

Article

How to Align the University Curricula with the Market Demands by Developing Employability Skills in the Civil Engineering Sector

Livia Anastasiu ^{1,*}, Alexandra Anastasiu ², Mihaela Dumitran ¹, Codruța Crizboi ¹,
Alexandra Holmaghi ¹ and Maria Nicoleta Roman ¹

¹ Civil Engineering and Management Department, Technical University of Cluj-Napoca Romania, Daicoviciu Street no. 15, Cluj-Napoca 400020, Romania; mihaela.dumitran@ccm.utcluj.ro (M.D.); ioana.codruta.crizboi@gmail.com (C.C.); alexandra_holmaghi@yahoo.com (A.H.); curtean_m_nicoleta@yahoo.com (M.N.R.)

² International Relations and Image Department, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca Romania, Manastur Street no. 3-5, Cluj-Napoca 400372, Romania; ina.anastasiu@gmail.com

* Correspondence: livia.anastasiu@ccm.utcluj.ro; Tel.: +40-721-205-004

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Abstract: The purpose of the research is to discover which employability skills may be developed by students from technical universities in order to meet market demands. Since graduates from technical universities face unemployment or over qualification for vacant jobs, we presumed that there is a misalignment between employers' expectations concerning graduates' skills and what they really get from school. Therefore, we conceived a questionnaire to see the demands of the business environment regarding graduates' technical and professional skills. After analyzing the data, we proposed an interdisciplinary module system, where the mentors coming from the companies involved in the study teach voluntary or optional courses and applications in the domains where they have expertise. We used the employability skills model to find that mix of competencies that may help graduates find jobs in their field of knowledge. This innovative method serves universities, students and companies as well: the prestige of a university is quantified by the experts delivered into the labor market; companies will have well prepared employees in their specific area, with less costs; students will find jobs which will match their expectations, giving them motivation to perform. The limitation of the present research is that the study refers only to the Civil Engineering specialization of the Technical University Cluj-Napoca Romania.

Keywords: employability skills; performance; modular courses

1. Introduction

In a highly computerized society, modern technologies play an important role for employees' performance, in terms of quality and cost [1]. The economic growth based on knowledge relies on the human capital with competencies that help companies to surpass competition. Therefore, the business environment demands employees with a solid education background, but also with transversal skills (ability to learn, to take initiative), which allow them to hold managerial positions in the companies [2]. Moreover, there is a higher interest in professional skills than in degree-specific knowledge [3,4].

The late 2000s triggered the biggest economic crisis for the past 80 years, as unemployment has reached alarming levels. Eurostat had published statistics regarding the number of unemployed in the EU area [5]. At the end of February 2017, 15,439,000 unemployed were enrolled, of which 3,905,000 represent young people under 25, meaning 19.40% of young people able to work.

A survey developed in 2016 by the Accountancy Court of Romania [6] revealed a strange situation: 55% of the graduated subjects consider that the needed competencies and abilities (technical and practical) were acquired at the workplace, and only 32% said that the university was the source of these competencies.

The figures express only the unemployment rate, but an important aspect is that the hired graduates do not perform in their expertise field [7]. The diploma is only a social plus, and is not reflecting the competencies they acquired in the higher education cycle. Research made by McKinsey among graduates show that only 20% are satisfied with the skills achieved in university that will provide jobs according to their education level [8].

Another problem that the Eastern European countries are facing is the migration of the young people, who are seeking big financial compensation, even if they do not work in the domain of their specialization [9]. Figure 1 shows that among the European countries, Romania has the highest migration aspiration (61.90%).

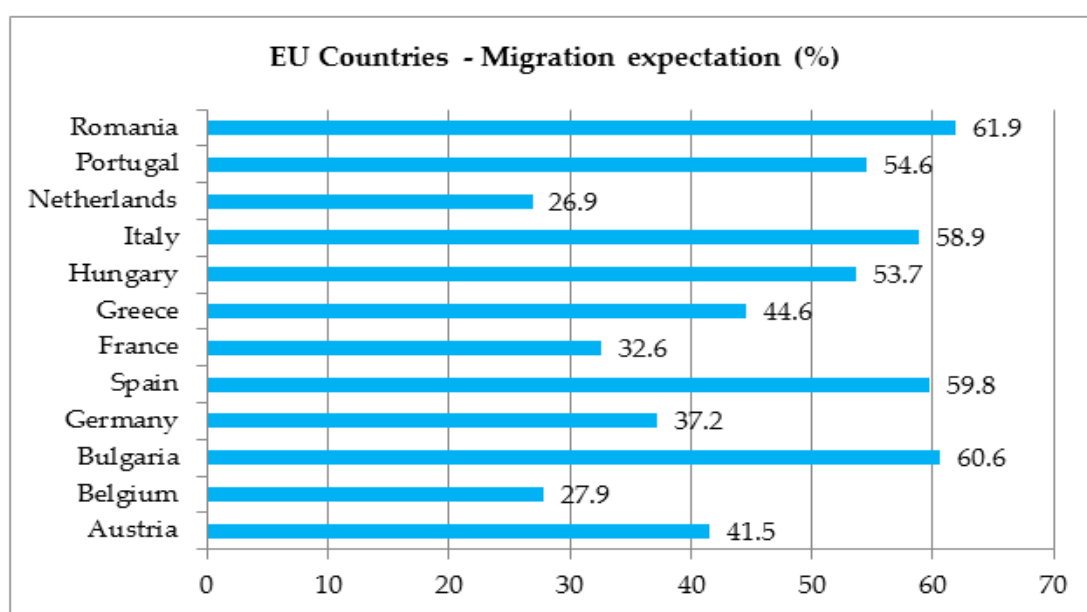


Figure 1. Migration expectation in EU countries. Source: www.ippr.org/files/publications/pdf/migrant-employment-outcomes-in-europe-labour-markets_April2015.pdf.

They accept jobs with poor qualification, but high salaries, meaning that, for those jobs, their technical competencies are rather useless. According to Financial Journal Romania, in July 2016, 90,000 youngsters, most of them graduates, applied for jobs abroad. They did not choose jobs to fit their specializations, but jobs like waiters, drivers or bartenders, which are paid four or five times more than specialized jobs in Romania (www.romaniajournal.ro/romanian-youth-still-on-the-point-of-leaving-to-work-abroad).

The gap between the competencies provided by the universities and the ones expected by the companies was highlighted also by AACU (The Association of American Colleges), which made a survey in 2015 regarding the perception of students and employers on the skills needed for vacant jobs. The results show big differences on their opinions concerning professional skills [10,11].

By analyzing the results presented above, one can obviously conclude that there is a major problem in the higher education system, because the outcome should be the best candidates for the competitive labor market [12]. Since the students and the employers do not share the same perception (Figure 2) regarding the employability skills, our opinion is that the universities should be more than training providers in different areas of specialization, but to find ways to deliver professional training too.

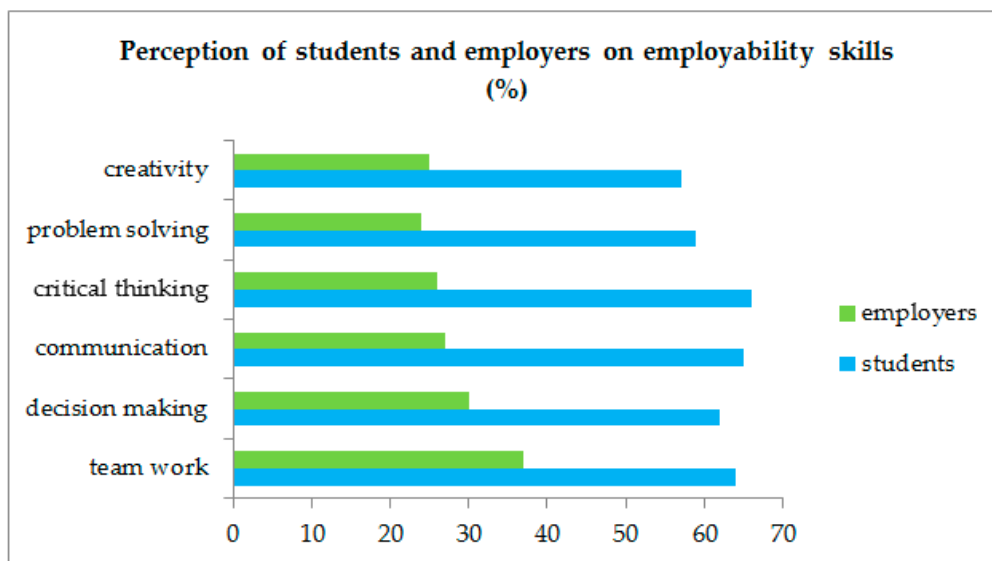


Figure 2. Gap on the perception of employability skills (employers and employees). Source: www.insidehighered.com/news/2015/01/20/study-finds-big-gaps-between-student-and-employer-perceptions.

In Romania, the youth unemployment rate is larger than Europe's average and reached 20.40% at the end of 2016. The most affected were the graduates coming from Social Science Universities. The Technical Universities remained at an average of 18%, which is, without question, a high rate. Yet, the technical sciences students are thought to be more likely to start-up technology-oriented ventures than the students of any other disciplines [13]. However, the statistics shown in Figure 3 reveal a decrease in the number of students enrolled in the universities with a technical profile [6].

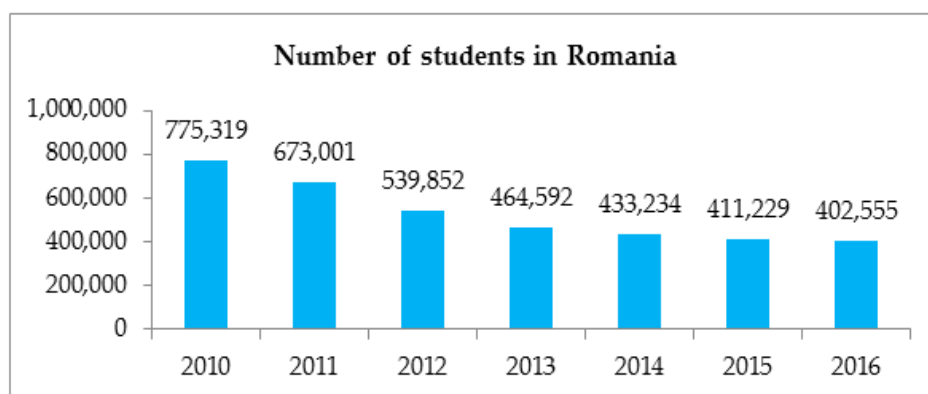


Figure 3. Evolution of the number of students in Romania. Source: www.curteadeconturi.ro/Publicatii/SINTEZAAPInvsup.pdf.

In our opinion, the causes for this phenomenon may be multiple: decrease of the population, lack of interest for study, but also the gap between the competencies provided by the universities and the market demand.

The European Union has adopted a strategy concerning the prevention of youth unemployment: the "Youth on the Move" initiative, which is part of the Europe 2020 Strategy [14], advocates the need of sustainable educational programs connected to the labor market's needs for an easier employment of the graduates. In this context, one of the roles of higher education is to prepare the students so they will find a suitable job in a competitive and globalized market.

In this respect, the research is a prospective study which aims to investigate the causes of the misalignment of university teaching and on-jobs needs, and to identify the employability skills the students need for finding jobs according to their technical and professional competencies [15]. As the higher education system provides mainly theoretical knowledge, there might be a need for cooperation between the universities and the business environment [16,17].

One of the main causes of high unemployment among university graduates is the lack of competencies required by the employers. A survey developed by Manpower Group showed that companies choose to train their employees in order to provide suitable competencies for their business [18]. When hiring, the companies give a high score for employability skills (65.30%) among other criteria, as interview performance (69.60%), internship (10.90%) or studies abroad (2.70%) [19]. A survey conducted by CBI/Pearson Education and Skill Survey in 2015 revealed that 34% of the subject employers are not pleased with the quality of the graduates coming from technical universities. In their opinion, there must be a strong connection between business and universities that might provide competencies as communication, team working or leadership.

The social and economic context involves three actors: universities (service providers), students (customers or recipients of the services) and employers (the end users of the students' knowledge and skills).

What does each part aim at?

- Universities, centered on clients (in their case the students) quantify their reputation in the area by the number of students who apply and are accepted every year. However, another important criterion is the number of graduates that are employed according to their university training [20]. Knowledge and competencies acquired should be strong aspects in job seeking. As explained above, the number of students decreases every year, so there is a strong need to attract them.
- Students enroll in the higher education system for different reasons: comfortable social status, intellectual development, and competitiveness in the labor market. Studying in a technical university requires involvement and effort, so most of them chose universities that demand less effort in graduating. According to GMAC, students decide to have university diploma for a future managerial positions, potential higher earnings, or personal accomplishment [21].
- Companies fight for profit, achieved only through people, with knowledge and skills like adaptability, communication, innovation, flexibility [22]. A perfect profile for a specific job requires a mix of technical and transversal skills, which enable the employer to give the employee complex tasks, consequently minimizing the employment costs and maximizing the profit. An analyze made by Wall Street Journal found that the most important employability skills are communication (57.90%), organization (56.50%), teamwork (56.40%), critical thinking (55.80%), creativity (55.00%) and adaptability (54.90%) [23].

As practice showed, it is almost impossible to combine the three entities' expectations, so one of the solutions is to find a mix of employability skills that may match the most of them. The first step is a prospective research that involves the three parties, to identify the most important employability skills for a future job in the field. Each party plays a role in the next steps, with mandatory implication, for delivering suitable information to support the process of acquiring the students' skills.

The research is focused on finding the competencies the graduates will have to achieve for an easier employment based on their specialization; it develops a scenario and will formulate a proposal for voluntary (optional) modular courses agreed by the cooperation between the universities and the companies. The results will aim to help the university's management to adapt the academic curricula in order to meet the market demands in the construction sector.

The employability skills [24] resulted from the research are not developed during the academic studies, therefore we proposed courses, applications and internships for the students belonging to the target group. Since the curriculum is very restrictive, we suggested voluntary or optional courses and applications.

The courses must align to modern curricula principles to develop specific skills for the students, no matter of specialization: updated information, applications connected to the courses, friendly delivery, interactive and discussion oriented, access to bibliography support, significant case studies [25].

The present paper is a within-case analysis, because it studies only one set of graduates' specialization, i.e., civil engineering. The research is mainly based on quantitative data, but it has some qualitative data as well, in an interim analysis.

2. Literature Review

The literature review focuses on describing the effects of unemployment among young people [24,26], without arguing on mitigating the phenomenon. In our opinion, this is a limited approach, on which we intend to intervene by studying the skills needs in the labor market to lower the unemployment rate.

Romania became a member of the European Union and must adapt its policies to European regulations. The overall Romanian economy must support the priorities stipulated in the Europe 2020 Strategy [14], which are: smart growth (more funds and attention to life-long learning and innovation), smart sustainability (care for the environment, smart use of resources, competitive strategies), and inclusive growth (workforce migration should be diminished).

Over education is an indicator of job requirements (market demand) and the graduates' competencies (market supply) [27]. The risks are dissatisfaction and less motivation in work. Moreover, further education cycles (masters or doctorate) are not seen as alternatives, if the companies ask for low level of knowledge and high level of practice. Over education leads to the dilution of the academic diploma, which have effects on job-taking below a graduate's qualification [28].

The labor market fluctuates from country to country regarding the number of vacant jobs and skills [18]. According to statistics, most of the EU countries demand occupations like managers, engineers or craft workers. The Great Recession (2007–2009) affected all the countries in Europe. One of the effects was a big rate of unemployment. The economies have recovered, but the workforce faced another challenge: underemployment [29]. Companies are reticent on hiring people for two main reasons: risk of a new crisis and threats coming from Unions who excessively protect the members' rights. Therefore, management prefers to decrease the number of employees and create pressure on the existing employees, like: more hours/working day, low wages, or accent on part-time contracts. In Romania, the Ministry of Labor have registered 1,078,033 part-time contracts at the end of January 2016, meaning 18% of the total contracts. Most of them (944,000) were an undetermined period, which may represent an indicator for "gray" wages (Financial Journal, 23 February 2016). The effects of these actions on the employees are: anxiety, health problems, small earnings, dissatisfaction, or lack of professional training [30].

The statistics are relevant in terms of the type of occupations demanded by the labor market. The European countries have almost the same needs; therefore the graduates have the possibility to migrate to markets that offer superior level of wages. The Central and East European countries face a major challenge: to keep the talents within their boundaries. A survey conducted in 2013 by Ruby Gropas and Anna Triandafyllidou [31] accredited the idea that a lot of high-educated young graduates chose to migrate for at least 5 years in developed countries: UK, Germany, The Netherlands and Switzerland, USA, Canada and Australia. Regarding their level of education, 38.37% are undergraduates, 49.94% have a masters degree, and 11.68% have a Ph.D. The reasons are the lack of career opportunity, lack of wages, lack of meritocracy or corruption [32].

Iwa Tomic [33] argues that the crisis (2007–2008) and the Great Recession (2007–2009) that followed are not the main causes for migration of the graduates; it happened long before and still lasts and it is connected to the GDP growth rate or the Corruption perception index (CPI).

Analyzing the Civil Engineering sector, it is expected to have a growth of 8% till 2024 [34]. The jobs will be focused in traditional buildings, but also in renewable energy projects, which require specialized training.

Regarding this industry sector, Romania had to adapt its regulations to the European norms. Accordingly, the buildings should be sustainable and to be designed with attention in preserving energy and respecting the environment. The Civil Engineering students should be prepared, both theoretically and practically, by specialists.

A survey developed by McKinsey in 2013 showed that, in the employers' opinion, the graduates do not have the skills needed for their business. There is a gap that generates unemployment for the academic graduates [35]. The companies surveyed said that they face difficulties in finding graduates for entry level, because they didn't acquire proper skills in the university. Moreover, as explained in Figure 4, when the students (future employees) and the employers were asked about their perceptions of the skills of entry level candidates [36,37], the results showed that there is a huge gap between how students perceive their skills and the organization's appraisal on this matter (64% versus 37% concerning the teamwork, 62% versus 30% on decision making and ethics, 62% versus 28% in oral communication, 65% versus 27% on written communication, 66% versus 26% on critical thinking, 57% versus 25% on innovation and creativity, 59% versus 24% on problem solving, 55% versus 18% on working with people from different backgrounds, 43% versus 18% on keeping updated with the global development) [8].

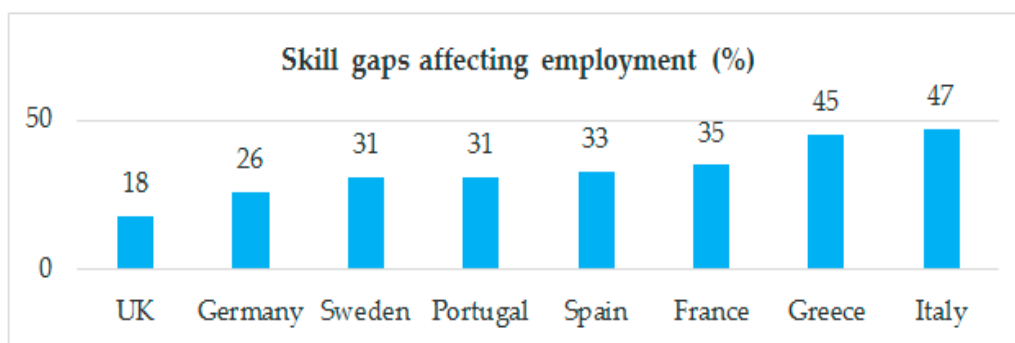


Figure 4. Skill gaps on entry level jobs [14]. Source: McKinsey Survey, 2013.

Based on the studies developed by the National Network of Business and Industry Association [38], there is a set of four categories of employability skills, consistent for all job types: people skills (teamwork, communication, respect), personal skills (integrity, initiative, adaptability, professionalism), applied knowledge (reading, writing, science, technology, critical thinking) and workplace skills (planning, organizing, problem solving, decision making, customer focus, working with tools and instruments). That makes us argue that in the labor market there is interested in employability skills, which are a mix of technical knowledge and other skills that may be transferred between jobs and industry sectors. It will allow candidates to prove flexibility, adaptability, or skills related to management and entrepreneurship.

A study conducted by Hart Research Associates [39] highlights the interest of employers in the students' cross-competencies, no matter the area of education: problem solving, institutional values, critical thinking, or intercultural skills acquired in internships outside the university walls. Moreover, the students must be involved in projects (institutional or not) for exercising teamwork and responsibility for actions and results.

A moderate attention was given to virtual training for civil engineers. Technical knowledge is hard to deliver, but professional skills may be acquired through virtual internship during the years of study [40]. However, the process of measuring this type of getting employability skills is almost impossible, but helps the employers find candidates from many students [41].

In terms of professional skills, the employers' most rated are: teamwork, written and oral communication, self-development, problem-solving, and decision-making. All these transferable skills will help the graduates to find jobs that match their expectations [42].

3. Methodology

The problem that we have identified and which is the purpose of the research, is to assess the employability competencies the graduates should possess, from the employers' perspective, because there is a gap between the educational supply and the demand of the labor market.

The literature review underlined that the studies analyze the causes of the high rate of unemployment, which, as we detailed above, are almost the same in all European countries. Diagnosis is an easy step of the disease and it is based on statistics. Over-qualification in a specific job may lead to the loss of interest in personal development and will stop learning or improving their skills. Figure 5 shows that the number of graduates in non-graduate jobs is increasing in Europe.

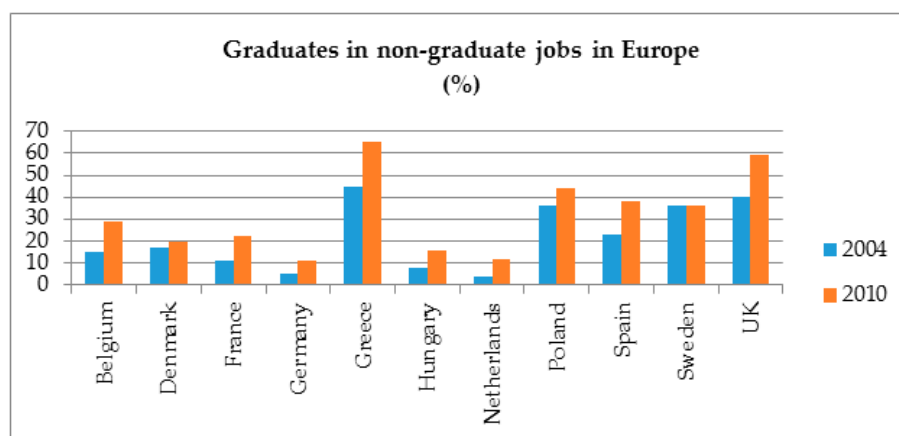


Figure 5. Graduates in non-graduate jobs in Europe. Source: CIBD Policy Report 2015—Over-qualification and skills mismatch in the graduate labor market, 2015.

Therefore, what about the treatment? It is not enough to find the causes for unemployment, but to prevent the phenomenon by implementing methods of teaching and practice (internship) agreed by the university and the business environment.

The main hypothesis (H0) of the research is that there is a mismatch between employability competencies and employment according to specialization: an individual must be prepared in a specific domain, he/she must understand and accept the tasks of a job in order to be motivated to have results. The next step will be a pro-active behavior in the workplace, which will lead to performance.

Studies made by Manpower Group in 2015 showed that unemployment among youngsters has several causes, and one of them is the “lack of skills relevant to the workplace”. Even those young people who have pursued a course of study with a specific career in mind often find themselves with general or theoretical knowledge that does little to prepare them for the actual tasks they will encounter on the job. This is partly the fault of school curricula and poor connections between employers and the educational system. Young people also lack specific “21st century workplace skills” such as cooperation, communication, critical thinking, creativity, and a focus on the needs of the enterprise.

In our opinion, competencies are a mix of professional knowledge, personal skills and attitudes that will allow the person to apply for a job. In the case of students, knowledge is provided by the university, meaning that the competence mix is not complete. Figure 6 represents the process of transforming competencies into individual performance.

Most of the authors of the present paper are teachers from the Civil Engineering Faculty belonging to the Technical University of Cluj-Napoca, Romania; therefore, for the research, and due to the unemployment rate of the technical sciences students in their area of knowledge, we chose the Civil Engineering specialization to be the subjects of the study. Transylvania, the region where the university is located, is the most developed in the country. Civil engineering companies from Transylvania are

representative in their field and have subsidiaries all over the country, so we can assume that this sample is representative enough for this industry sector.

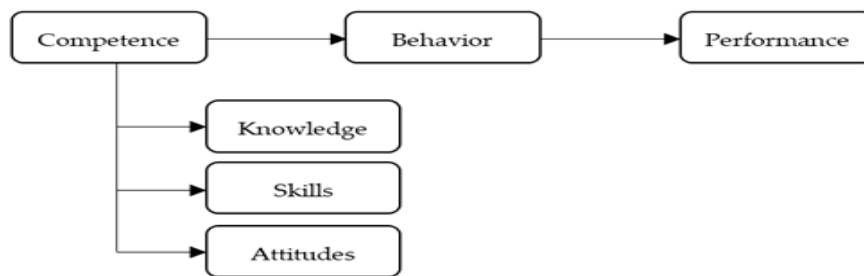


Figure 6. Competence as motor to performance.

We started from the hypothesis that the Civil Engineering graduates should possess both technical and professional competencies in order to be competitive in the labor market. As long as the site practice is the only direct connection of the students with the business environment, we wanted to find what extra training is required for a successful employment.

We chose a within-case analysis, because we assumed that there is a gap between the competencies provided by the universities and the companies’ expectations regarding the graduates’ competencies on the hiring process. The object of our case study is a group of students from the Technical University of Cluj-Napoca, Civil Engineering Faculty. The purpose of the research is to find if there is a need for employability skills. A pilot survey developed by the authors in 2015 showed the interest of companies in participating to this research. We gathered data from the construction companies in the area, by applying a questionnaire, as explained below. We focused on the employability skills they expect from the future graduates for entry-level jobs. The next step was to rank them and to deliver them to the students, through courses, applications and internships.

We designed a model that, in our opinion, brings at the same table the three entities involved in the graduates’ employment process: students, universities and companies (Figure 7).

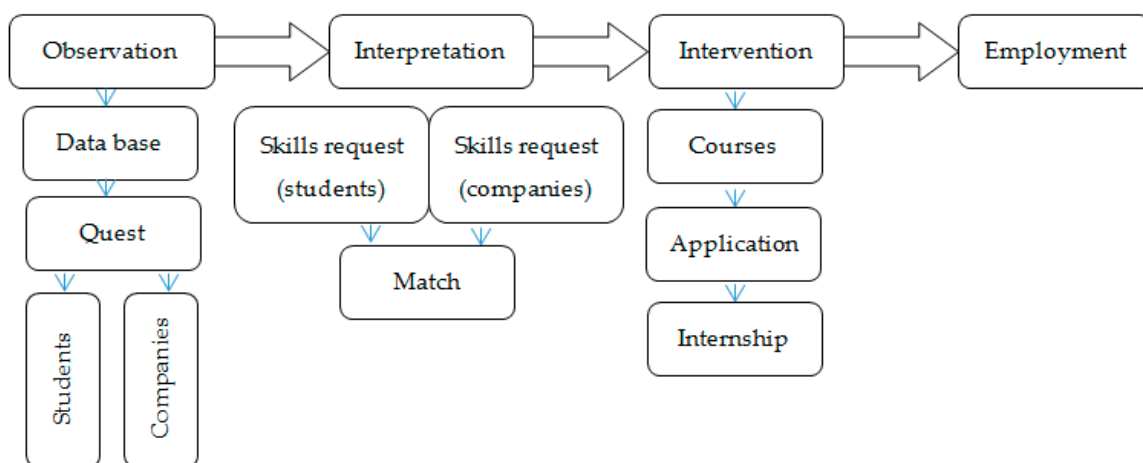


Figure 7. Model to adapt the curriculum to the labor market demand.

According to the model we have designed, our research is developed in four phases:

- a. Observation phase: we gathered a database with the students from the Civil Engineering Faculty and the Construction companies from Cluj-Napoca.
The Civil Engineering Faculty has 407 students enrolled in the third year of study. From the total number, almost 40% (158 students) didn’t pass all the exams, so we eliminated them from the list.

We have designed a web page and 160 students showed interest in the research. In cooperation with ASCUT (Civil Engineering Students Association), we selected 120 students as target group. The Trade Register of Cluj-Napoca has evidence of 25 construction companies with subsidiaries all over the country. For gathering relevant information, we chose the Top 10 companies ranked by the Chamber of Commerce Cluj-Napoca according to their turnovers and profit. The non-disclosure agreement binds us to keep the companies' names secret. Only the companies that agreed to be published on our web page will be nominated, if needed.

We performed a mixed research, developing quantitative and qualitative methods. We designed the research instruments, which are two questionnaires, with the same queries, self-administrated to the students and the construction companies, to find the expectations of both sides concerning the occupation of a vacant job. At this stage, our research studies only the companies' answers. Further research will combine the answers of both entities.

The survey developed by the authors in 2015 targeted the managers of the construction companies in Cluj County, Romania. It involved 47 companies, which were asked about their interest in the level of technical and professional competencies of the Civil Engineering students. They were also asked to suggest competencies they think are important for their employees and to rank them based on their importance. After analyzing the data collected, we conceived the questionnaire, which was distributed to the target companies. The structure of the questionnaire respects the Employability Skills Model.

The questionnaire, as explained below, contains questions about required competencies for an entry-level job, such as: technical knowledge, cross competencies, experience in the field. Moreover, the companies were asked about the importance they attribute to the syllabus disciplines.

- b. Interpretation phase: we analyzed the answers given by the companies. For an accurate interpretation of the results, most of the questions are close-ended and presume quantification of the answers on a Likert scale from 1 to 5, where 1 is very poor and 5 is maximum importance. The results highlighted what kind of competencies the students should have to find jobs related to their skills.
- c. Intervention phase: the next step was choosing the optional disciplines to complete the students' training: courses and applications taught by the companies' experts who are connected to their specializations, in cooperation with the teachers from the faculty, then internships in the subject companies for at least two weeks. The process of choosing the disciplines that will develop the professional skills is explained in detail below. At the end of the training, the students will receive recommendations assimilated to experience in the field.
- d. Employment: the advantage for the companies is that, since they supervise the students during training, the recruitment and selection phases are redundant. All the tests required are already done, but the real plus is that they already know the candidates in terms of knowledge, behavior, personality, aspects that are impossible to achieve on a first glance interview. It saves time, money and risks. This approach increases the chances to acquire a candidate that fits the firm's profile, who does not need induction programs, if he/she is already familiarized with the organizational culture and its staff.

We adopted the Employability Skills Model, which may be applied to all industries, and shows a combination of knowledge, skills and attitudes an individual should possess in order to be competitive in the labor market [41].

The Employability Skills are those that go beyond the ones provided by the academic studies. They are also called transferable skills, because they may be used in any job, in any field of activity. They help the employee succeed in a competitive environment, where the synergy of all the organization's members is more than every individual's performance. Therefore, as people work in teams, they should have skills that will help the company completing the goals.

The model ranks the employability skills in four categories, which should exist for a suitable job candidate, as shown in Figure 8:

- Personal skills: are related to the individual's personality. No matter the job, the individual should adapt to the working conditions, have initiative not just obey, and to prove professionalism and integrity in his/her actions.
- People skills: represent the individual's ability to work with others in teams. Written and verbal communication, ability to adapt to the team spirit and treat the subordinates, peers or superiors with respect are some examples.
- Applied Knowledge: are skills connected with performing a specific job. The knowledge achieved in school should be combined with long life learning and ability to select and update available information in the field and related domains.
- Workplace skills: deal with the ability to concentrate and solve problems that arise in the job and are not related to knowledge. Depending on the level in hierarchy and the organizational structure, the employee might have to make decisions and solve problems under pressure and to plan or organize the workplace for achieving the goals.

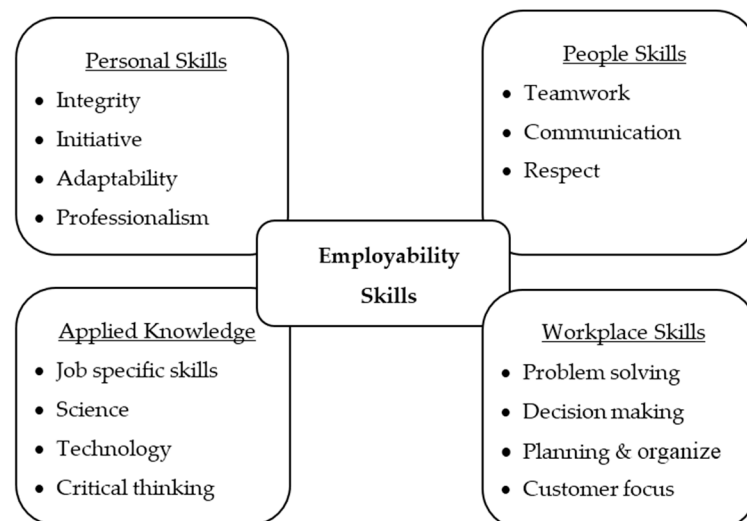


Figure 8. Employability Skills Model. Source: National Network of Business and Industry Association.

The questionnaire we have designed analyzes the employability skills from all the categories, meaning:

1. Personal skills: ethics (Q5), respect for institutions (Q5), life-long learning (Q6), entrepreneurship (Q6), adaptability (Q6).
2. Applied Knowledge: disciplines connected to the job (Q3), site apprenticeship (Q4), technical skills (Q6).
3. People Skills: respect for people (Q5), communication (Q6), teamwork (Q6).
4. Workplace Skills: leadership (Q6), project management (Q6).

According to specialized sites (<http://www.clujconstruct.ro/constructii-civile.html>), 60 construction companies perform in Cluj-Napoca. We developed a pilot survey and sent it via email to all. We received answers from 47 companies. After analyzing the data and designing the questionnaire, we chose 10 top companies from the construction area, coming from the major sectors of this industry: roads, buildings, steel, concreting, and design. Since they have subsidiaries all over the country and abroad, we considered them relevant in the field to provide external validity to our research. The questionnaire was addressed to the firms' top managers. For a better support for our decision on the

sample, we should mention that all the companies participate in the students' site practice, which is a compulsory discipline in the curricula.

The queries are structured as follow:

- On a scale from 1 to 5, why do you think this research is a benefit for your company, in developing the students' competencies for an easier employment?
We listed four alternatives: students training, employment supply, involvement of the company in the syllabus design, and the connection with companies with other area of expertise. The response categories were chosen based on the project's initial need analysis.
- On a scale from 1 to 5, how you consider the utility of this project for a future employment of the students from the Civil Engineering Faculty?
Previous discussions with the managers of the subject companies targeted the scope and objectives of the project.
- On a scale from 1 to 5, how important are the theoretical knowledge for a future employment?
We listed six disciplines: mechanics, concrete, steel, civil engineering, management, and technology (these are the most popular subjects within the faculty, awarded the most university credentials).
- On a scale from 1 to 5, how important is the site apprenticeship for a future employment?
Since in Romania internship is not regulated by the Ministry of Education, the only position in the curriculum connected to experience is the on-site apprenticeship. It is scheduled after the third year of study and lasts 90 h, 6 university credentials.
- On a scale from 1 to 5, how important is the students' attitude for a future employment?
We listed four types of attitudes, related to: work, ethics, institutions, and people. These response categories were chosen because they ranked highest in past research studies.
- On a scale from 1 to 5, how important are the students' skills for a future employment?
We listed eight types of skills: technical, leadership, communication, entrepreneurship, life-long learning, innovation (creativity, flexibility), teamwork, and project management (budget, time, quality). These categories were chosen because they are the most frequently analyzed in the European research studies.
- What other training do you think the graduates of the Civil Engineering Faculty need for an easier employment?
This is the only open-ended question, which allow the companies to express their opinion based on previous experience on the employment of entry-level candidates.

The data are collected in Table 1 below:

Table 1. Data collected from the questionnaire.

Questions	SCORES				
	1	2	3	4	5
Utility of the research					
Q01 • Students training	-	-	3 (30%)	5 (50%)	2 (20%)
• Employment supply	-	1 (10%)	1 (10%)	3 (30%)	5 (50%)
• Syllabus design	2 (20%)	5 (50%)	3 (30%)	-	-
• Cooperation with other firms	3 (30%)	1 (10%)	6 (60%)	-	-
Q02 Importance of the project	-	1 (10%)	2 (20%)	3 (30%)	4 (40%)
Importance of theory					
Q03 • Mechanics	1 (10%)	6 (60%)	3 (30%)	-	-
• Concrete	1 (10%)	-	7 (70%)	1 (10%)	1 (10%)
• Steel	1 (10%)	-	6 (60%)	1 (10%)	2 (20%)
• Civil Engineering	-	-	1 (10%)	4 (40%)	5 (50%)
• Management	-	-	1 (10%)	2 (20%)	7 (70%)
• Technology	-	1 (10%)	2 (20%)	2 (20%)	5 (50%)

Table 1. Cont.

Questions		SCORES				
		1	2	3	4	5
Q04	Importance of apprenticeship	-	-	-	2 (20%)	8 (80%)
Q05	Importance of attitudes					
	• Work	-	-	-	7 (70%)	3 (30%)
	• Ethics	-	-	1 (10%)	3 (30%)	6 (60%)
	• Institutions	-	1 (10%)	1 (10%)	3 (30%)	5 (50%)
	• People	-	-	-	2 (20%)	8 (80%)
Q06	Importance of employability skills					
	• Technical	-	-	3 (30%)	4 (40%)	3 (30%)
	• Leadership	-	2 (20%)	3 (30%)	2 (20%)	3 (30%)
	• Communication	-	1 (10%)	2 (20%)	6 (60%)	1 (10%)
	• Entrepreneurship	-	-	2 (20%)	2 (20%)	6 (60%)
	• Long life learning	-	1 (10%)	3 (30%)	3 (30%)	3 (30%)
	• Innovation	-	-	4 (40%)	2 (20%)	4 (40%)
	• Teamwork	-	-	-	1 (10%)	9 (90%)
	• Project management	-	-	1 (10%)	2 (20%)	7 (70%)
Q07	Other types of training (suggestions)	Open-ended questions				

Note: Where 1 is for very poor importance and 5 is for very high importance.

The purpose of the research was to find methods to develop or/and improve the competencies of the graduates from Civil Engineering Faculty. This process involves three main actions: specialized modular courses, applications based on theory, and internships on the companies' construction sites and headquarters.

The inter-disciplinary modules aim to train the students in areas of practical applicability. They do not reiterate the theoretical knowledge the students already acquired during the years of study. The emphasis is on the competencies based on practical applications and internship.

This research leans on the cooperation between the teachers from the Civil Engineering Faculty and the practitioners from the construction companies. This win-win process allows the face-to-face flow of information regarding technical notions and the professional way of delivering it.

We focused on the answers that revealed the competencies that should be developed for increasing the chances of employment on an entry-level job. Items Q01 and Q02 were designed to understand the perception of the importance of the project from the companies' viewpoint. Items Q03, Q04, Q05, and Q06 involved a quantitative analysis; for the item Q07 we performed a qualitative method, the interim analysis (our research is a single research study). The results of the research are presented in the dedicated section below.

We considered that the descriptors belonging to Q06 are depending on the individual's attitudes and it is hard to influence them on this life stage. For the item Q07, which is the purpose of the research, we gave codes to the descriptors like follow: D1 for technical skills, D2 for leadership, D3 for communication skills, D4 for entrepreneurship skills, D5 for long life learning skills, D6 for innovation skills, D7 for teamwork, and D8 for project management skills.

The goal of the research was to find the employability skills that the future graduates should possess in order to fit the demands of employers in a competitive labor market. Therefore, we chose the Analytic Hierarchy Process (AHP) as the multi-criteria method used to plan in selecting the skills we should develop. Based on this theory, a problem is fragmented in sub-problems that can be analyzed easily and with more accuracy. The qualitative answers are then converted in numbers using Saaty scale, which compares the importance of each descriptor with the others [43].

This method is suitable for group decision making, since in our study we are dealing with the same eight items (descriptors) analyzed by ten decision making entities.

The results are three best alternatives that will be applied to courses focused on developing the key competences (Figure 9).

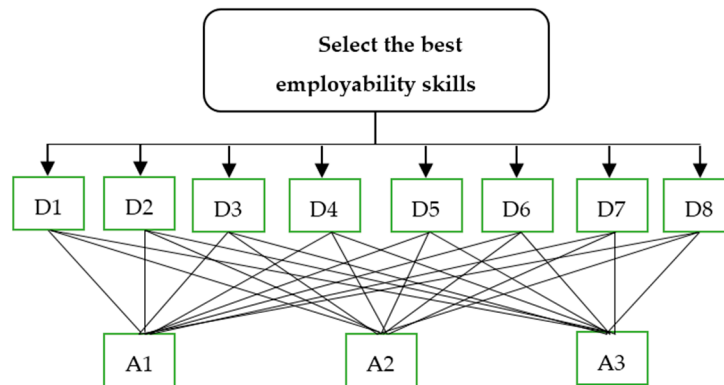


Figure 9. Analytic Hierarchy Process to choose the best employability skills.

We self-administered the questionnaire to the managers of the 10 companies (C1 ... C10) and asked them to score eight descriptors (D1 ... D8), from 0 to 100%, to rank them according to the perceived importance and to find the best three alternatives (A1, A2, A3). The data are gathered in Table 2.

Table 2. Scores of descriptors given by companies (%).

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	Σ
D1	7	10	8	11	10	6	4	15	11	12	94
D2	8	15	24	9	10	18	16	10	16	12	138
D3	14	12	8	15	10	18	15	10	13	12	127
D4	16	18	18	14	15	16	18	15	16	12	158
D5	10	8	7	12	10	8	8	8	9	12	92
D6	16	8	10	13	15	5	9	6	12	12	106
D7	11	10	11	14	10	12	14	16	10	12	120
D8	18	19	14	12	20	17	16	20	13	16	165
Σ	100	100	100	100	100	100	100	100	100	100	1.000

Notes: D1 is for technical skills; D2 is for the leadership skills; D3 is for the communication skills; D4 is for entrepreneur skills; D5 is for long life learning skills; D6 is for innovation skills; D7 is for teamwork skills; D8 is for project management skills.

We rated the answers given by the companies based on the rate they ranked each employability skill, then we converted the results for each descriptor. As presented in Table 2, there are different rates given by managers for each descriptor.

We used the Saaty scale of importance (Table 3) for pair-wise scoring of the answers.

Table 3. Saaty scale for pair-wise scoring.

Scale	Numeric Rating	Reciprocal
Extreme importance	9	1/9
Very strong to extreme importance	8	1/8
Very strong importance	7	1/7
Strongly to very strong importance	6	1/6
Strong importance	5	1/5
Moderately to strong importance	4	1/4
Moderate importance	3	1/3
Equal to moderate importance	2	1/2
Equal importance	1	1

As seen in the table, we rated the pair-wise answers, giving 1 for equal importance and 9 for extreme importance, and we used reciprocal scores, meaning 1 for extreme importance and 1/9 for equal importance of the descriptor.

We designed an 8 × 8 criteria comparison matrix using the numeric and reciprocal rating from the Saaty scale (Table 4).

Table 4. Comparison matrix.

	D1	D2	D3	D4	D5	D6	D7	D8
D1	1	1/6	1/5	1/8	1	1/2	1/4	1/9
D2	6	1	2	1/3	6	5	3	1/4
D3	5	1/2	1	1/5	5	3	2	1/5
D4	8	3	5	1	8	7	5	1/2
D5	1	1/6	1/5	1/8	1	1/3	1/4	1/9
D6	2	1/5	1/3	1/7	3	1	1/3	1/7
D7	4	1/3	1/2	1/5	4	3	1	1/6
D8	9	4	5	2	9	7	6	1
Σ	36.00	9.37	14.23	4.11	37.00	26.83	17.83	2.48

The sum of all descriptors is the base for normalizing the criteria by weighing them compared to the sum (Table 5). For example, the value of D1 is obtained by dividing 1 to 36, resulting 0.027. By summing all the weights of D1 compared with all the other descriptors, we will find the total weight of D1 (in our case 2.40%).

Table 5. Normalized criteria comparison matrix.

Σ	36.00	9.37	14.23	4.11	37.00	26.83	17.83	2.48	Criteria Weights (%)
	D1	D2	D3	D4	D5	D6	D7	D8	
D1	0.027	0.018	0.014	0.029	0.027	0.019	0.014	0.044	2.40
D2	0.167	0.107	0.141	0.080	0.162	0.186	0.168	0.101	13.90
D3	0.139	0.053	0.070	0.049	0.135	0.112	0.112	0.081	9.38
D4	0.222	0.320	0.351	0.243	0.216	0.261	0.280	0.202	26.18
D5	0.028	0.018	0.014	0.029	0.027	0.012	0.014	0.044	2.33
D6	0.056	0.022	0.024	0.034	0.082	0.037	0.019	0.056	4.13
D7	0.111	0.035	0.035	0.049	0.108	0.112	0.056	0.069	7.19
D8	0.250	0.427	0.351	0.487	0.243	0.261	0.337	0.403	34.49
Σ	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	100%

The next step is checking for consistency of the ranks we found using Analytical Hierarchy Process (Figure 10).

$$\begin{bmatrix} 1 & 1/6 & 1/5 & 1/8 & 1 & 1/2 & 1/4 & 1/9 \\ 6 & 1 & 2 & 1/3 & 6 & 5 & 3 & 1/4 \\ 5 & 1/2 & 1 & 1/5 & 5 & 3 & 2 & 1/5 \\ 8 & 3 & 5 & 1 & 8 & 7 & 5 & 1/2 \\ 1 & 1/6 & 1/5 & 1/8 & 1 & 1/3 & 1/4 & 1/9 \\ 2 & 1/5 & 1/3 & 1/7 & 3 & 1 & 1/3 & 1/7 \\ 4 & 1/3 & 1/2 & 1/5 & 4 & 3 & 1 & 1/6 \\ 9 & 4 & 5 & 2 & 9 & 7 & 6 & 1 \end{bmatrix} \times \begin{bmatrix} 0.0240 \\ 0.1390 \\ 0.0938 \\ 0.2618 \\ 0.0233 \\ 0.0413 \\ 0.0719 \\ 0.3449 \end{bmatrix} = \begin{bmatrix} 0.1989 \\ 1.2061 \\ 0.7888 \\ 2.3473 \\ 0.1920 \\ 0.3289 \\ 0.5881 \\ 3.0397 \end{bmatrix} = \lambda_{\max} \times \begin{bmatrix} 0.0240 \\ 0.1390 \\ 0.0938 \\ 0.2618 \\ 0.0233 \\ 0.0413 \\ 0.0718 \\ 0.3449 \end{bmatrix}$$

Figure 10. Analytic Hierarchy Process to choose the best employability skills.

We considered $[Ax = \lambda_{\max}x]$, where λ_{\max} is the Eigenvector.

$$\lambda_{\max} = \text{average} \left(\frac{0.1989}{0.0240}, \frac{1.2061}{0.1390}, \frac{0.7888}{0.0939}, \frac{2.3473}{0.2618}, \frac{0.1920}{0.0233}, \frac{0.3289}{0.0413}, \frac{0.5881}{0.0718}, \frac{0.0397}{0.3449} \right) = 8.966$$

The Consistency Index $CI = \frac{\lambda_{\max} - n}{n - 1} = \frac{8.966 - 8}{8 - 1} = 0.044$.

Where n is the number of descriptors, λ_{\max} is the Eigenvalue.

The Consistency Ratio $CR = \frac{CI}{RI} = \frac{0.138}{1.41} = 0.097 < 0.10$.

Where RI is the Random Index = 1.41 for 8 criteria.

The value of the consistency ratio (9.7%) shows that the error in evaluating the importance of the descriptors is within accepted value (less than 10%).

4. Results

The results of the research were based on the evaluation of the questionnaire administrated to the civil engineering companies. The purpose of the study was to find employability skills that should be delivered to the students coming from the Civil Engineering Faculty (Technical University of Cluj-Napoca, Romania) for matching the employers' demands.

The results were synthesized as follow:

- Result 1: company benefits for involving in students training;

Figure 11 reveals the importance the managers give for the present research, in terms with the benefits they perceive for their companies.

The interpretation of the results shows that:

- 40% of the companies had a strong interest in students training, 20% had a very strong interest;
- 30% of the companies had a strong interest in employment supply, 50% had a very strong interest;
- 20% of the companies had a very low interest in syllabus design, 50% had a low interest;
- 30% of the companies had a very low interest in cooperation with other companies in the area, 60% had a medium interest.
- Result 2: importance of the research for future employment of graduates 30% of the companies considered that the project has a strong importance in developing employability skills for the students, 40% gave a very strong importance;
- Result 3: curriculum courses and applications;
 - The companies gave a low or medium importance to disciplines as mechanics, concrete, or steel;
 - 50% of the companies gave a very strong importance to the discipline: civil engineering;
 - 70% of the companies gave a very strong importance to the disciplines: management and civil engineering;
 - 50% of the companies gave a very strong importance to the discipline: technology.
- Result 4: attitudes of the students related to the workplace;

Figure 12 presents the rank the managers gave to different disciplines related to the theory delivered during the courses and applications in the Faculty of Construction, on all civil engineering specializations.

The companies showed an average of 40% strong importance and 70% very strong importance on the students' attitudes on the job, which are: respect towards work, public and private institutions, ethics and people.

- Result 5: employability skills.

Figure 13 show the rates the managers gave for the employability skills: technical, leadership, communication, entrepreneurship, life long learning, innovation, teamwork, and project management.

Regarding the employability skills, the managers ranked them as follows:

- The companies ranked with rather low importance the professional skills related to technical abilities, lifelong learning and innovation. In our opinion, technical skills are presumed as implicit, so the managers are considering them as condition of the candidate selection;
- The companies ranked as first important skill (34.49%) the competencies which involve project management;
- The companies ranked as second important skill (26.18%) the competencies which involve entrepreneurial spirit;
- The companies ranked as third important skill (13.90%) the competencies related to leadership.

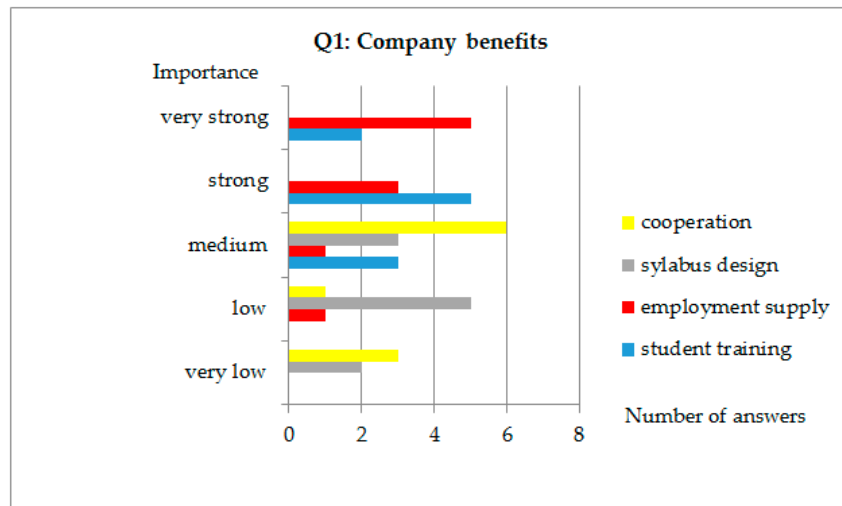


Figure 11. Result 1: Company benefits for involving in students training.

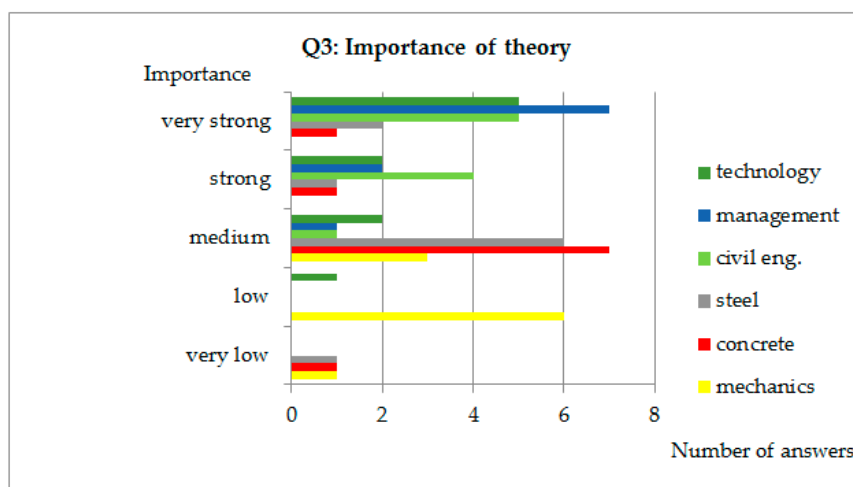


Figure 12. Result 3: Curriculum courses and applications.

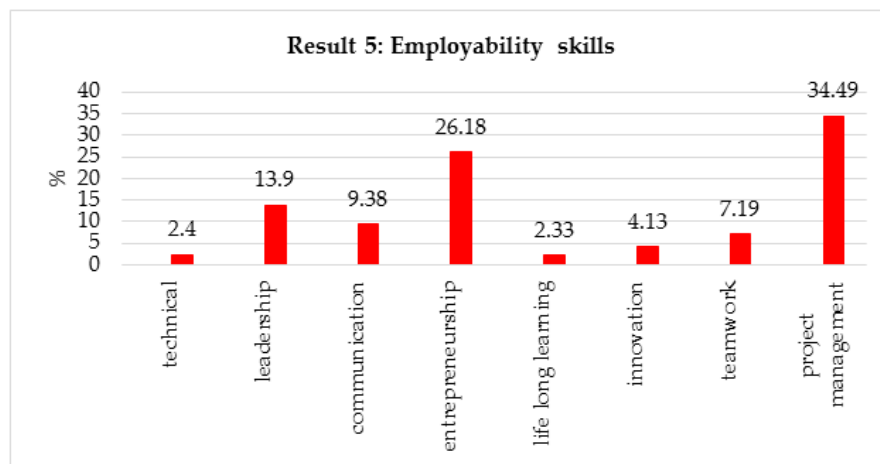


Figure 13. Result 5: Employability skills.

5. Discussion

By analyzing and interpreting the results of the research, we found that a gap exists between the training the students are acquiring during the academic studies and the demands of the business environment.

The findings of the research (Table 1) reveal conclusions regarding the answers that the companies provided for each of the seven questions (Q01 to Q06 are close-ended, Q07 is open-ended).

- Q01: Benefits for the companies involved in the study:

The companies were accepted to participate in this research because they were the employers for the future graduates of the Civil Engineering Faculty.

- The organizations give a strong importance (50%) to the students' training, as their own benefit for lowering the training costs;
- The organizations show interest in hiring the students coming from the Civil Engineering Faculty on a rate of 50%;
- The organizations are not interested in the syllabus design (50% gave a low importance). All the companies are specialized in manufacturing and design, so the practical competencies are a strong plus for students;
- In terms of cooperation, the companies do not perceive the benefit, since there is a huge competition in the area, and everyone is fighting for a market segment.
- Q02: Importance of the research for future employment of the graduates:
The companies are seeking for well-trained employees and they give a strong importance (40%) on the academic training, if it is connected to the market demands.
- Q03: Importance of theoretical knowledge for future employment of the graduates:
The organizations give a low and medium importance to theoretical knowledge (mechanics, concrete, or steel), as they are fundamental disciplines and stand as base for understanding specialty disciplines, but rank the practical disciplines very high (50% for civil engineering, 70% for management and 50% for technology). In their evaluation, the students should acquire knowledge focused less on overall theory and more on specific areas.
- Q04: Importance of site apprenticeship for future employment of the graduates:
80% of the subject companies give a very strong rate for site apprenticeship, because that is the place where the employee receives those key competencies that allow him/her to perform.

- Q05: Importance of attitudes for future employment of the graduates:

The attitudes toward work are evaluated as very important (respect for work, people and institutions, responsibility and ethics).

They are not certified yet, because the entry-level graduates are at the beginning of their career in engineering. However, the undergraduate training may develop those professional skills through internships, volunteering, site apprenticeship, and others.

- Q06: Importance of employability skills for future employment of the graduates:

By applying the Analytical Hierarchy Method, we found three categories of employability skills:

- The skills evaluated as medium utility (2.33% for life-long learning, 2.40% for technical skills, and 4.13 for innovation);
- The skills evaluated as important (7.19% for teamwork and 9.38% for communication skills);
- The skills evaluated as very important (13.90% for leadership, 26.18% for the entrepreneurship, and 34.49% for project management skills).

According to the results, we have focused on a package of employability skills that may be developed through training.

- Q07: Suggestions on other types of training for future employment of the graduates:

This section of open-ended questions allows the companies to express their opinions on other types of training to enable the graduates to find a job that matches their expectations. Some of the suggestions are:

- At least two stages of 1 month apprenticeship, finalized with exams;
- Workshops in the civil engineering companies;
- During the site apprenticeship, the students should work in combined teams: students and company's employees from different departments;
- Involvement of the students in volunteering activities;
- Implication of the students in research, validated by conferences and/or symposiums;
- Cooperation between the companies and the universities.

Therefore, we are presenting our proposal for the intervention in the students' curriculum, as seen in Figure 14:

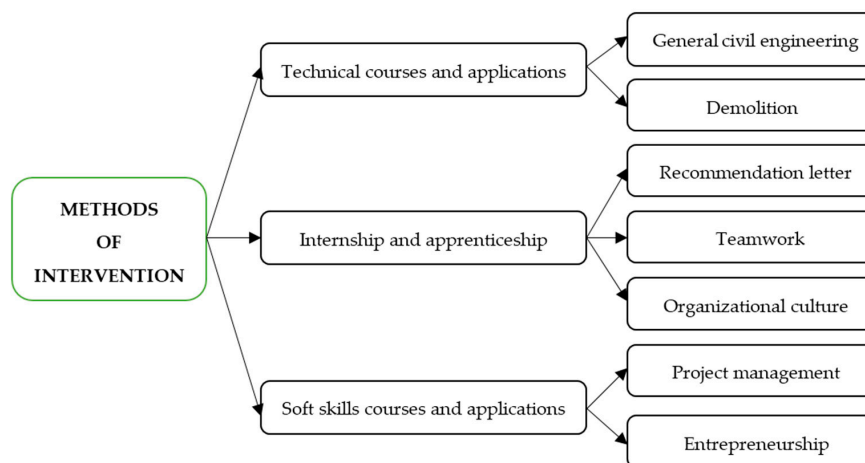


Figure 14. Methods of intervention on employability skills.

The intervention's goal is to develop employability skills for the Civil Engineering students, through the cooperation between the Civil Engineering Faculty and the business environment. This innovative approach will benefit all the three entities involved:

- The students will acquire the competencies required by the companies, and this will motivate them to perform in the job. Moreover, since they have theoretical and practical knowledge delivered by specialists in different areas, they may apply to wide civil engineering specializations.
- The faculty's staff will be prepared in practical domains in civil engineering specialization. According to the literature, there is a major problem in the academic field: the teachers are focusing on theory rather than practice, losing their connection with the business environment. Therefore, the companies complain that the students are not prepared for business jobs, because they cannot link the theory to practice. This research aimed to provide solutions for this matter, by "teaching" the teachers in practice-oriented knowledge.

The companies, almost entirely focused on profit, do not have time to train their employees, so they pay for training programs; however, a short timetable of these programs is not efficient, and does not drive the expected results. Students may participate to optional modular courses and applications, scheduled during the four years of study, to be prepared in different specializations. Moreover, the companies' staff may be trained in teaching skills by the faculty's teachers.

6. Conclusions

The present research emphasizes the need for a mix of technical and professional skills that the graduates might need in a competitive market. Since the academic system provides fundamental and specialized training in a specific area, students have the possibility to choose between continuing the educational development through PhD programs or post-graduate specialization, or to find jobs in their area of expertise.

The findings of our research show that there is a need for cooperation between universities and the business environment in order to align the university teaching with the on-the-job needs. The companies will stay close to the academic field, since they are involved in business and have little time for research. The university staff may provide knowledge and scientific results that might help the firms in using new materials and technologies for a sustainable development.

The universities may take advantage of the cooperation with the companies because every notion they deliver has to be linked with practice, therefore the teachers have the opportunity to update the courses and applications accordingly.

At the end of the chain are the students, who will acquire both theoretical and practical knowledge, which will result in better career planning: either choosing research or practice.

In conclusion, our interdisciplinary training proposal is:

- a. Modular interdisciplinary theoretical courses, in subjects that shouldn't be redundant with the faculty's syllabus. From the companies' variants, we decided two optional courses, focused on practical notions and with a strong attention to environment preserving: general civil engineering and demolition. The mentors will be the specialists from the companies that chose to cooperate with the faculty, assisted by the teachers. The project-based courses and applications may be accessed on the project's platform, www.pact.utcluj.ro.
- b. Internship and apprenticeship at the companies' headquarters and site, finished with exams. The students with good results will receive recommendations that may be assimilated with experience in the field, and should help them find jobs in the area. These actions will also give them teamwork skills and will help them understand the organizational culture.

The companies may benefit from the students' internships in the recruiting and selection phases: they can supervise the students and find their level of knowledge, attitudes and skills, in order to minimize the risk of choosing an unsuitable job candidate, meaning they will save money and time when a vacant job occurs.

Modular professional skills courses and applications will be focused on project management and entrepreneurship. The students will be trained by teachers from the Civil Engineering Faculty and the experts from the companies. The main subjects will be PMBOK (with accent on PRIMAVERA software) and entrepreneurship skills, developed also during internships and apprenticeships.

Therefore, the main hypothesis H0 is validated: there is a strong link between theory and practice in the proposed academic curricula, and the most sought-for competencies in the labor market are technical, practical competencies and professional skills.

Any project, and in this case a research one, has difficulties in its applicability, which are caused specially by the resources to be used. Thinking of the fact that human resource is the main input involved, we have identified issues that might jeopardize the goals set by the management team.

- Universities: the legislation in higher education system requires the drawing of the syllabus by respecting some regulations concerning the rate of different types of disciplines. Moreover, the accreditation of the programs is done periodically, every 4–5 years. For this reason, the disciplines set in partnership with the companies must be only optional or voluntary, and cannot be included on the graduate's transcript;
- Students: the courses do not deliver immediate results: from a psychological standpoint, the students in the final year of study didn't face the refusal of the employers so it is difficult to understand what they have not experienced. Another reason may be that these courses are not found in the university's curriculum so they do not have credentials. The project will mitigate this risk through grants and will motivate students through diplomas awarded by the companies;
- The business environment: in terms of human capital, the unemployment status offers companies the opportunity to choose the suitable employee from numerous applicants. There are few organizations that have a long-term job design. On the other hand, the crisis brought more layoffs than employment. For this reason, it is difficult to estimate the number of vacancies in a certain time. For future reference, the project proposes a qualitative research (interviews with the companies' managers) regarding the offer of available jobs on short, medium and long term.

However, it is essential to highlight the socio-economic importance of the investigated problem, namely graduates with a few employability competencies, eager to join as quickly as possible the companies, which, due to underperforming staff, do not get the expected profits. It is, therefore, presumed that solving the problem will be of interest in the medium and long term, and the solution is only the cooperation between parties, by actions mutually agreed upon.

Another limitation is the sample of the subjects: the research was an exploratory study involving only the students from the Civil Engineering Faculty, at the Technical University of Cluj-Napoca, Romania. However, the piloted project yielded results that could be conveyed to a higher scale, upgrading the sample to other universities or national specializations. Thus, the present paper opens avenues for further research on comparative analysis, as well as in terms of developing and implementing other student-tailored trainings.

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