Enhancing the Quality of Services and Reputation Level in Technical Engineering Higher Education

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***Abstract* – Providing true quality services, better adapted to market requests in technical engineering higher education, poses a series of challenges for all Romanian and European universities. To overcome these issues, the first mandatory step is to conduct a thorough market research in order to identify the needs and the expectations of the stakeholders involved in the educational processes. Both former and present students and also companies, active on the labour market who will finally "buy" the qualified work force trained by each technical university, should be taken into account in gathering and processing the required data. For this to be accomplished, the Quality Function Deployment (QFD) method has been adapted and applied in conducting a research that will constitute the first step in helping a technical university to identify the main issues that require improvements or immediate change, in order to be able to fulfil the present and future labour market requests and increase its reputation level at the same time.**

***Keywords* – quality of service, QFD, labour market, technical engineering, higher education.**

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1. Introduction

In today's society, higher education services must be seen and understood as a link from an extremely complex social chain, this complexity being generated by an increasing diversity degree of the domains in which firms operate. The beneficiaries of these services, the final customers, are the organizations present on any labour market, which theoretically may be more or less involved in the provision of the service itself. They indirectly contribute to the payment of educational service benefits through tax contributions to the budget, from which most of the funds for educational processes are allocated, and they pay directly the professional competence resulting from the provision of the educational service through salaries to the employees. If economic organizations no longer "buy" the professional competence of certain faculties / universities that have failed to adapt their education offer on actual demand sufficiently, then eventually they can simply disappear from the system.

As the competition in the field of university education services is increasing, the offer being very varied, including options for studies abroad, the faculties of the Romanian technical universities must work together to build a better image on the usefulness and quality of the educational services offered. They are in a constant search for new ways to improve both the educational level as well as to streamline the presentation of the educational offer to the outside stakeholders. The online environment is from this point of view insufficiently exploited by many institutions of higher education. In order to compete, all universities, down to the faculties level must try to adapt and apply the marketing principles found in industry and adopt different strategies through which the objective of having an improved image and reputation with each new academic year should be achieved.

2. The overall complexity of the problem and the current state of knowledge related to the research

In terms of educational marketing, all efforts are justified by the fact that, in general, education and culture need to become the most cost-effective domains, giving value to what they have to offer, capitalizing on any opportunity. If no rational decisions can be made in the business environment without prior market investigation, in a similar way education must make periodical studies on public needs.

These studies can also be done with greater accuracy using online domain if the specific techniques are known and applied correctly.

Therefore, certain special concepts such as: educational market, educational request, educational offer, educational consumption, educational online marketing strategies, perception of the online created image of the educational services' quality etc., must be defined, but these aspects are not always easy to establish and quantify.

Classic marketing principles can be seen from a certain point of view as a science of selling and an art of persuading customers to buy. According to other specialists, marketing is the art of creating the conditions in which the buyer convinces himself to buy the product or service. To that end, scientific methods and techniques for market investigation and effective adaptation to consumer needs should be used. This approach should also be adapted to the academic education services that can benefit from a proper promotion campaign for instance in the online environment by constantly building a positive image and reputation in this regard.

At present, in Romania (and many other countries throughout Europe), there is still no detailed research done periodically into the needs and the expectations of clients benefiting from university education services, including all the stakeholders involved: past, present and future students and companies active on the labour market.

Such a study of these issues becomes imperative necessary for each technical university, and its application and implementation of the results through combining techniques specific to the online environment and digital marketing with classical methods, would bring a certain novelty in the field, together with many benefits.

Many researchers approached similar subjects. For instance, Mark (2013) studied student satisfaction and customer focus in higher education, arriving at the conclusion that the philosophy that "the customer is always right" might not necessarily apply to any higher education scenario [1]. Voss and others (2007) studied the role of student expectations in higher education service quality and their findings were that students want the lecturers to be knowledgeable, enthusiastic, approachable, and friendly [2]. Warn & Tranter (2010) measured students' perception of the overall quality of their degree [3], Mullen and others (2012) researched the problem of university branding in an attempt to understand the students' choice of an educational institution [4], while Clewes (2010) proposed a conceptual model of service quality in higher education [5]. Further, on these topics, Owlia & Aspinwall (2010) approached a study regarding the methods for measuring the quality in engineering education [6]. Mergen, and others (2010) [7] and Mukhopadhyay (2016) [8] studied other issues related to quality management applied to higher education services area in order to identify improvement opportunities.

3. Objectives of the research

This research consists of a study particularized for Romanian technical universities, but with broader international applicability. The aim is to highlight the key aspects where the improvement and/or change should first be implemented in order to generate real growth both in the quality of services offered, but also in terms of fast adapting them to the market request thus raising their usefulness level. At the same time, this will lead to a significant enhancement of the overall image's perception for a technical university and its specific faculties in the general public's view, generating more satisfaction for the students, more confidence and credibility, a better reputation for the university, thus ensuring each faculty a stable place for years to come.

The study was carried out at one of the most important technical universities from Romania: University Politehnica of Bucharest (named throughout this paper with short form, as "UPB"). The survey was done by taking into account the perspective of the first hand category of beneficiaries of the educational services: past and present students. An important number of employers from private companies have been contacted and they will be surveyed in a similar way in the near future, some of them being former students of different faculties from the UPB.

The global aim was to find out the urgent aspects that need to be implemented in order to increase the quality of the educational services offered and to better adapt them to the real market needs while bringing enhancements at the same time for the reputation level.

4. The risk and challenge elements

For this research was used the adaptation of the Quality Function Deployment (QFD) method to achieve the research's objectives. This implies a relatively major degree of complexity, thus presenting both a number of novelty elements applied for a technical university and issues that bring about a series of challenges and risks of errors during data gathering and evaluation.

One of the risks that has been taken into account was that students from the main technical university analysed (UPB) would not fill in a sufficient number of questionnaires in order to draw rigorous conclusions when adapting and applying the QFD method. Another risk could have been that some of them are subjective or relatively disinterested in completing the answers to the issues included in the questionnaire. These risks have been minimized by personally submitting a significant number of the questionnaires and providing detailed explanations on the importance of accurate data completion. For students from other faculties in UPB where the author had no teaching hours, the questionnaire model was multiplied and delivered to them through the secretariats, but also published online using the free service offered by Google. Over a period of three and a half months, the total number of persons who completed the questionnaire was 287 (21 were ignored because they were incomplete), as the online link was made available and shared through social networks (Facebook, Twitter, Instagram etc.) in order to achieve a sample as representative as possible and to obtain the necessary information.

5. Enhancements through the QFD method

Shigeru Mizuno and Yoji Akao developed the QFD method in Japan in the late 1960s.

The introduction of the QFD into America and Europe began in 1983 when the American Society for Quality Control published Akao's work in Quality Progress and Cambridge Research (today the Kaizen Institute) invited Akao to hold a QFD seminar in Chicago.

Today, QFD continues to inspire strong interest throughout the world, always generating new areas of application, new practitioners and new researchers each year. Countries that have held National and International QFD Symposia to date include: Japan, Sweden, Germany, Australia, Brazil, and Turkey [13], [14].

QFD is the method for transferring customer requirements into the design of a functional and competitive product or service. Some experts synthesize this idea by saying that this method represents "the voice of the customer translated into the voice of the engineer".

In the past years, other researchers worked with the QFD method in different ways when evaluating the quality of educational services, for instance: Hwarng and Teo (2001) [9], Sahney and others (2003, 2004, 2007) [10], [11], [12], as the method is suitable for such an approach.

By using this method to improve the product or service provided, the QFD connects customer needs with marketing, design, development, engineering, production and service functions. So besides products, it can also be used for other things like services or software.

Ultimately, the goal of the QFD is to translate often subjective quality criteria into objective ones that can be quantified and measured and which can then be used to design, manufacture or improve the product or service. It is a complimentary way for determining how and where priorities will be assigned.

6. Methodology: adapting and applying the QFD method

In order to best determine the key aspects that will require improvement in the particular case of each technical university, the QFD method must be adapted to the current context, the method being applicable to an entire university, or just to a single faculty. This may open the way for future in-depth research down to faculties' level, which can be further extended by any faculty in a university also from other fields of education not necessarily related to engineering.

The adapted method, if properly applied and implemented, will allow any university or faculty to intervene quickly where there really is a need to change or update the services offered in order to better comply to the current labour market requests.

The first stage in the adaptation of the QFD method is to identify clients' wishes and expectations. This may lead to the improvement of the quality of the provision of educational services, but also to the improvement of the image and the reputation of the university abroad, both among the present and future students and for the companies operating on the labour market.

The next step consists in designing the questionnaire needed to adapt and apply the QFD method, in order to determine the expectations and the needs from the educational services provided by a technical university, in this case, the UPB. During this stage, the adaptation of the QFD method by designing the adequate questionnaire to be addressed to the first category of stakeholders involved (past and present students) is of major importance, as

seeking to find those key issues that they see as priorities to be improved within the university is fundamental.

One very important issue that must be kept under periodical surveillance during the following years is monitoring and quantifying the consequences of implementing this method, in order to further refine it in all its aspects and to constantly be aware of the changes that take place in the external environment.

To document the work steps as a graphical support for the QFD, the method uses a special diagram called "House of Quality", which is synthesized in Figure 1:

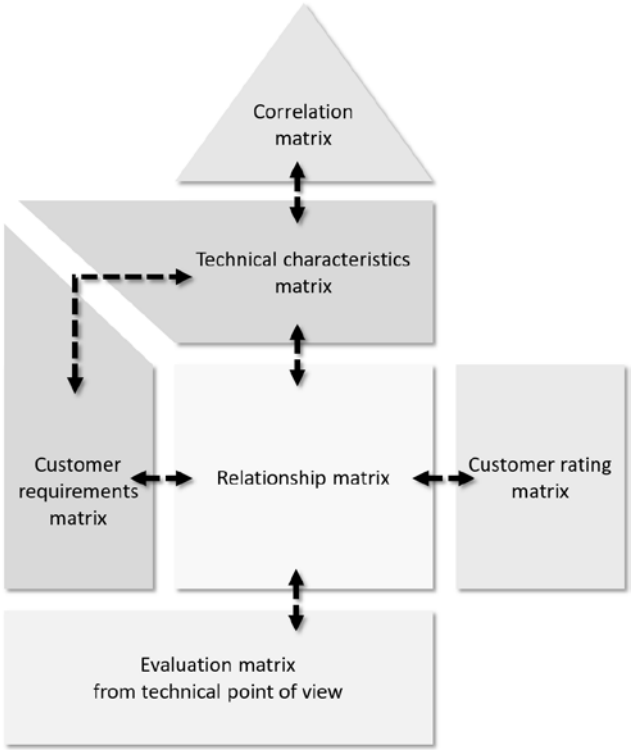

Figure 1. The general matrixes connections layout of the QFD method

The central area of the chart is a matrix of relationships that can help identify deficiencies in the specified quality characteristics.

The matrix has two main entries, respectively customer requirements – on the horizontal line and quality (technical) characteristics – on the column.

Its basics components are:

- *Customer requirements matrix*: their desires and expectations regarding the product are highlighted, as well as the importance given by the customer to each requirement.
- *Technical characteristics matrix*: highlights the requirements of the organization, which the supplier must ensure to give the product consistency. It also specifies how each technical feature needs to evolve.
- *Relationship matrix*: highlights the correspondence between customer expectations and technical characteristics of the product, being the basic central element of the chart.
- *Correlation matrix*: shows the interdependence of the technical characteristics of the product.
- *The product/service evaluation matrix against competition from the customer's technical point of view*: for each individual requirement, the position of the product/service itself and similar products/services of other competing organizations are identified from the customer's perspective.
- *Customer rating matrix*: includes information on the degree of difficulty in achieving each technical characteristic of the product, the value to which each technical characteristic has to arrive expressed in the specific measurement units, the importance of each characteristic in absolute and relative size, and comparative analysis with technically competing products or services.

The analysis was done between the UPB and two other important technical universities from Romania, in this paper named UT1 and UT2 due to privacy reasons.

In order to collect the necessary information to improve the services and implicitly the image and reputation of the UPB in the exterior environment, information is needed on:

- Customer requirements and expectations
- The importance that customers give to meeting requirements and expectations
- Assessing the competitiveness of the educational process
- Customer perception of the service, also achieved through communication, public relations (PR) activities with the external environment
- Customer preferences

The requirements of the clients for the services offered in the higher education field gathered statistically from different sources of information in the past years are:

- Useful and updated knowledge
- Modern teaching methods
- The complementarity of the main subjects in educational curricula
- The solicitude and involvement of the educational staff

In order to gather as much information as possible on these regards, a questionnaire was carefully designed, for some of the questions the Likert scale

with five levels of choice was considered the most appropriate.

Taking into account that nowadays everybody has limited spare time, to make things easier and faster to complete, it includes ten questions, presented below in their logical order.

1. Which aspects are most important when choosing to pursue a technical university?
.....

2. Have you ever been interested in the offer of another technical university, besides the UPB?
Yes / No

3. In the affirmative case, what determines you to choose the educational services offered by the UPB?
.....

4. How important is it for you that a technical university should meet the following characteristics?

A. Useful and updated knowledge
B. Modern teaching methods
C. The complementarity of the main subjects in educational curricula
D. The solicitude and involvement of the educational staff
Extremely important / Quite important / Important /A little less important / Not important

5. What do you think about the UPB in terms of the following aspects:

A. Useful and updated knowledge
B. Modern teaching methods
C. The complementarity of the main subjects in educational curricula
D. The solicitude and involvement of the educational staff
Very good / Good / Satisfactory / Poor / Very poor

6. How important is it for you to follow a state technical university instead of a private one?
Extremely important / Very important / Important / A little less important / Not important

7. How do you appreciate the overall quality level of the educational services offered by UPB compared to UT1 and UT2, on a scale of 1-5? (circle the appropriate answer):

A. Useful and updated knowledge
UPB: 1 2 3 4 5
UT1: 1 2 3 4 5
UT2: 1 2 3 4 5
B. Modern teaching methods
UPB: 1 2 3 4 5
UT1: 1 2 3 4 5
UT2: 1 2 3 4 5
C. The complementarity of the main subjects in educational curricula
UPB: 1 2 3 4 5
UT1: 1 2 3 4 5
UT2: 1 2 3 4 5
D. The solicitude and involvement of the educational staff
UPB: 1 2 3 4 5
UT1: 1 2 3 4 5
UT2: 1 2 3 4 5

8. In the future are you willing to pay for better quality of the educational services?
Yes / No

9. If you had any questions or concerns or asked for additional information, are the teaching staff trained and helpful in any problem?
Total agree / Agree / Partial agree / Disagree / Total disagree

10. Please answer the following questions about yourself:

A. You are:
Man / Woman
B. How many years have passed since you completed the Baccalaureate exam?
5 years or less / 5-10 years / over 10 years
C. Are you, or have you been a student at the UPB?
Yes / No
D. Are you working or did you have a job in an engineering related domain until now?
Yes / No

Thank you for your time!

In designing the questionnaire model, the main aspects known as necessary to be implemented were taken into account, using proper formulations to find the answer to the question “how many” think in a certain way, and also the answer to the question “how thinks” a certain category of potential customers.

The questionnaire model was distributed about 38% personally and 62% online, using the main social platforms to a significant number of prospective Romanian students after all data was centralized.

The data interpretation of the questionnaires led to the following percentage results:

Question 1: About 65% of those interviewed mentioned that the most important aspects are "Useful and updated knowledge", and "The solicitude and involvement of the educational staff".

Question 2: 43% responded "Yes", 57% answered "No".

Question 3: Of the respondents with "Yes" from the previous question, 35% responded that "the reputation of the university" is a primary factor, 30% said "trust", 20% answered "good teacher training". The remaining 15% were other responses.

Question 4: 45% responded "extremely importantly" to "C - The complementarity of the main subjects in educational curricula", 40% answered "very important" to "A - Useful and updated knowledge", 10% to "D - The solicitude and involvement of the educational staff" and 5% responded "important" to "B - Modern teaching methods".

Question 5:
- Useful and updated knowledge: "very good": 65%, "good": 30%, "satisfactory": 5%;
- Modern teaching methods: "very good": 30%, "good": 50%, "satisfactory": 20%.
- The complementarity of the main subjects in educational curricula: "very good": 55%, "good": 30%, "satisfactory": 15%.
- The solicitude and involvement of the educational staff: "very good": 15%, "satisfactory": 60%, "poor": 25%.

Question 6:
- 35% answered "Extremely important"
- 20% answered "Very important"
- 15% answered "Important"
- 10% answered "A little less important"
- 20% answered "Not important".

Question 7: On this question, most of the respondents considered the following:

A. Useful and updated knowledge
UPB: 4
UT1: 3
UT2: 2
B. Modern teaching methods
UPB: 3
UT1: 5
UT2: 2
C. The complementarity of the main subjects in educational curricula
UPB: 3
UT1: 4
UT2: 2
D. The solicitude and involvement of the educational staff
UPB: 4
UT1: 1
UT2: 3

Question 8:
- 46% responded negatively,
- 54% responded affirmatively.

Question 9:
- 40% answered "Total Agreement",
- 25% answered "Agreement",
- 10% answered "Indifferent",
- 20% answered "Disagree",
- 5% answered "Total Disagreement".

Question 10:
A. 42% answered "woman", 58% responded "man"
B. 62% completed the baccalaureate exam less than 5 years ago, 27% between 5-10 years and 11% over 10 years
C. 76% responded "Yes", 24% said "No".
D. 37% had or still have a job in an engineering related work domain

Using these data, the QFD method can be set to improve the quality objectives.

Applying the QFD solution must be done sequentially, requiring eight steps:

Step 1: Knowledge gathering and understanding the customer requirements
Step 2: Development (for existing product/service - identification) of technical requirements (product or service characteristics)
Step 3: Demonstrate the relationship between customer requirements and technical requirements
Step 4: Identifying the correlations between technical requirements
Step 5: Evaluation of product / service competitiveness level
Step 6: Prioritizing customer requirements
Step 7: Prioritizing technical requirements
Step 8: Final evaluation

Steps 1 and 2 were covered by the distribution of questionnaires mostly to Baccalaureate graduates who were actually present students at the UPB and by the interpretation of the results so that both client requirements and technical requirements are already known.

Stages 3 and 4 (correlations between technical requirements and also between client's requirements and technical requirements) are presented below, in Figure 2:

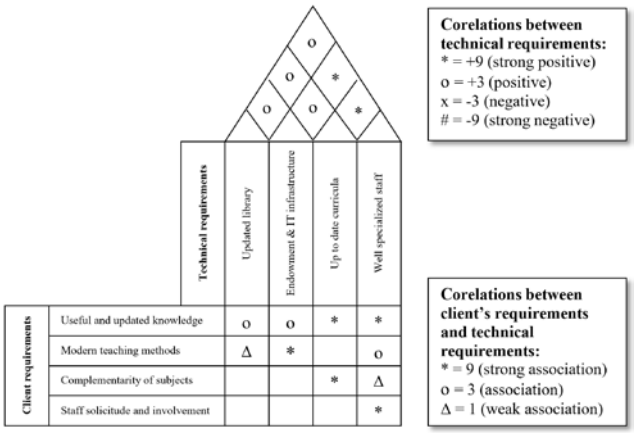

Figure 2. The correlations between requirements

The next step is to evaluate the competitiveness level by reporting to the main competing universities UT1 and UT2, as presented in Figure 3:

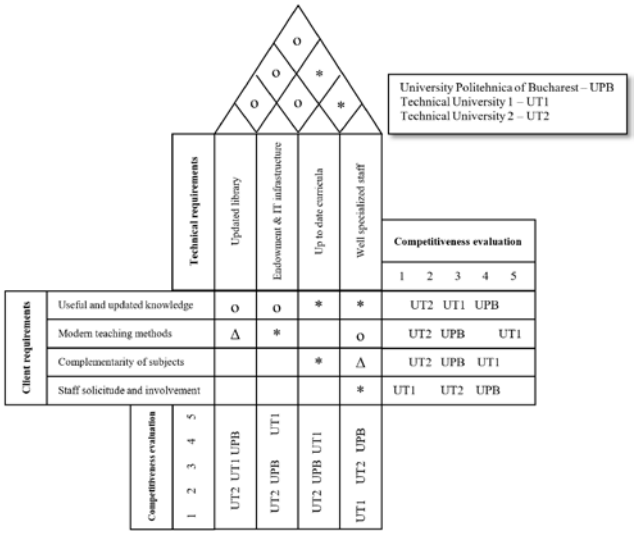

Figure 3. Evaluation of the competitiveness with UT1 and UT2

After this, the prioritization of customer requirements follows, as shown in Figure 4.

According to the questionnaire survey, the importance of the customer's requirements (X), on a scale of 1-10, and the need to improve service (Y), called "target value", on a scale of 1 to 5, it takes the following values:

- 1, does not change
- 3, the service will be improved
- 5, the service will be better than the one of the competitors

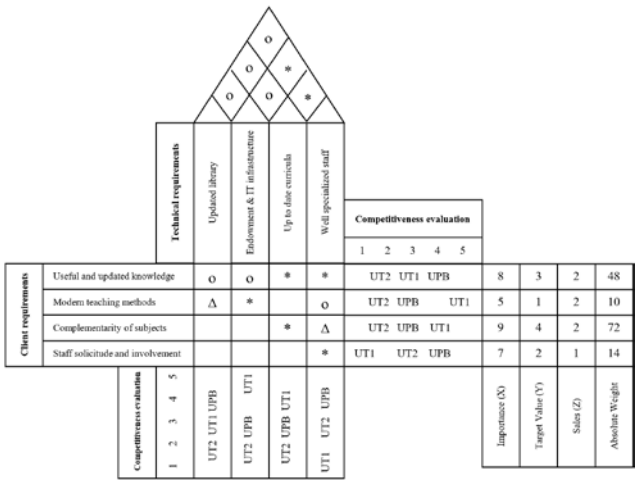

Figure 4. The prioritization of customer requirements

The effect on sales (conversion of Baccalaureate graduates into future students) (Z) is scored with:

- 1 if the effect is low
- 2 if the effect is high.

Maximum priority (absolute weight) is the multiplying operation of the three XYZ parameters.

Useful and updated knowledge: 48
Modern teaching methods: 10
The complementarity of the main subjects in educational curricula: 72
The solicitude and involvement of the educational staff: 14

The next step is to prioritize the technical requirements, shown in Figure 5.

The degree of difficulty is represented on a scale of 1 to 10, and the need to improve the service has a target value represented on a scale of 1 to 5.

Next, the Absolute Weight (AW) and the Relative Weight (RW) have been calculated, using the following formulas:

$$AW = \sum(Correlation\ Value \times Importance)$$

Updated library: 29
Endowment & IT Infrastructure: 69
Up to date curricula: 153
Well-specialized staff: 159

$$RW = \sum(Correlation\ Value \times Absolute\ Weight)$$

Updated library: 116
Endowment & IT Infrastructure: 828
Up to date curricula: 2754
Well-specialized staff: 3498

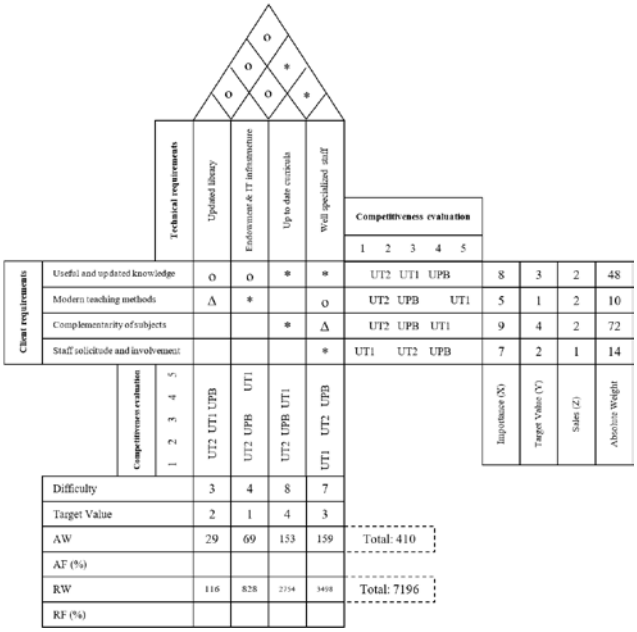

Figure 5. The prioritization of the technical requirements

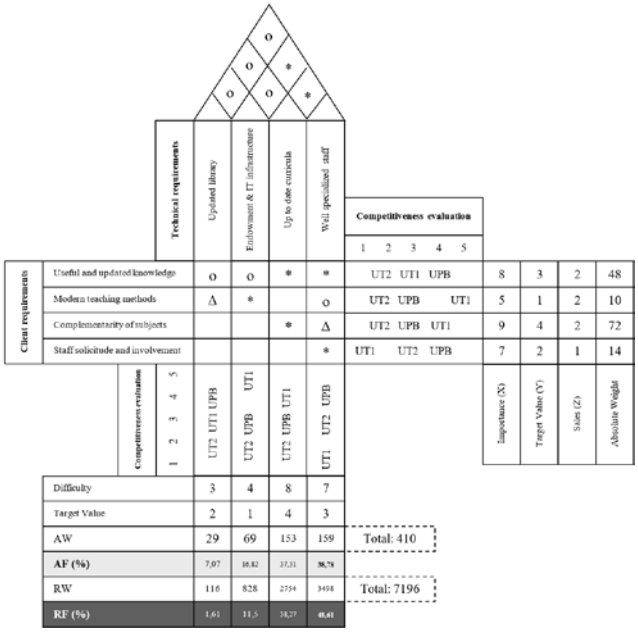

Figure 6. Final evaluation of AF and RF values

The next phase is the final evaluation. The decisions needed to improve the service are adopted according to the values of percentage weight factors, namely the Absolute Factor (AF) and the Relative Factor (RF), that were calculated with the following formulas:

$$AF\ (\%) = \frac{Absolute\ Weight}{\sum Absolute\ Weight} \times 100$$

Updated library: 7,07
Endowment & IT Infrastructure: 16,82
Up to date curricula: 37,31
Well-specialized staff: 38,78

$$RF\ (\%) = \frac{Relative\ Weight}{\sum Relative\ Weight} \times 100$$

Updated library: 1,61
Endowment & IT Infrastructure: 11,50
Up to date curricula: 38,27
Well-specialized staff: 48,61

7. Results

After completing the questionnaires, analysing the correlation between customer requirements and technical requirements, evaluation of competitiveness level, prioritization of customer requirements and technical requirements, a final evaluation of the QFD analysis has been done.

As a result from the QFD calculations, it was found that the highest AF value is 38.78 and that of the RF value is 48.61, both corresponding to the technical requirement for well-trained teaching staff.

Therefore, the most positive effect on the continuous attraction of new potential students, raising the university reputation and meeting the labour market requests will be to always have the best professional trained teachers, having an absolute factor (AF) of 38.78% and a relative factor (RF) of 48.61%.

The following priorities in the decreasing order of importance are:

- Up to date curricula (AF = 37.31%, RF = 38.27%),
- Endowment & IT infrastructure (AF = 16.82%, RF = 11.5%)
- Updated library (AF = 7.07%, RF = 1.61%).

8. Discussion

For an overall view of the quality improvement objectives (AF and RF factors), Pareto charts have been developed and can be seen below in Figure 7.

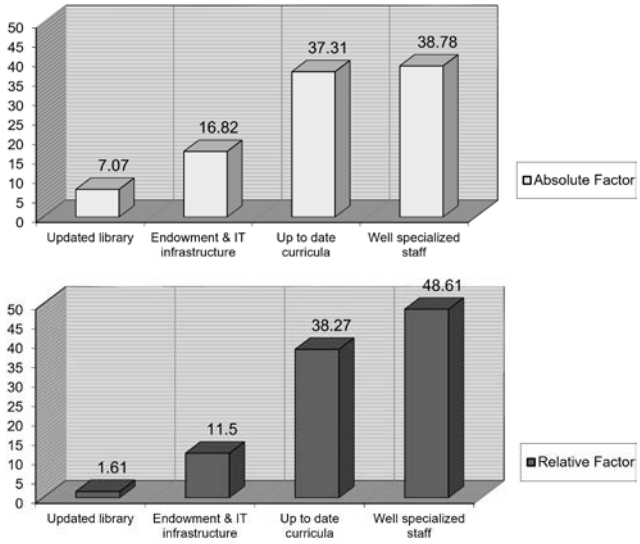

Figure 7. The quality improvement objectives in a graphical representation of AF and RF values

As the bottom line, in order to improve the quality of the services provided within the technical university, the main objective will be to hire highly trained and experienced staff and to encourage the permanent improvement and adaptation to the market requests of the existing one. This proves once again that the human resource component is always the most valuable part of any organization, including the ones from higher education field that make no exception on this matter.

Identifying the key areas for improving both the reputation and the quality of the technical university's services by applying the QFD method has proven to be useful and viable, as the method can be successfully adapted and applied to products or intangible goods, i.e. services.

9. Conclusions

This research was carried out in order to propose a viable method to establish a way of identifying the key aspects that may prove essential for a technical university that wants to adapt its educational services and increase their quality to meet the labour market requests. A technical university has to manage these issues with the aim to increase both the quality of the educational services provided and the degree of adaptation speed to market needs, in order to enhance the satisfaction level of the beneficiaries and improve its overall reputation.

The level of satisfaction must always be considered and measured from the perspective of all categories of stakeholders involved: on one hand the students, as future graduates and on the other hand, the firms that are active in the business environment. For this to be accomplished, the future phase of the research will be to adapt and apply the QFD method to a significant number of firms of different sizes that operate in at least five different activity areas related to engineering field, in order to find out their needs, desires and expectations in relation to the general level of training and skills required for graduates. This step has been already started but it will be completed in a future survey, the present paper focusing on finding out the issues regarding mostly the first category of stakeholders involved in the educational process: present and past students. By having this approach, a technical university will also improve its image and reputation in the general public's perception and will assure itself a stable place in technical engineering higher education field for years to come.

Moreover, in time, by implementing the findings resulted from adapting the QFD method, this strategic approach may eventually also lead to a better insertion of graduates into the labour market, thus generating a positive impact on improving the functioning of the entire economic system.

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