Introduction of a career planning system for Aerospace Engineering students

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Abstract

Today’s world has been frequently described as volatile, uncertain, complex and ambiguous (VUCA). Changes in the world of work are taking place at a faster pace than ever before and access to information has never been greater. In order to prepare their students for this increasingly complex future and to qualify them for successful careers, education institutions need to reimagine themselves and provide curated access to information and relevant tools beyond the traditional technical knowledge. In recent years, Tecnico took a great step in this direction by developing the Tecnico 2122 model. The present work aims to support the implementation of this new teaching model by focusing on one critical aspect of 21st-century engineering education: career development learning.

Several different approaches to career planning are possible and valid. The present work presents various initiatives from other leading universities, analyses the systems currently in place in Tecnico and gives an overview of vocational psychology theories that typically inform this kind of interventions. The views of the main stakeholders of the career development process of Aerospace Engineering graduates (students, alumni, university bodies and Aerospace companies) are analysed in order to identify the main problems and possible solutions. Finally, a set of suggestions is proposed to contribute to a more coherent career planning system by adapting or developing current practices and introducing new ones.

Keywords: aerospace engineering, career planning, engineering education, transversal skills, vocational psychology

1. Introduction

For many years it has been understood that an engineer is more than someone who possesses a lot of knowledge about several technical and specialist disciplines. The ability to synthesise, to think creatively, to develop different types of thought, to address socially-relevant problems, and to integrate and connect seemingly unrelated topics, will be much more relevant in the 21st century [1–3].

The roles of engineers in the industry and in society in general are increasingly diverse and students need support and guidance in understanding the type of engineer they want to become and developing the necessary skills for their professional life. Unfortunately, many students lack the understanding of what engineering is and what engineers do, even close to their graduation [4].

1.1. Motivation and Context

The personal interest in the topic of Education stems mainly from the author’s learning experiences in the Portuguese educational system. Even with all its excellence features and diverse optional paths, in most classes or degrees the idea of a “one size fits all” Education is still very present and there is little institutional support for making informed career decisions. This interest also influenced the choice of extracurricular activities and curricular options, which strengthened the desire to have an impact and contribute for future generations of students to have a better support.

This desire to have a real tangible impact in the system in place in Tecnico was fueled by the work done by the university since 2018 with the aim of updating its teaching methods and curricular structures in order to keep up with current trends and best practices in Engineering Education worldwide [5]. The resulting new model will be implemented in the upcoming academic year, being the present work an effort to support its implementation.

In particular, the focus of the present work is in one critical measure that still lacks specific actions to be taken: introduction of a career planning concept.

The development of career education and career planning practices has had many faces, highly de-
dependent on contextual factors and with different approaches for each application. Nevertheless, four main general goals can be identified [6]:

• Developing employability and adaptability skills;
• Encouraging the personal development of the individual;
• Helping students choose between educational options;
• Encouraging societal integration.

Aligned with these general goals, the present work aims to develop a system to support Aerospace Engineering students in Tecnico in acquiring some important knowledge and skills for their careers, having a more positive approach towards learning, making better decisions regarding their curricular and extra-curricular options and developing career goals which are relevant for society and aligned with the school position.

1.2. Objectives

To design a system that gives Aerospace Engineering students the opportunity to learn about career development and develop some of the key skills needed to thrive in their careers, which could be extrapolated to other degrees in Tecnico and eventually outside of the faculty, is the main goal of this work.

The main research question being addressed is “How can Aerospace Engineering students have better career planning support?”. In particular, the goal is to understand what can be changed or added in the current activities, programmes and curricula in Tecnico to better support these students in their career planning process. To address this issue, five subquestions were tackled:

• How do Aerospace Engineering students plan their careers?
• How do current bodies and programmes in Tecnico support students?
• What are the best practices in terms of career support in European universities?
• What is the state of the art in vocational psychology?
• What are the needs and expectations of the Aerospace industry?

To answer these questions, in addition to an extensive literature review in the fields of vocational psychology, career development, engineering education and future trends in engineering and employment, there was an effort to understand the views of students, alumni, Aerospace companies and representatives from different university bodies. These insights were gathered through a combination of questionnaires and semi-structured interviews by video call with some of the stakeholders.

2. Background

Career planning can be defined as the ongoing process of matching career goals and objectives with the individual’s aptitudes, personal preferences and career choices. The process of exploring different possibilities for the student’s career and learning about the job market will be referred to as career exploration. All the activities and initiatives that aim for preparing the student for their integration in the job market (such as workshops about job interviews or courses on career-related skills) will be referred to as career training. Career support refers to all the activities that generally contribute to the students’ career planning process, in which career training and career exploration initiatives are included. The term career development and career planning will be used interchangeably in the context of this work.

The term mentoring can have several different meanings and connotations. Throughout this work, it will be defined as a general process in which someone perceived as more experienced or knowledgeable (mentor) supports someone perceived as less experienced (in this context, a student) in achieving predefined goals. Mentoring programmes can be a powerful tool to support career planning in general and career exploration, and many different existing systems will be explored.

In the context of this work, the desired outcome of the career planning process is making decisions about alternative curricular paths and extracurricular opportunities that improve students’ motivation and confidence in their careers.

There are currently several initiatives aimed at supporting students in learning more about their possible training and learning paths and exploring different possibilities regarding their careers. Such initiatives are developed and promoted by different bodies, such as the Pedagogical Council (CP), NDA (Academic Development Unit), NAPE (Student Support Unit), TT (Technology Transfer Office), AEIST (Students’ Association of IST), BEST Lisbon (Board of European Students of Technology) and other students’ nuclei.

2.1. Tecnico 2122 model

Following international expert recommendations and its strategic alignment, Tecnico is invested in reviewing and updating its teaching methods and curricular structures in order to keep up with current trends and best practices in Engineering Edu-
cation worldwide. With this in mind a commission was created in the beginning of 2018 to analyse and reflect upon the current situation and possible improvements to the educational offer for undergraduate and graduate programmes.

The result of this work was a final report (Portuguese only), published in February 2019, after consultation from the school, from relevant stakeholders and from external experts [5]. This report includes a proposal of a new model for the faculty, Tecnico 2122, and an implementation strategy, aiming at applying the model in the academic year 2021/2022.

This model proposal includes several actions divided in 3 main fields:

- Curricular structure, organization and philosophy;
- Pedagogical practices;
- Human and material resources and teaching staff management.

The measure being tackled closer, introduction of a career planning concept, is included in the Curricular structure, organization and philosophy bundle and is tightly related to another measure of the same group: increase in curricular flexibility.

The Aerospace Engineering degree in Tecnico was created in 1991 and the curriculum has been evolving ever since. The last two changes happened in 2014 and 2017, and a new curricular structure, based on the Tecnico 2122 model, was approved in November 2019, to be implemented in the academic year 2021/2022.

Regarding the changes planned for the academic year 2021/2022, one of the most relevant changes is that the 1st and 2nd cycles will be separated, which means that they have to be consistent independently from each other. Additionally, extracurricular activities will be credited up to 6 ECTS in each cycle. Another interesting change is the introduction of 9 ECTS of HASS (Humanities, Arts and Social Sciences) courses, from which 3 are Introduction to Economy or Management and the remaining 6 are for the student to choose from a list of subjects that will be offered by the university.

In the final semester of the first cycle, an integrator project will be introduced ("Projeto Integrador de 1º ciclo" - PIC1) where students can work on a project proposed by a company or research unit, on a capstone project (conceptual design of an aerospace vehicle) or on other project-based learning proposals. This is also the subject in which the 6 ECTS for extracurricular activities can be credited.

Regarding the second cycle, the students will have more flexibility to choose their courses, compared to the current curricular plan. They have the freedom and responsibility of choosing the curricular units for the secondary specialization as well as their minor, whenever they want, depending on the curricular offers in each semester and the limits regarding curricular units and ECTS.

The Tecnico 2122 model assumes an increase in the curricular flexibility, as well as in the autonomy and co-responsibility of students. Considering this, it’s very important to provide the students with all the relevant tools and information, to ensure that they make informed decisions that are aligned with their personal and professional interests and goals.

### 2.2. Vocational Psychology theories

John Krumboltz said that a good theory is like a well-drawn map which provides a representation of reality that can be very useful in specific situations, despite some inevitable distortions [7]. Even without analysing each theory in detail, we can gather some important concepts and ideas that can be useful in the context of the present work, without deciding which theory is best or whether different career theories can converge or not.

Taking into account the current trends in the field as well as the expected developments and uncertainty in the world of work and the professions, the interventions must take into account much more than the matching between aptitudes, interests and values of the individual and the characteristics of a certain job. The focus of interventions should be in the subjectivity of one’s beliefs and perceptions, as well as the development of skills and knowledge, to prepare the individual for independent career decision-making throughout life. [8]

Summarising some of the key ideas from different theories which are relevant for the present work:

- Matching one’s aptitudes, abilities, interests, ambitions and resources with the characteristics of certain occupations can be useful to explore and to help narrow down different options but is never sufficient by itself for career planning. The more knowledge and understanding the individual has about the career options and about oneself, the better. [9]

- Understanding that career development is an ongoing complex process and that the development of certain skills and beliefs are more important than the content of individual career decisions is key. [10]

- Understanding the role of self-efficacy and outcomes expectation in career choices allows individuals to work on these beliefs and develop new personal goals. [7]
The professional roles of engineering graduates are increasingly diverse. Not only the diversity in the roles and career paths is increasing, but also the diversity of transversal skills required by the labour market, such as entrepreneurship, innovation, communication, teamwork and lifelong learning skills. It's clear that engineers can have very different responsibilities and tasks to perform, which means that the knowledge and transversal skills that they need to employ can vary greatly. Even though these distinct roles are understood and experienced everyday by professionals, students struggle to acknowledge this and to discern which skills (technical or non-technical) they should employ can vary greatly.

To better understand these different roles, students should be given opportunities to experience them or, at least, to have direct contact with examples from working professionals. Ideally, students would be immersed in different professional profiles that engineers in their field follow in their careers. This, of course, is not feasible due to the virtually infinite possible roles that one can have and to the current structure and content of the curriculum. To solve this problem, there has been extensive research aiming at categorising and clustering these diverse roles into a simple model, with a small number of distinct categories students and professionals can identify with. This approach allows experts to design assessment tools that help students better understand which roles are most appealing to them, as well as which roles their skills are mostly aligned with. [12]

Some universities are already incorporating the different professional roles into their curricula by having separate curricular tracks based on these engineering roles and/or by introducing assessment tools to help students understand which roles are most aligned with their interests and skills.

From a vocational psychology point of view, there are three main constructs that are typically identified as key for career counseling: interests, needs/values and abilities. Besides these, many other constructs/factors have been identified as important to be considered when thinking about one's career, such as personality, strengths and learning styles.

Moving further away from the psychological models and focusing more in the engineering field, students can be grouped according to engineering roles. Different professional roles presuppose different interests, personality types and strengths, so even though there is not a direct correlation between these constructs and each role, it's relevant to understand and assess some of them to better align students and their engineering roles.

There are different models that describe engineering roles. For example, following a study of three hundred job vacancies and validation from engineering recruitment agencies, eight distinct profiles were identified: product, process and automation engineer; maintenance engineering; quality, prevention, environment and safety engineer; project engineer; research and development engineer; planning and work preparation engineer; method engineer; and the commercial engineer. For each of these profiles, different competencies are identified. [13]

As another example, the CDIO syllabus identifies five different roles: the researcher, the system designer/engineer, the device designer/developer, the product support engineer/operator and the entrepreneurial engineer/manager. The syllabus not only defines and details a large set of skills applicable to all roles, but also identifies specific skills (both technical and non-technical) for each of the five roles. It's also specified that graduating engineers are not expected to be experts in all of these roles and that it's even reasonable that they are not experts in any of them. What's crucial is that these students understand the importance of different roles, that they are able to effectively work with individuals in each of the five tracks and that they are prepared to follow a career in any one or combination of these roles. [14]

The PREFER Project studied the Treacy and Wiersema model, which distinguishes three value disciplines [15]. After refining the framework, three main engineering roles have been identified: operational excellence (focus on process optimization and increasing efficiency), product leadership (focus on radical innovation and research and development) and customer intimacy (focus on tailored
solutions for individual clients). The model also proved to be quite flexible, allowing for a combination of the different roles within one job. [4]

A later study with industry expert panels identified the most important professional competencies for each role, resulting in three competency profiles made up of up to nine key competencies, which are presented in the table 1 [16].

It’s key to keep in mind that most of the times engineers do not function in a single specific role during their whole professional lives, so it’s important not to completely disregard the skills and knowledge required by other roles, even if there is a clear preference towards one of them. Most likely one specific role in a company will fall in the intersection between different roles. In the same way, some students will have preference towards more than a single role. [17]

2.4. Industry changes

The world we live in is volatile, uncertain, complex and ambiguous (VUCA). The rapid developments in artificial intelligence, bioengineering, big data and other critical areas are causing multiple disruptive changes to take place across all sectors. In particular, the worlds of work and education are changing and the pace of development that professional and educational institutions are used to is not enough.

The definition of Fourth Industrial Revolution or Industry 4.0 is not universally accepted as some argue that it is simply the continuation of the third industrial revolution, powered by the generalised use of computers, the internet and increased connectivity. No matter how we define it, it’s clear that the rhythm at which new technology applications are created is faster than ever and it’s continuously increasing.

Some technological megatrends are having a tremendous impact in the world. Most of these trends are possible because of the increased computational and digital power, but their impact reaches out of the “digital world” impacting the physical and biological realms as well. The World Economic Forum groups these trends into three interrelated clusters: digital, biological and physical. [18]

When it comes to the digital sphere, many of the impressive innovations are connected to the Internet of Things, which allow for products, services, places and human beings to interact through the internet. Sensors and transmitters of information are increasingly small and cheap to produce, allowing it’s integration virtually in everything, including the human body. Apart from this bridging role between the three realms, digital innovations affect businesses and systems of all kinds. An on-demand economy has been created because of platforms enabled by big data and artificial intelligence such as Uber or Amazon, and radical changes in the way information is shared are being introduced with the use of blockchain technologies.

The second cluster is the biological realm. The innovations in this field, such as genetic sequencing and synthetic biology are extremely disruptive in the fields of medicine and healthcare, but also in agriculture, livestock and the production of biofuels. Despite enabling radical improvements in several areas, these technologies have extreme legal and ethical constraints. In any case, there are not a lot of direct applications expected for the Aerospace industry.

Finally, in terms of the physical cluster, the main trends identified are autonomous vehicles, additive manufacturing (3D printing), advanced robots and new materials. These innovations have more direct implications for the Aerospace industry than the previous two realms. Regarding autonomous vehicles, the developments of highly sophisticated sensors, increasingly powerful batteries and artificial intelligence are catalysing the advancement of drones, aircrafts and other self-driving vehicles, which are slowly becoming commercially available. When it comes to 3D printing, advanced robots and new materials, all of them have already several applications in the Aerospace industry and their importance is likely to increase in the years to come.

When talking specifically about the world of work, some other trends are identified as very disruptive, such as the work relations becoming increasingly on-demand, automation replacing unskilled workers, a shift from face-to-face to online services, outsourcing of technical work to countries of cheaper labour and the increase in remote work. Even without getting into many details about these interrelated trends, we can see how much they can drastically change the job market in upcoming years. [19]

In a broader perspective, we can look at more general sociocultural and economic trends which affect the trends already mentioned and the world as a whole. These general megatrends are global forces that influence business, societies, economies, cultures and individual lives. Airbus Global Workforce Forecast identifies six of these trends [20]:

- Economic Globalisation
- Resource Scarcity and Climate Change
- Global Governance
- Demographics and Social Evolution
- Innovation and Technologies
New consumption patterns

These trends and their evolution have direct and indirect influence in all industries. Employment policies, product development priorities, financing and other key factors are strongly affected by these six megatrends, so it’s important to always take them into account when making decisions or plans for the future.

A new world, requires new skills, in particular, engineers need to understand the complex systems and trends going on and to be able to act with a global mindset. The Attributes of a Global Engineer Project developed by the American Society for Engineering Education (ASEE) gathered input throughout several years from globally representative groups of experts from academia and the industry to understand which skills are the most important for a global engineer. The final publications of the project highlight twenty attributes which can be divided into five categories [21]:

- Technical: Engineering-related knowledge, skills, and abilities needed for success;
- Professional: Workplace related competencies for global performance;
- Personal: Individual characteristics needed for global flexibility;
- Interpersonal: Skills and perspectives to work on interdependent global teams;
- Cross-cultural: Society and cultural understanding to embrace diverse viewpoints.

This framework was also highlighted in The Engineer of the Future report by Airbus Global University Partner Programme (AGUPP). This extensive report also highlights other trends already mentioned with a specific emphasis on the impact they will have over Airbus. [22]

Based on the main trends affecting society and the world, particularly the developments in the fields of technology and education, Aldert Kamp summarises his vision for engineering education in 2030 in his book “Engineering Education in the Rapidly Changing World”. Eight key aspects for the education of future engineers are highlighted [1]:

- Rigour of engineering knowledge;
- Critical thinking and unstructured problem solving;
- Interdisciplinary and systems thinking;
- Imagination, creativity, initiative;
- Communication and collaboration;
- Global mind-set: diversity and mobility;
- Ambitious learning culture: student engagement and professional learning community;
- Employability and lifelong learning.

Even though many different frameworks and views are possible, what is key to understand is that the skills required by the workplace and society in general are changing and Education is changing as well. It’s key that everyone develops a solid understanding of themselves and understands the importance of commitment to lifelong learning. By always developing new skills, exploring and investing in opportunities and increasing self-awareness, individuals will more likely discover their passions and live meaningful lives.

When it comes to changes in the Aerospace industry in particular, it has experienced a small descent in 2019 after a very strong year in 2018. In 2020, due to the COVID-19 pandemic, the commercial aviation sector is experiencing disruption in production and it is likely that there will be considerable long-term effects. Since the companies in the field are capital intensive, short-term effects can also be dramatic in terms of liquidity and employment. Suppliers and specialised providers, such as some aeronautic companies in Portugal may become financially stressed.
On a more positive note, the effects of the pandemic in the space and defense sectors is likely to be smaller, since the budgets are made years in advance and considering that security threats continue to intensify. Regarding the Aerospace industry in general, some of the key trends that are likely to have significant implications in the mid-to-long-term are electric propulsion systems, urban air mobility and automated flight decks. [23]

3. Methodology

The methods used in the present work are partially derived from social sciences studies, but the biggest focus was put on the applicability of the outcomes rather than on the procedural rigour that often characterizes sociology studies, for example. Some concepts from the grounded theory were applied, such as the balance between objectivity and sensitivity when analysing data, as well as an effort to gather data from various sources and be in close contact with the real world when inductively developing a theory [24]. The original research design was mostly inspired by mixed methods research since it includes the collection and analysis of both qualitative and quantitative data in response to the research questions, but defining it as a convergent parallel mixed methods research is not completely accurate since not all the procedures inherent to this type of research design were followed [25].

The research process conducted was emergent, as it's typically the case for qualitative studies, meaning that the specific objectives and processes used were changed or shifted after the beginning of the research, as new data was gathered and integrated into the project.

Quantitative data was collected from four questionnaires created and distributed in the context of the present work and complemented with data from the Graduate Employability Observatory (OEIST) and from the reports from the Tutoring Programme, from NDA. Qualitative data was collected via semi-structured interviews at different stages of the research and complemented with open questions within the questionnaires created.

3.1. Interviews

The semi-structured interviews conducted can be divided into two groups based on their relation to the project being developed. Let's call them external interviews and internal interviews. External interviews involved individuals not currently connected to Tecnico or to the possible implementation of the suggestions being presented. These interviews were designed to understand best practices in other universities and gather ideas for possible implementations in Tecnico. Internal interviews involved the stakeholders of the career planning system being introduced. They were designed to understand the functioning of current systems in Tecnico, gather feedback to refine the suggestions being presented and, at the same time, raise the interviewees' awareness of the problems being tackled and involve them in the discussion. The interviews didn’t have a common script and the questions asked were prepared for each of them independently, subject to the context of the interviewee and the information sought at each stage of the research. The interviews were also complemented with information shared through email and text messages with the people involved.

3.1.1. External practices

In terms of external interviews, there were nine calls in total, which supported the information gathered online from public sources. These calls were mostly with individual students of the universities being studied, except for the cases of UCL Engineering (there were two calls, one with a degree coordinator and another with the careers office team), ISAE-Supaoero (the call was with three students) and KU Leuven (the call was with a researcher from the PREFER Project and it was mostly related to this project and its implementation). It's also worth noting that the students contacted from TU Delft, ISAE-Supaoero and NOVA SBE were former Aerospace Engineering students in Tecnico, so they were able to draw valuable comparisons.

The universities being studied were chosen to ensure a diverse sample of top universities with some particularly relevant features in terms of career planning, based on the author's knowledge and research about top universities. In particular, ETH Zurich and UCL Engineering were included for their outstanding prestige; TU Delft and ISAE-Supaoero were included for their relation with Tecnico and for being particularly recognised in the field of Aerospace Engineering; and NOVA University of Lisbon for being present in the same city as Tecnico.

3.1.2. Stakeholders insights

When it comes to internal interviews, they were quite diverse in terms of scope and content, but generally there were two phases, one exploratory and another confirmatory. The former, which took place between April and July 2020, had the goal of connecting information previously gathered and developing hypothesis for the solutions. The latter, which took place between September and October 2020, had the main goal of confirming and gathering feedback about the proposed suggestions.

The university bodies that were reached were the Aerospace Engineering degree coordination, the CP, the NDA, the NAPE, the TT and the OEIST.
Outside of Tecnico, a Human Resources professional, specialized in Aerospace industries, and the coordinator of an Aerospace industry cluster were contacted.

3.2. Questionnaires
In total four questionnaires were created, disseminated and analysed: one for European engineering students (N=32), one for Aerospace Engineering students from Tecnico (N=203), one for Aerospace Engineering alumni from Tecnico (N=39) and another one for Aerospace companies in Portugal (N=14).

In an exploratory step, a survey was created to get a broad overview of the situation in European universities regarding career planning and mentoring systems, and was disseminated in the author’s personal network. The survey, disseminated between the 10th and 15th of April, collected 32 answers from students from 27 different European technology universities (no Portuguese university was considered).

Then two questionnaires, one for students and another for alumni were created in parallel to test several hypothesis and to draw comparisons between the perceptions of students and alumni. Responses on the students survey have been gathered between the 9th and 31st of August of 2020, after sending the questionnaire to all current students by email and sharing it in social media groups. A total of 203 current students submitted valid responses to the questionnaire. The responses on the alumni survey have been gathered between the 17th of August and the 13th of September of 2020, by sending the survey by direct message on social media channels to 33 alumni from different graduation years and by sharing it in social media groups, gathering a total of 39 valid responses.

Finally, the fourth questionnaire was created to understand the interest of Aerospace companies in cooperating with Tecnico and to validate the feasibility of the suggestions presented which relate to the connection with the industry. The responses on this survey have been gathered between the 5th of October and the 3rd of November of 2020, resulting in 14 valid answers. The questionnaire was sent to more than 40 companies involved in the Aerospace industry with activity in Portugal through general email addresses and was later sent to representatives from some of these companies, especially bigger ones, through social media. The names of the companies that participated in the survey are the following: Active Space Technologies, Albatroz Engenharia, Caetano Aeronautic, Celia, D-Orbit, Edisoft, Foco Aeronautical Services, GMV, LusoSpace, Omnidea, QSR, TAP Air Portugal, Thales and Valispace.

4. Results & discussion
The results of the present work can be divided into general insights that can be relevant for the stakeholders of the Aerospace Engineering degree (such as students, professors, university bodies and Aerospace companies) and specific suggestions for some of these stakeholders to take action and improve the career planning system.

4.1. General insights
By analysing the inputs gathered through the unstructured interviews it was possible to better understand the career support system in Tecnico and some of its limitations. The first problem identified was that, due to the organisational complexity, there are different groups working in parallel projects that sometimes have overlapping objectives that do not efficiently communicate with each other. In addition to this, the implementation of projects and ideas in most of these groups are constrained by the allocation of human and financial resources.

Another big problem identified, was that the voluntary engagement of students in career related activities is generally low, since many students don’t perceive career planning as a crucial thing to engage in before they are actively looking for a job. This is reinforced by the emphasis put on the activities aimed at helping students finding a job versus the ones that have a more developmental approach and put emphasis on career exploration and planning from an early stage. The motivations of the different stakeholders (companies, university and students) are aligned with this approach, since the main goal is for students to find a job shortly after graduating, rather than finding their passions and having long-term fulfilling careers.

Data from the different surveys shows that problem solving and autonomous learning are considered the most important skills acquired at Tecnico, by students, alumni and companies (over maths knowledge, programming, project management, specific technical knowledge and software experience).

Regarding the career-related activities in which students engage and their perceived impact, it was understood that the ones that involved direct contact with companies had the most impact, in the perspective of students and alumni.

A particular insight that can be relevant to complement the information gathered in the annual reports of the Tutoring Programme, from NDA, is that only 10% of students had more than one meeting with their tutor.

Regarding the students preference between Tu-
tors and Mentors for different kinds of support, almost all students prefer the support of a fellow student for the integration in the university. It was also understood that the vast majority of students (77%) prefer a fellow student to help them make a study plan. The only topic for which most students would prefer the support of a Tutor (professor) is choosing the master's specialization.

Another important result is that only the majority of first-year students agree that they understand the applicability of the theoretical knowledge learned. From the second year onwards, only around 25% of students agree or strongly agree with this statement. Comparing this with the data from alumni, it becomes clear that while around 30% of current students believe they understand the applicability of theoretical concepts, only 13% of alumni believe they had this understanding as students. This may indicate that what students perceive as the applicability of theoretical concepts is different from the real applicability experienced by professionals.

In terms of information regarding career opportunities, less than 25% of students (and 18% of alumni) agree or strongly agree that they have access to information. Objectively, students have access to some relevant information regarding the curricular units and also regarding career opportunities, meaning that these results can be indicative of lack of quality/quantity in the information provided and/or in its accessibility.

Regarding the perceived support in making career decisions, it’s clear that a very small percentage of students agree or strongly agree that they feel supported. It’s also noteworthy that while 15% of students feel supported, only 5% of alumni felt this way. In the same way, while 46% of students disagree or strongly disagree with the statement, this number is 69% for alumni. This may indicate that support systems are improving over time.

From the survey for Aerospace companies, the main outcome to be highlighted is that the majority of the companies answering the survey are, at least moderately, interested in cooperating with the suggestions proposed.

4.2. Suggestions
Based on their areas of impact, the suggestions presented are grouped into three areas:

- Access to relevant and up-to-date information and tools;
- Support from a mentor;
- Connections with the industry.

The suggestions are a result of an iterative process of brainstorming or gathering suggestions, refining them and cutting irrelevant ones, done through meetings, surveys and literature review. The focus of these suggestions is the Aerospace Engineering degree, but most of them can be expanded to other degrees in Tecnico.

4.2.1. Access to relevant and up-to-date information and tools
Having access to relevant information about the job market and career possibilities, as well as access to tools that support individuals’ self-awareness, are relevant factors to provide students with adequate career support. In line with this thought, the suggestions presented are to:

- Create a central platform with all career-related information;
  - In the short-term, improve the current Career Discovery page;
  - In the long-term, create a robust platform, using third-party software, that encompasses all the offers in Tecnico regarding career exploration and support;
- Make information for students more accessible;
- Introduce the PREFER Project assessment tools.

4.2.2. Support from a mentor
Being in the form of a career coach, an older student or a professor, it has been a common practice for universities to provide students with support from a mentor. In order to improve the current mentoring programmes to better support the career planning of students, the proposed actions are to:

- Adjust NDA’s Tutoring programme;
- Increase the usage of the Alumni Mentoring programme.

4.2.3. Connections with the industry
Understanding the job market allows for creating a coherent plan and focusing the academic curricular and extracurricular paths in order to maximise the chances of career success. Taking into account that the industry needs and possibilities are constantly changing, it’s important that universities are in touch with the industry and that they create opportunities for the students to experience it first hand. In order to give better career exploration opportunities for students, the suggestions presented are to:

- Create an Advisory Board with industry experts;
• Have PIC1 proposals by companies;
• Introduce guest lecturers for specific subjects inside various courses;
• Promote job-shadowing experiences for 1st-year students.

5. Conclusions
The introduction of a career planning concept is expected to instigate students to be more autonomous, proactive and responsible regarding their curricular and career paths [5]. This means that not only the system should evolve but also the students’ attitude must change.

The present work collects opinions from students, alumni, companies and university bodies regarding career planning which can inform future decisions and projects. The research done regarding best practices in career development and in the fields of vocational psychology, professional roles and future trends can be useful to help students think about their careers in a different way and also help professors and university bodies providing a better support for students.

The suggestions presented are informed by the information collected and the opinions gathered from the various stakeholders consulted. The involvement of the stakeholders led to an increased awareness of the problems and deficiencies in terms of career planning, which will hopefully lead to an easier implementation of changes. The bodies involved in the implementation of the suggestions were contacted and their input was taken into account when proposing a solution.

The hardest part of this project is the actual implementation of the changes in the career development offer for students. It’s great to see the example of NDA that took some of the insights of the present work to shape the changes to be implemented in the upcoming year. Hopefully this work can support other stakeholders involved in the transition to the Tecnico 2122 model.

References