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Multi-aspect analysis of the added value of technical
higher education institutions, in the light of
development trends and potentials

THESIS BOOKLET

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1. Introduction

The impulse that led to the field of scientific research is related to the manifestations of quality in the higher education system. The *image of quality is always created by the evaluator*, which is painted extremely diverse by personal value systems based on socialization and culture. The definition of the quality of higher education is further colored by the value judgments and viewpoints of the groups (stakeholders) involved in the use of the higher education service. Quality is a relative, multifaceted, complex concept.

How do I approach and squeeze this multi-faceted, widely researched, complex topic within the framework of a doctoral dissertation? The *breakthrough came* from the realization that I wanted to create a value-added model for higher education. Thus, I narrowed my topic from the research of the complexity of quality to the investigation of the added value as the value transferred during the higher education service. With this, I put the special approach to the quality of higher education, the added value, at the center of my research. Within this, I focused the research on the field of technical higher education. In summary, I set out to create a value-added model based on the defining elements of the added value of technical higher education and their connections.

I chose the technical or STEM (Science, Technology, Engineering, and Mathematics) training field because, on the one hand, the *responsibility and role of technical higher education* is outstanding in terms of sustainable development. On the other hand, due to the turbulence of technological development, the danger of innovation/technological competition and education drifting away is most intense here. Furthermore, it can be said that technical/STEM higher education is particularly affected in terms of the high proportion of those who leave the training without a degree. The technical bachelor's degree is characterized by 40-44%, natural science and IT bachelor's degree fields with close to or more than (!) 50% dropping out without a degree. (Mrs. Demcsák dr Ódor, 2020).

The value-oriented approach of my research represents an important *educational science connection* of the chosen topic, which is significantly enriched and enriched by the diversity of educational sociology, educational policy, sociology, economics, and management science resulting from the higher education context, the functions, actors, processes, and trends of the higher education system.

The educational science-focused approach and modeling the added value of technical higher education defined as a research focus still requires a lot of research and exploratory work. It can be stated that the STEM training area faces significant challenges in terms of value creation in higher education. This is one of the reasons why I am extremely committed to the research of the chosen topic, since the dialogue that might be started would draw attention to the actual quality of domestic higher education, the elements of the value-added model, and as a result, the quality and the added value would become visible from the aspects of the value-creation processes of higher education as well as the critical points, and the development opportunities.

2. The framework of the research

Glossary and concept network in Appendix 1 of the doctoral dissertation contains a detailed interpretation of the defining concepts of the research. Among the thirty concepts analyzed, I will now present my own interpretation of the most prominent key concepts of the research, and then I will summarize the purpose of the research. This is followed by a brief summary of the research questions and hypotheses.

Technical higher education (STEM higher education)

For this research, which I interpret as technical higher education (and related institutions) those higher education institutions that provide courses in the field of STEM (science, technology, engineering, and mathematics), which does not exclude the possibility that the *higher education institution* also provides courses in other disciplines.

Quality of higher education

In developing my own definition, I have drawn on the modern quality interpretive framework as a good organizing principle for understanding the essence of quality, which is the quality of the demand satisfaction process at its core. Quality is the value judgement of the stakeholders in the consumption process, based on their value systems, about the value they receive from the satisfaction of their needs. Thus, quality is the value transferred through the demand satisfaction process (Veress, Birher & Nyilas, 2010). Putting this in the context of higher education, quality of higher education as a service process is the value transferred through the higher education process, based on the value judgements of stakeholders, which (adapted from Veress et al., 2010) is, in a narrow sense, the 'individual' gain of stakeholders, such as the labor market position and income gained by a graduate student, or the profit generated for the employer by

an easily recruited, efficient workforce; in a broad sense, it is the social value of higher education.

The added value of higher education

Based on the economic interpretations of the added value, according to my own formulation, the added value shows the result of the organizational value creation process between the transformation of input factors used during organizational production or service into an output product or service.

In researching the definition of the added value of higher education, I have collected a number of useful approaches in the Glossary. I would like to highlight two of them:

In Harvey's (2004) Analytic Quality Glossary, the added value of higher education is defined as "the growth/development/gain that a student has achieved as a result of their university studies in terms of knowledge, skills, abilities, competences and other attributes/qualities" (Harvey, 2004, [Glossary index \(qualityresearchinternational.com\)](http://qualityresearchinternational.com)).

According to Braxmair (2012), the added value of higher education is the added value generated by the impact of higher education at both the student and institutional level.

During our research - considering the definitions focusing "only" on the student's individual profit, and Braxmair's (2012) expanded approach from the institutional side - *I define the added value of higher education as the social value generated by the value(s) transferred through the higher education process, which includes the "individual" gains of any "stakeholder" that support sustainable social development.* With this, I open Braxmair's (2012) student-institution approach to other stakeholders and society.¹

Dropout

In my research, dropout is represented by students who leave the course without a degree. In this way, *I interpret the definition broadly, including those students who do not permanently leave the training or the institution, but interrupt their studies and even re-admit within the institution or to another institution.* With this, my goal is to monitor all attrition losses.

According to our own definition, a student who drops out, is for whom the training is terminated with the below reasons:

- exceeding the permitted number of fails the remedial and repeat exams,

¹**Example of the** added value of higher education can be an engineer who strengthens his problem-solving skills during his studies, who can work in a team, who is placed in his profession based on the recommendation of his professor, becomes a reliable member of the engineering team, supports his family with his income and performs alumni activities. Or, for example, the engineer who creates a business with his university classmates, etc. (author's note).

- failing to check in more times than permitted,
- payment arrears in training,
- exclusion by disciplinary decision,
- failure to fulfill training obligations,
- self-declaration to interrupt the training,
- transfer to another higher education institution upon request,
- change of training within an institution.

Quality culture

In my writing, whenever possible, I use the term quality culture instead of the term's quality management or quality assurance. This is because, in line with Hrubos (2021), quality culture reflects the values of institutional actors and is not about whether a quality system is in place at the institution. Quality culture focuses on students, partnership, cooperation, self-reflection, knowledge sharing and teamwork. It is not dictatorial in any way, but its implementation requires well-communicated, consistent institutional policies (Hrubos, 2021). Kerekes et al. (2012) defines quality culture as the path to quality. In my own formulation, I interpret the quality culture as the *basic institutional value system striving for inclusive excellence, the focus of which is the student, partnership, knowledge sharing, teamwork and continuous development based on self-reflection.*²

From the above definitions, additional definitions and findings arise:

- I define higher education as a service process, where the quality of the process depends not only on the quality of the service provider and receiver, but also on their ability and willingness to cooperate (Veress, 2008, Tóth & Surman, 2020, Braxmair, 2012).
- The quality of higher education is an extremely important area from the point of view of sustainable social development, and thus *clarifying the interpretation of quality in the higher education system with its complicated relationships is a fundamental common interest* (Hrubos, 2014).
- *Quality has a thousand faces*, can appear in a metamorphosis based on as many stakeholders and as many values; during my research I focus on the social point of view.
- In addition to all this, the question arises as to how the quality of higher education *can be measured, and is it necessary to measure it?*

²Extending inclusion in higher education. See in detail. Glossary and concept web (author's note).

For a systematic approach, *I follow* the demand-driven process approach of modern quality management and the value-adding process approach of lean management³ (Tóth, 2009) (Liker, 2008) (Tóth & Surman, 2020). I examine the added value of higher education providing training in the STEM field, that is, the social value created by their value-creating processes, keeping in mind the need for a "competitive, equal opportunity and sustainable" business paradigm shift (WEF, 2019), (Håkansson, 2010).

2.1. The objective of the research

My research objective is to contribute to *the mapping of the added value and quality of technical higher education with a new approach*, and thus to *the development of the added value and quality*. My aim is to identify and model the value-adding processes and system elements that make visible a model of the added value of technical higher education from an educational science perspective.

The main goal and the most expected result of my research is to create an *educational science-focused value-added model* in relation to domestic technical higher education, which I primarily dedicate to institutional self-evaluation. In this way, development trends and potentials can be identified. Its usefulness lies in the aspect that it could be an alternative to the 'rankings' that many people (wrongly, in my view) identify with quality, since equal opportunities are also a right of our institutions.

In my research I take a *value-based process* approach, which differs significantly from the methodology of current rankings in higher education. *The focus is not on the quality of input or output, but on the quality of the higher education process itself, i.e., the added value*. Within the framework of this research, I focus on the higher education value-added process itself, using a specific approach and aiming to identify the key value-added elements of the higher education process and their connections, and to model the value-creation processes. *I do not approach the added value from a metrical point of view but model it*.

I narrowed down the research to the three defining institutions of the domestic higher education classified by Hrubos (2012) in cluster 5 (with a broad profile, but different from the classic professional composition, and a large number of students), *but with different technical priorities in terms of location and operational potential*. Due to confidentiality obligations, I

³Officialized by the American researchers of the Massachusetts Institute of Technology (MIT), lean management is a management and development approach centered on the added value, which focuses on increasing the proportion of activities and resources that provide the added value from the point of view of customers and employees, while all resources, activities, that which does not produce value is unnecessary, and therefore considered a loss and strives to minimize them through continuous self-reflection.

will not give the names of the institutions. The reason for secrecy is that I received extremely sensitive information both from the heads of the institutions and decision-makers, as well as from the students who dropped out. In this research, I consider it important not to identify the institutions, but the added value elements. I chose a large technical university in the capital and two in the rural areas. Another selection criterion was that one of the rural institutions had already switched to the new operating model during the selection process. Since then, the other rural institution has also been maintained by a foundation⁴.

During the research, *I approach the value-added model from several angles*. I analyze the available literature on the added value of higher education, with particular regard to international and domestic practices. With the help of in-depth interviews, I investigate the views of the key stakeholders of technical higher education on quality and the added value. Another aspect, deriving the approach to the added value according to the philosophy of lean management, considers dropout in higher education as a loss element of the added value model, so by examining dropout, I can approach the elements of the value-added model in an inverse way. The research result was born from the methodological tripartite of the results of the literature review, in-depth interviews, and the questionnaire, as well as their interrelationships and interactions.

2.2. Questions and hypotheses

I converted the research problem into the following questions:

- a. What do I mean by the added value of technical higher education? What kind of educational science-based value-added model can be set up? (What elements and connections can be revealed?)
- b. Can the added value be measured? If so, is it necessary to measure? If so, for what purpose do I measure it? (measurement dilemmas - how and why do I measure?)
- c. How and with what tools and methods can the added value of technical higher education be increased? (What development trends and potentials can be identified?)
- d. Is it necessary to rethink the role and approach of the instructor/teacher, the learning-teaching environment? (Quality of education, dimension of network thinking.)

⁴According to the research, the university model change (began with Corvinus University of Budapest on 01-07-2019, except for five institutions since then, state universities have become maintained by public foundations) holds opportunities in terms of the development of higher education quality and the added value. I mark this as a topic for future research.

There are three main hypotheses in the focus of the research:

1. There is no social consensus on determining the quality and the added value of domestic technical higher education institutions. The evaluators/stakeholders evaluate according to the aspects of their own subsystem.
 - I investigate this hypothesis primarily with in-depth interviews.
2. I currently do not measure the added value of domestic technical higher education institutions.
 - I investigate my second hypothesis using the primary method of literature exploration and analysis, as well as in-depth interviews.
3. The added value and sustainable quality can be increased by rethinking the role and approach of the instructor/teacher, as well as the joint application of network thinking, which positively influences the quality of teaching and learning.
 - By conducting a questionnaire survey among students who drop out (terminate/interrupt their studies), I am looking for the reasons for failure along student, teacher, institution, support networks. In-depth interviews with stakeholders may also be relevant to test this hypothesis.

3. Applied methodology

The choice of the research methods was guided by the approach most suitable for testing the hypotheses.

3.1. Selection and justification of the methodology

For the analysis of the first hypothesis: "*There is no social consensus on the definition of the quality and the added value of domestic technical higher education institutions. The evaluators/stakeholders evaluate according to the aspects of their own subsystem*" qualitative research method proved to be the most appropriate. As an initial step, my goal was to listen to the opinions of the most decisive technical higher education interest groups regarding the added value of technical higher education. I followed Steiner Kvale (1996), Cserné Dr. Adermann (1999) and Babbie (2001) in the interviewing process and in identifying the necessary decision points. Based on the reasons presented in detail in the doctoral thesis, I chose the semi-structured in-depth interview technique, where I was able to conduct a purposeful, focused conversation with a "soft questioning behavior" (Cserné dr. Adermann, 1999, 80). I managed

to conduct several interviews in person, and a few with the help of telecommunication devices due to the COVID-19 pandemic.

According to the second hypothesis *"The added value of domestic technical higher education institutions is not currently measured"* to which I approached my research primarily through special literature review and analysis. However, I also stood ready to find out more about this hypothesis during the semi-structured in-depth interviews.

As for my third hypothesis *"The added value and the sustainable quality can be increased by rethinking the role and approach of the instructor/teacher, as well as the joint application of network thinking that positively affects the quality of teaching and learning"* the in-depth interviews of the stakeholders can also be a relevant approach on the one hand. On the other hand, I felt a great need for a more structured research method, which gives a greater scope for quantitative studies. A questionnaire survey proved to be a good observation method for this purpose. However, there are still plenty of questions: among which, and with what content should I conduct the survey.

3.2.A more detailed explanation of the chosen methodology

Semi-structured in-depth interview

I conducted a semi-structured in-depth interview with decision-makers and heads of institutions of technical higher education (who also teach), students representing students, managers representing industrial/corporate actors. The structure of the interview consisted in the identity of the opening question, which read: *"What does the quality of technical higher education mean to you?"* *What do you think about the quality of technical higher education and its added value? How would you identify the elements of the added value?"* After the question was posed, my role was focused on paying attention, clarifying statements that were not clear to me, where necessary, bringing up additional ideas, and maintaining the "flow".

The research approach led me to consult with as many *broad-minded experts as possible, who gathered the opinions of several stakeholders, experienced and well-versed in technical higher education*. I also expected a high degree of diversity within and between the individual groups. In the decision-making and institution management group, I asked the minister responsible for higher education and the rectors of the selected technical institutions, who also have a lot of experience as active participants in the teaching and research world. In the student group, I asked the head of the student representation of one of the universities, and I interviewed the president of the National Student Self-Government Representation. I asked the vice president

of the Hungarian Chamber of Industry and Commerce responsible for training and education matters, as well as the president of a national organization bringing together engineers - who is both an industrial specialist and a company director - about the employer perspective. I recorded the interviews with a prior permission request, and after writing them down, following a multi-step coding structure, I looked for what elements and approaches I could identify for the creation of the value-added model. I was curious about the communications of the various actors and interest groups, in which elements they form common sets, and where different approaches can be seen.

As the first step of *coding*, I marked the basic ideas regarding the quality/added value in the interview text. This was followed by the second stage of coding, when I gave headings to the extracted ideas and defined the central idea. As the third step of coding, I transformed the central ideas into words, word structures or simple sentences, preserving the central line of the basic idea as much as possible. For those contents where I used frequency analysis and word image training, I further simplified the third level of coding - if it was necessary - following the rules of content analysis. Finally, as the fourth step of coding, I organized the thoughts of the interviews into a structure: I created an analysis unit from the initial and summarizing thoughts and extracted the "general approach" of the quality and the added value from them.

I was looking for an answer to the question of how, in *general*, one approaches the definition of quality and the added value. In addition, I created the "*details*" category, which I was able to divide into larger units based on the additional content and headlines, such as "who teaches?", "what is taught?", "how do they teach?", and some other important focuses emerged. In the content analysis, my goal was to retain and return the diversity of the in-depth interviews, so I primarily presented the trends and opinions emerging from the content extracts in the general parts. It was also important for the details, which individual thoughts enrich the topic that can be expressed with a single word structure. In those cases where it helped the systematization, I analyzed the coding contents based on their frequency. I scrutinized each interest group separately, then in the picture with added value that can be drawn due to the analysis, I indicated all the defining elements and looked for interoperability between the interest groups, as well as determined which elements I had to deal with when modeling the added value with a possible educational approach.

In *the last stage of the research*, when I had already compiled the value-added model, I *conducted an interview with a teacher-researcher who was named by several of my interviewees as an outstanding teacher*. In this interview as well, I started with the questions presented above, but I moved the direction of the conversation towards the teachers' specific

experiences, suggestions, and reflections on the set up the value-added model. I used the valuable information obtained from this *very useful professional discussion to finalize the value-added model*.

The questionnaire survey

The questionnaire contains ordinal and nominal scales of measurement, and I have adapted the possible methods of analysis accordingly. I have identified two main research directions for the questionnaire study, one focusing on the determinants, correlates, and patterns of student dropouts and the other focusing on the categorization and a sophisticated analysis of dropouts as a loss. Both research directions aim to find elements and relationships that can be positioned in the value-added model. The examination of the issues related to the research directions will be described in detail in the presentation of the research results.

In connection with the research of the background factors, I conducted *frequency, association, and rank correlation studies*. Typically, I worked with Pearson's chi-square test, Cramer's V coefficient, and Spearman's correlation coefficient (Babbie, 2001). As a first step, I examined the independence hypothesis, then analyzed the strength of the relationship using the Cramer's V coefficient and checked the significance of the entire test. I considered the value of the Cramer coefficient between 0.1 and 0.3 to be weak or negligible, and values between 0.3 and 0.5 to be moderate. I did not find a stronger association during the tests. I analyzed the co-movement between the variables of academic difficulties with the Spearman-rho rank correlation (Molnár, 2007) and the Kendall's Tau rank correlation test, which is also recommended for ordinal variables. I primarily examined the Spearman coefficient, whose values above 0.55 were interpreted as a strong relationship. I controlled for the existence of a strong relationship with Kendall's Tau values. As a novice researcher, I tried several programs: the rank correlation analyses were done in the open-source program Jamovi, and the chi-squared and Cramer V association analysis were done in STATA and SPSS. Data cleaning was not necessary for the database of the research questions currently under investigation.

During the analysis of other free-text (hereinafter "other" or free-text) answers related to the personal reasons for terminations/interruptions of the student relationship, I started with data cleaning work, during which I ignored uninterpretable answers⁵. I performed the analysis based on the data of university A⁶. I used *content analysis* (Babbie, 2001) *to categorize the free-text*

⁵ Consisting of random characters, "nothing else", expressing mood, etc. answers.

⁶ The other answers of university B were not relevant in several cases. (In many cases, the data was cleaned, and there were many people who wrote irrelevant content here.) However, the few interpretable content could be matched to the categories

answers, so that the excesses compared to the pre-structured personal reasons, the aspects worthy of special explanation from the students' point of view, and their frequency distributions became visible. After that, I *analyzed the relationship between the categorical variables and the background factors of academic difficulties in the context of a contingency study*. I performed the contingency analyzes in the Jamovi open-source program. In preparation for the study, I converted the four-item Likert scale grades of the background factors of academic difficulties into binary⁷ (important – not important) and examined which are the free-text categorized personal reasons whose frequencies are decisive (reaching 65%) in relation to the importance of a given academic background factor. Thus, some statistically significant ($p < 0.05$) correlations between certain freely stated other personal reasons and study background factors became visible. The most important "other" personal reason categories were transformed into *word clouds* with further content analysis. I created the word clouds using the open-source program WordArt, following the rules of content cleaning (Géring, 2014). I prepared the word cloud training in English in order to clean up the content, which made it easier for me to see the essence and simplify leaving the content elements.

For a more *in-depth study of dropout*, the continuing education status variable was converted into a binary⁸, and it became distinguishable into a group that remains in an institution or leaves an institution (institutional loss), as well as a group that stays in higher education or leaves higher education (social loss). Our goal is to explore the patterns of these homogeneous groups that can be useful for the value-added model. I have identified *cluster analysis, which is designed to create homogeneous groups*, as a well-suited method for this. In relation to the research questions examined, the questionnaire uses ordinal (study difficulties) and nominal (continuing education) measurement scales, and I need to examine two dimensions (study difficulties and further education situation) at the same time. The question examining academic difficulties asks the respondent to rank 17 variables, that is, to decide how decisive each variable was in his academic difficulties. Thus, the respondents individually ranked the variables causing their academic difficulties on a four-point scale. These rankings were transformed using a

found in connection with university A, I did not find any new categories. Based on these, I abandoned the analysis of the free text answers of university B at this level.

⁷The systems theory approach of the binary code was introduced to the social sciences by the German sociologist and social scientist Niclas Luhmann. At this point in the research, it significantly simplifies the analysis.

⁸With the research, I have now created a pair of values: obtaining a *degree/interrupting your studies, all of this from an institutional and social point of view*. According to Luhmann's theory, all social subsystems can be defined based on a binary code system (Luhmann, 1990). It is interesting that Béla Pokol (1991) writes in his study of professional institutional systems that the educational subsystem does not have an internal central value dual, therefore external systems are used to evaluate quality, e.g. the binary codes of the scientific subsystem. This will be discussed in more detail in Chapter 5.

ranking function in such a way that, for each respondent, the 17 variables were ranked relative to each other. With this, I created the conditions for a *ranking cluster* analysis, with which I was able to form homogeneous groups based on the order of preference of the factors of academic difficulties (their ranking relative to each other in a 17-vector field). I treated the two institutional samples as one. Taking the identified specifications into account, I used the *R Project Rankcluster* package (Jacques, Grimonprez & Biernacki, 2020) to examine attitude changes, which uses a model-based clustering algorithm to analyze the data.

This algorithm is an extension of the *ISR* (Insertion *Sorting Rank*) model for ranked data (Biernacki & Jacques, 2013). The *pairwise comparison modeling algorithm is well-suited to the investigation of multidimensional cases*, so I identified it as a cluster analysis procedure perfectly suited to our research. The procedure is non-hierarchical clustering: individual respondents may have given significantly different answers from the formed groups, yet the groups characterize most of the respondents well. The ISR algorithm is highly recommended for modeling "human ranking" (Biernacki & Jacques, 2013, 2). In our case, the *complexity of the model is special, since there are 17 variables in the first dimension and 2 in the second*, which is far from typical in the literature I have read so far (they work with 4-5 variables). The questionnaire deals with 17 background factors of academic difficulty on a four-point Likert scale, and the further education situation also has four attributes. As already mentioned, the background factors were transformed with the help of a ranking function in such a way that, for each respondent, the 17 variables were ranked relative to each other, with the most important factor in the first place.

With the cluster analysis, *I made visible the homogeneous groups of the rankings of academic difficulties, treating the answers*⁹ to the further education situation as a second dimension. Based on the rankings of the study difficulty variables and the further education categories, the cluster analysis was carried out along two dimensions: dimension 1: background factors of study difficulties, dimension 2: loss. For the cluster analysis, I created a study with missing data and then a study without missing data. When evaluating the results, I focused on the study without missing data.

To examine the *causal relationship*, I used the *logistic regression* (also known as logit) method. The logistic regression analysis was performed in the *R program*, *similarly to the cluster analysis*. In order to perform the logistic regression test (Hastie et al., 2009), I selected the most independent and relevant background factors based on the correlation between the 17

⁹ I have transferred to another higher education institution (1), I am resuming my studies (2), I am not continuing my studies (3), I am continuing my studies abroad (4).

background factors describing academic difficulties and the results of the cluster analysis. I examined the correlations using Pearson's correlation. I took into account correlations greater than 0.55, but correlations above 0.6 and 0.7 formed a separate category. My principles were to place important factors in the cluster and to highlight one of the factors with a strong correlation.

For the *logistic regression* analysis, I used the previously determined factors of the institutional and social (higher education) analysis as explanatory variables. The target variable was institutional and social dropout (binary indicator; with a value of 0 if no loss occurred, with a value of 1 if dropout occurred). In the case of the logit study, the institutional and social (higher education) studies were carried out along three main lines: (1) The values of the variables were treated together. (2) Treating the values of the variables as separate categories (according to the scale values). Thus, I could separately examine the relationship between the Likert scale attributes of each variable and the target variable. (3) In the third approach, the values of the variables were "completely" and "of decisive importance", i.e., 1 or 2 of the Likert scale ("important" group), as well as "not typical" and "not at all", i.e., values of 3 or 4 were also treated in a ("not important") group. These refinements ensured the understanding of the results.

4. Special literature antecedents

In the introductory reflections, I have sought to demonstrate that the definition of quality, the key role, and challenges of higher education in our society today, require a nuanced and multifaceted approach in focusing the research topic. The special literature explored reflects the thousand-faceted nature of the added value of higher education and the factors influencing the quality of higher education and of a particular institution. The thesis presents a detailed literature review, and the thesis booklet presents a concise summary of the findings.

Narrowing down the literature review to the added value of higher education, I identified seven groups of special literature: (1) NGO literature, relevant projects; (2) literature focusing on the quality of education, learning and teaching; (3) specialized literature that considers one factor in the added value of higher education (e.g. employability, services, curriculum, etc.) of particular importance, which does not set up a model, but its useful information and approaches can be identified; (4) a model based on the added value of the student learning outcomes and competence; (5) a model based on the added value of the individual or social advantage associated with higher education; (6) other highly important literary works that are decisive

from the point of view of the research; (7) literature on the added value of technical/STEM higher education.

By reviewing the researched and selected special literature, it can be concluded that *many prominent domestic and foreign researchers are active in the field of the quality and the added value of higher education, with an extremely rich, diverse, multi-faceted conceptualization*. At the same time, the educational science-focused approach and modeling of the added value of technical higher education, defined as a research focus, still requires a lot of research and exploratory work.

5. Research results, new scientific results

5.1. Stakeholders of technical higher education on the added value

In the first stage of my research, I tried to profile the quality of technical higher education with a thousand faces, that is, *to see behind the value system of the interest group that exerts the greatest influence on quality*, to draw the main features. My main research question is what elements I can identify to compile a model of the added value of technical higher education, and how the added value of technical higher education can be outlined from the point of view of various actors and stakeholders. Furthermore, the question is how this can be shifted in the direction of social synergy.

By juxtaposing the most important factors, criticisms, and good practices formulated by the three main interest groups, a holistic approach to the added value of technical higher education according to the examined sample emerges, as well as the possible transition between the views of the interest groups. It can be observed that the points of who, what and how they teach are visible everywhere. In addition, the *dimensions of talent management and networks* are identified.

All the factors mentioned in the interviews were collected according to the structure of the study, which led to the need for a *general* approach and an analysis of the *details*. The opinions, suggestions and good practices expressed in the sample were aggregated in terms of the general definition, characteristics, determinants, and opportunities of the added value of technical higher education (thesis Table 1). *As a general definition, the quality of education (theoretical and practical) and research¹⁰ can be grasped as the added value of technical higher education.*

¹⁰In my thesis, I focus on issues of educational quality. I treat the quality of research as an element integrated into the quality of education, which implicitly appears in the lecturers, the curriculum, the teaching, evaluation, and student involvement methods.

The added value of higher education is unanimously characterized by the quality of graduates based on the interviews.

Summing up the determining factors and opportunities, a *complex picture* emerges, where the importance of corporate and international relations appears, starting from the quality of incoming students¹¹, career guidance, management of academic recruitment, reduction of dropouts, and cooperation within and between universities. Several people touched on the added value-increasing potential of the higher education model change. An improved coordination between stakeholders and institutional and organizational (departmental) leadership was also identified as key areas of concern.

Among the elements of the added value that can be characterized by the quality of graduate students are good professional training, the acquisition of a systems approach, solid professional knowledge for industrial activities and further education, engineers capable of further training, teamwork and (self-)reflection, the networking capital acquired at university and the teacher-student turn, as well as preparation for the labor market. *Because of its impact on career and lifeline development, I treat university network capital as a key element of the network dimension of the value-added model.*

A detailed study revealing the main dimensions and elements of the added value is who, what and how they teach, the talent management and the networks. I identified opportunities and threats (doctoral thesis table 2). The result I obtained in this way *forms the basis for the creation of the value-added model, and answers my research question, with which I searched for the development trends and potentials of the added value.* In this way, I do not see specific methods, but rather what can be outlined in which value-creating areas the added value of technical higher education can be increased. *The professional and pedagogical preparation of the school-creating professors, the teaching staff, the curriculum created in collaboration with the industry players, engineering ethics, student competitions and the strong community are just a few of the most important opportunities that were identified.*

5.2. The added value of technical higher education and the background factors of the loss element

I conducted a questionnaire survey among students who interrupted their studies without a degree to find the reasons and characteristics of failure along student, teacher, institution, and support networks. Using a multi-aspect approach, I investigated whether there are patterns in

¹¹Although it appeared as an important aspect, in the research I do not deal with the quality of incoming students, which leads to public education.

the cases of students who have experienced termination/interruption of their student status at their own request or for other reasons, which allow certain elements to be positioned in the value-added model. Another research goal is the sophistication and categorization of dropout as a loss. I am looking for patterns with which I can better understand the reasons and factors behind dropout, as well as identify the added value elements and prevention opportunities. It should be emphasized that the main goal of the research is the modeling of the added value elements of technical higher education, the inverse approach of this includes the dropout study, and the final goal is to "turn" the results into a value-added model.

The questionnaire

Using the results of the previous research, I conceptualized and operationalized a possible approach to the added value of technical higher education and constructed a questionnaire¹², the relevant parts of which are included in the 6th appendix of the doctoral thesis. The time allotted to fill out the questionnaire and the ability to analyze it (easily assessable and definable aspects) represented an important aspect in addition to maintaining the main dimensions of the model (student, teacher, institution, and network). As a consequence of this, the individual variables of student success that are certainly linked to an important person (e.g., brought cultural capital, personal competences and motivations, sociological status characteristics), or the factor of institutional culture, for example, are not included in the model. That is why I assigned an important role to the option given to "other" free text answers given to several questions of the questionnaire. I considered it important that individual opinions can shape the structure of the model, perhaps bringing in new factors, shading and enriching the model. In a study published last year, I published the analysis results of these free text responses (Mészáros, 2021a). *I conceptualized and operationalized the causes of academic difficulties along four dimensions - student, teacher, institution, support networks*. For the personal reasons for the termination of the legal relationship and the background factors of the academic difficulties, I edited a four-item Likert scale questionnaire (completely, decisively important, not typical, not at all containing scale degrees), with which my aim was to eliminate the middle scale value. I left it possible to give individual explanatory answers to several questions of the questionnaire, and I equipped the non-Likert scale variables - where this could be interpreted - with optional answer types. I sent the questionnaire *through the Neptun study system in the form of a*

¹²With the survey conducted among students who dropped out, I asked the target group about the personal and official reasons for the termination of their legal relationship, the number of semesters spent at the institution in connection with the relevant training, the background factors of possible academic difficulties, their further education situation, housing during the training and some characteristics describing the relevant training (author's note).

*UNIPOLL*¹³ questionnaire to students who terminated their student status at their own request due to other compelling circumstances, selecting a five-year time-period and sending *the questionnaire to the students affected from January 1, 2015, in the first semester of 2020*. After a few months of filling out the questionnaire, the number of respondents did not change, thus *I asked for the questionnaires to be closed in July and November 2020*.

Sample and population

From the three designated technical institutions, two university evaluable samples were created (n=863). As the first step in examining the research questions, I compared the characteristics of the sample and the basic population, using the distribution of the official reasons for the termination of the legal relationship¹⁴ for comparison. Unfortunately, the sample to basic population ratio was not very encouraging. In addition to the fact that the proportion of the sample is quite low compared to the basic population, I also find cautionary findings regarding stratification.

In summary, the sample represents an easy-to-manage mapping of the basic population, in addition, a versatile approach and cautious, careful conclusions are the analytical aspects to be followed. The phenomenon of re-enrollment caught my attention.

Research directions of the questionnaire analysis

I have defined two main research directions and specific research questions within them:

1. Based on the responses of students who experienced the termination/interruption of the student relationship at their own request or for other reasons, the exploration of the determining factors, correlations, and patterns, with the results of which certain elements can be positioned in the value-added model.
2. Sophistication and categorizing dropout as a loss, as well as detecting patterns with which I can better understand the reasons and factors behind dropout, thereby approaching the components of the value-added model and identifying preventive actions.

The issues within the analytical directions are described in the description of the results.

¹³Provides complete anonymity.

¹⁴There was a question about this in the questionnaire.

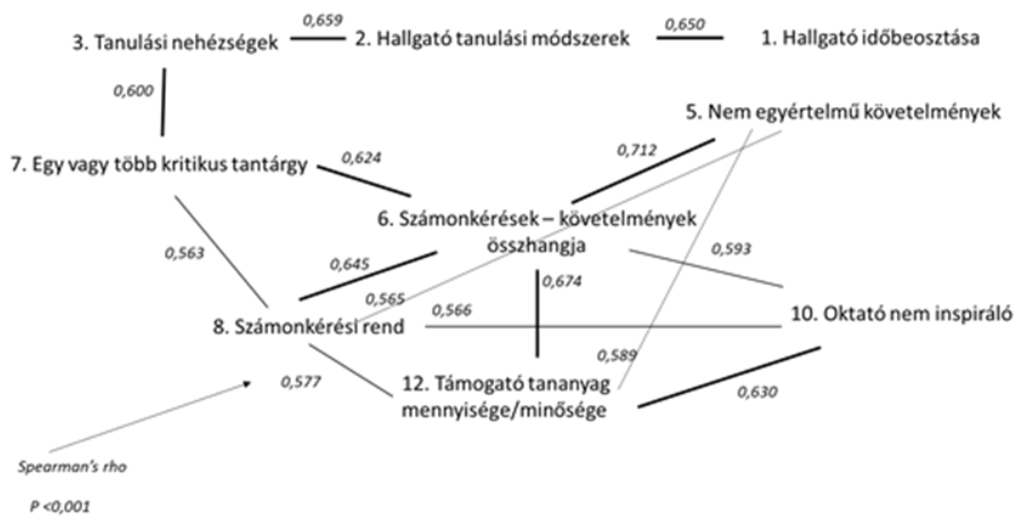
Results, summary of the new scientific results

Summarizing all the approaches I have taken to analyze the questionnaire research from several angles, I will highlight the most important findings for me:

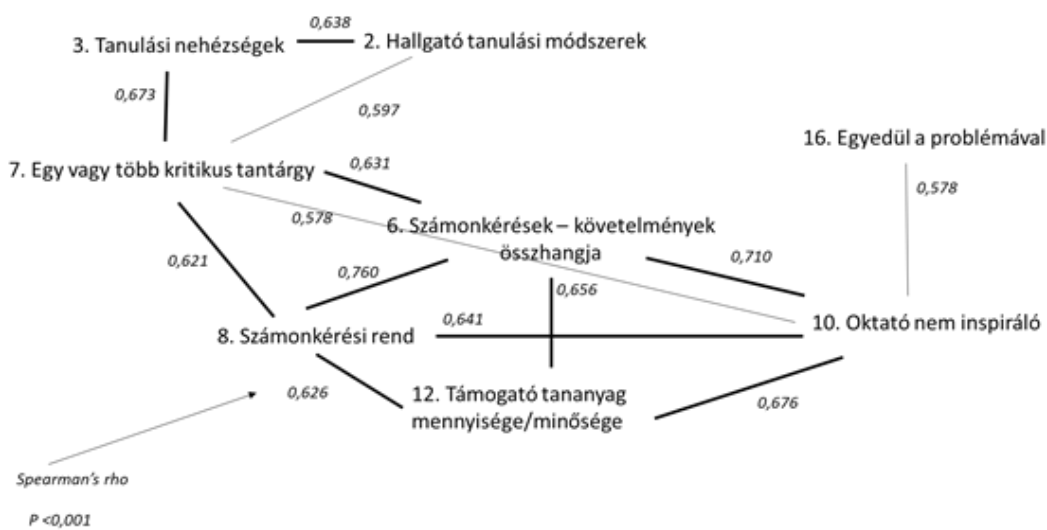
" 1.1. Which personal reason is the most common in relation to the termination of the legal relationship? Can co-movements between the factors be found?"

Fig. 1: Relationship map of the background factors of academic difficulties at two universities

A egyetem



B egyetem



Source: Own editing

I confirmed my hypothesis for the question that the personal reasons behind the interruption of studies were most often linked to academic reasons in the termination of legal relationships. Thus, *a good approach is to focus on study factors*¹⁵.

Based on the drawn *relationship maps*, it became clear that I can talk about a *network* of background factors that cause some academic difficulties. Looking at the relationship maps (Figure 1), the pattern is very similar, but the relationship strengths of the centers and the background factors belonging to the student dimension are slightly modified. With this, the "1.2. *What are the most common background factors for academic difficulties? Can co-movements be observed in terms of the four dimensions and the variables*" questions, with which I assumed relationships between the different dimensions and factors.

These network centers are typically concerned *with the critical subject(s), consistency of assessment requirements, order of assessment, insufficient quantity, and quality of supporting course material, uninspiring teachers, student learning difficulties*, and at one institution the network variable also appears (*alone with a problem*). In other words, *certain deficiencies in educational (institutional) and teaching excellence* came into focus, and student and network factors also appeared.

Regarding the „1.3. *What patterns can be found in the free text answers to other questions and how can they be linked to the value-added model? What unstructured motifs emerge?*" questions, I categorized the meanings with the analysis of the free text answers to the question as described in the research methods. As a result of the frequency analyses, the list of explanatory answers is led by "the choice of major was not suitable", "dissatisfaction with the quality of the training", "mental health reasons" and "change in funding status".

I discovered that the answers identified during the analysis of the free-text responses in the categories of "*academic failure*", "*mental health reasons*" and "*dissatisfaction with the quality of the training*" are positively associated with several background factors of the study, among which "*the teacher is not inspiring*" and "*critical subject(s)*" background factors are related to all three personal "other" categories. Another important finding is that the category of free-text responses "*the choice of the major was not suitable*" shows a close association with the study background factor "*began to be interested in another field*" i.e., it proved its importance in the model based on the individual responses as well.

¹⁵It should be noted that the combination of work and studies as a reason for terminating personal studies emerged in one of the university samples. As well as in the analysis of the text answers, I also explored the category of difficult compatibility of work and studies. Although I initially had intentions to turn my research in this direction as well, I found that several studies deal with this phenomenon, so I will not go into it separately during my research, I will let it go out of focus (author's note).

The "2.1. *How can the dropout be categorized? From whose point of view does it appear as a loss?*" in relation to the above group of questions, for a deeper examination of dropout, I looked for the answer to the question of what patterns can be found between academic difficulties and further education situation in the examined sample.

Following the interpretation of the loss dimension, I defined two cluster analyses:

1. *Institutional loss approach*: dropout examined from the institution's point of view as a second dimension. In this case, the person who leaves the institution is considered a loss (dummy_1= I restart my studies - stay; dummy_2= I continue in another institution, abroad, I do not continue - institutional loss).
2. *Social loss approach*: dropout examined from the perspective of higher education and society as a second dimension. Here, I only interpreted it as a loss if I received the answer "I will not continue my studies", otherwise dummy_1= stays in higher education (re-enrolls, goes to another domestic or foreign institution); dummy_2=loss of higher education (I do not continue my studies).

In summary, it can be said that the main aim of the *cluster analysis study* is to support the narrowing and focusing of the study background factors. Based on the analysis of the homogenous groups formed in terms of institutional and social loss, I established the most determining background factors based on the results of the sub-study without missing data of the institutional and social cluster analysis and searched for the elements that could be omitted. I found that "*access to student services*", "*unclear requirements*" and "*other*" factors can be omitted, all other background factors need to be further investigated. Another conclusion of the cluster studies is that *interest in other training is a particularly important factor in terms of institutional dropout*. At the same time, no loss group could be identified in the social cluster analysis, so I identified the determining factors of social loss as a further question to be investigated.

"2.2. *Can the background factors that cause academic difficulties predicting dropout be determined?*" By carrying out the logistic regression analysis chosen for the above question, I hoped that it would be possible to *further narrow the range of study background factors determining the added value by identifying causal relationships*. It became apparent that all four dimensions can be involved in increasing the probability of dropout. At the same time, I consider it important to emphasize that, *according to the study, the probability of dropping out of higher education was not influenced by the teacher dimension, while the same can be said about the network dimension about institutional dropout*. This can also be interpreted as a lack of teaching inspiration leading to leaving the institution, while this is no longer an explanatory

variable for dropping out of higher education. However, the network dimension can lead to social loss, while according to the study, it does not increase the probability of dropping out of the institution. *Based on the logistic regression analysis, the following dimensions and factors represent the explanatory variables of the technical higher education (institutional and social) loss based on the examined sample:*

- *Student dimension: "time schedule", "learning methods", "became interested in something else"*
- *Teacher dimension: "teacher was not inspiring"*
- *Institutional dimension: "critical subject(s)", "supporting curriculum"*
- *Network dimension "I felt alone with my problem"*

These results can be considered as a *new scientific result of the research*. Causality and persuasiveness *due to correlations, it seemed appropriate to focus on the factors brought out by the logistic regression, in addition to considering substitute and other qualitative factors during the compilation of the value-added model.*

In summary, as a common cross-section of cluster analysis, Pearson's correlation studies and logit regression, as well as other explanatory free answers, *all dimensions included in the study can play a role in the value-added model of technical higher education*. Typically, with the elements listed above, but always aware that there are substitute elements. In my opinion, this way I hopefully do not let go of important factors while focusing and reducing the size of the model to a manageable size.

6. The value-added model of technical higher education

The main goal of my research is to create an educational science-focused value-added model for technical higher education. As I have emphasized several times, I undertook to investigate and systematize the value-creating processes that define the value-added model of technical higher education. *The value-added model focusing on technical higher education can be considered a new scientific result of the research*. However, it is emphasized that - although I based the research on technical higher education - the created value-added model can provide opportunities for *other disciplines with further research work*, even for the *extension to higher education in general*. During the necessary research, it can be assumed that there will be a rearrangement of emphasis and proportions between the identified factors, new elements may appear, the model will be refined; however, the dimensions, the revealed elements, and causal reasons can provide a good basis for further research.

I consider it important to highlight some defining principles:

- In researching the relationship between quality higher education and the ESG²⁰¹⁵ standard, it can be said that during my research I did not come across any regulatory obstacles that would create legal or regulatory barriers to the development of a quality culture in higher education. In other words, the framework for a culture of quality is given, it must be filled with content.
- The results of the interviews, the special literature and our own research history confirmed the importance of institutional management in the formation of the added value. Here I list all heads of organizational units who are responsible for instructors and educational content and have the opportunity to influence the added value as a leader.
- During the processing of the ESG standards, I collected the most important institutional regulations. However, in my research I do not deal with the analysis of these regulations, because, on the contrary, I see it as possible to establish and develop a real quality culture in domestic higher education institutions. As we say: "paper can handle anything". Therefore, when setting up the model, I ignore the institutional regulatory compliances, their defining content and form elements can form part of a research based on it.
- It does not currently deal with aspects of the added value measurement, the examination of this may also be the topic of a later research.

I worked with two category systems during the research. One is related to the interview analysis, and the other is the criteria system of study background factors used during the questionnaire analysis of students who have interrupted their studies. I combined these two aspects when building the model. Based on the results of the *interview analysis*, *the dimensions of the model have been slightly reshaped. I defined a teaching and educational dimension and transferred the factors related to educational organization and curriculum content of the institutional dimension to this added dimension. The institutional dimension remained, but its content was transformed.* I distinguish between *student, teaching and educational, institutional and network dimensions.*

6.1. Presentation of the model

The full value-added model for technical higher education is presented in Table 1¹⁶. Based on the research results, I named the defining the added value elements of each dimension, assigned a value-creating process or processes to them, mentioned the resource assurance possibilities, and the expected result (where possible in a measurable form). In the textual presentation of the value-added model, I focus on the main elements, the value-creating processes, and the expected results.

I defined the value-added model elements of *time management*, *learning methods and motivation/interest in training*. The level 1 value-creating process (the first step) uses the team coaching¹⁷ method to enable the affected (volunteer or "found") students to operate safely in the decision axis of importance and urgency, by revealing the cause of procrastination and improving time management skills. A second value-creating process may be that the institution supports the participation of interested students and teachers in coach training. This can create an internal development network that can strengthen the university community. The expected result is a reduction in dropout rates.

The organization of inclusive learning support circles dedicated to the development of *learning methods*, as well as the collection of domestic and foreign good practices, can be formulated as a complementary value-creating processes. As the findings of Håkansson and other researchers have shown, *learning as part of a network* is more effective while at the same time it can gather the relational capital that the student stakeholder has identified as a priority. The expected results can be captured in better academic results and fewer failed exams, according to our expectations.

I consider the element of the added value "motivation/interest in training" to be a particularly important element of my research. I attach great importance to the care of students' life paths and the management of quasi-"positive dropouts". In this value-creating process, not only self-awareness processes, but also study counseling plays a big role. Supporting the search for a life path in youth, which can be said to be a natural phenomenon, is a novelty of the value-added model. According to our assumption, the expected result could be better communication about the competencies required for the training, more students participating in study counseling and fewer mental health complaints.

¹⁶ Elements from quantitative studies are highlighted (author's note).

¹⁷ Nowadays it is a popular organizational and personality development trend. The essence of the coaching process is to mobilize the existing internal resources, to enable them to achieve their goals, to help them learn and develop (Whitmore, 2008).

Table 1: The value-added model of technical higher education

Hallgatói dimenzió	HÉM fő elem	Értékteretítő folyamat_1	Értékteretítő folyamat_2	Eroforrás biztosítása	Várható eredmény
	időbe-osztás	team coaching segítségével képessé tétel	érdéklődő hallgatók, oktatók részére coach végzettség biztosítása	coach képzettségű belső erőforrás felderítése, hallgatói szolgáltatások újragondolása, költségvetési "árgyalások"	kevesebb tanulmány megszakítás/megszűntetés
	tanulási módszerek	tanulást támogató inkluzív körök működtetése	benchmarking folyamatok, jó gyakorlatok gyűjtése és adaptálása	pl. belső hallgatói tutor rendszer, tankörök kialakításával járó forrásigény felterképezése, költségvetési "árgyalások"	jobb tanulmányi eredmények, kevesebb sikertelenség
	motiváció/érdeklődés a képzés iránt	team coaching révén tudatosítás	más képzési terület iránt érdeklődők tanulmányi menedzselése, tanszéki/kari kommunikáció fejlesztése	coach képzettségű belső erőforrás felderítése, hallgatói szolgáltatások újragondolása, költségvetési "árgyalások"	hatékonyabb kommunikáció a szűkséges kompetenciákról, több tanácsadásban résztvevő, kevesebb mentálhigiénés panasz
Oktatói és Oktatási dimenzió	HÉM fő elem	Értékteretítő folyamat_1	Értékteretítő folyamat_2	Eroforrás biztosítása	Várható eredmény
	oktatói inspirációs képesség	képzők képzése - team coachinggal képessé tétel	pedagógiai ismeretek átadása	megtervezett szakmai program, pályázatok, költségvetés	kevesebb intézmény elhagyás
	tanárügyi programok	hallgatói, vállalati partnerek bevonásával tanárügyi programok fejlesztése	mérnöki tudástér tagítása a szabadon felvehető tárgyakkal	szakmai partnerségek, hallgatókkal, oktatókkal közös tevékenység, pályázatok, költségvetés	kevesebb intézmény elhagyás, jobb munkaerőpiaci visszatérések, nő a mesteroktatók száma
	támogató tananyag	tananyagfejlesztés hallgatói, vállalati bevonással	"vevői" elégedettség mérés és rendszereszerű visszacsatolás	tananyagfejlesztési projektek releváns tartalommal	fejlesztett tananyagok
	tehetség gondozás	hallgatói versenyek	érdeklődés alapján bevonás	szponzoráció biztosítása	tudományos életpályá utánpótlás, motiváció növelés
Intézményi dimenzió	HÉM fő elem	Értékteretítő folyamat_1	Értékteretítő folyamat_2	Eroforrás biztosítása	Várható eredmény
	tudatos HR terv	tudományos életpályák gondozása (minősítettség és utánpótlás tervezés)	oktatói fejlesztő pool kialakítása, mátrix model	költségvetés	növekvő minősített oktatók aránya
	egyetemi oktatási programok	tanárügyi programok intézményi összefűstülése	önismereti lehetőségek biztosítása	oktatásszervezés	motiváció növekedése
	hallgatói konzultáció, egyéb fejlesztő tevékenységek ösztönzése	teljesítményértékelési rendszerbe beépítés		költségvetés	ösztönző rendszerben kimutatható
	hallgatói szolgáltatások vállalati együttműködések	fejlesztés		költségvetés, szponzorok, pályázatok	bevonott hallgatók
Hálózati dimenzió	HÉM fő elem	Értékteretítő folyamat_1	Értékteretítő folyamat_2	Eroforrás biztosítása	Várható eredmény
	erős közösség	kortárssegítő hálózatok létesítése, erősítése		költségvetés	csökkentő lemorzsolódás, eszéklődő tanulmányi sikertelenség, kevesebb mentálhigiénés probléma
	oktató-hallgató partneri viszony	oktató-hallgató versenyek, pályamunkák		költségvetés, szponzoráció	oktatói utánpótlás, motiváció, kapcsolati tőke, kettős életpályák
	oktatói kapcsolati tőke	oktatók kutatási, nemzetközi, gyakorlati bevonása		pályázatok, mobilitás	több inspiráló, hiteles oktató

Source: own editing

The latter is probably difficult to detect, perhaps if there were such surveys, I could generate a base value. It is also conceivable that the number of early training leavers would initially increase, so *it is necessary to build a suitable monitoring and controlling system in order* to see a transparent picture of the results.

In the *teaching and educational dimension*, I have listed the added value elements of the teacher's ability to inspire, the subject programs, supporting curriculum, and talent management. Among these, I consider the first two factors to be particularly important. If these are in good "condition", in my view, they drag the other two value-added model elements and the related value-creating processes along with them. The question of the teacher's ability to inspire includes a lot of questions, starting from personality aspects, socialization, the degree of burnout and many other factors. Nevertheless, I am of the firm opinion that this element must be dealt with, since it was clearly demonstrated in the examined sample that this phenomenon emerged from all sides (I can call it a problem, but even more so an opportunity). I believe less in the power of one or two appropriate sensitizations, based on what has been revealed, *internal forces, strengths, and motivations must be mobilized, which is certainly a longer process*.

Here, too, I consider the *coaching* method to be the best tool, which has potential for development and could be a separate research topic. How would we notice that the teaching attitude is starting to improve in an institution? Based on my research results, I assume that there would be fewer people leaving the institution. To follow up my results, I propose to conduct an *'event-driven' structured systematic survey of students who drop out of their studies and leave the institution*. Let us find out for what reason they leave the institution or interrupt their training. Compiling a questionnaire of this kind would be an important accompanying element and self-reflection tool for the value-added model.

There is no doubt about the importance of the curriculum, based on the results so far, and it should be stressed that a review of the curricula in the field of technical education is proposed at institutional level, also through pilot projects, with the selection of a major. I consider this to be a very complex task, but anyone who has been following the reform of the vocational education and training field over the last few years, which has been outcome-based and outcome-focused, will not be surprised to learn that it is not necessarily necessary and possible to think in terms of subjects. *Project-based learning, as mentioned by the business stakeholder and reflected in the research history, is a good example of a task-based, problem-solving learning methodology where it is possible to add modules tailored to the student*. Furthermore, I suggest that self-awareness content useful for students could be included in the curricula of optional subjects, but of course more detailed target research is needed to establish this. The

expected results could be seen in increased numbers of master teachers, reduced drop-out rates and more positive feedback from employers.

The basic value-creating process for the development of the supporting teaching materials is the involvement of students and employers, followed by the "customer satisfaction measurement" and systematic feedback as the next step. As a result, teaching materials developed taking into account student and employer aspects could be published. With proper communication of the results, the question "Why is this necessary?" would become more transparent and perhaps more understandable. Why do you have to learn this?" issue.

I would also highlight *the value-creating process of participating in student competitions*, which, although I have classified, is not only linked to talent management, but also to the interest-based, project-based education concept. *The intersection of problem-centered education and teamwork education, which we need to deal with more if the topic is the development of engineering education.* Talent management is effective if it is inclusive and accessible. As a result, the supply of scientific career paths and motivation are strengthened.

The importance and weight of the *institutional dimension* and the institutional management's role in increasing the added value is decisive. The value-added module elements listed here are the *conscious HR plan, university education programs, student consultation, encouragement of other development activities, student services, and corporate collaborations*. Among the added value-creating processes assigned to the elements, a very important role is played by *the conscious management of the career path of the teacher and the stimulation of the constructive energies devoted to the student*. Along these lines, teacher qualification and motivation can increase, and the integration of student developments into the performance evaluation system could increase the quality of the institutional remuneration system.

The reason why I classified *the cross-education programs between university units* here and not in the curriculum part is because it is the competence of the institution's management to encourage these collaborations within the institution. Based on interviews, this greatly helps the training of interdisciplinary, well-educated, motivated engineers. The number of students involved will increase as an expected result with the development of student services and better communication. The development of corporate cooperation increases the institution's market revenues and the number of other areas of cooperation.

The central elements of the *network dimension* are *the strong community*, the other two key elements are based on this: *the master-student relationship and the relationship capital of the instructor*. *All of these strengthen and develop the student relationship capital*. In my opinion, a strong community can be created and developed by the joint application of the listed value-

creating processes - *establishment and development of peer support networks, teacher-student competitions, internships, international, research and practical involvement of teachers* - and by making use of their synergies.

Because of its impact on career and life trajectories, I treat the network dimension of the value-added model as a key element. On the one hand, this network of relationships (of which the teacher-student relationship is a part) strengthens the context of learning during the university years (Håkansson , 2010; Néray, 2013), and not least has the effect of multiplying the joys of university life, but at the same time, these often life-long relationships they can represent an important basis for economic and social value creation, as well as being of decisive importance to individuals both in their private lives and in the world of work. The university management and the teaching staff must consciously support the opportunities for the development of this relational capital.

The teacher-student partnership can be a strong foundation for these networks, enabling the life paths of the "universitas" actors to enhance each other, while building bridges to the corporate actors and developing into an ever-expanding relationship system of the teacher-student-professional triangle, which in many cases accompanies them through life paths. *Together, network inclusion and equity can make these communities strong.* The expected results are assumed to be reduced dropout rates and academic failure, fewer mental health problems, the development of dual (master teacher) life paths, and the appearance of more authentic, inspiring teachers. A supportive institutional attitude can act as a catalyst to help the development of a strong community.

6.2.Applicability

The true value of research results is their applicability. I prepared the value-added model created as a result of the research with a practical approach in accordance with my original ideas. *I strove to balance the mapping of research results and the feasibility of practice.* The systematic introduction of the value-creating processes classified according to dimensions and tied to the added value elements is recommended to be implemented in a smaller scope as a first step. *The formation of a pilot project could help practical validation.* During the implementation, the support of the management of the institution concerned and of the participants of the pilot project is of course indispensable. Furthermore, multi aspect systematic measurement in several dimensions is essential.

The applicability of the model - in addition to its expansion possibilities - can be supported by several findings:

- The fact that the proposal of the The International Advisory Board of the Hungarian Accreditation Committee’s 2021 proposal focused on the area of teaching and research quality during the accreditation procedures is a boon for the implementation. In my view, the results of my research can serve as a good basis for self-evaluation of the quality of teaching.
- The Office of Education is also working with great efforts to measure the added value, in my view, joint thinking and my results could bring synergies.
- During the research, I discovered that although there is no social consensus among the evaluators, there are crossovers between the different interest group sub-systems. The formation of these transitions into a consensus can also only be helped by practical implementation, where I now perceived openness.
- The model change affected the majority of state universities. The necessary reorientations in this context and the more direct involvement of business interests could also be a good basis for new initiatives, quality improvement projects and, in the long term, projects to enhance the added value of higher education and thus its reputation.
- The factors and the value-creating processes articulated in the model are a combination of the views of the stakeholders in the sample, with the potential for consensus.

7. The evaluation of the hypotheses and the summary of main findings

7.1. The evaluation of the hypotheses

Hypothesis 1

There is no social consensus on determining the quality and the added value of domestic technical higher education institutions. The evaluators/stakeholders evaluate according to the aspects of their own subsystem.

I could only partially prove this hypothesis, as there are important common aspects, openness between the definitions of the actors. The research results show that there is indeed no social consensus between social groups, that they are indeed typically evaluated according to their own subsystem, but that bridges between subsystems are beginning to be built, which is a very positive message regarding the timeliness of my research. In addition, the employers introduced

elements typical of company operations that only appeared for them, such as the importance of teamwork and cultured reflection (in case of persuasion or disagreement), the importance of training engineering intellectuals¹⁸ (who understand themselves even among non-engineers), games, professions, the potential of projects and the importance of technical career guidance activities. To summarize, *we can find the priorities of the interest groups according to their own sub-systems, and we cannot speak of a typical identity between the groups. Together, they paint a very complex picture of the quality and added value of technical higher education, where the focus of the elements is often different, but common sets can be identified.*

Hypothesis 2

We currently do not measure the added value of domestic technical higher education institutions.

I researched my second hypothesis using the primary method of special literature exploration and analysis, as well as the results of in-depth interviews, which I found to *be justified*. A more complete, broader-viewed investigation would require a separate research resource, which I did not focus on when writing this thesis for reasons of length.

During the special literature analysis, I identified two main metric approaches for measuring the added value. One is the model based on student learning results and competence (hereinafter the outcome-based model), the other is the model based on the individual or social advantage associated with higher education (hereinafter the benefit-based model). *The domestic practice* has set the goal of implementing the result-based model. "At the beginning and at the end of the training, the general level of competence of the students must be examined, so that it becomes clear to what extent the given training has contributed to the development of the students' skills and knowledge" (Grade change in higher education p. 20, 2014). We learn more about the implementation of this action plan from the study volume published in 2020 by the Education Authority and edited by Goldfárthné Veres¹⁹, which describes the planned system and operation of competence measurement in higher education. According to the results, in 2018 the Education Authority carried out an experimental higher education competence assessment, which will be repeated in 2023 with the relevant group, so there will be an entry

¹⁸ Although among the opinions of the institution's head and the students, this arose as an aspect of the training of engineering intellectuals, generally educated engineers. The sensitive term is so much more that the employer's side expresses the need for the engineer to be able to understand himself among graduates in other fields. Speak a common language (author's note).

¹⁹ It was prepared within the framework of EFOP-3.4.5-VEKOP-17-2017-00001, System-level developments and sectoral programs for expanding access in higher education. On January 30, 2020, at the closing conference of the project referred to above, Ádám Hátori, a staff member of the Office of Education, reported on the results of the preparation of the higher education competency measurement.

and exit competency result, at which point changes between the two levels of competency will be visible, i.e., the added value. It can be said that *preparations have been made to measure the added value, but currently there are only input competence results*. The testing of this hypothesis cannot be considered complete, as it is possible that some institutions are further along in the measurement process and have an "in-house solution.

Hypothesis 3

By rethinking the instructor/teacher role and approach, and by combining network thinking that positively influences the quality of teaching-learning, added value and sustainable quality can be increased.

When examining the hypothesis, it is necessary to grasp two important factors, the rethinking of the role and approach of the instructor/teacher, as well as network thinking. I assume that the combined application of these factors can increase the added value and sustainable quality²⁰. To test the hypothesis, I used the results of in-depth interviews with stakeholders and a questionnaire survey of students who had dropped out (interrupted/terminated their studies). *Based on the results of both the interview analyses and the analysis of the free text questionnaire responses, as well as rank correlation cluster analysis and logistic regression analysis, it can be said that this hypothesis was confirmed.*

In the analysis of the interviews, the common denominators of teaching excellence were the partnership between teacher-student (professor-student, master-student), the ability of the teacher to inspire, the practical experience of the teacher and the importance of continuous international and corporate knowledge renewal. The professor-student partnership was also identified as a kind of network node, which is a good network resource for the transfer of contacts between the student and the relevant labor market. *The students identified the networking capital gained at the university as a particularly important added value, of which student-teacher relations are an important part.*

Examining the free-text answers of the questionnaire survey, behind the category *"dissatisfaction with the quality of training"* are primarily factors related to the teachers and the education/training system. I consider the element *"teacher attitude"* revealed among them to be significant in relation to the relevant hypothesis test. *In several places in the answers, the reference to the feudal system of relations revealed in the in-depth student interviews can be identified, which is often defined by "toxic superiority". During the questionnaire research, it*

²⁰ That is, the quality culture can be developed (self-reflection is present).

became visible that *"the teacher was not inspiring"* has a variable association with academic failure and mental health reasons, in addition to dissatisfaction with the quality of training.

The results of the rank correlation cluster analysis identified the factors *"the instructor was not inspiring"*, *"the instructor did not follow my progress"*, *"I felt alone with my problem"* as *prioritized factors*²¹ in both the social and institutional study.

Based on the results of the *social logistic regression* study, *"I felt alone with my problem"* was classified as a defining explanatory variable in terms of social loss (leaving higher education), i.e., *the added value can be increased by improving the network dimension*.

In the *institutional logistic regression* study, I looked at the above correlation system for those who left the institution as dropouts. Here, the variable *"the instructor was not inspiring"* proved to have a decisive explanatory power, whether I treated the scale values together or separately. In other words, the factor *"the instructor was not inspiring"* increases the probability of dropping out of the institution based on the tests from the sample. The added value can be increased by reversing the way of thinking, *by shaping and developing the educational approach*.

These factors can be treated together, and it can be said that our hypothesis is confirmed that *the added value and sustainable quality can be increased by rethinking the role and approach of the instructor/teacher, as well as by applying network thinking that positively influences the quality of teaching and learning*.

7.2. Summary of the main findings in the light of new scientific results, development trends and potentials

In response to the questions posed at the beginning of my research, I first determined that the quality of technical higher education as a service process is a value transferred during the higher education process - based on the value judgment of the stakeholders - which (adopting the definition of Veress et al., 2010) in a narrow sense is the "individual" of the stakeholders' profit, the social value of higher education in a broad sense. Based on this, by the added value I mean the social value arising as a result of the value(s) transferred during the higher education process, which includes the "individual" profits of any "stakeholder" supporting sustainable social development. This can also be interpreted as the fact that individual and social profit only contribute to the added value together.

In researching the measurability of added value, *we have reviewed the literature and identified some current international examples*. The main difference is the learning outcome, i.e.,

²¹ Here, I only highlight the factors necessary for hypothesis testing.

competence-based development or the impact/advantages of higher education are measured. The domestic initiatives are clearly competence-based, the systematic implementation of which, in my view, would be important, however, I did *not focus on the metric approach in connection with my thesis, because in my opinion it requires separate research*. I would definitely take the possibility of intervention²² as a key question in this particular research, because at the beginning of the studies, dropouts are typical in a large proportion.

To the question "*How, with what tools and methods can the added value of technical higher education be increased?*" the factors revealed during qualitative and quantitative research and the value-added model set up based on them provide the answer. It should be emphasized that I primarily identified factors, opportunities, threats, and connections. *I defined the value-creating processes during the modeling, but I would like to draw attention to the fact that my thesis is not emphatically centered on tools and methods but was able to identify the elements of the value-added model, the development trends, and potentials. With these, it can of course be easily approximated in subsequent research, what kind of tools and methods can be adapted to the development of certain elements.*

In response to the questions of the research problem, I explored the dimensions and elements of the value-added model of technical higher education with a multi-aspect approach, defined the value-creating processes that can be linked to the factors, the necessary resources, and the expected results. *I have created a model, the framework of which is validated in further research, and the systematic value-creating processes aimed at increasing the added value of technical higher education can be introduced and followed. The created model provides good foundations for extension to other disciplines and higher education in general. The goal is the introduction and development of a quality culture.*

I consider it one of the greatest findings of my research that it can be deduced both during the interviews and from the results of the questionnaire research that *there is a need to rethink the role and approach of the instructor/teacher, the learning-teaching environment*. This way, the educational orientation of the model has been confirmed. Its causal *justification can be assessed as a new scientific result of the research*.

To conclude, I will briefly summarize some important research findings reflecting trends and potentials for the added value:

- The term "network" grew out of nowhere in the second half of the 20th century and came closer to the frequency of the term "quality" than the term "value".

²² One university (n=490), I examined that nearly 50% of students in the sample terminate their studentship in the first two semesters, the next jump is experienced in the 4th semester. Similar findings are made by Goldfárthné et al (2020).

- When implementing Håkansson's organizational learning model for higher education, it can be said that the relational context of learning is the most decisive. The importance of the relationship capital acquired at the university should be highlighted. This should be built on when building the value-added model of technical higher education.
- The 2021 proposal of the MAB (HAC) International Advisory Board focuses on the area of teaching and research quality during accreditation procedures. It is advisable to take advantage of these development trends and potentials.
- Almost 100% of those with a technical and an IT master's degree, and almost 90% of those with a natural science degree, complete graduate work, which data indicate the "hunger" of the labor market. It can therefore be misleading to base graduate student quality as the main characteristic of the added value on early employment data.
- At the beginning of the questionnaire research conducted among students who interrupted/terminated their studies, I helped to keep my research focused with several questions and assumptions. I proved that the personal reasons behind the interruption of studies were most often linked to academic reasons in the termination of legal relationships. Thus, it is a good approach to focus on academic factors when creating the value-added model. This also supports the *raison d'être* of the educational focus.
- Based on the drawn relationship maps, it became visible that we can talk about a network of background factors that cause some academic difficulties.
- Another important finding is that the category of free-text responses "the choice of major (profession) was not suitable" shows a close association with the study background factor "*I became interested in another field*" i.e., it proved its importance in the model, based on the individual responses as well. This factor is one of the novelties of research.
- As a common cross-section of the test results of the rank correlation cluster analysis and the logistic regression and other explanatory free answers, all dimensions included in the study can play a role in the value-added model of technical higher education. The following elements summarize the conclusions of these studies:
 - *Student dimension: "time schedule", "learning methods", "I became interested in another field"*
 - *Educator dimension: "teacher was not inspiring"*
 - *Institutional dimension: "critical subject(s)", "supporting curriculum"*
 - *Network dimension "I felt alone with my problem"*

- *importance of the curriculum* can be clearly perceived.
- The most prominent finding of the research is the establishment of a possible version of the *value-added model*. This is a prominent new scientific result of the research.

8. Final thoughts, outlook

The main goal of my research was to establish a model with a focus on educational science, which reveals the dimensions and elements of the added value of technical higher education. The research frameworks were provided by the higher education institutions of the domestic technical (STEM) majors, of which I selected three institutions (one in the capital and two in the countryside) for a closer examination. In connection with the research antecedents and the research of the special literature, I discovered that there are many initiatives to approach, model and as foreign examples have shown, even to measure the quality of higher education and within it the added value of technical higher education. In terms of domestic processes, there is currently no nationwide system-level developed and "operated" value-added measurement system, but at the same time serious preparations and input measurements have been made by the Office of Education. In which I *tried to complete and advance simultaneously with my research to understand the quality and the added value of domestic technical higher education*. It is the conceptualizing and operationalizing of the added value identified primarily with the help of the value-oriented process approach and setting up a model based on multi-point research results. On the other hand, I tried to *examine the results already revealed by the Educational Authority and its staff*. While I confirmed several of their results during the research, I identified many new factors and correlations.

Among *the new scientific results of the research, I include the methodological diversity of the multi-point approach*. The exploration of the opinions of various interest groups, as well as the nearly 900 sample questionnaire survey, with which I asked students who interrupted/terminated their studies, enabled a multi-perspective approach, thus ensuring the most holistic overview of the topic. By applying ranking cluster analysis and logistic regression methods, which are not so common in the world of ordinal and categorical variables, I also established the foundations of the value-added model of technical higher education in a quantitative way.

One of the novelties of *interview* analyses is the complexity of the results, as well as the importance and social value of the relational capital acquired at the university. Among the results of the *quantitative studies*, it can be summarized that the "*critical subject(s)*" is the only

common point between the explanatory variables of the institutional and social loss patterns. Based on these, the subject program deserves a special place in the value-added model, and as a separate research topic, it holds countless opportunities for what we teach the students.

It is noteworthy that, based on the sample, *the probability of the occurrence of an institutional loss is also increased by the marked characteristics of the teacher-educational environment*, such as the "supporting curriculum" and "teachers were not inspiring" and "learning methods" variables.

In addition to *"time schedule" problems*, the students who left higher education drew attention to two very interesting aspects: *"I became interested in another field"* and *"I felt alone with my problem"* background factors. Based on the research carried out on the sample, these factors can increase the probability of dropping out of the higher education system and social loss, so they are extremely important at the social level.

The emergence of "I became interested in another field" and "loneliness" as predictors of social loss is another novelty. The importance of consciously dealing with students who are looking for a way in life, who have become uncertain in terms of their field of study, and helping these young people change professions or even institutions as a *"positive dropout phenomenon" is a great responsibility.* Similarly, the importance of *strong communities came to the fore as a result of the research.* These factors can save a student based on the test performed on the sample.

The value-added model of technical higher education, established on qualitative and quantitative tests, intended for practical implementation and self-evaluation can be considered a new scientific result of the research. Student, teacher-educational, institutional and network dimensions can be distinguished. Within the dimensions, the factors that were formulated as the results of the qualitative and quantitative tests were placed. The novelty of the model is that it *reflects a systemic approach, includes dimensions, associated elements, value-creating processes related to them, necessary resources and expected results (where possible in measurable form).* It is interesting that during the quantitative tests, the student and teacher-education dimensions were added, and the network dimension was enriched with one element. The added value elements of the institutional dimension were provided by the results of the qualitative studies.

Regarding the novelty of the model, I would also name the *system of value-creating processes*, which is a new approach to the development of the added value of higher education and the sharpening of its inherent potentials. Furthermore, *the creation of control systems that can be linked to value-creating processes should be highlighted*, which makes it possible to measure

the added value within a short period of time and is suitable for self-reflection. Such control systems e.g., the measurement of student and teacher satisfaction, the systematic questioning of students who interrupt/terminate their studies about the reasons behind the decision, the evaluation of the information built into the system of peer support networks, etc.

I consider the element of the added value "motivation/interest in training" to be a particularly important element of my research. I attach great importance to the care of students' life paths and the management of quasi-"positive dropouts". I consider the "wanderings" of young adults in search of a career to be a natural phenomenon, and I consider it the institutional responsibility to know about these students and to support their changes of profession and training. Another addition is that the "mission" of young people who know themselves and their chosen profession better extends to the public education stage as well, it is useful to connect career guidance activities with self-knowledge activities and, in my view, higher education (based on its well-identified interests) should also take part in this work.

Outlook

As I indicated in the introduction, I saw it as the organization of a *research group*. The number one reason for this is that only the first small step of the creative and research process fitted into my doctoral thesis to which I was committed. I also indicated that I had conducted an extra interview with an outstanding teacher-researcher, whom two interviewees (one the head of the institution, the other the employer) had marked as an inspiring teacher example to follow. I used the interview with the teacher-researcher to discuss the results I discovered and whether or how one sees an opportunity for the applicability of the model. As a result of a very inspiring conversation, I came to the decision to organize a research group to implement the pilot project. The pilot project of the model of the added value of technical higher education is a well-articulated direction for further research. Within this, I would like to pay special attention to the teacher-student relationship.

In addition, the extension of the model to other disciplines, even to higher education in general, is also a well-articulated further research goal. The first domestic results of the measurement of the added value of higher education, expected to be published soon, may also show new directions, and raise further research questions. Based on these, the topic can still offer many researchers some meaningful ammunition.

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Appendix: Publication list (source: MTMI2, 2022.10.08.)

2022

1. Dinnyés, Álmos; Mészáros, Virág
Humán erőforrás fejlesztés kontrollinja személyiségelemzés és vállalati eredményesség mutatók összekapcsolásával
CONTROLLER INFO 10. 1 pp. 24-29., 6 p. (2022)

Közlemény:33047062 Nyilvános Forrás Idéző Folyóiratcikk (Szakcikk) Tudományos
2. Mészáros, Virág; Takács, Éva
MEGSZÜNTETETT/MEGSZAKÍTOTT HALLGATÓI JOGVISZONYOK, TANULMÁNYI NEHÉZSÉGEK ÉS AZ ÚJRAKEZDÉS ÖSSZEFÜGGÉSEI : - EGY KLASZTERELEMZÉS EREDMÉNYEI
TUDÁSMENEDZSMENT 23: 1 pp. 119-138., 20 p. (2022)

Közlemény:33088040 Admin láttamozott Forrás Idéző Folyóiratcikk (Szakcikk) Tudományos
3. Mészáros, Virág
Some Explanatory Variables of Dropout in Technical Higher Education : Institutional and Social Loss
POLGÁRI SZEMLE: GAZDASÁGI ÉS TÁRSADALMI FOLYÓIRAT 18. évf. 1-3. (2022)
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