipality), the width of the product portfolio (lab instruments, tools, consumables), as well as the number of manufacturers represented and exclusivity were included.

R_5: As the age of sales professionals advances and they have higher professional experience, the performance of male colleagues is higher. However, it is not affected by the individual's education level. In the context of the above study, in the framework of qualitative research, I constructed a model summarizing the motivation system, which can help the management to effectively encourage and motivate their salespeople by age group.

I have demonstrated by covariance statistical analysis that the performance of salespeople of Hungarian laboratory instrument distributors is greatly influenced by a person's gender, age, and professional experience.

R_6: Among distributors, the most effective marketing communication tool is personal sales (average: 4.42), the sales promotion of which was rated the lowest by laboratory customers (average: 2.72).

As an unexpected result, I would highlight the personal sales considered by distributors, on a five-point Likert-scale, to be the most effective marketing communication tool (average: 4.42), the effectiveness of which was rated the lowest by laboratory customers (average: 2.72). The results of the empirical study seem to overturn the effectiveness of the decades-long sales strategy of domestic distributors. Product characteristics and sales competencies were rated similarly by the three segments, with only the salespeople's personality (distributors: 4,405; manufacturers: 3,403; customers: 3,806) and connectivity (distributors: 4,620; manufacturers: 3,712; customers: 4,084) rated higher by distributors, which is consistent with judging the importance of customer visits.

R_7: The continuous growth of R&Đ sites over the last three decades is due to the increase of entrepreneurial R&D sites.

The study was established with a dynamic basis ratio. A linear trend line can be fitted to the increase of entrepreneurial R&D sites (R2 = 0.938). In contrast to the prediction of the future number of business R&D sites, the change in higher education research sites is described by a quadratic polynomial function, which is valid only for the studied range.

R_8: The two sectors of the customer segment (for-profit and non-profit) have different instrumentation and tender support, which is largely determined by sector-dependent (profit-taking) factors (budget background). The non-profit sector has low utilization of instrument capacity.

The tests were proved by cross-tabulation analysis and two-sample t-test. Capacity utilization forms hidden reserves in the segment, which is a factor shaping competitiveness. The different instrument procurement backgrounds of the customer segment sectors, which differ in several points (single- and multi-stage procurement center, different level of procurement demand, and - procurement amount limit authorization). The following factors place ever more stringent expectations on non-profit central-budget laboratories.

R_9: When purchasing instruments, distributors have to take into account different aspects of customer demographics (mainly age characteristics).

I proved by cross-tabulation analysis that customers prefer marketing communication tools that vary with age. The young age group (25-35 years) finds the website presence useful (86.4%), while the older age group over 55 prefers the product catalogue over the website (83.8%). Customer visits are not considered by young people to be a relevant marketing communication tool, while 58.1% of older people find it useful. The results can provide an excellent segmentation foundation for successful targeting.

The process of my research work - from the objectives through the hypotheses, through the results to the drawing of conclusions and recommendations - is summarized in Table 9.

Table 9: Relationships between research objectives and results

<table>
<tr><th>OBJECTIVES</th><th>HYPOTHESIS</th><th>NEW SCIENTIFIC RESULTS</th><th>CONCLUSIONS, SUGGESTIONS</th></tr>
<tr><td rowspan="3">O1: Exploring and analyzing the variables influencing the Hungarian laboratory instrument distributors' SME sector as well as the international laboratory instrument manufacturers, measuring and comprehensively examining their sector-specific factor characteristics and operating conditions, modelling and optimizing their operation in order to increase their efficiency.</td><td>H1: A multivariate linear regression model can be fitted to the competitiveness of the laboratory instrument manufacturer and distributor market, companies that are at a higher level of competitiveness are able to achieve higher profitability leading to more efficient operations.</td><td>R_1: I have proved that the competitiveness of the international instrument manufacturer and domestic instrument distributor segment can be modeled by segment.</td><td rowspan="2">S1: By making their cooperation with their members in the supply chain more effective, and by building trust in their partners, and by more open communication and information sharing.</td></tr>
<tr><td rowspan="2">H2: In the laboratory instrument market, the most determining factor of competitiveness is partnership cooperation, both on the side of international manufacturers and domestic distributors, and within this, a special role can be attributed to an exclusive contractual relationship.</td><td>R_2: The more efficient operation of international manufacturers in the case of both target variables (market share, turnover) is greatly influenced by their efficient cooperation with their distributors in the supply chain (p = 0.000; 0.000), while the joint cooperation shows no statistically significant correlation for domestic distributors. p = 0.609; Specific result p = 0.875; ROS: p = 0.137; ROA: p = 0.14; ROE: p = 0.113) with profitability.</td></tr>
<tr><td>R_3: In the examination of the exclusive representation of the international manufacturers' side in the supply chain, indicates a statistically significant correlation (p = 0.000) to the market share (p = 0.000), in the case of domestic distributors, this form of close cooperation does not show a significant value for net sales, only the number of represented manufacturers indicates a statistically significant correlation (p = 0.000) for the achieved turnover.</td><td>J2: Survival strategy of distributors with low liquidity: increasing the number of represented manufacturers, exclusivity, expanding the product portfolio.</td></tr>
<tr><td>H3: The results of the competitiveness studies, operational features, problems, limitations and shortcomings of laboratory instrument distributors operating in the SME sector are the same as the results of professional publications analyzing the SME sector widely. However, geographical segmentation does not affect the profitability of instrument distributors.</td><td>R_4: The profitability of the distributor segment was statistically significantly indicated by the ownership of the company (p = 0.000) and the width of the distributed product portfolio (p = 0.000), however, unlike most corporate activities, the geographical segmentation of the market (p = 0.740) in sales is not a relevant factor in the distribution of laboratory instruments supporting R&D (p = 0.740).</td><td>J3: Budgetary bodies should be increasingly involved in industrial projects, in which they could themselves generate the capital needed for their operation. A solution could be to establish knowledge centers and technology parks that are used more and more often abroad.</td></tr>
</table>

OBJECTIVES	*HYPOTHESIS*	*NEW SCIENTIFIC RESULTS*	*CONCLUSIONS, SUGGESTIONS*
O2: Identification of factors influencing the motivation and performance promotion of sales professionals in laboratory instrument distribution companies.	H4: The motivation of sales people greatly influences the companies' competitiveness, furthermore salespeople's performance varies by gender, age, education, and experience.	R_5: As the age of sales professionals advances and they have higher professional experience, the performance of male colleagues is higher. However, it is not affected by the individual's education level. In the context of the above study, in the framework of qualitative research, I constructed a model summarizing the motivation system, which can help the management to effectively encourage and motivate their salespeople by age group.	S4: Group and individual examination of the motivation of sales professionals responsible for distributors, the most effective motivation system is the breakdown of sales professionals by age group, Joint evaluation of individuals from time to time.
O3: Identification of factors influencing the motivation and performance promotion of sales professionals in laboratory instrument distribution companies.	H5: There are differences in the use of marketing communication tools used by the surveyed companies, but the importance of customer visits is the most significant sales promotion tool for all distributors.	R_6: Among distributors, the most effective marketing communication tool is personal sales (average: 4.42), the sales promotion of which was rated the lowest by laboratory customers (average: 2.72).	J5: Distributors should conduct market research and customer satisfaction surveys in the future and choose a 'customer-tailored' marketing communication tool (professional advice, demonstration device, free consumable support, workshop, etc.) based on the results.
O4: Domestic overview of the laboratory instrument market supporting research and development in the light of current R&Đ activities level of the country.	H6: The increase in the number of R&Đ laboratories since the regime change is mainly due to the continuous expansion of the laboratory for-profit sphere. The number of researchers in all sectors (academic, higher education and business) is positively correlated with the increase in the number of R&Đ labs.	R_7: The continuous growth of R&Đ sites over the last three decades is due to the increase of entrepreneurial R&D sites.	J6: Strong collaboration between private and public bodies would be needed to help laboratories in the low-budget NP sector operate more efficiently and thereby increase instrument utilization.
O5: Exploring the operational differences of the laboratory client sectors (non-profit, for-profit sphere).. Enumeration of factors influencing the laboratory customer-side instrument procurement decision and evaluation of the decision process.customer-side instrument procurement decision and evaluation of the decision process.	H7: In the laboratory customer (buyer) side segment, the instrumentation and tender support of the for-profit and non-profit spheres are different, and the more optimal capacity utilization of laboratory instruments results in a more competitive laboratory market.	R_8: The two sectors of the customer segment (for-profit and non-profit) have different instrumentation and tender support, which is largely determined by sector-dependent (profit-taking) factors (budget background). The non-profit sector has low utilization of instrument capacity.	J7: Take into account the affiliation of for-profit customers when purchasing instruments for laboratory customers.
	H8: A laboratóriumi ügyfél oldali szegmensen a vizsgált két szféra eszköz-, és műszerbeszerzés elemei nagymértékben eltérőek, továbbá a különböző életkorban lévő ügyfelek eltérő marketingkommunikációs eszközökhasználatát preferálják az értékesítésösztönzés során.	R_9: When purchasing instruments, distributors have to take into account different aspects of customer demographics (mainly age characteristics).	J8: Distributors work as closely as possible with customers, through device support, instrument placement, and involve customers in product development. Targeting customers differently by gender and age.

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