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Soft Skills in Engineers, a Relevant Field of Research: Exploring and Assessing Skills in Italian Engineering Students

Habilidades transversales en ingeniería, un ámbito de investigación relevante: Explorando y evaluando habilidades en estudiantes de ingeniería italianos

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ABSTRACT

Soft skills are important for any career and are necessary to access and face the labor market. This research focuses on soft skills by exploring engineer profiles. It also determines how soft skills are developed through the study of a representative sample of 314 undergraduate engineering students from 15 different Italian universities. The instrument used is a questionnaire that investigates soft skills and is based on the Business-focused Inventory of Personality (BIP). Answers are grouped into four areas: intrapersonal, interpersonal, activity development, and impression management. Results show that these engineers have more self-confidence than the reference sample; they demonstrated a great commitment in setting job goals and pursuing projects, a good emotional adaptation to social situations, and enough attitudes in terms of problem solving and openness to change. Perception on the ability to work under pressure is in the average, and they seem ready to take on challenging tasks. The score shows that engineers from the sample are able to express positive and negative ideas and feelings in balance with the reference average, but sometimes they have difficulties in establishing personal relationships. Therefore, they are unable to understand the moods of those who around them and may also have difficulty in understanding their expectations. This results in some difficulties in teamwork. The general result underlines the opportunity of empowerment programs regarding soft skills.

Keywords: soft skills, engineer, BIP, curriculum, university

RESUMEN

Las habilidades transversales son importantes para cualquier carrera y son necesarias para acceder y afrontar el mercado laboral. Esta investigación se enfoca en el tema de las habilidades transversales explorando los perfiles de los ingenieros. También determina cómo se desarrollan las habilidades sociales a través del estudio de una muestra representativa de 314 estudiantes de ingeniería de 15 universidades italianas diferentes. El instrumento utilizado es un cuestionario que investiga las habilidades interpersonales basado en el Business-focused Inventory of Personality (BIP). Las respuestas se agrupan en cuatro áreas: intrapersonal, interpersonal, desarrollo de la actividad y gestión de la impresión. Los resultados muestran que estos ingenieros tienen más confianza en sí mismos que la muestra de referencia; demostraron un gran compromiso en establecer metas laborales y seguir proyectos, una buena adaptación emocional a las situaciones sociales y actitudes suficientes en términos de solución de problemas y apertura al cambio. La percepción sobre la capacidad de trabajar bajo presión se encuentra en el promedio, y ellos parecen dispuestos a asumir tareas desafiantes. El puntaje muestra que los ingenieros de la muestra son capaces de expresar ideas y sentimientos positivos y negativos en equilibrio con el promedio de referencia, pero a veces tienen dificultades para establecer relaciones personales. Como resultado, no pueden comprender los estados de ánimo de quienes los rodean y pueden tener dificultades para comprender sus expectativas. Esto resulta en algunas dificultades para el trabajo en equipo. El resultado general subraya la oportunidad de un programa de empoderamiento en habilidades transversales.

Palabras clave: habilidades transversales, ingeniería, BIP, currículum, universidad

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Introduction

Currently, soft skills are receiving attention from different age groups alongside occupational education programs to better equip people for their future careers. Nevertheless, introducing such concepts in a fitting way is an important challenge in higher education. There are a lot of definitions regarding soft skills. In general, education programs focused on soft skills have the goal to make or reduce the number of unemployed graduates and to efficiently match graduates with companies, not only in technical matters, but also in the aspects related to company values. According to "The Research Agenda for the New Discipline of Engineering Education" (Borrego and Bernhard, 2011) the skills that future engineers must master in the classroom and develop during their professional practice are mainly soft skills. These are transferable behaviors that can be used in different contexts of life, specifically in highly competitive work scenarios (Schleutker, Caggiano, Coluzzi and Poza-Lujan, 2019). They are absolutely necessary to access the labor market, and they have become more crucial to acquire in engineering professional contexts, together with hard and technical skills (King, 2012; Gemar, Negrón-González, Lozano-Piedrahita, Guzmán-Parra and Rosado, 2019). Today's engineering graduates have a plenty of technical knowledge, but mostly lack the social skills required by current job settings, such as leadership, communication and teamwork. One of the crucial areas of research in engineering education is focused on designing higher education engineering courses to predispose competent, autonomous, and decision-making future engineers (Itani and Srour, 2016) in order to respond to labor market demands for highly qualified professionals. Engineering has focused mainly on its technical aspects. This is because engineering is more isolated from human relations than other disciplines. In these disciplines, the result is the most important thing, and focusing on personal matters is not necessary to obtain successful results (Barrera, Duarte, Sarmiento and Soto, 2015). However, currently, the classical vision of an engineer working alone, designing some personalized product, has changed. Companies develop a lot of projects with a lot of people involved. That means that relations between different people in a project are one of the pillars to achieve its goals (Brunhaver, Korte, Barley and Sheppard, 2017). Therefore, some personal characteristics, which we prefer to call soft skills, such as teamwork or leadership, have started to be recognized. Traditionally, these skills are not considered in the curriculum of engineering programs. However, these soft skills needs are being considered, especially since engineers perform their work in a project-oriented environment (Henkel, Marion and Bourdeau, 2019; Ballesteros-Sánchez, Ortiz-Marcos, Rodríguez-Rivero and Juan-Ruiz, 2017). In emerging fields of engineering, such as Information and Communication Technologies (ICT), the study of soft skills is one of the future trends (Matturro, Raschetti and Fontán, 2019).

These aspects raise some interesting questions: what soft skills are necessary in engineering? Can soft skills be learned? To answer these questions, it is necessary to know the current state of soft skills in engineering, in other words, what are the most common soft skills in engineers, and if these soft skills depend on age or gender. The research presented in this paper is focused on determining the most relevant soft skills that engineers have in order to answer these questions, as well as whether there are differences between the soft skills that engineers possess and the average of other university students. If there are, probably the syllabus of the degrees and masters engineering curriculum must consider incorporating them as part of their training. It is important to know these soft skills since they are are necessary to design university programs based on competencies (Tulgan, 2015).

Defining soft skills

There is a significant parallelism between system components: hardware (hard skills) and software (soft skills). Without hardware, software does not work, and without software, hardware cannot be used efficiently. From a business point of view, engineers need soft skills to obtain benefits from their hard skills (Robles, 2012). Previous researchers noted that many graduated engineers have good technical skills (or hard skills) but not enough soft skills. That is, there is an insufficiency of skills related to employability and moral values, communication and leadership, confidence level, and ability to adapt in the workplace (Beckton, 2009; Elsen, Jaginowski anf Kleinert, 2005; Leroux and Lafleur, 2006; McIntosh, 2008).

Empirical researches confirm that, nowadays, employers are hunting for workers who have good technical skills but have additional skills such as communication, interpersonal, teamwork, problem-solving, thinking, and technology skills, as well as continuous learning and a positive work ethic (Raybould and Sheedy, 2005). Soft skills, as generic skills, have become a main factor that is needed by employers, and graduates must consider this to start any career (Hinchliffe and Jolly, 2011; McQuick and Lindsay, 2005). This was demonstrated when many unemployed graduates stated that they needed additional training programs to improve soft skills as well as lifelong learning skills, team building, career development, interpersonal skills, and the especially necessary entrepreneurial skills (Fabregá, Alarcon and Galiana, 2016; Pineteh, 2012).

Soft skills are among the skills that are necessary to improve the performance of self-employment graduates in relation to international needs. The increase in the total number of unemployed graduates is one of the subjects that arises, due to the lack of proficienct soft skills (Redomero, Caggiano, Poza-Luján, and Piccione, 2019). For this reason, it is necessary to deepen and develop this subject.

European university curriculum

Currently, continuous change in the socioeconomic environment demands highly skilled graduates from universities (Possa, 2006; Sleezer, Gularte, Waldner and Cook, 2004; Weil, 1999). Consequently, it is necessary to match companies' skills needs with the skills provided by universities in order to increase the quality of the alumni

(Elias and Purcell, 2004; Teichler, 2003). Following the Bologna Declaration on June 19, 1999, titled *The European Higher Education Area*, and given their importance in the development of a knowledge-based economy, European universities are required to produce graduates who are able to respond to the ever-changing workplace requirements (Andrews and Higson, 2008). This has resulted in questions about the ability of graduates to meet the needs of employers (Caggiano, Schleutker, Petrone and González-Bernal, 2020). Certainly, "serious concerns have been expressed about an increasingly wide 'gap"' between the skills that graduates have and the requirements of the global work environment (Andrews and Higson, 2009, p.1; Mocanu, Zamfir, and Pirciog, 2014).

Curriculum development is a key educational process that can support the innovative capacity of a higher education institution. Thus, implementation of educational curricula in the European universities should always be up to date to make certain that graduates possess not only knowledge but also mastery of soft skills (Stevenson and Bell, 2009). Communication skills, life-long learning, entrepreneurship skills, and moral and professional ethics are some of the skills needed by graduates to improve their employability (Evans, 2006; Pineteh, 2012). There are growing concerns for graduate employability and the expansion in the size and diversity of student populations (Fallows and Steven, 2000).

In the case of engineering students, the importance of soft skills has been acknowledged in recent years (Bancino and Zevalkink, 2007). Recent studies indicate the complexity of the learning process to determine which soft skills are necessary for engineers (Aponte, Agi, and Jordan, 2017). Consequently, it is very important to incorporate soft skills to the curriculum, especially in order to obtain the degree certifications of the international agencies. In this case, such skills are called 'professional skills' (Shuman, Besterfield-Sacre, and McGourty, 2005).

The concept of competency-based curricula appears in order to incorporate competencies into the engineering curriculum (Lunev, Petrova, and Zaripova, 2013). This model focuses on the learning process and is oriented towards results (Tomić et al., 2019). This makes the model perfect for engineering degrees. Given that soft skills are important in engineering and that the competency-based model is very suitable for these disciplines, it is convenient to determine which soft skills engineers must have and develop. These competences must be acquired by students but are also necessary in teachers (Carvalho, Corrêa, Carvalho, Vieira, Stankowitz, and Kolotelo, 2018).

It is also convenient to quantize the dependence on soft skills with regarding some structural aspects. Among the various aspects, it is possible to highlight two statistical dimensions: age and gender. In the case of soft skills, age can be used as a variable (Fournier and Ineson, 2014). However, experience is not age, and it is a more accurate factor in acquiring certain soft skills (Joseph, Ang, Chang, and Slaughter, 2010). Usually, students do not have enough labor experience to deem this variable significant. In the case of this study, we consider age because the people who answered the questionnaire were mainly last year students who became graduates during this study.

The perception of the need for soft skills in engineering varies depending on the experience (Chanduví, Martín, and De los Ríos, 2013). That is to say, when an engineer has been working for many years, he or she knows what hard skills are necessary, but experience also allows to determine which ones must be developed. This is due to the fact that experience provides knowledge about the personal profiles that drive engineering projects to have a good result. Regarding gender, it is obvious that engineering has an issue to solve (Wang and Degol, 2017). It would be very important to know if the appreciation of transversal competences is different in terms of gender, since it could determine whether the low percentage of women in engineering depends on hard skills or soft skills. Knowing what competencies are different between men and women would make it possible to improve the actions aimed at achieving more gender equality in engineering.

Method and tools

This research was classified as descriptive, since the general objective was to determine the skills already developed by graduates in engineering, in order to address the lack according to the needs of the job market. In this sense, we tried to identify and characterize a series of soft skills, highlighting their qualities and characteristics. It was a non-experimental, cross-sectional design that simultaneously collected data, particularly during the months of April 2015 to June 2018. The research focused on a population of undergraduates in different engineering disciplines in Italy. Out of this population, an accidental sample was developed through the Department of Engineering of the University of Roma Tre, through personal contacts with a snowball sampling, and thanks to the publication of the questionnaire in different social networks.

The final sample used consisted of 314 people. Although it is a small sample, it must be considered that more than 1 000 responses were received. However, only those persons who were students and graduated within two years after taking the survey were considered. This is because we wanted to determine the soft skills of the graduates, but we also desired to know the needs of the students, in order to adapt them to the curriculum. The result was a small but qualified sample.

Likewise, the confidentiality of personal data was guaranteed, requesting permission to treat them according to the Italian law D'Lgs 196 of June 30, 2003. The next step in this research was to collect data from Spanish informatics engineering graduates. With this comparison, we proposed to extend the study into two branches -European and South American undergraduates and/or graduates- in order to compare the cultural and economic influence in the development of soft skills.

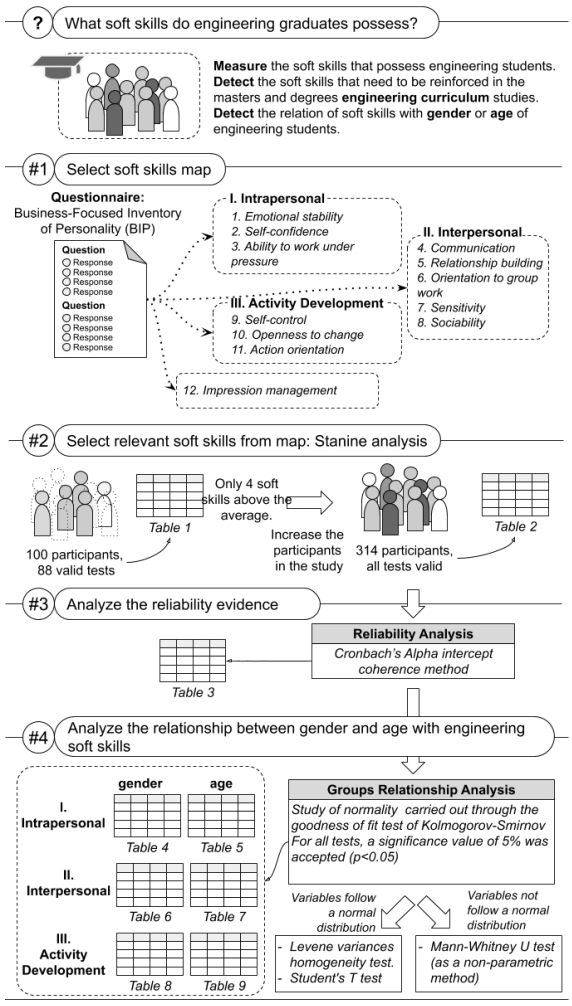

Figure 1. Full process of experimentation carried out and presented along with the performed.
Source: Authors

Sample

A representative sample of 314 engineering undergraduates from 15 universities of Italy s selected. Among all respondents, there were 221 (70,38%) male students and 93 female students (29,62%), all aged between 19 and 24, with the exception of a 52-year-old subject. To avoid altering the presented age-related study, we had separate the main group and the exception in another one. Results only considered 19 to 24 because one exception could cause a high bias in the analysis. 49,68% of them were bachelor students (three-year engineering program) and 50,32% were master's degree students (three-year engineering program). Regarding the type of engineering, students came from Computing and Systems Engineering (70,06%), Industrial Engineering (28,66%), and the remaining percentage (1,7%) was divided between different engineering branches: mechanical, civil, environmental, electronic, management, transportation, energy, and biomedical engineering.

Procedure

Participant consent was obtained before undertaking the study. The students volunteered and indicated their agreement to participate in the study through a form.

They were informed that their participation was completely voluntary and that all collected information would be anonymous and confidential. The questionnaires were administered in the last year of their degree to test the above-mentioned hypothesis: whether soft skills were developed in their academic paths.

Instrument

Detecting soft skills like creativity requires the use interesting methods and specific tools (Olivares-Rodríguez, Guenaga, and Garaizar, 2017). Questionnaires are the most frequent, since they allow homogenizing results and are easily filled out by students. The latter justifies their use in the studied population (Fernández-Sanz, Villalba, Medina, and Misra, 2017). Questionnaires are easily included in methods. For example Redoli, Mompó, De la Mata, and Doctor (2013) present a full procedure to detect and train soft skills which uses questionnaires in the early stages of the training. On the other hand, to measure a concrete soft skill, concrete methods can be used. For example, Joseph, Ang, Chang, and Slaughter (2010) use the critical incidents methodology to measure practical intelligence. A list of different methodological approaches for measuring soft skills can be found in Balcar (2014). The greater is the number of evaluated soft skills, the more generic should the employed method be. That is why we decided to use a questionnaire as a measuring tool instead of other practical methods.

The questionnaire included the following sections: Sociodemographic characteristics (gender, age and, provenance) and studies (university and engineering type). The next section was the Business-focused Inventory of Personality (BIP). Engineers develop their activities mainly in companies, so the use of BIP is justified by the similarities between the evaluated competences and the meta-competencies that are usually required in engineering (Chanduví et al., 2013). Additionally, the questionnaire has been adapted and translated for the Italian population by Luissa Fossati and Matteo Ciancaleoni (2013).

Regarding BIP, to avoid equidistant position, a specific used response format was chosen. The answers were arranged into a six-point scale that varies between 'completely true' and 'completely false', between which four intermediate points are not anchored. These questions are based on dichotomous statements, so the respondent must choose between one or the other pole. For example, 'I prefer to answer emails than to make phone calls' can be answered in the range of 1 ('completely false for me') to 6 ('completely true for me'). In this case, the number of responses is even to avoid the 'impartial' effect; it is necessary to decide in one way or another.

The current version of the BIP is the result of an intense revision (Fossati and Ciancaleoni, 2013). Not all the variables in the questionnaire have been selected, in order to cover

only the competences closest to the engineering field of work (Allen, Reed-Rhoads, Terry, Murphy, and Stone, 2008). The evaluated scales are grouped into three areas plus one isolated Impression Management skill. Next, we present the definition of these soft skills which were used and explained to participants.

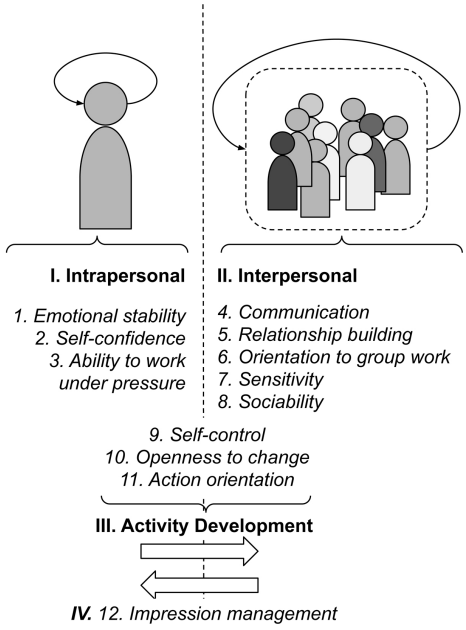

Figure 2. Areas in which the BIP questionnaire separates the soft skills and their placement in the process of personal interactions.
Source: Authors

Intrapersonal area

- **Emotional stability**: It focuses on appropriate management of emotional reactions. It concerns the ability to react positively to stressful or difficult situations in life.
- **Self-confidence:** It is the conviction or security of being capable of doing a good job. When there is no self-confidence, other personal skills can be ignored.
- **The ability to work under pressure**: It gives us the image that the sample have of themselves regarding the ability to perform their functions in adverse circumstances while maintaining a constant level of efficiency.

Interpersonal area

- **Communication**: It is assessed through assertiveness, a social ability that allows us to express our rights, opinions, ideas, needs, and feelings in a conscious, clear, honest, and sincere way without harming others. It includes the ability to convince others, persevering in supporting one's position.
- **Relationship building**: It is close to the Big Five Model extroversion construct (McRae and Costa, 1987), but there are differences with the present research. In this case, it concerns the development of interpersonal relationships and the creation of a network of contacts.
- **Orientation to group work**: The preference to work in a group or individually is evaluated, as well as the ability to integrate into work groups and the level of performance in both contexts.
- **Sensitivity**: It is the ability to interpret and understand people's thoughts, conduct, feelings, and concerns; to perceive if any behavior is appropriate depending on the social situation.
- **Sociability**: This has similarities with the broad domain of the Big Five Model's Agreeableness (McRae and Costa, 1987). It concerns the ability to interact friendly and kindly. It deals with a basic social competence in the processes of adaptability to new environments or new conditions of social coexistence.

Activity development area

- **Self-control**: It is inserted in the Conscientiousness factor from the Big Five Model (McCrae and Costa, 1985). However, in the present case, we mean the commitment with work objectives or projects. This dimension is also based on planning, organization, and execution of tasks.
- **Openness to Change**: This scale shows an overlap with the openness to the experience construct of the Big Five Model (McCrae and Costa, 1985). Still, this factor has a greater breadth in the model. In the present research, adaptability and flexibility are evaluated. It concerns adaptation while coping with changing situations.
- **Action Orientation**: It broadly corresponds to the construct described by Kuhl and Beckmann (1994). It is a bipolar dimension, aimed at evaluating the orientation to the action in opposition to the orientation to the state. The first one favors the transformation of intention into action, while the other is characterized by having thoughts related to the attainment of a goal in the mind.

Impression Management

It comprises the tendency for responses to be socially desirable. This variable refers to the own impression about the effect of the social interaction and has a direct relation with important aspects such as motivation and ethical point of view (Brockmann, Clarke, Méhaut, and Winch, 2009).

Data analysis

Data was collected through Google Forms, through a payment account for the project. This account allowed to obtain progressive copies of all the changes and guaranteed the integrity and full availability of the data. Access to data could

only be done by researchers. Given that the study did not collect private data that enabled the recognition of people, it was not allowed to alter the response of the participants. The data processing was carried out through the exporting a CSV file. A data audit was performed to verify that the analysis program had not altered the original data.

SPSS (IBM Corp., 2015) was used for all analyses. Descriptive statistics for individual item scores of the soft skills competency level were analyzed to establish a general profile of the engineering students' self-assessment qualification patterns. The BIP is a questionnaire that refers to statistical rules. In other words, it defines the level of each characteristic detected in the examined subject by comparing it to the raw score. The normative scores are expressed as stanine points on a scale that has an average of 5,5 and a standard deviation of 2. In order to compare results, we used the results from the whole study performed by authors as a reference group. These groups included students from different degrees and different Italian universities. The reference group consisted of undergraduates from different degrees: 314 from engineering, 174 from education and 683 from different sciences degrees (Chemistry, Biology, Mathematics and so on). Regarding gender, 48,3% were women and 51,7% men. The age average was 21,3 years old. The characteristics of the reference group were close to the characteristics of the applied questionnaire. The average of these groups, including other degrees, were the values used as a reference group in the soft skills level analysis. This group was used to compare the results of concrete subsets. For example, in Redomero et al. (2019), only education and engineer degrees were compared.

Then, a psychometric validation was performed for the item set. The reliability analysis of the questionnaire was carried out with the sample of engineers by using Cronbach's internal consistency method. This coefficient allows to verify that the items measured the same variable on a Likert-type scale and were highly correlated. It varies in value from 0 to 1: the higher the score, the more reliable the scale will be.

The comparison between means of different groups (age, gender) was carried out through independent samples T-test, checking first if the variances were similar through the Levene contrast test. Both Mann-Whitney U and Kolmogorov-Smirnov non-parametric tests were performed to compare two different and unpaired groups of two-variable data. These methods compute P values that test the null hypothesis that the two compared groups have the same distribution. For all tests, a significance value of 5% was accepted ($p < 0,05$).

Results

Soft skills level in engineering students

In the first phase of the research, the first deep analysis was performed on a sample of 100 subjects, but only 88 questionnaires were considered valid. The fee costs and time invested in carrying out a complete test is very high. For this reason, a first sample was chosen to determine which soft skills should be analyzed in more detail. This research was intended to verify that soft skills were below the reference group average of the questionnaire. In this case, with a representative sample of 88 subjects, with scores above the average and with the knowledge that, by shortening the test, more subjects would be reached. Table 1 shows the high scored soft skills in engineering students.

Table 1. Soft Skills with high scores obtained by engineering students

Soft Skill	N	Mean	Standard deviation
1. Emotional stability	88	6,204	2,029
2. Self-confidence	88	6,375	1,883
9. Self-Control	88	6,727	1,679
10. Openness to Change	88	5,818	1,698

Source: Authors (data analysis performed by SPSS v.23).

These results suggest that engineering students have intrapersonal and activity development skills above the level of previous studies. As a consequence, we decided to increase the application of the BIP questionnaire to a representative sample of 314.

The soft skills shown in Table 1 do not change in the results. The other soft skills included in the BIP questionnaire are shown in Table 2. The results observed in it show that the scores on all the variables of the interpersonal skills area are below the average with respect to the reference group in which the mean was 5,750.

Table 2. Soft Skills results in the Interpersonal area and corresponding stanines of the whole group of students

Soft Skill	N	Mean	Standard deviation
3. Ability to work under pressure	314	5,675	1,614
4. Communication	314	5,675	1,614
5. Relationship building	314	3,427	0,888
6. Orientation to group work	314	3,306	1,034
7. Sensitivity	314	3,854	1,068
8. Sociability	314	4,789	1,571
11. Action Orientation	314	4,153	1,022

Source: Authors (data analysis performed by SPSS v.23).

The result is really interesting, since it indicates a lack in the development of soft skills in personal relationships for teamwork. This lack implies that the engineering curriculum should include training in teamwork or learning methodologies such as team-project-based learning, through which these soft skills can be developed. In order to anticipate this aspect, the questionnaire included another important question: whether the respondent was willing to be an active researcher by participating in the training project for the development of these skills. 62,1% showed interest by responding positively to the proposal to participate in a Soft Skills Training Laboratory. This aspect implies that undergraduates know their needs.

Reliability evidence

The study of the internal consistency (CI) of the BIP scales with the engineers' samples was measured by calculating Cronbach's alpha coefficient. As can be seen in the

Table 3, the reliability of the scales is very good in self-control, relationship building, orientation to teamwork, communication, emotional stability, ability to work under pressure, and self-confidence. The scales with moderate reliability are openness to change, sociability, sensitivity, and impression management. The action orientation scale has an unacceptable reliability.

Table 3. Reliability evidence of soft skill scales

Soft Skill	α	Number of items
1. Emotional stability	0,840	13
2. Self-confidence	0,810	12
3. Ability to work under pressure	0,750	13
4. Communication	0,740	11
5. Relationship building	0,840	15
6. Orientation to group work	0,870	13
7. Sensitivity	0,700	11
8. Sociability	0,510	11
9. Self-control	0,750	14
10. Openness to Change	0,690	10
11. Action Orientation	0,320	14
12. Impression Management	0,540	5

Source: Authors (data analysis performed by SPSS v.23).

Soft kills relation with gender and age

The age of the respondents was between 19 and 52 years, with a mean age of 25,04 years being the standard deviation of 3,83. It grouped the age of the sample participants from 19 to 25 and from 26 to 54 years in order to facilitate the subsequent statistical analysis of this variable with the other variables included in the study.

The Levene test for the difference in means between each of the variables observed and the gender is not significant in any case. T-Student was used with parametric variables, and, although it is true that there is some small difference, there were no significant differences between men and women. With non-parametric variables, two independent samples have been used: Mann-Whitney U (U-MW) and Kolmogorov-Smirnov (K-S).

Table 4. T-test for difference between means and Mann-Whitney U/ Kolmogorov Smirnov tests in gender in the intrapersonal area

Soft Skill	Levene	T	p
1. Emotional stability	0,535	-1,380	0,169
2. Self-confidence	0,719	- 0,126	0,900
3. Ability to work under pressure	0,157	0,577	0,564

Source: Authors (data analysis performed by SPSS v.23).

In the intrapersonal area, there are no significant differences in gender (Table 4) or age (Table 5). The 'p' associated with the statistical T is greater than the prefixed level of significance $\alpha = 0,05$. Results demonstrate that, in personal engineering-related skills, both men and women are equally prepared. This result suggests that the small number of women in technical degrees is not related to gender. The next analysis focused on the interpersonal area, regarding both gender (Table 6) and age (Table 7).

Table 5. T-test for difference between means and Mann-Whitney U/ Kolmogorov Smirnoff tests in age in the intrapersonal area

Soft Skill	Levene	T	p
1. Emotional stability	0,621	-0,824	0,411
2. Self-confidence	0,167	-1,901	0,058
3. Ability to work under pressure	0,535	-1,380	0,169

Source: Authors (data analysis performed by SPSS v.23).

Table 6. T -test for difference between means and U-Mann Whithey/ Kolmogorov Smirnoff in gender in the Interpersonal Area

Soft Skill	Levene	T	p
4. Communication	0,011	U-MW: 0,510 K-S: 0,526	
5. Relationship building	0,343	- 1,018	0,310
6. Orientation to group work	0,742	- 0,665	0,507
7. Sensitivity	0,798	0,737	0,462
8. Sociability	0,326	0,109	0,789

Source: Authors (data analysis performed by SPSS v.23).

Table 7. T-test for difference between means and Mann-Whithey U/ Kolmogorov Smirnoff tests in age in the interpersonal area

Soft Skill	Levene	T	p
4. Communication	0,915	-1,006	0,315
5. Relationship building	0,849	-0,103	0,918
6. Orientation to group work	0,512	0,976	0,330
7. Sensitivity	0,621	-0,824	0,411
8. Sociability	0,020	U-MW: 0,625 K-S: 0,845	

Source: Authors (data analysis performed by SPSS v.23).

In both cases, gender and age, there are no significant differences between the groups in the interpersonal area, since the 'p' associated with the statistical T is greater than the prefixed level of significance $\alpha = 0,05$. Although an increase in the mean is observed as the age increases. Consequently, the skills necessary for team interactions in current engineering do not differ either. Finally, Tables 8 and 9 present the results of the activity development area.

Table 8. T-test for difference between means and Mann-Whitney U/ Kolmogorov Smirnoff tests in gender in the Activity Development Area

Soft Skill	Levene	T	p
9. Self-control	0,742	-0,665	0,507
11. Action Orientation	0,199	0,268	0,789

Source: Authors (data analysis performed by SPSS v.23).

Levene's test is not significant in any of the performed analyses. Consequently, the minimum differences that may exist between the different age and gender groups are not significant.

Table 9. T-test for difference between means and Mann-Whitney U/ Kolmogorov Smirnoff tests in age in the activity development area

Soft Skill	Levene	T	p
9. Self-control	0,512	0,976	0,330
11. Action Orientation	0,167	-1,901	0,058

Source: Authors (data analysis performed by SPSS v.23).

Conclusions

Detecting and measuring soft skills in people through questionnaires allows researchers to access relevant information to design syllabi adapted to the social and economic environment. In this study, the BIP questionnaire has been used to detect the soft skills in engineering students. This study shows the state of soft skills in Italian undergraduate engineering students: self-control, self-confidence, emotional stability and openness to change are above the average of different fields analyzed for the reference group. These skills are mainly related to the intrapersonal and activity development areas. Perhaps, these high scored skills are due to engineers' having a high demand for understanding physical concepts not directly related to people. Skills close to the average are the ability to work under pressure and communication. These skills are common for degree and master students. The skills below the average are sociability, action orientation, sensitivity, relationship building, and orientation to group work. These skills are only needed in a social context. Perhaps, the perception of an engineer working alone and using their own knowledge is a stereotype and can force people to avoid these skills. Consequently, it would be interesting to reinforce the social aspects of engineers.

Regarding self-control, flexibility, emotional stability, and self-confidence, statistical data indicate scores above the average. Thus, they were deemed to be far from one of the main objectives of the project: to design a university program that improves soft skills. Furthermore, the evaluated sample is considered significant to draw conclusions from this descriptive analysis.

It is interesting to observe how the engineers' soft skills that are above the means of the previous studies are the soft skills related to the intrapersonal and activity development areas. The results with the expanded group suggest that the soft skills related to the interpersonal area, such as teamwork, should be reinforced. This reinforcement can be done, either by specific training or through teamwork-oriented methodologies in the engineering curricula.

Engineers who participated in the research have more self-confidence than the reference sample, which means they rely fully on their ability to perform tasks in their field. They are active people who are confident when they face new challenges. Potential training in this area can be very useful. Self-confidence is something that is not usually hard-wired in us, and we must try to develop it. The results also show a great commitment in setting job goals and following projects. A good emotional adaptation to social situations is observed, since attitudes for a good problem solving are involved. The scores obtained for openness to change were similar to those of the reference sample. Probably, scores close to the average like this one are a common aspect of university students and, consequently, graduates. There is not a clear reason for this absence of differences between degrees. A possible cause may be that, at the intellectual level of a university, research provides a continuous change in the knowledge base. This implies that the technical contents of the subjects change over time. Therefore, in any area of knowledge, students assume these changes and, at the end of their studies, they know that they must be flexible and open to admit that, during their career, they will develop in a changing and innovative environment.

With the total sample and the rest of the variables, some conclusions have been drawn. The perception of the ability to work under pressure that engineers have of themselves is in the normative average. The subjects show that they are ready to deal with challenging tasks. This ability can be achieved by managing stress and correctly organizing the tasks to achieve the proposed objectives. These skills are relevant to explain a general openness to change; students are aware of the need to be flexible in the current job market.

An important aspect in the field of interpersonal relationships is the ability to communicate. Assertiveness is a way to firmly communicate one's rights. The score shows that the engineers of the sample are able to express positive and negative ideas and feelings in an open, honest, and direct way, thus finding themselves in the reference average. The data reflects the fact that sometimes they avoid social gatherings and have some difficulties in establishing personal contacts, particularly with strangers. This is the result of personal interviews with some students after obtaining the results. It is important to highlight that the perception of their social relationships is characterized by friendliness and respect, although the data also shows that in conversations it is possible that they are unable to understand the moods of those who are facing them and, therefore, may also have difficulty in understanding what their expectations are. From the results, it has been interpreted that there are some difficulties in working as a team compared to other people in the reference sample. They feel more comfortable and show greater efficiency by working individually and at their own pace. Currently, there is a greater demand for group thinking in many professional areas, which is why individuals with an individual focus must increase their range of behaviors in order to contribute to effective group collaboration when necessary. The engineers involved in this research are at an intermediate point between the two forms of orientation: to action and to the state. The statistical data indicate similar scores to the reference samples. The results are relevant for the future of engineering masters and degrees and can be used to determine the needs and adapt the syllabus for the future of engineering students.

Orientation to action favors the transformation of intention into action. On the other hand, orientation towards the state is characterized by having thoughts related to the attainment of a goal in the mind. It is important not to forget the fact that the

sample of engineers is heterogeneous. The study represents a relevant trend regarding the engineering curriculum degree, an opportunity to highlight the strengths and the weaknesses relative to implement the curriculum dedicated to engineers. The feature they share is the engineering degree, having in common an interest in the development of technical issues, but there are many types of engineering and, in turn, a large number of jobs and a wide range of functions to be performed.

The result of the research presented in the article generates a wide set of future works. The world of soft skills is in continuous growth. In the field of engineering, it is especially important. Traditionally, soft skills have been associated with the field of humanities, but their acquisition in engineering can lead to an increase in the efficiency and the addition of the 'human touch' of the resulting work.

Regarding soft skills, possible paths can be suitable for engineering should be sought. In our research, we have used soft skills related to the business environment, but some soft skills start to be associated with specific engineering fields, such as the 'structured mind' in the case of industrial engineering, or 'resilience' in the case of computing engineering. Matching soft skills with concrete engineering can adapt curricula to fit with specific engineers and companies' needs.

Regarding syllabi in engineering, it is necessary to look for ways to include soft skills. There is no efficient recipe. Including soft skills contents in all subjects will increase study hours or decrease the time dedicated to hard skills. Using teaching methods appropriate to specific soft skills could improve their acquisition by the students. This implies that research should be done on how to associate teaching methodologies with the necessary soft skills in engineering. This aspect is also a good field of work.

Finally, the detection and evaluation of soft skills is another issue that must be solved. Currently, for large groups, questionnaires like the BIP used in the article are the most efficient method. However, methods such as observation by experts, or empirical measurement of aspects such as the efficiency of team communication will be of great value in order to ensure and certify the acquisition soft skills.

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