Raising awareness for professional roles in the Bachelor's and Master's programmes in Engineering Technology

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INTRODUCTION

There are many reasons why we want engineering students to be well-informed about their possible future careers. It can increase their motivation and study persistence, and help them in making informed decisions and in being well-prepared for their first professional experiences [1,2]. Furthermore, there is an increasing call

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in engineering education research and policy networks for more emphasis on the diversity of engineering careers and more specifically on the transversal skills that are required by the labour market, like teamwork, communication or problem-solving skills [3,4]. Yet, there is a lot of room for improving students' awareness. For example, Karataş et al. [5] showed that a substantial number of first-year engineering students did not consider social skills such as teamwork and communication skills as important for a good engineer.

At the Faculty of Engineering Technology of KU Leuven, the 'Rolling' project was therefore initiated in 2014 with the aim to bridge this awareness gap and to provide students with realistic prospects of the engineering profession. In this paper we describe how we aim to achieve this and discuss our lessons learned so far.

THE ROLLING PROJECT: METHODS

In a first stage, a conceptual model of professional roles was developed, based on the three value disciplines of Treacy and Wiersema [6]. This model was presented to a large number of HR specialists in the field of engineering. Almost all specialists recognized the model in their respective organization [7]. In order to create a recognisable competency profile for each role, the roles were matched with the Faculty's official learning outcomes. The three roles were labelled 'product leadership', 'operational excellence' and 'customer intimacy' (see figure 1). Product leadership engineers focus on new ideas, on developing the best product. It is important that they have strong research, design and development skills. The main focus of the operational excellence role is process efficiency, and on finding ways to achieving the best total cost. These engineers oversee and standardise processes and have an eye for analysing and solving problems. At last, the customer intimacy role has as a goal to provide customers with the best total solution and to respond to customers' specific technological needs. Professionalism, communication, and ethical responsibility are important features for those engineers.

Figure 1: Three professional roles in engineering technology

In a survey of 197 first-year students in engineering technology conducted at our institution mid-2015, we asked students about their future professional self-image. Only 9% of the participating students indicated that they had a clear image of their professional future. 63% did not yet fully have an idea of what they want to do, and 29% did not have an idea at all. Students were also asked to choose one out of three job descriptions as their favourite [8]. These three job descriptions corresponded to the three roles mentioned above. A large majority (57%) of students favoured the product leadership job description, 23% favoured the customer intimacy job and 19% favoured the operational excellence job (see figure 2). However, from an earlier research analysing job openings in Flanders, we know that only 24% of alumni start in a product leadership role. 30% start in customer intimacy, and nearly half (46%) of the alumni start in an operational excellence role. Thus, there seems to be an imbalance between the preferred engineering profession of first-year students and the available positions when graduating.

Figure 2: Job preference of students and alumni starting jobs in Flanders [8]
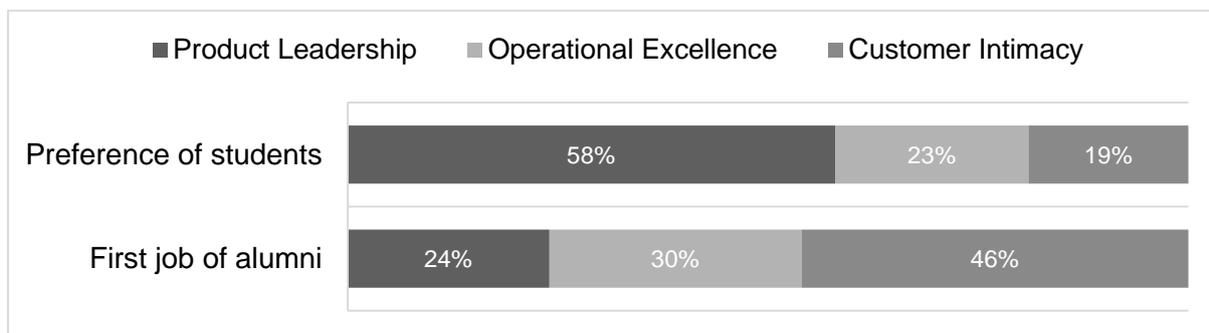
In the current stage we are integrating this conceptual model into the study programmes of the Bachelor's and Master's programmes in Engineering Technology. We aim to introduce students to their possible professional prospects and to encourage reflection on their interests and talents. We presented the model and the research outcomes to the teaching staff on a faculty-wide study day. In the corresponding workshop, participants were asked to list examples of activities and courses that inform students on career perspectives, encourage reflexivity, and/or practice the transversal skills necessary for these roles. This resulted in quite some ideas and practices, an overview of which can be found in table 1.

Table 1: Results of lecturer consultation on how to implement "Rolling"

Step 1: Familiarize students with the roles	Step 2: Raise students' awareness of their own interests/talents
Guest speakers	Role playing: to give students within a project team one role each to focus on.
Company visits	Project work
Job fairs	Bachelor's/Master's thesis
Within coursework (e.g. realistic exercises, making references to	Training programmes (e.g. interview training)

professional practice)	
Information days about major choices	Internships
Practical sessions	Practical sessions

We opted for a strategy where we work with several "Rolling ambassadors". These ambassadors are lecturers who are interested in the Rolling project and are willing to spend time and attention to reaching its goals. These ambassadors are early adopters who disseminate these ideas and methods among their colleagues. In our following steps, we support these ambassadors in the implementation and integration of the roles model in their good practices. The reason we decided on the strategy of "ambassadorship" has to do with our institutional reality. The Faculty of Engineering Technology at the KU Leuven has a quite complex structure and history. It was established in 2013, merging 7 university colleges and integrating them into the University structure of KU Leuven [9]. As a result, the faculty is very diverse and geographically spread out among seven campuses. All these factors complicate efforts to introduce education innovations. That is why we need one or two ambassadors at each campus, functioning both as an antenna and an advocate within their respective campus (and engineering specialization).

Especially in this institutional complexity, it is important to identify possible barriers and enablers for our ambassadors at an early stage. Moreover, as our project's success is highly dependent on the participation and the willingness of all staff members, it is especially important to address these barriers wherever possible. In supporting this, the literature on the diffusion and acceptance of ideas and knowledge in education reform is a useful guidance [10]. Some potential barriers to implement educational change, as identified in previous research, include: (i) lecturers' time and course schedules; (ii) personal motivation/disposition; (iii) familiarity with the topic; (iv) self-confidence; (v) familiarity with the faculty administration and with colleagues; (vi) lack of institutional and environmental support; and (vii) the understanding of the necessity and practicality for students [11-13]. These are both contextual and individual aspects that influence the teacher ambassadors' participation in the Rolling project, and we therefore tried to address them where possible.

Based on our observations and discussions with ambassadors and other faculty staff we recognize many of the barriers described in the literature. Firstly, finding interested and willing lecturers proved to be very challenging in itself. Time, motivation and familiarity with the topic and with the faculty are undoubtedly explaining factors. As we are a very dispersed and large faculty, a "knock on the door" with colleagues takes some more effort. Scheduling time to meet proved to be very difficult, both between the ambassadors and the project team, and between teaching staff and their students, due to a high number of contact hours. In one of the campuses, teaching staff organised themselves in such a way that everyone conceded one hour for the organisation of activities. In supporting communication, we also built a website with all relevant information and resources (iiw.kuleuven.be/rolling). These include presentation material and essay questions

that we developed after consulting with the rolling ambassadors, in supporting the implementation and fine-tuning of their good practices.

One specific challenge has been to translate our conceptual model into an understandable and unambiguous terminology for the students. In April 2016 we presented our model to a group of first-year students at one of the campuses, followed by five alumni guest speakers who spoke about their careers. By means of a questionnaire we obtained student feedback on the event and on our presentation of the model. In the following case study we elaborate on the results and the conclusions to be drawn from them.

CASE STUDY: ALUMNI GUEST SPEAKERS

As part of an information session at the end of the academic year informing students about their specialization majors, a group of first-year students was presented with a panel of alumni. The panel was introduced by a short presentation explaining the three roles and their according competences. The guest speakers then shortly presented their career choices and developments and answered the students' questions. Interestingly, even though the guest speakers were not briefed about the roles model, they recognized it and could spontaneously apply it to their own careers.

A few weeks later, the students filled in a questionnaire about the event. Questions focused on their understanding of the roles model as well as on the perceived effect the guest speakers had on the students' perceptions of the profession. The questionnaire had both closed- and open-ended questions. Altogether, 43 out of 74 students responded to the questionnaire. The goal of the questionnaire was on the one hand to know how the roles model and the guest speakers were understood and perceived. On the other hand we wanted to compel the students to reflect again on the roles and on their own interests in this regard.

In this sample, 21% answered positively when asked whether they already had an idea of their professional future after graduation. Only 2% answered negatively, the rest (77%) was still not completely sure. This shows a large difference to our previous survey, where 29% of the students did not have an idea at all. All of the students in the survey agreed that learning more about their possible career paths motivated them (see table 2). The majority of the students (84%) also agreed that the roles model is helpful in identifying career paths and that it expands their view on possible career paths (70%). However, still 1 out of 3 did not find the model very relevant for them, which leaves us some room for improvement. Also, 1 out of 4 did not see a clear connection between the explanation of the roles model and the guest speakers.

As to the alumni guest speakers, 86% of students found their stories relevant, and almost all students (93%) thought the speakers' presentations motivated them. There was more difference of opinion as to whether the guest speakers had an effect on the students' views about their own careers: 58% disagreed with this assertion.

Table 2: Students' perceptions of the roles model and the guest speakers (N=43)

	Don't agree at all	Rather not agree	Rather agree	Fully agree
"The model is relevant to me"	0%	30.23%	65.12%	2.33%
"The model is helpful in identifying career paths"	2.33%	13.95%	76.74%	6.98%
"The model expands my view on possible career paths"	2.33%	27.91%	62.79%	6.98%
"The connection between the model and the guest speakers was clear"	0%	25.58%	62.79%	11.63%
"The guest speakers' explanation was relevant to me"	0%	11.63%	34.88%	51.16%
"The guest speakers influenced my view on my future career"	2.33%	55.81%	37.21%	4.65%
"Learning more about my possible career paths motivates me"	0%	0%	58.14%	41.86%
"Hearing the guest speakers' stories motivates me"	0%	6.98%	51.16%	41.86%

In the questionnaire we also examined students' preference for each of the three roles. In an open-ended question, students had to explain which role they preferred and why. In the following close-ended questions, students were asked to indicate their opinions about the three roles. In line with our previous survey, we see that there is still a large preference for the product leadership role among our students. However, while in our previous research 57% of the students preferred the product leadership role, in this sample this amounts to 40% of the students. The difference could be accounted to a large part (31%) of the students not indicating any of the roles as their preferred one, either because all the roles seemed interesting (6 out of 13), because they have no idea yet (3 out of 13), or because they don't fully understand the meaning of the roles (1 out of 13). When looking at the students' explanations for their preferences, it appears as if most students rightly understood the content of the roles. There were both references to matching skills (for example: *"Customer intimacy, because I'm a people's person and can anticipate clients' needs"*) and to personal interests (for example: *"product leadership, because I want to develop environmental-friendly products").* However, with regards to product leadership one misunderstanding came up several times: they believe that leadership or management is essential to this role.

When asked about the most important take-home messages, three themes recurred. Firstly, 37% of the students mentioned the diversity in engineering careers and in job content (for example: *"some of the speakers had a lot of choices on the way. They did all kind of things", "the job is very diverse, there are a lot of possibilities").*

Secondly, a lot of the students (23%) also referred to the importance of lifelong learning (*"you learn new stuff every day"; "you will have to do extra trainings"*). The third important theme consisted of comments about the working conditions, with 26% of the students mentioning it. These were mainly positive (*"one of the alumni makes more money than his boss", "you quickly find a good job"*) but there were also more neutral comments (*"it is hard work", "you have to be flexible, it is not a 9 to 5 job"*).

Finally, in an open question students were asked whether they underestimated the importance of certain competencies before this event. Only 14% of the students answered positively to this question, and they referred to the social and communicative skills as well as to the amount of responsibility some engineers have.

DISCUSSION

Paying more attention to the disciplinary future self of students in engineering technology is important and necessary. We have seen that our first-year students do not yet have a clear idea of what they will do after graduating, but that they do find it very motivating to learn more about career options. We acknowledge that is normal for first-year students not to know perfectly what engineering career they prefer. However, our goal should be to inform them as soon as possible about the multitude of career options.

We have learned that the relevance of the model and the link between the roles model and the good practices need to be improved. As to the three different engineering roles – operational excellence, customer intimacy and product leadership – the latter is a definite favourite among our first-year students. However, it seemed as if some students misunderstood certain aspects of this role. This is definitely something to keep in mind: we will have to provide more and better examples in the presentation of the model, and discuss other possible improvements in accordance with the ambassadors.

There was a clear signal from the students in the sample that they are motivated by learning about their professional futures. Also, even though the questionnaire was administered weeks after the event and students were not warned that there would be a questionnaire, in general they remembered and understood remarkably well the topics discussed there.

Getting students' and ambassadors' feedback is an important step in improving our project implementation. These results can in turn work as a motivation for teaching staff to consider this roles model in their daily practice.

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REFERENCES

[1] Walker, A.; Stewart, R.A. and Panutwanich, K. (2014). "Cementing engineering student engagement through early program exposure to industry practice using aligned project case studies presented by industry professionals". *Proceedings of the AAEE2014 Conference Wellington, New Zealand.*

[2] Frymier, A.B. and Shulman, G.M. (1995). "What's in it for me?": Increasing content relevance to enhance students' motivation, *Communication Education,* 44(1), 40-50.

[3] Vlaamse Raad voor Wetenschap en Innovatie (VRWI) (2012). Choosing STEM: young people's educational choice for technical and scientific studies. Retrieved from http://www.vrwi.be/pdf/Choosing%20STEM.%20Young%20people%27s%20educatio nal%20choice%20for%20technical%20and%20scientific%20studies.pdf

[4] Murphy, M., Hawwash, K., & Vigild, M. (2015). SEFI Position Paper on Developing Graduate Engineering Skills. Retrieved from http://www.sefi.be/wp-content/uploads/SEFI Position Paper on Skills lt.pdf

[5] Karataş, F.Ö.; Bodner, G.M. and Unal, S. (2015). First-year engineering students' view of the nature of engineering: implications for engineering programs. *European Journal of Engineering Education.*

[6] Treacy, M., & Wiersema, F. (1993), Customer intimacy and other value disciplines, *Harvard business review*, 71(1), 84-93.

[7] Hofland, E., Pinxten, M., Wauters, D., & Langie, G. (2015). "Roles" in the Bachelor's and Master's programmes in Engineering Technology. *Proceedings of the 43d SEFI Conference, June 29- July 2, 2015,* Orléans, France.

[8] Hofland, E. (2015) ."Rollen in de opleiding tot industrieel ingenieur". Poster presented at KU Leuven educational project fair,https://www.kuleuven.be/onderwijs/ nieuwsbrief/onderwijsontwikkelingen/archief-2015/posters/wandeling2-poster-fiiw-ondernemerschap.pdf

[9] Langie, G., Bruneel, D., Buijs, J., De Samblanx, G., De Vos, L., Van den Steen, K., Van Gysel, A. Va, Ham, G. & Willems, K. (2013). A multicampus faculty in 6 cities, 1 common view and 6 distinctive features thanks to learning paths. *Proceedings of the 41th SEFI Conference, 16-20 September 2013,* Leuven, Belgium.

[10] Spalter-Roth, R., Fortenberry, N., and Lovitts, B. (2007). The Acceptance and Diffusion of Innovation: A Cross-Disciplinary Approach to Instructional and Curricular Change in Engineering. Washington, DC: American Sociological Association.

[11] Henderson, C., & Dancy, M. H. (2011, February). Increasing the impact and diffusion of STEM education innovations. In *Invited paper for the National Academy of Engineering, Center for the Advancement of Engineering Education Forum, Impact and Diffusion of Transformative Engineering Education Innovations, available at: http://www. nae. edu/File. aspx.*

[12] Finelli, C.J.; Daly, S.R. and Richardson, K.M. (2014). Bridging the research-to-practice gap: designing an institutional change plan using local evidence. *Journal of Engineering Education,* 103(2), 331-361.

[13] Davis, K.A.; Perkins, R.A.; Cline, R.C. and Miller, S.M. (2013). Bridging the valley of death: examining the work environment influencing adoption of innovations in engineering education. 120th American Society for Engineering Education (ASEE) Annual Conference, June 23-26.