IPS' Technology and Industrial Management graduate course: an improvement process

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Abstract

The key activities to achieve quality (satisfaction of needs and expectations of customers) move increasingly to the previous phases to service delivery and particularly to the organization's interface with the market, where the most appropriate techniques and methodologies will have to identify what customers want, and perceive the quality and what features the services must have, as well as the price they are willing to pay. The Technology and Industrial Management (TIG) course of Polytechnic Institute of Setúbal, Portugal (IPS), is a four year graduate course organized by quarters with three courses per quarter. In the last two quarters internships or real context projects prepare students for a smoother integration in the professional activity. From its beginning, in 2007, TIG was designed for active adults who develop their professional activity in industrial entities, and need to supplement their skills with those of managers and engineers. The B-learning methodology was adopted since it enabled the targeted students to better reconcile their academic, professional and family responsibilities.

In 2010-2011 the first TIG students concluded their graduate studies and, within IPS' Integrated Management System, it was decided to monitor the suitability of the TIG course curriculum. There is, then, the question of

what is and what is intended for an technology course, to an active adults in a region like Setúbal and in a polytechnic . This question corresponds to the first phase of QFD, where is therefore necessary to define the characteristic parameters of each profile that meet the expectations and needs of students and other stakeholders.
If the question of the requirements of the course interacts with the objectives of the students, those requirements interact with the curricular content of their curricula. We are, therefore, in the second phase of QFD. The way the course is implemented will influence the means to administer the various components of the curricula, also determining the significant upfront investments in infrastructure and equipment facilities (laboratories, workshops, equipment, consumables), and will also influence the teaching-learning methods. The measurement conditions for the provision of the service, including monitoring of students, the way it measures the satisfaction of stakeholders and the availability of the facilities already include the third and fourth phases of QFD.
With this methodology we expect to have the guidelines to improve the curriculum, teaching-learning methods and operating conditions of TIG course towards meeting the needs of stakeholders.
Keywords: adult learners; stakeholders satisfaction; b-learning, improvement

Introduction

Today's Higher Education Institutions (HEI's) are facing a huge pressure from society, on one hand public funding is decreasing and on other hand the applications to the degrees courses are decreased, so HEI´s are living in strong competitive environment. To survive in this environment, HEI´s have to know the stakeholders aspirations and more specifically the student needs, the business needs, in order to supply the best services.

The quality cannot be assured in the provision of service only. We can ensure that services are provided in accordance with the specifications. However, if the service is poorly specified, the activities of quality control can only ensure that you get the desired results (a specified quality) and therefore they will not be meet consumer needs. [1]

The key activities to achieve quality (satisfaction needs and expectations of customers) move increasingly to the previous phases to service delivery and particularly to the organization´s interface with the market, where the most appropriate techniques and methodologies will have to identify what customers want, and perceive quality and what features the services must have. [1]

As the importance of engineering accreditation increases, colleges and universities interact with multiple constituents or quality monitoring groups that require the assessment of student learning. Thus , a new system is installed in each university, and engineering curriculum content is revised to meet the standards of accreditation. [2]

The Quality Function Deployment (QFD) was conceived by Yoji Akao during the late 60's in Japan. However, it was not until 1972 that QFD was publicly recognized when applied at the Mitsubishi shipyards in Japan [4]. Two main QFD approaches to production development emerge from literature analysis (namely the ''matrix of matrices'' and the ''four-phases model'' - the customer requirement planning matrix, the product characteristics deployment matrix, the process and quality control matrix and the operative instruction matrix) [3].

The goal of 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 and manufacture the product [4].

QFD as "voice of the customer" is a tool for preventing problems. This model is a systematic method for planning and development structure, which allows those responsible for the design to clearly identify the expectations and needs of students, and thus evaluate each proposed component, or each service's ability to systematically, in terms of its impact of going against the wishes of customers [3].

1. IPS' Technology and Industrial Management graduate course

The Technology and Industrial Management (T&IM) course was designed for adult workers developing their professional activities in industrial companies located at Setúbal and nearby districts and sought to complement these workers technical skills with expertise typical in business management and in engineering. The objectives of the course were: (a) Acquisition of basic engineering knowledge for understanding the key industrial technologies; (b) Acquisition of basic business management knowledge to allow better performance in the professional activity; (c) Contribution to career advancement; and (d) Encouragement of innovative and entrepreneurial spirit, a vehicle for organizational change and business creation.

1.1. Curricular structure

Taking into account the needs of the targeted public (adults with full-time jobs) the course classes are scheduled at night and a reduced workload of three course units per trimester is considered. The curriculum was designed for a total course duration of four years. With a total number of ECTS equal to that of Bologna graduate degrees, each trimester has a total of 15 ECTS, which amounts to 45 ECTS per year and 180 credits in four years. The course curriculum is divided in equal parts between course units from management science and course units from engineering, each representing 43% of the total ECTS. The remaining 14% is divided between course units from mathematical sciences (4%) and project/internship (10%). The project/internship takes place during the two last trimesters of the course. The internship is primarily for students who do not have a job, while students who already have a job typically address project topics related to their professional activity.

1.2. B-learning

The T&IM course implements a b-learning methodology, blending conventional face-to-face classes with e-learning (online autonomous learning). Half of each course unit hours are taught at a classroom, with the presence of colleagues and teacher. The other half takes place with the help of an e-learning environment where the students can develop their work independently. Laboratory classes are always face-to-face. The e-learning activities can be synchronous or asynchronous; regardless of their type, these online activities (project, chats, forum, shared work, self-test, conference–video, etc.) are designed to promote independent learning.

While designing the T&IM course a great deal of thought was given to the teaching and learning methodology that better suited the needs of adult students with full-time jobs. The decision to use the b-learning methodology presented the disadvantage of less face-to-face contact hours between student, faculty and peers. Student integration in the academic environment plays an important role in academic achievement and dropout, especially for traditional students and residential HEIs [5]. . However, with b-learning students had the chance to better reconcile professional, family and academic responsibilities. Having two or three days of face-to-face classes per week meant that students (often working shifts) could better manage the time spared from work and family, and perform the required independent e-learning activities. On the other hand,

some authors [6] [7].report that for adult students and commuter HEIs, academic integration plays a less important role in student academic achievement and in dropout.

2. Metodology

With the focus group and the satisfaction survey to the students [8], we identified the students requeriments, which give an importance level with focus group basis. And with the differentiating features from T&IM, we built the House of Quality.

2.1. The House of Quality

The House of Quality (HOQ) is a matrix that displays the interrelations between the needs felt by the clients (Whats) and the technical responses from the organization to those needs (Hows).

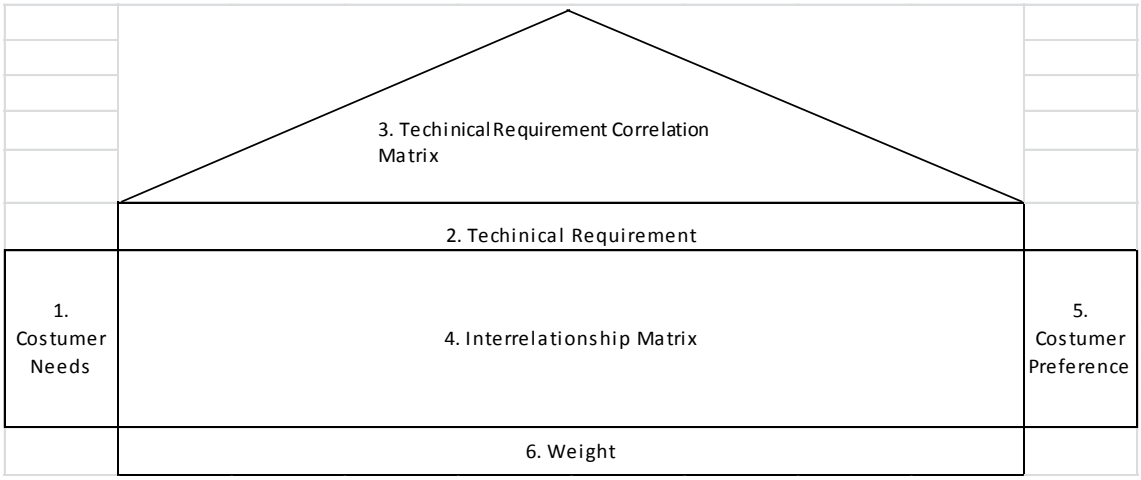

Figure 1 – HOQ Structure [2]

a) Customer Requirements – Earing the voice of the students

The first step to build the House of Quality is to know what should be analyzed and in order to do it to this study, it were considered as "costumer" the students of the T&IM course (Technology and Industrial Management), students that are still attending the course and former students. The information from the students was gathered using questionnaires and focus-group and then, analyzed, organized and grouped in three central requirements: Planning (the teaching – learning process), implementing and the operationalization needed. These requirements were hierarchically organized.

b) Costumers Importance Ratings

After identifying the costumers requirements it was needed to rate them. Usually this classification is made directly with the costumers that classified the requirements with a "note" between 1 and 5 (1 being the less important and 5 the most important). In the particular case of this study it was a group of teachers from the T&IM Course that rated the requirements,based on the results from the questionnaire applied to the students and the focus-group.

c) Identifying the Technical Requirements

The third step is to identify the technical requirements of the T&IM course, which means to identify what the course was doing to accomplish the student needs.

The T&IM course has a specific design that intends to respond to some of the needs of the specific public that is the adult workers, which are already developing their professional activities in industrial companies and need to complement their worker skills with expertise in the management and engineer areas. Based on these characteristics, an identification was made of the main requirements of the course and its curricular units, which were conceived as fundamental requirements to respond to the needs of the students.

Curricular Organization					**Organization of the Curricular Units**					**School Organization**				
Evening Classes	Course in 3 Quarters (Reduce Workload)	3 Curricular Units per Quarter	Distance Learning	Presence need of 2 or 3 times per week	Continues Assessment	Specific and appropriate language considering the	Type of assessment methods	Oral presentation of projects / works	Tutoring schedules and / or personal contact	Visual Supports	Classrooms and study rooms	Adequate number of students in class	Laboratorial infrastructures	Informatics infrastructures

Figure 2 – Technical Requirements

d) Correlation Matrix (Roof of the Quality House)

The correlation matrix is the roof of the House of Quality.This matrix crosses the technical characteristics with each other, in pairs, allowing the identification of how they are correlated. This relation can be positive, when the increase performance of one characteristic helps to favorable another, or it can be negative, when the increase of one characteristic affects the performance of the other in the opposite way.

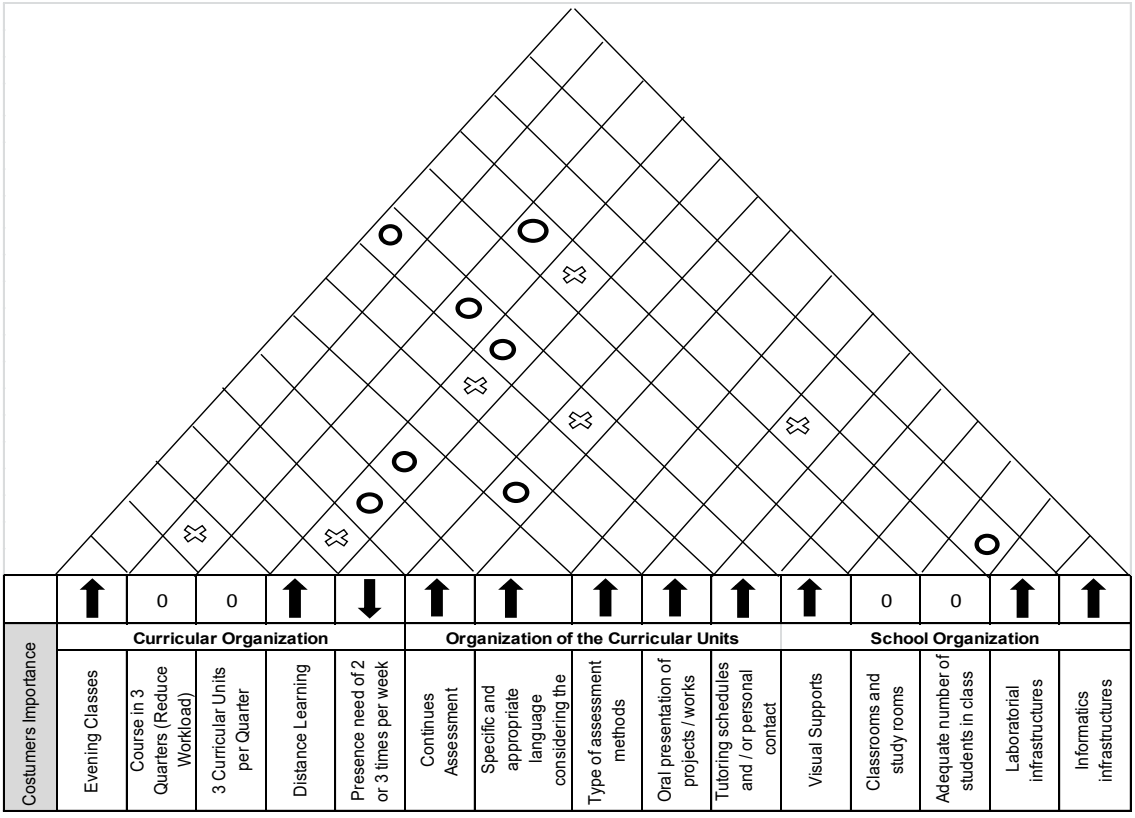

Figure 3 – The roof of the House of Quality

In this case, to complete the roof of the house of Quality, we established positive (**o**) and negative relations (x).

For example, if we reduce the duration of the course, the number of CU (Curricular Units) per quarter will increase, so the relation between these two characteristics is negative (x). Considering the distance learning, the relation whit the presence needed in class is also negative because if we reduce the distance learning, then the students will need to attend to school more often, so the presence will increase. On the other hand, the relation of the distance learning with the continuous assessment is positive because if we increase the distance learning probably the continuous assessment will also increase. The relation

between the distance learning and the tutorial schedules is also positive because if we increase the distance learning the need for monitoring and support will also increase.

In the case of services the relations established are not as linear as in the case of products. In case of services it doesn't mean there is always a relation between the technical requirements, sometimes there are no relation at all.

In this paper will not be analyzed the roof of the House of Quality in detail. This development and analyses will be considered in future works.

e) Interrelationship Matrix

This matrix results from the intersection from the student requirements and the technical characteristics of the T&IM course to respond those needs.

The objective of this matrix was to identify how each one of the technical characteristics influence and respond to the needs of the students. To accomplish this objective the relations were identified according the following symbols:

△	Weak – it scores 1 point.
○	Medium - it scores 3 points.
●	Strong – it scores 9 points.

Each symbol carries a numeric value (1, 3 or 9) that will influence the achievement of the absolute and the relative importance of each technical characteristic. This step will be described further in this paper.

The relationships that were identified were consensual between the researchers group, and they were based in the results of a satisfaction surveys applied to the students, in the analyses of data such as dropout rates, number of enrolments until graduation and the results from the focus group.

The relationships where established considering how the technical requirements can response to the needs of the students. For example, when the materials to support learning are referred we are talking about documents and information, and not equipment and/or buildings. So, the evening learning does not affect the kind of materials, because is just related to the schedule and the target public of the course. But if we talk about the assessment, this can have an influence in the materials that are created to support it. If we

look to the technical characteristic distance learning, it has a strong relation to the materials to support learning.

In the interrelationship matrix there are two costumer needs that didn't showed any type of relation with the technical characteristics, the coordination between the different modules in the course and the adequacy of the programs of the UC to the course objectives. There were no technical requirements answering to these needs, which means there are no responsible or ways to assure it. In future work it would be interesting to construct a matrix between the course objectives and the content of each Curricular Unit, in order to find the technical characteristics that could satisfy the student needs.

f) Technical Difficulty

After establishing the interrelation between the student needs and the technical characteristics was time to define the technical difficulty. This technical difficulty represents the characteristics that take more, or less, effort and resources from the organization to accomplish.

This difficulty was scored from 1 to 5 (being 1 the less difficult and 5 the most difficult).

The Distance learning was considered the most difficult to assure, because it needs more means and more time from the teachers to assure it. Tutoring schedules takes a big effort from the organization and it can be harder to implement, that's why it scored 4. In the opposite side continuous assessment is, that was considered easy to implement and with a lower technical difficulty to the organization.

g) Weight

The last step in this paper was to calculate the absolute importance of the technical requirements. This is calculated by the product of the cell value and the costumer importance rate. After these calculi it was possible to verify the technical requirement that matter the most to the costumer.

				↑	0	0	↑	↓	↑	↑	↑	↑	↑	↑	0	0	↑	↑
				Curricular Organization					Organization of the Curricular Units					School Organization				
			Costumers Importance	Evening Classes	Course in 3 Quarters (Reduce Workload)	3 Curricular Units per Quarter	Distance Learning	Presence need of 2 or 3 times per week	Continues Assessment	Specific and appropriate language considering the	Type of assessment methods	Oral presentation of projects /works	Tutoring schedules and / or personal contact	Visual Supports	Classrooms and study rooms	Adequate number of students in class	Laboratrial infrastructures	Informatics infrastructures
Teaching - Learning Process	Planning	Curricular activities distributed in time (distribution of exams, works, class schedules)	3	△	△	○			●		○	○	●		△		△	△
		Correspondence between the workload and the number of student credit units.	4		○	○	△		○		○							
		Teaching/learning methodologies adopted	5	○	○	○	●	●	●	●	●	●	●	●		○	○	○
		Material to support learning	4				○		○	○	○			○			○	○
		Assessment methods adopted (exams, papers)	5		○	○	○	○	●	△	●	●						
		Infrastructures for research, to conduct studies and access to Moodle	4				●											●
	Implementation	Coordination between the different modules / courses	3															
		Adequacy of the programs of the UC to the course objectives	5															
		Stimulate the active learning of students	3		△	△	○	○	○	△	○	●	△	△			●	○
		Development of soft skills (critical thinking, oral and written communication, time management and team work, etc.)	4				△					●						
	Operationalization	Facilitated individual and group study	4				○	△							●	○		○
		Study at an individual rhythm	3	△			●		○									△
		Need to contact with the Teacher	3	△			●	○					●					
		Possibility for experimentation and applied work	4					△	○		○	○				○	●	○
		Technical Difficulty		1	2	1	5	4	3	4	3	2	4	1	3	4	3	3
		Absolute Importance		24	48	54	191	86	171	65	144	174	102	60	39	39	93	102
		Relative importance		2%	3%	4%	14%	6%	12%	5%	10%	13%	7%	4%	3%	3%	7%	7%

Figure 4 – Weight (Absolute and relative importance of the technical requirements)

Considering the available data in figure it was possible to identify the four most important technical characteristics where the efforts should be concentrated, because they had a great impact in the client satisfaction. These characteristics are the distance learning (14% of relative importance), the oral presentation of projects/works (13% of relative importance), the continuous assessment (12% of the relative importance), and the type of assessment methods (10% of the relative importance).

On the other hand, the technical characteristics that have a low impact in the satisfaction of the student needs are the evening classes (2%), the course in 3 quarters (3%), the classrooms and study rooms (3%) and the adequate number of students in class (3%).

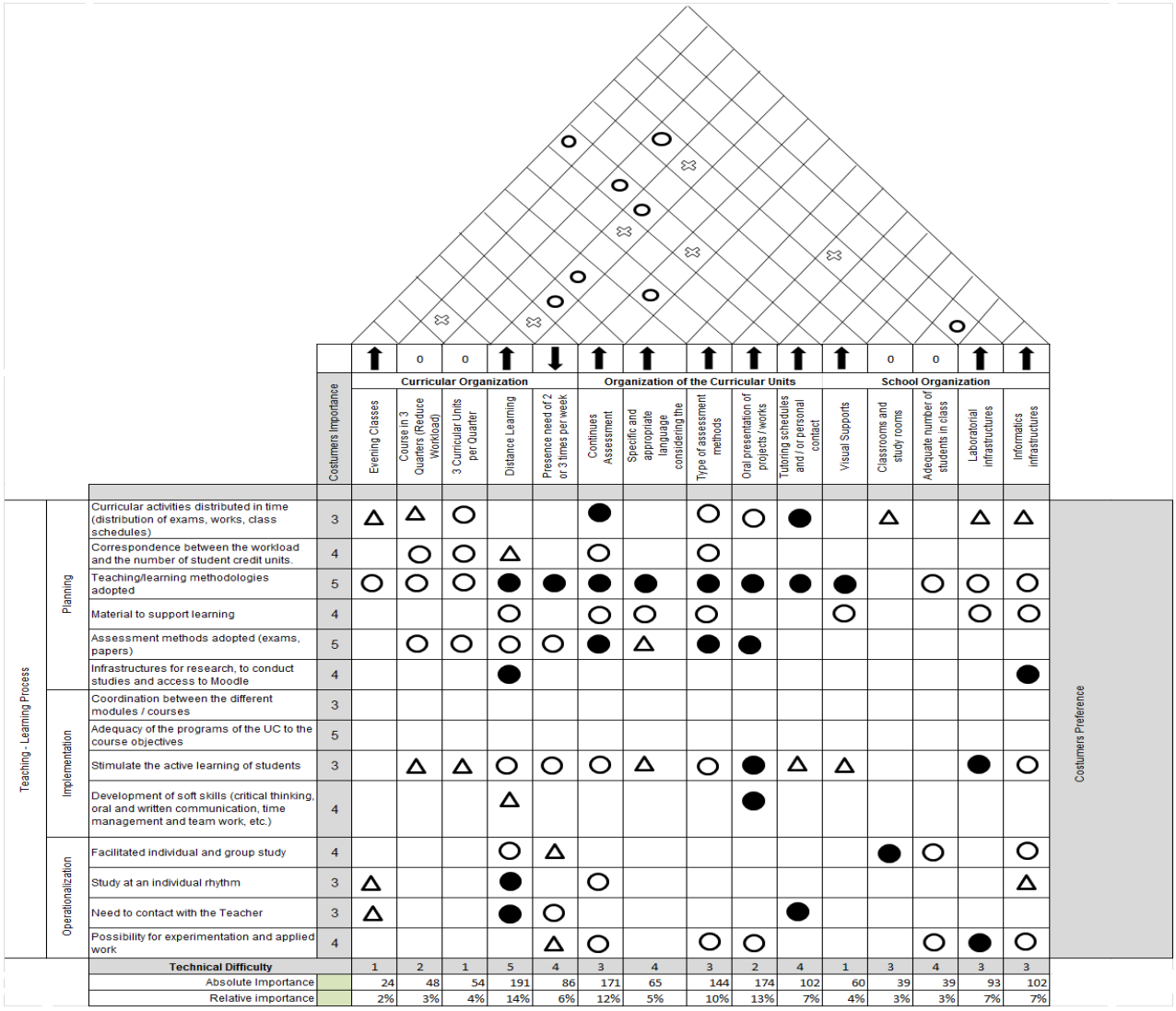

Figure 5 – The House of Quality (T&IM Course)

3. Conclusions and future work

With this study we can identify the requirements that are of particular importance in student satisfaction (customers importance), and which technical requirements will need to be looked at with special attention:

1. The teaching methodologies implemented are the need with the greatest relevance for the students and the TIM Course has several technical requirements that answered that need.
2. Assessment methodologies have the same importance that the teaching methodologies but doesn't have as many technical requirements responding to them.

It would be an improvement to follow and validate the procedures associated to the different forms of assessment;

3. To respond to the need of adequacy of the program of the CU to the course objectives it could be nominated a coordinator, in each quarter of the course, that assure the organization between the CU, considering that this is a requirement that does not have a response from the technical requirements of the TIM course.

4. To improve the course quality, it should be develop a procedure (in the technical characteristics) that would respond to the coordination between the different modules;

5. The oral presentation of projects and works could be increased, because it has a high relative importance (13%) and have a low level of technical difficulty to implement.

This study also highlighted four factors with a high importance in student satisfaction: (a) Distance Learning, (b) continuous assessment, (c) Oral presentations of projects/works, and (d) types of evaluation. On the other hand, the technical characteristics that have a low impact in the satisfaction of the student needs are the evening classes (2%), the course in 3 quarters (3%), the classrooms and study rooms (3%) and the adequate number of students in class (3%).

To analyze in the required detail the T&IM course is needed to continue this process, this paper is a preliminary work.

In this paper it wasn't analyzed the roof of the House of Quality in detail. This development and analyses will be considered in future works.

It wasn't developed the area of the customer preference because there were no available data from other Higher Education Institutions. Although is an important part of the House of Quality, that will be considered in futures studies.

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