Reasons for and Factors of Motivation in the Choice of Engineering as a Profession

Results from research carried out with students of the Technical University of Graz (TUG)

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Theoretical background

Everyone is interested in making good decisions. Or more precisely, decision makers are interested in making decisions that have positive results. What is meant by "good"? This is commonly a subjective measure reflecting the beliefs and inner reflections of an individual decision maker.

Decision-making involves the evaluation of alternative courses of action whose outcomes are to some extent uncertain. One of the characteristics of a decision problem is that objective criteria to define the "correct" choice are rather arbitrary. The alternatives available to a decision maker are multi-attribute and involve conflicts across attributes. The resolution of conflicts among the attributes is essentially a subjective matter.

Another characteristic of decision-making is that it is extended over time. In the early part of planning the information is gathered and a mental representation of the choice problem is formulated. Later on, some evaluation strategy must be applied, in order to integrate diverse pieces of information and form a judgement as to which would be best. The post-decisional phase of the process is also important. People have to justify their decisions to themselves, to other persons of significance and to the world at large.

One of the most important decisions that young people have to make is the choice of a career. Career choice implies that individuals

have gone through a decision-making process, that they have surveyed the work field, have assessed their competencies, have some understanding of what brings a sense of fulfilment and have examined alternatives and the likely effect of these alternatives on their self-concept. Choosing a career is a *matching process*, where the person matches his/her personal needs with the field that best fits them.

Despite the numerous articles that have appeared in the literature discussing and describing the reasons why students selected a specific profession, few of these studies explore more than a single dimension and most are exploratory in design. As a result, little is known about the multidimensional aspects attracting individuals who are willing to make the investment necessary for a career in engineering. Personal values and the valence, or match between personal values and the values of the engineering profession have not been the major focus of study examining career decisions in engineering along with other dimensions such as family background, characteristics of the profession, interests in science and professional education.

A good example in this area is a study that focuses on social and psychological explanations, offered by the expectancy-value model of academic decision-making. (Eccles, Parson, Adler, & Kaczala, 1982; Eccles, Adler, & Meece, 1984). According to this theory, the two factors that best explain an individual's academic choices and performances are: (a) their perceptions of the task's value and (b) the expectations they hold for success in the task. Task value includes the individual's perceptions of the importance of doing well in a task (attainment value), the importance of a task for the future (utility value), the enjoyment of a task (intrinsic value), and the cost or effort required to complete the task. Expectations for success are based on students' perceptions of their own abilities related to a specific task, and their perceptions of the task's difficulty. As a multiple criteria decision problem (where decision maker preferences are combined with the

absence of any one single alternative that is by some measure the "best" across all criteria) career choice comprises two components: an objectively defined *set of alternatives* and subjectively defined *criteria*. There may be many or few alternatives, but all of them are explicitly defined. As the other component in the most general sense we understand criteria as a reason, a reason why the decision maker has an interest in the decision problem.

Reasons for choice can be many and varied. On the one hand, they might be intrinsic (I), related to the inner interest in the subject content and need to enhance one's identity, self-worth and personal growth. On the other hand, they might be extrinsic (E), when the individuals are motivated by external factors and focus on their external performance and enterprise. It is likely that there is an interaction between the two types of reasons. A balance or equilibrium between them must be maintained if the individual is to experience a sense of fulfilment and personal growth.

The decision-making process is a creative process by which the decision maker understands his criteria, looks for, adds, combines and possibly reduces its number. Usually, the decision-making process starts ambiguously, with some initial alternatives and criteria. Contradictions and conflicts naturally surface but through these contradictions, the reasons for the decision maker's criteria become clearer. It is by necessity an iterative process whereby the reward is a better understanding of the decision maker's preferences and a possible extension of the set of alternatives.

A study of theoretical and practical research on career choice and decision-making with emphasis on factors of motivation in women's attitudes toward engineering showed that many efforts are made to resolve this problem. Special programs like FIT ("Frauen in die Technik") are launched to contribute to women's involvement in engineering, but there is a paucity of research on the psychological aspects of the problem. If we want to manage the process of career

choice in line with social needs, we have to know this process and its special characteristics. The knowledge of the motives for entering engineering could also be helpful for education programs. If we know the factors of motivation, career choice models, decision-making structures and gender differences that refer to the area of engineering, we could construct programs, by which it is possible to influence the decision-making process of young people. Related to this the present study is designed to correct the deficiency of information and provides useful data on engineering motivation which could influence program development in engineering. The data will help in determining the composition of profession (i.e. who enters the field and why) and in understanding the process of engineering choice (i.e. how do they make their decisions and what kind of models do they use). Information on attrition is important to determine the personal values and employment outlook.

Main purpose

To explore the career choice of beginners in engineering including the following:

– the main socio-psychological reasons for and factors influencing the motivation to choose engineering as a career;
– the attitude toward engineering as a profession and the subject of studies;
– the students' aims and goals regarding their future professional achievement.

Main hypotheses

H1.: There are some special socio-psychological factors that influence the choice of engineering as a profession. These factors of motivation

are different for males and females. Engineering students of both genders are most likely motivated by intrinsic and developmental reasons (e.g. interests) and attainment values (e.g. importance of subject).

H2.: There are significant gender differences with regard to attitudes towards the profession of engineer and subject of studies. These are in general positive but there are some differences in the gender role models, as well as in expectations from university education. Males are more stereotypical in their perception of profession while females are more disappointed because of the unrealistic idea they have had about engineering.

H3.: There are no significant differences in the direction of the students' goals, aims and ambitions regarding their professional achievement, although men seem to be more motivated and to set themselves more ambitious aims than women.

Sample

The research was carried out with students who had completed one year of studies at TUG. The survey was mailed to all beginners (about 800 students). Responses were received from 197 of them (25% of all students). The gender composition of the sample included 44 women and 152 men (plus one participant who did not indicate his/her gender).

Instrument

All subjects were asked to complete a 75 item questionnaire comprising structured and unstructured questions designed to elicit data on the respondents' reasons for and motivation to choose engineering as well as the socio-psychological factors influencing this choice. The items were grouped in four sections (scales):

(1) Socio-demografic information (age, gender, type of graduate school, parents' education and profession etc.).
(2) Students' reasons for choosing engineering as a career and factors influencing this choice.
(3) Perception and attitude regarding engineering and subject of studies as well as the programs giving publicity for fields of studies at university.
(4) Level of motivation, aims, goals and expectations from university education.

Results

Before beginning the analysis of the data I would like to draw attention to two important points related to the interpretation and the right understanding of the data. The first one is the small sample size for women taking part in the research, only 44. It was the most significant methodological problem that made it difficult to find statistically significant differences, even when it appeared that large differences existed. Thus, the small sample size should be taken into consideration when reviewing the results of the study, especially the interaction effects for women. In order to obtain relevant interpretation of the results the answers to each question have been analysed within the number of the particular students who had answered this question and not within the overall number of those who had taken part in the research. The second point is about the large difference between the sample sizes of the two gender groups. Considering that, I think the analysis and the conclusions would better be done for each gender separately.

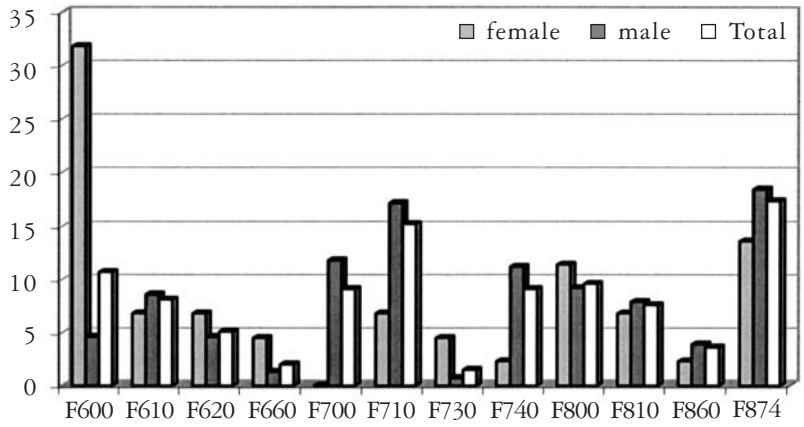
In order to make the data clear the results and their interpretation will be presented with respect to each of the four research scales.

1. Data about some sociological features of the participants

1.1 Subjects of study

Chart 1

Distribution of subjects
(percentage within gender)



Legend:

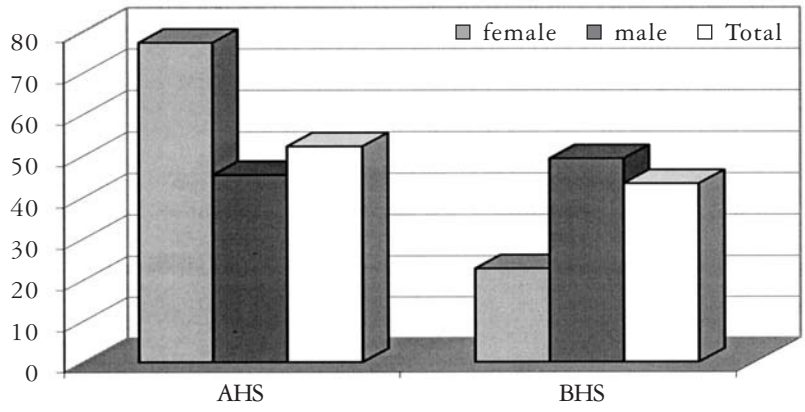
F600 – Architecture
F610 – Civil engineering
F620 – Civil engineering (economic branch)
F660 – Land surveying
F700 – Mechanical engineering
F710 – Electrical engineering
F730 – Process engineering
F740 – Mechanical engineering (economic branch)
F800 – Technical chemistry
F810 – Technical physics
F860 – Technical mathematics
F874 – Telematics

The subject with widest participation in the research is F874 "Telematics" (17.3%). For females it is F600 "Architecture" (31.8%) and for males F874 "Telematics" (18.4%). This fact should be pointed out when the data from other questions are analysed. This also applies to the fact that F700 "Mechanical engineering" has the fewest participants among females (0%) and F730 "Process engineering" the fewest participants among males (0.7%).

1.2 Type of school

Chart 2

Gender distribution by type of school
(percentage within gender)



It is evident from Chart 2 that 49.3% of the males and 22.7% of the females have graduated from BHS types of school and 77.3% of the females and 45.4% of the males from AHS, respectively. What might this significant difference between the types of high school (especially for women) mean?

Firstly, it might mean that BHS attracts more male than female

students. Possibly because of the tradition to direct boys to a vocational type of education at an earlier stage of their education whereas girls more often go to a comprehensive or more or less humanities-oriented type of school.

As the difference between the number of students who come from AHS and BHS is significant, it is not possible to compare them and to search for correlations. It is evident though, that there is a high correlation between the type of graduate school (AHS) and lack of prior experience in the area of engineering for women. To the question "Do you have any experience in the area of engineering and what kind of experience?" 22.7% of female and 46.7% of male respondents answered they had had some experience at school.

In short, the data show that the BHS type of education is more vocational and practice-oriented than AHS education, which creates more opportunities to direct pupils to engineering by:

- creating a correct picture and positive attitude toward engineering;
- motivating pupils to study engineering;
- imparting knowledge and abilities necessary for studying engineering.

Thus, it seems that BHS education plays the role of a bridge between basic education and university technical education. But then the question is: What happens with girls who graduate from BHS (HTL)? Why does such a small portion of them continue their education at university? Have they been oriented to other fields of study or have they not been motivated enough to study at university? This may be one of the further directions that should be studied. I mean to find out the reasons why females from BHS (HTL) draw away from the engineering area of studies and the possible ways to encourage them to study engineering.

1.3 Parents

The most frequent level of education among respondents' parents is HS ("Hauptschule" or secondary school) – 43.7% among fathers and 48.6% among mothers. In second place is university education (for fathers) and *Matura*, or advanced secondary school certificates (for mothers). An interesting fact related to the theme of female motivation for choosing engineering is that 33.3% of the female students' fathers and 23.3% of their mothers have graduated from a university. I suppose it is a kind of family role model that plays a role as a strong motivational factor influencing female career choice. The high percentage of fathers working as engineers (29.72%) among female students confirms this convincingly and reveals one of the most powerful factors to stimulate women to study at university.

As for parents' profession and occupation, it is important to note that it is not the particular official position and post the parents occupy but the area of work and its relation to the engineering profession. By this means it could be discovered if there is some correlation and if the parents' professions (area of work) is a factor influencing the career choice of engineering students.

Thus, the highest percentage among *father's professions* is salaried staff (35.13% of females and 30.07% of males), i.e. employees, administrators, contractors, experts, inspectors and insurance agents. Especially among females the engineers rank first, which is a significant fact related to their career preferences.

The technicians and teachers are in second place. It is important to note here that most teachers teach engineering related subjects (maths, physics, chemistry etc.). Thus, the results show that the first five positions belong to the area of engineering and only 2.35% of parents are strictly limited to the area of humanities.

Most of the students (86.1% of the females and 82% of the males) answered that they had discussed their career choice with their parents and especially with their fathers. 53.8% of them (60% of females; 52.3% of males) said their parents (especially fathers) had exerted some influence on their career choice. It should be noted that the parents' (father's) impact on women is stronger than on men. Also, parents were indicated as a main source of information about the engineering profession (76% of females; 30% of males). It is evident again that when their career choice is to be discussed women address their parents more often than men who sometimes prefer friends (15% of them) and teachers (31.5% of them).

On the one hand, all those facts show that parents (especially fathers) are very powerful motivational factors for the engineering orientation of girls. On the other hand, it provides useful information about the possible opportunities for influencing female career choice.

As for *mother's professions* housewives account for the highest percentage (22.5% of females; 39.09% of males). This is a significant fact, indicating a lack of gender role models for women in the area of engineering and university education. Only one mother worked as an engineer and 36.18% worked as employees or teachers, but in contrast to fathers, they are more humanities than engineering oriented.

On this point we could conclude that:

– Parents are the most powerful motivational factor for career choice for both genders. Other important factors are friends, acquaintances and teachers working in the area of engineering, all of whom provide a positive role model for career orientation.
– Parents' influence on females is stronger than on males.
– Fathers represent a positive role model for studying engineering while mothers have a negative one.

– The father's level of education and occupation stimulates students (in particular women) to study at university and directs them to the area of engineering.
– The mother's level of education and profession provides a negative model for university studies and leads them rather to a humanities type of education than to a technical one.
– BHS type of high school contributes to the establishment of a motivational basis and gives a realistic idea about engineering as a profession.

2. Reasons and factors for choosing engineering as a career

The second main point of the analysis presented is when and how students have made their decisions to go for engineering as a future career, as well as their decision for studying at university.

The data show that most of the students became interested in engineering during high school (51.2% of the girls and 43.5% of the boys). The period of their childhood ranks second (19.8%). However, it should be noted that this high percentage applies rather to men (23%) than to women (10.2%). As we see here the gender difference is quite significant. Obviously male interest in engineering has a longer history and this fact could be an indicator of the depth and intensity of their interests as well as for their positive expectations and attitude toward the profession of engineering.

The following question arises: What are the reasons for this significant gender difference? It would seem in society where technologies and science are intensively developed that women continue to remain remote from this process.

It may seem strange but it is an important fact that 17.9% of female and 12% of male students became interest in engineering within the past year or one year ago (10.3% of women and 6% of men). The gender difference is again significant. This means that more than a quarter of the female students (28.2%) have a quite recent interest in engineering. This, combined with the fact that 67.4% of them had not had any experience in the area of engineering before they started their university studies, could explain the lack of realistic ideas about and attitude toward the engineering profession and provides an explanation for the existing discrepancy between their expectations before enrolling and the reality of university life (25% of females were dissatisfied with their studies).

Considering the data it is not surprising that most of the students, namely 67.2% of them, decided to study engineering at the very last moment or within their last year at school, which holds true for both genders. The high percentage of women who indicated that their decision dated back to their school years (AHS, BHS) is not an indicator for a long standing decision because, in this case, the time when they made their choice is not indicated. The question "Did you have any experience in the area of engineering before deciding on your studies?" is also related to the process of decision-making and the choice of engineering as a career.

This question gives us more information on the following points:
- Have engineering students had any practice in the area of engineering, as well as some practical idea about engineering?
- Have respondents had a positive attitude and desire to have such a practical experience prior to their career choice?

As the data show 70.9% of men and 32.6% of women have had

some experience but it should be noted that:

– There is a significant difference between gender results and one of the reasons for this could be the type of school they finished.
– The main source of experience for all participants was their school education (22.7% of females; 46.7% of males).
– Only 11.3% of the females had been working in the area of engineering in contrast to the males who show a much higher percentage, 18.9%.

As I have already stated, the fact that 70.9% of males indicated they had had some experience and engineering practice (most often they had been working during the vacations) is a very strong indicator for the profundity of their interests and the high level of activity (in contrast to females). On the other hand, this kind of practice helped them to be more motivated and having clearer ideas about the profession of engineering. They were already familiar with the professional requirements and not so disillusioned as most of the women.

Another interesting information is that nearly 44.2% of the females and 28.2% of the males (the difference is again significant) were not acquainted with the profession of engineering when they decided to study. This is a very important and, at the same time, alarming fact. This means that nearly half of the females started their university studies having no idea about the subject of their studies! That could also mean that they started studying influenced by some external factors and without any inner motivation.

As for the sources of information about engineering, parents rank first (76% of females and 30% of males). The significant difference between gender results again confirms that female behaviour (in this case, decision making and choice) is strongly influenced by external factors, especially by their parents. For

many women the personal contact with an engineering role model is the most significant factor for their decision to study engineering. In the current study 27.1% of them and 23.0% of males have engineering role models in their families and in particular 11.3% of females have fathers who have technical or science related positions.

Accordingly, an important question arises: What exactly does this parents' influence look like and how could it be improved to make it more helpful? The family as a motivational factor can be seen in two aspects, as a professional model and as a direct advisor. Another question then arises: Which are the criteria according to which parents advise their children to choose engineering or not? Do students copy parents' attitudes to engineering or construct their personal, internal ones?

As for the ways that the participants were introduced to engineering as a career option, they indicated a variety of forms: from informal discussions with family members, teachers, or friends through career materials, books, and consultations.

Conclusions

(1) Most of the students started being interested in engineering during high school. This makes it a sensitive period for career orientation, so it must be used intensively to influence the career decisions of young people, especially those for engineering. On the other hand, the involvement of females in the area of technology must be organised even in secondary school. The question here is how to increase the positive influence of high school in this direction and how to transform secondary school education so that it becomes a more powerful factor for attracting pupils (especially girls)

to technologies.

(2) This work should firstly be focused on widening and changing the female attitude to technologies in general, and to engineering in particular.

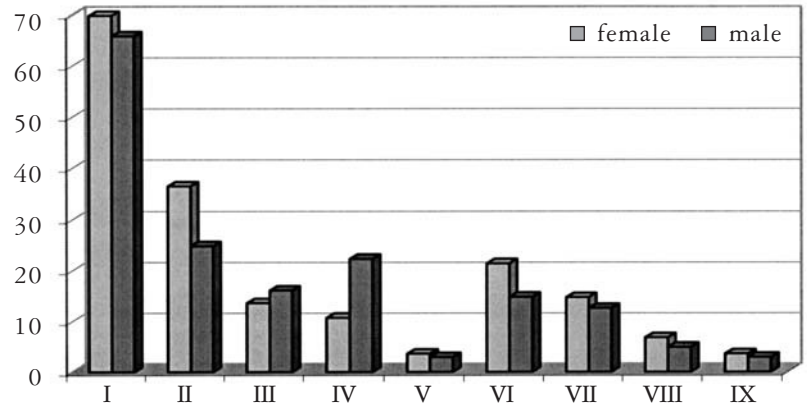
(3) The motivational work toward technological orientation of women could be successful if it focuses on the involvement of females in the practical world of technologies.

(4) It is firstly necessary to explore the reasons why women from BHS (HTL) move away and refuse to study engineering at university and along with this to organise suitable framework conditions for encouraging them to embark on a career in engineering.

(5) The content analysis based on the rating obtained from the respondents suggests that there is a balance between intrinsic and extrinsic considerations (interests and status). There are no significant gender differences in the first four positions (see Chart 3.): interest in the subject content of the field (I); characteristics of the job (E); availability of job (E) and opportunity for academic and personal development (I). The fact that both genders select engineering for similar reasons but motivated by different factors suggests that there are different processes at work for men and women. For males engineering is seen as a natural choice based on prior experience in practising with objects, while for women it is a choice influenced more often by external factors such as the family, for example.

Chart 3

Reasons for choosing engineering
(percentage within gender)



Key:

I – interest in the subject content of field (I)
II – features of the job (E)
III – availability of job (E)
IV – status and financial opportunities (E)
V – research interests (I)
VI – opportunity for academic and personal development (I)
VII – challenge of the position (I)
VIII – influence of others
IX – academic schedule (E)
X – other reasons
(I) – intrinsic reason; (E) – extrinsic reason

The students' opinion of the role of programs providing publicity for engineering (especially for women, such as the FIT program) is related to the question of career choice factors. The conclusions that could be drawn on the basis of the data are the following:

– It was found that only 56.8% of female and 40% of male students were familiar with such programs and only 43.2% of girls and 29.1% of boys took part in them. So, the question that remains is: Why is this percentage so low? Is it because of the lack of the necessary information at school, of the low level and ineffective actions on the part of schools and universities or because of the lack of interest and trust in such kinds of programs? Thus, only 20 of the women and 17 of the men mentioned a concrete program they knew. 18 out of 21 girls had taken part in a FIT program but these 21 girls present only 47.72% of the total number of females involved in the survey.
– However, if we focus on the opinion of students who had taken part in such programs, we could see that most of them (73.67% of females and 72.91% of males) were absolutely and mostly satisfied and think such programs were effective.

3. Attitude to engineering and subject of studies

What is meant is the actual attitude of the students to the subject matter of their studies, i.e. what appeals to them in engineering, would they change their subject, are they disappointed in their career choice etc.

The data show that most of the students were sure in their choice when they enrolled at university. Subsequently, it would be interesting to examine how their attitude to engineering has changed over time and if university education has contributed to its increase and reinforce their positive attitude and professional motivation.

Interesting information about gender attitudes to engineering is contained in the answers to the sex reversal question: "What profession would you have chosen if you had been of the opposite sex?". 96.96% of female and 66.01% of male students answered they

would have chosen the same subject of studies or other engineering subject, explaining that their choice did not depend on their gender. This means that most of the engineering students like their subject of studies and are satisfied with their career choice. The result of 96.96% for females on that point is very significant and indicates that their attitude and desire to study engineering is explicitly positive. Considering the fact that most of the girls have not been familiar enough with the profession and have not had prior experience in this area, this might mean that:

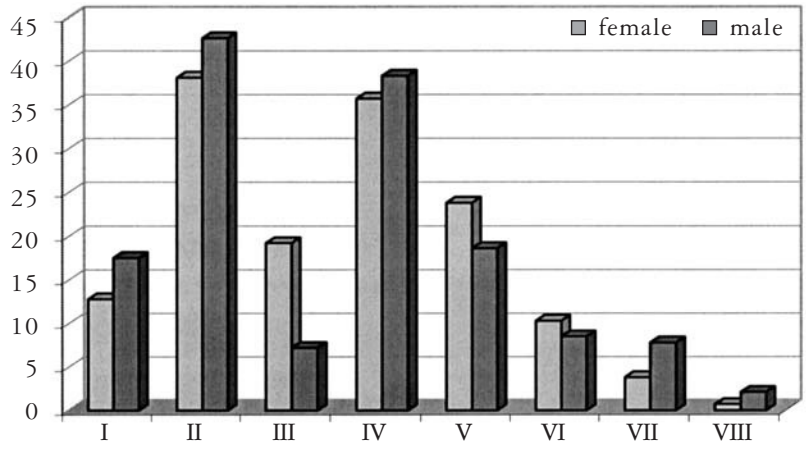
– The university provides a very high level of education and succeeds in compensating the lack of previous knowledge and in this way contributes to the students' satisfaction with their studies.
– This could also mean that the female aims and ambitions are not as high as the male ones, so they can be satisfied more easily. All these assumptions of course, need to be verified.
– Another interesting fact is that 23.14% of the men said that if they had been of the opposite sex, they would have chosen a humanities-oriented profession. What does this mean?

On the one hand, especially for men, it was very difficult to understand and to answer this question. However, as the interpretation of this male reaction is especially a psychological problem not related to our main object of study, it is not necessary to analyse it here. I just want to focus on the fact however, that men are more stereotypical in their perception of professions than women. They perceive some professions as more feminine than women do. For example, 23.14% of them think that humanities are a professional area more suitable for women than men. They indicated the following professions as most suitable for females: medicine, psychology, languages, law and multimedia. Nevertheless, taken as a whole, the attitude of men toward gender roles is positive.

The content analysis of the answers to the question "What appeals to you most in the area of your studies?" shows that there is no significant difference between male and female opinions toward their subject of studies.

Chart 4

Reasons to like the subject of studies
(percentage within gender)



Legend:

I – conditions of work (E)
II – just the process of activity (I)
III – good financial support (E)
IV – opportunities for academic and personal development (I)
V – opportunities for social contacts (I)
VI – pragmatic values (E)
VII – romance of work (I)
VIII – other preferences
(I) – intrinsic value; (E) – extrinsic value

Both genders named identical features as the three main reasons for liking their subject of studies. The most interesting fact is that all these features reflect internal incentives and values. Both genders rated "the process of activity" first (38.1% of females; 42.6% of males). They think that the process of engineering itself, the subject content of the work is most to their liking. If we look at the answers to the question "What were the reasons for choosing engineering as a profession?" we see that the interest in the subject content of the field and the features of the job have been the most powerful reasons for choosing engineering (65.8% of females; 66.8% of males). The fact that the internal factors (i.e. personal interest) rank first is a good indication for the attitude, the power of interests and the further intentions of the respondents with regard to their profession.

Significant information for engineering students about their subject of studies could be received from the questions: "Would you change your subject of studies?" and "If you had to choose a career again, which field would you choose?".

The results show that most of the students (72.7% of females; 95.4% of males) answered they would not have changed their subject. However, if we look at the results for females, we can see that 27.35% of the girls answered this question positively, so more than a quarter would have changed their subject, which is a significant percentage. If we look at the subjects, we see there is no significant difference and definite subject females want to change to.

As for the reasons, more than half of them (58.33%) indicated they did not like their current subject and were not interested in it and it was not the right subject for them.

The second reason given is the preference for and interest in other subjects, such as economics, law, multimedia, design, music, languages etc. Some girls also indicated that the studies were very difficult for them and they were afraid of not being able to graduate. When these students were confronted with academic difficulties

together with a lack of strong motivation and loss of self-esteem, they became more vulnerable to the lure of other fields of study. The number of men wanting to change their subject of studies is quite low and it is therefore not necessary to analyse it here. I suppose dissatisfaction is observed in cases when the decision-making has not been internalised and when no other type of inner motivation has been found. So, the process stayed merely on an external level.

Most of the respondents (69.02% of females; 78.51% of males) answered they would have chosen the same field of studies. 11.90% of women and 17.77% of men would have chosen another subject – but still in the field of engineering, which proves the strength and the stability of the students' interests, as well as the positive role of the university. Only 21.42% of the females and 6.66% of the males would have chosen a subject in another field (humanities, arts, sport etc.). The gender difference in this point is significant. The most preferable non-engineering subjects of studies for females are: psychology, arts and languages.

Conclusions

(1) Most of the students have a positive attitude to engineering as a profession, as well as to their subject of studies.

(2) Engineering students have no definitely gender related model of attitude to engineering as a masculine profession, although 25.24% of them regard some professions such as psychology, medicine and languages as more suitable for women than engineering.

(3) Most of the students are satisfied with their studies at university and do not want to change. The ones (in particular women) who want to change, would do so most often because of a lack of interest and availability of other preferences. This is an indicator

that they did not have a realistic idea about engineering studies and that there was a considerable gap between their expectations and the university reality.

(4) The main characteristics that engineering students like in their subject of studies reflect internal values and incentives, and this concerns both genders.

4. Self-confidence, level of motivation, goals, aims and expectations

This scale aims to define the level, breadth and direction of engineering students ambitions for the future, as well as their expectations and attitude to their future professional achievement. This is a kind of projection which reveals their as yet largely undeveloped desires and intentions. The level of abstraction of these aims could be a good indicator for their level of consciousness, clarity and orientation, furthermore for the probability of their being successfully achieved. The more concrete and well defined the goals and desires, the more conscious they are and the more likely they are to be attained.

Self-confidence

Table 1

	Female		Male	
direction of change	in past	now	in past	now
unconfident	4.7	16.3	5.9	6.0
neither	16.3	9.3	4.6	6.0
partially confident	39.5	25.6	31.6	28.5
completely confident	39.5	48.8	57.9	59.5

The level of self-confidence of the respondents is now in general, as high as it was at the moment when they started their studies. One year ago 39.5% of the women and 57.9% of the men were completely confident. It is evident that the male level of confidence is higher than that of the females, which is true for the past and the present self-perception of the participants. However, most interesting is the direction of change of the students' self-perception during their first year of studies. Table 1 shows that the percentage of unconfident women has grown from 4.7% to 16.3%, which is a significant margin of change, while the percentage of the men did not change. This means that the period of studies has exerted a negative influence on girls who had had a low level of confidence before the beginning of studies but it did not influence the self-perception of men with the same previous level of confidence. As we can see the growth in the percentage of unconfident females comes from the group who had been neither confident nor unconfident at the beginning. It seems that the studies at university transformed these hesitant and unsure girls into unconfident persons. It would be interesting to know the reasons for this change! Is it because of study problems or because of dissatisfied expectations? Additional data on the actual exam results of students could clarify the situation above. At the same time, there is some change from partially confident students to confident and completely confident. For men there is a change from partially confident to either confident or completely confident. Obviously for this portion of the students studies at university have exerted a positive influence on their self-perception. The results concerning this point have been confirmed by the data from the question "In comparison with your colleagues how hard do you learn?". Most of the students (64.61%) say they need to learn just as hard as their colleagues. A significant difference between genders is shown in the percentage of females who need to learn much harder than their colleagues

(22.7%) while for men this percentage is only 15.33%. Taken as a whole, female engineering students have problems with their studies more often than males and it is possible that this determines the lower level of their confidence. Unfortunately data on exam results are not available, so we could not draw conclusions about any correlation between the learning efforts and the success achieved.

The questions "Do you want to study a minor subject?", "What do you want to achieve as the outcome?" and "How do you intend to reach your goals?" aim to define the level and direction of students' goals and ambitions. The data show that more than half of the students, 62.8% of the women and 58% of the men, want to study an additional subject, a positive indicator for the broad interests of the students, for their ambitions and extensive plans for the future. As for the field of their preferences it is evident that both genders prefer the area of humanities (83.33% of females and 70.56% of males). The most preferred subjects in humanities are: languages, psychology, law and arts. Nevertheless it should be noted that nearly half of the male students (49.14%) and 29.16% of the female ones would choose a minor subject from the area of engineering. Why such a strong interest in humanities among engineering students? Is it only a sign for the diversity of their interests or is it a need driven by the social reality? It is curious that when students choose a minor subject it is one which is absolutely different and not related to their major and thus it is outside the scope of our research goals.

Irrespective of the great diversity of answers, some major aims and results could be deducted. The values that engineering students pursue can be combined in four groups:

– general, indefinite results (e.g. good job, good life, graduation, satisfaction, "don't know"), which is understandable taking into consideration the fact that they are still beginners;
– internal goals (e.g. competence, development), supposing an improvement of personal capacities and abilities;

– pragmatic goals (e.g. good position, experience, scientific work), which are related to achievement of practical results;
– "goals – path", the respondents' attitude to engineering as to a path, an instrument for reaching other goals, such as independence, financial freedom, security, good life etc. I think the advantages that students aim at (e.g. independence, good life, financial security etc.) are related rather to university education than to the profession of engineering itself.

The answers to the question "How do you imagine your future career to be?" clearly show that the students are not able to make a distinction between the results of education and career achievement, which is again an indicator of the immaturity of their professional images. The uncertainty and vagueness of the students' expectations might reflect a lack of information about the subject content. This raises the idea that the university should provide more information on the system of studies at the time of application. The data show that male ideas are more concrete and clear. The availability of such concrete and clear images about the future are indicators of a purpose-orientation and clarity about goals, which in turn means that there is a higher probability for their being achieved. This fact correlates to a great extent with the profundity of the male interests and the high level of their motivation and ambitions.

Most of the students believe they will achieve their aims by learning hard and maintaining sound self-discipline (45.45 of females; 70.27% of males). A high percentage of them (30.30 of the women and 27% of the men) are also aware that learning is not enough for good professional achievement and for this reason they intend to search out additional means for professional improvement such as practical work, additional courses and specialisations, experience abroad etc.

As for the students' expectations on entering the university, their answers are again more often general, vague and irrelevant

to the question, e.g. good education, to graduate, to be interesting etc.). It is a curious and a strange fact that 10.8% of the females and 11.33% of the males indicated they had not had any expectations or they were not aware of them. This correlates with the opinion of some students who had had no idea about the possibilities of their achievement. This general and vague idea could again be due to the lack of information about the further opportunities for achievement. The highest percentage of girls (32.4%) answered they had expected interesting courses, something new and thought provoking. The highest percentage of boys had expected to receive a good education, knowledge and success, which correlates with the level of their interests and aims. Both genders had expected more practice during their studies, more diversity and understanding from their professors. Have the students' expectations been satisfied during the first year of their education?

Chart 5

Satisfaction with the studies
(percentage within gender)

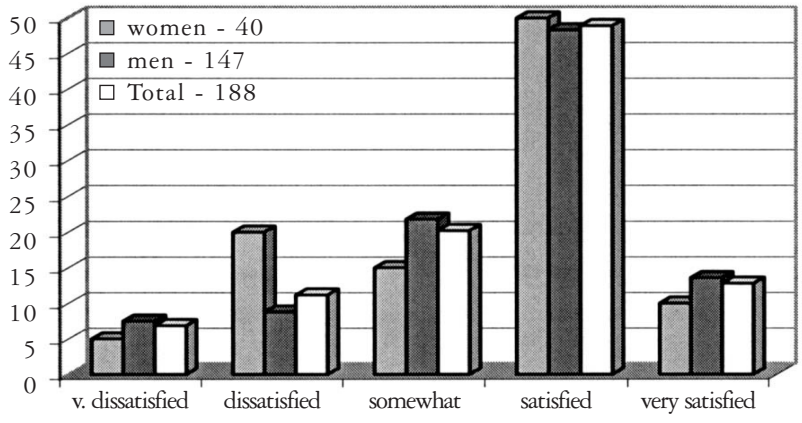


Chart 5 shows that most students were satisfied and very satisfied. As for those who were dissatisfied, there is a significant gender difference (25% of females and 16.3% of males). The percentage of dissatisfied women is significantly high but additional interviews with these students are necessary before more detailed conclusions can be made.

Conclusions

(1) The general level of self-confidence of engineering students is high. The level of men is higher than that of women. During the first year of their studies the students' confidence changed into two directions: Those who were less confident became unconfident (mostly the women) and those who were confident became even more so.

(2) The students' idea about their further achievements is quite vague and indefinite. The men's ideas are more clear and concrete, which corresponds to their high level of aims and stronger interests.

(3) As a main way to reach their goals students from both genders indicated hard work (learning) and practice (abroad), additional courses and specialisations.

(4) The students expectations are general, vague and often unrealistic. Women expect more interesting courses and men a good education, knowledge and success. Both of them want more practice and diversity in their studies.

(5) Most of engineering students from TUG show satisfaction with their first year of university studies. Nevertheless, men are more satisfied than women.

5. Summary

The current research aimed at designing three main aspects concerning the career choice: the reasons and factors for choosing engineering (relevant to past decisions); the actual attitude regarding this choice and profession itself (relevant to present decisions) and further goals, aims and expectations regarding professional achievement (relevant to future decisions). This research scheme reveals the unity and the relationship between causes and effects of students' decisions and contributes to finding out which kind of decisions and choices ensures successful achievement of their aims and goals.

(1) Generally speaking, the research hypotheses were mainly proved. There are some special socio-psychological factors that influence the choice of engineering as a profession. Family is the most powerful factor for both males and females. The family influence is stronger on women than on men. The factors of motivation are different for the two genders. For female students they are mostly external (other people), for males mostly internal (personal interests).

The most important factors for women are:
- Family influence (particularly fathers, who represent a positive role model).
- Friends and acquaintances working in the area of engineering.
- Encouragement by high school teachers.

The most important factors for males are:
- Early interest in the field of technology and engineering.
- Type of high school education (BHS).
- Personal experience (work during holidays, experience at home etc.).

(2) The respondents from both genders are equally motivated by intrinsic (I) and extrinsic (E) considerations and reasons. The inter-

est in subject content of the field (I); specifics and availability of job (E), and the opportunity for academic and personal development (I) rank highest.

(3) The fact that men and women select engineering for similar reasons, but are motivated by different factors suggests that there are different processes at work. For males engineering is seen as a natural choice based on prior experience, while for females it is a choice influenced more often by external factors. This peculiarity shows that applying male models of motivation to females would not be as effective as examining the successful female models toward engineering and using them as a basis for planning relevant programs designed to promote the publicity of engineering.

(4) The similarity in reasons and factors given by students from different European countries suggests that the attraction to engineering is motivated largely by certain common intrinsic desires which transcend cultures. These thoughts raise such questions as:

– Should there be an aspect of the university/school program designed to address the development factors?
– Should the school programs be structured in the future so as to give trainees a realistic view of what engineering really is about, including expected problems of inadequate funding. Such discussion could also be relevant when examining the philosophy and the aims of education.

(5) Despite the differences between the factors influencing the career choice of both genders (they make their decisions in different ways) there are no significant differences in their attitude to engineering and their subject during the first year of studies at TUG. Most of the students have a positive attitude to the profession of engineering, are satisfied with their studies at university and do

not want to change. The main characteristics that appeal to the engineering students reflect internal values and incentives, which applies to both genders. The process of activity, the opportunity for academic and personal development and social contacts are rated highest.

(6) The general level of self-confidence of engineering students is high. The level of the men is higher than that of the women. During the first year the students' confidence has been differentiated in two directions: those who were less unconfident became unconfident (mostly women) and those who were confident became even more confident.

(7) There are no significant differences in the direction of students' goals, aims and ambitions regarding their professional achievement but men show stronger motivation and have more ambitious aims than women. The students' ideas about their further achievements are quite vague and indefinite. However, men's ideas are more clear and concrete, corresponding with their aims and stronger interests.

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