

Gender and Diversity as Structural Components of Quality in New (Engineering) Study Programs

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1. Problem

In February 2006 the German Accreditation Council - as supervisory body for all accreditation activities in higher education in Germany - debated the relation between gender mainstreaming and the accreditation of study programs. As a result of this debate the implementation of gender-mainstreaming-concepts of an HEI (higher education institution) shall be reviewed in the accreditation procedures for single study programs (Drs. AR 05/2006). The pre-condition is that gender-mainstreaming-concepts exist within an HEI and have their impact on study programs. Therefore HEI have to decide themselves about appropriate ways to integrate gender mainstreaming into their new study programs. If concepts and measures are present, effects have to be evaluated in accreditation procedures. Consequently HEIs and accreditation agencies need evaluation/accreditation criteria and/or appropriate review-procedures for observing the effects of gender-mainstreaming-concepts in higher education.

Despite a broad variety of measures, programs and public relation activities of HEIs, professional associations, ministries and companies, qualitative and quantitative development in the field of engineering education needs much effort. In comparison to the expected needs of engineers within European societies and economies in the near future student numbers in engineering are too low at present. Even though job opportunities are good in general, the participation of female students in engineering study programs stagnates (VDI Ingenieurstudie 2005). For years their numbers remain lower than 10% of study entrants (cf. VDI 2003). This seems to be not only a question of economic resources, but also of structural changes.

The present paper approaches the question how gender as well as diversity requirements and the assurance of quality for study programs in engineering sciences are related. On this basis the consequences for quality management and the resulting challenges for the management of HEIs have to be debated.

2. Gender mainstreaming, diversity and quality

Not only within this paper the term of gender mainstreaming is meant to describe the concept:

„(...) to incorporate the different living situations and interests of men and women within all societal projects a priori and regularly, because there is no such thing as a gender neutral reality.“
(BMFSFJ 2006)

Subsequently diversity (management) is understood as the concept to incorporate the different living situations and interests of individuals or groups of individuals deriving from their specific background and or their specific life situation within policy- and management-processes. “Diversity” can be seen as an umbrella term describing individual varieties of beings within organisations (comp. Vedder 2005, 36). Thus gender mainstreaming with regard to management processes might be seen as part of a broader diversity management approach.

When looking for a definition of “quality“, it turns out to be a code, too. With the help of this code one merely states, that requirements are met (Crosby c1979, 14, 44). But who defines the requirements? And what are the requirements?

From the point of view of an external quality assurance organisation – such as accreditation agencies are in the quality assurance systems of HEIs – the so called stakeholders in the process of university education are the ones to define the requirements marking quality for each single study program. Those individuals or groups that are directly involved in education processes at HEIs can be seen as primary stakeholders (e. g. students, professors, administration). But also secondary stakeholders from around an HEI must be taken into account (e. g. future employers). All of them define their interests, bring in beliefs and convictions within a specific environment that imposes specific political, juridical or economic constraints. And not to forget: stakeholders in most of the cases are male or female, too.

Departing from the above mentioned descriptive understanding of quality the concept of gender mainstreaming belongs to the contents that can be set as a requirement for quality. Why should gender mainstreaming then be set as a requirement for quality by designers of study programs in engineering sciences? To ask in the sense of the title of this conference: Why should gender mainstreaming become part of the quality culture at HEIs? The answering thesis at the bottom of this paper is: Because including gender mainstreaming as one of the quality requirements for the education process within a study program not only helps to meet political requests on a formal level or to increase the number of female students in engineering sciences. Furthermore effects of gender mainstreaming in their education belong to the success factors for future engineers – male and female – in their future working environments and with this to the success factors for the earning and surviving of the organisations they work for.

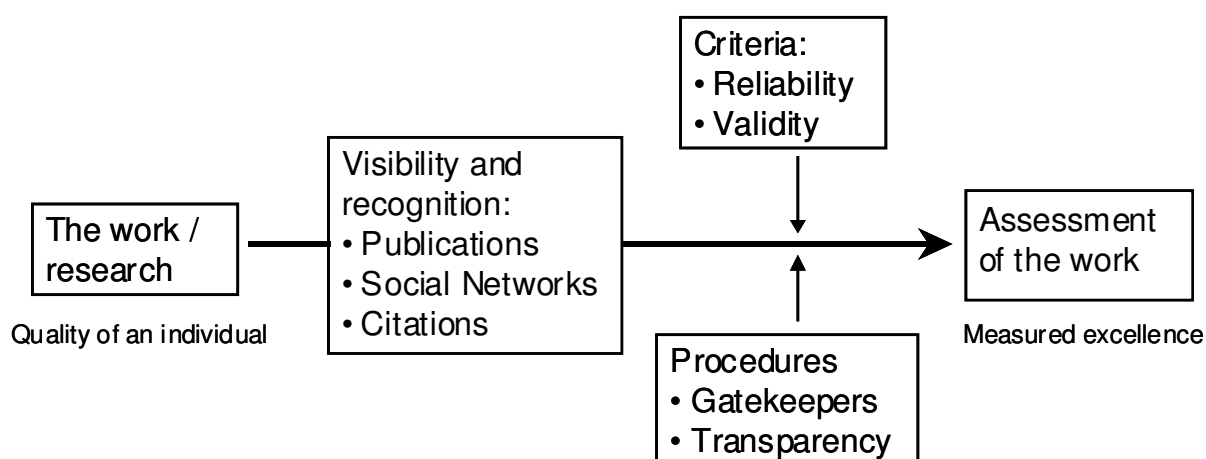
3. Why we connect excellence and quality assurance with gender

Already in 1942 Robert Merton argued that science should be a democratic project and thus not excluding anyone: “The acceptance or rejection of claims entering the lists of science is not to depend on the personal or social attributes of their protagonist; his race,

nationality, religion, class and personal quality are as such irrelevant” (Merton: 607). Although Merton still used “his” in accordance with the reality of his time, transferring his belief to today’s time the scientific community at large would agree with the statement that science should be free of gender stereotypes. But how can this agreement be translated “into a strategy that really leads to a ‘gender-equal’ or ‘gender-sensitive’ scientific environment” (EC 2004: 27) is still an open question. “The first step in this direction is cultural; it is the understanding by the entire community, that the problem is there and must be addressed” (EC 2004: 27).

To show where the problem becomes evident and thus working towards reaching this understanding, is one of the aims of this article.

Firstly, Merton’s statement has to be applied to the judgment of quality also, since the general ideal is that being recognized in the scientific community should be based on the quality of research, only. However, there is evidence that recognition in the scientific community is not based on the content and results of research alone, but also on factors that are outside the actual research¹, as summarized in the following illustration:



Based on Margo Brouns (2006)

The factors visibility and recognition, the criteria and the procedures that influence the assessment of scientific work are not purely objective. Instead, they are based on grown ideas and grown structures that must be considered a social construct of those who built the system. Women were only allowed into this system once certain rules had already been developed that were based on the “normal” male life style.

¹ The first collection of different aspects of this issue is the publication “Gender and Excellence in the Making”, following the workshop “Minimising gender bias in the definition and measurement of scientific excellence” that took place in Florence in 2003.

Thus, the criteria used to assess quality of research have to be considered not only biased in favour of men, but more precisely towards a certain kind of men that follow an established mainstream. Following this thought, a connection between the construction of excellence and gender will also be a possible connection between other factors of diversity. But where exactly does the bias in the different influencing factors given in the illustration above lie? In the following we will be looking at different factors in more detail.

3.1 Publications

The number of article publications generally is more important than the content of an article. This is true in different ways: the first is the importance a journal is given, the second is the field of science or the subgroup of a discipline, i.e. not doing research in the mainstream of science; the third is “non-scientific” literature like readers and reports or literature that is published in the national language.

3.2 Social Networks

The integration into the scientific community is a vital factor for the career advancements of women scientists, indicated e.g. in results from Lind (2006). But even where we don't have results from empirical research, networks are widely accepted in their importance for many aspects of careers, e.g. the invitation to be key note speaker at a conference or the inclusion in committees.

3.3 Citations

Citations are another by-product of the inclusion in social networks and thus the so-called “citation circles”. Publications alone are of limited use in the assessment of a work if they are not cited; on the other hand, the citation index does not really prove that the thoughts and results of the cited research are really as good as implied.

Thus, *bibliometric criteria* used in the present system do not give us *reliability* and *validity* concerning the research results.

3.4 Gatekeepers

Gatekeepers tend to be middle-aged men since women are still under-represented in the relevant positions in academia. There is some evidence² that this hinders the success of new ideas, new ways of research designs, and a closer look at the social relevance of research.

3.5 Transparency

Transparent rules and responsibility of evaluators towards the (scientific) public reduce subjectivity and minimise double standards in assessment. The negative effect on women

² e.g. Allmendinger / Hinz (2002)

as a result of double standards have been shown by Foschi who defines this term “as the mechanism through which women are assigned less ability than men” (Foschi 2004: 51).³

Why the gender-bias is a problem for the scientific system

Merton saw a great danger in social pressures on scientific research and as a result urged that only peers were able and allowed to judge scientific quality. This has been the foundation of today’s system of assessing science with the pitfalls described above. Nevertheless, the main conviction is that the “scientific freedom” has to be defended. At the same time academic and industrial research become more alike in the sense of a focus on the outcome of the research about to be funded.⁴

With human resources being the main resource for many countries that can be considered the “big players” in the global scientific community, there is growing focus on the education of scientists. Innovation, i.e. development of new ideas and products, is the key word in this process, often connected directly to excellence.

Thus, scientific excellence seems inseparable from the possibility of developing exploitable knowledge from scientific research, more so in science, engineering and technology (SET) disciplines than in social sciences.

Here lies one reason why the bias towards a certain dominating type of research and behaviour in the current scientific system must be looked at critically. If scientists are encouraged to behave and think in one particular way, this must be considered to be hindering the development of new ideas and new thoughts. One example is interdisciplinary research, often encouraged and asked for officially, yet in case of a publication list; interdisciplinary research publications are considered to be less worthy or are not considered at all. This means that especially young or not yet established researchers are discouraged from working in areas off the mainstream of research. However, innovation cannot be expected along the ever followed road, or, as the former CEO of Hewlett Packard, Carly Fiona, has put it as the basis of HP’s diversity strategy: “Cloned minds produce cloned ideas”. HP, like more and more other companies, is convinced that diversity will lead to creativity, creativity will lead to innovation, and innovation is the key to success.

Different fields of science have proven that recognizing the diversity of costumers makes sense and leads to better research results. In medical technology results of the recognition of diverse users strengthens the security of the patients. Here it is no longer disputed that women and men, children and older people, or people of different races, need different medication – and the lack of consideration of that fact may well have led to many unnecessary deaths in the past. This change in the design of medical research was directly linked to more women being engaged in medical research.⁵

³ This is true not only for the assessment of women by men, but often even stronger in the assessment of women by other women.

⁴ This line of argumentation has been laid out in Ziman (1998) with a focus on the need to justify research by its potential outcome and social relevance in order to be publicly funded.

⁵ For an overview of the development of women in the medical science see Dalhoff (2005).

In order to allow for new ideas and creativity prosper, the current notion of scientific excellence and the bias of the indicators influencing the assessment of scientific work have to be seen and understood to be a construction of the system. Only through changes in the system this construct will change.

The following arguments will draw attention to the areas in higher education that are currently in the process of changing, thus offering the chance to include changes that might lead to a different assessment of excellence.

4. The political and socio-economic framework for the use of gender criteria in quality assurance when educating engineers

Based upon the Amsterdam Treaty of the European Union of 1997 and the herewith declared common goal of gender equality, the request to integrate gender criteria into the quality assurance for study programs is formulated in the communiqué of the Berlin Conference 2003. With the Amsterdam Treaty the signing nations commit themselves to introduce gender mainstreaming systematically in their national arenas. The Berlin communiqué declares the consistent quality assurance within and of HEIs as a binding rule in Europe and the signing nations have committed themselves to establish internal and external quality assurance management in their national higher education systems. To assure quality of tertiary education, the education ministers consider it compulsive to reduce inequalities in the higher education due to gender or other social criteria.⁶

With this the goal (equality)⁷ and the method (implementation of gender mainstreaming) is set by European policies. Consequently respecting gender mainstreaming when planning, implementing and evaluating study programs is defined as requirement for quality already by the socio-political external environment of HEIs (Michel, 2004). Startingpoints to consider and implement these policies are shown in Mühlenbruch/Beuter/Dalhoff/Löther (2004).

In addition to the demands from the political arenas, industrial environments request specific qualifications of job entrants. They give orientation about the important future topics: Besides pointing at the necessary raise of student numbers to reduce the lack of technical professionals, employers have been articulating at many occasions during the last years their need for entrants, who are not only technically trained, but also equipped with key competences, making team work nationally and internationally more efficient (cf. VDI 2004).

Additional impact arises from the diversity concept. Interesting for the fields of engineering, this concept predicts a change in product development and marketing processes, if the now relatively homogenous male development teams change into mixed

⁶ The goals of processes and ways to achieve them can be found in: Bergen Communiqué 2005

⁷ Nationally, we should not fall behind European standards as set out e.g. by the reader "Gender and Excellence in the Making"

teams, encountering the wishes of male and female customers in a different way. Consequently, the attention of human resources management shifts to technically educated female professionals, followed by representatives of different generations and of different ethnic backgrounds.

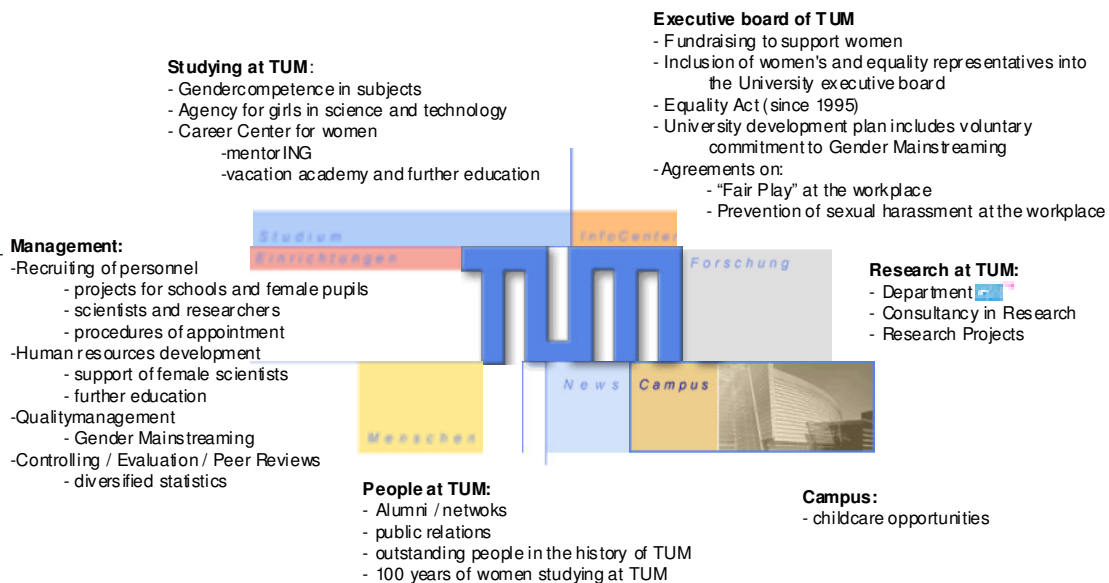
5. Observations and lessons learned from projects of gender mainstreaming in HEI processes: the concept of gender mainstreaming at the University of Technology, Munich (TUM)

Since the 1990s TUM declares gender mainstreaming as structurally relevant for the institution as a whole. Therefore, gender mainstreaming is included in all internal processes, especially in planning, by-law and regularities, e.g. in recruiting processes and personnel development. It is a top-down-approach and some of the processes and offers have not reached all departments. For supporting these processes and for making sure quality management and controlling, an equity board with an equal opportunity commissioner and women's representatives in each faculty would be installed. Together with the university leadership they developed an equality act. With this the faculties are asked to send yearly equality reports to make sure that the processes are successful. First steps towards a new management approach and management culture for universities in Germany are target agreements, between government and university and between university leadership-teams and each faculty. The increase of the proportion of women at all levels is one possible target still under discussion within this framework. This would mean that in all newly developed programs, percentages of men and women will be counted and target measures will be set to equalise the numbers.

The university also changed its concept of public relations and pays special attention to the fact that research and development are processes and results of the co-operation of men and women, young professionals, senior professors and contributors from several cultures and disciplines. This will be published for example in the vision and mission statement of the university, in TUM History as well as with regard to alumni and other networks.

The gender program of TUM has several connected parts (see picture 1). As a university with strong orientation on successful international enterprises, TUM identifies three reasons for developing the specific gender program: through new technical trends a worldwide economic growth of about 20% is forecasted for the working field of research and development; meanwhile a lack of 15.000 engineers is estimated in Germany (VDI 2003). At the same time internationally oriented enterprises develop concepts of diversity management to integrate more women, people from varying cultural backgrounds, and different generations into research and development teams. They realized that they can expect new, better or more specific inventions and products.

Gender Mainstreaming at TUM



Picture 1: The gender mainstreaming concept of TUM

Central for Good Corporate Governance and eminent to TUM's equality concept is the promotion of talent-based equal participation by men and women in science, research and development (comp. TUM). At TUM a number of measures concerned with the achievement of this goal are already in existence including activities like the "Agency for Girls in Science and Technology" (Agentur für Mädchen in Wissenschaft und Technik), the "Mentoring Program for female Pupils, Students and Workforce Entrants", the "Women's Office" (Frauenbüro), which provides advice and seminars for female students and scientists, child care for TUM scientists, equality aspects in special programs for promoting high potentials and obliging equality conventions in each faculty. Additionally, the vacation academy for female students and young scientists at the protestant academy in Tutzing offers an extraordinary program for women at TUM. With these programs TUM has been able to raise the participation of women in studies and science from 30% (5500 in total) in 1999 to 32% (6500 in total) in 2006 (during a period of increasing school enrolment).

Because of the situation in engineering faculties, TUM recently established a new professorship for "Gender Studies in Engineering" (Ihsen 2005). Study interest lies on "gender and diversity" and the economic relevance of mixed teams in research and development. Analysis and studies on how to attract more talented women into engineering studies and science are on the research agenda of this professorship. The

major aspects in teaching and learning are soft skills and gender competence for future engineers.

With the start of the “initiative of excellence” of Deutsche Forschungsgemeinschaft (DFG) and the National Ministry of Research new impulses for research areas and departments have been given. Each applicant had to write down gender issues in all proposals in relevance to the research topics (research cluster), to the new graduate school concept and, of course, for TUM as a whole. In a lot of preparing discussions researchers, teachers, managers and women representatives worked on special gender issues according to mainly technical research and teaching projects. Here are some examples:

➤ **Cluster of Excellence:**

- Concept for international recruiting of young excellent female researchers
- Gender mainstreaming integrated into the project management
- Preparing of research results for young (female) students for showing how the professional life of engineers has changed
- Networking for all female scientists working in the cluster
- Gender and diversity research as part of the technical research topics

➤ **International Graduate School of Science and Engineering (IGSSE):**

- Concept for recruiting of young excellent female students
- Home work places for Master- and PhD-students as well as for teachers

Both, the clusters and the graduate school will take part at all initiatives TUM will create after being successful, especially in child care and the development of a Munich Dual Career Center, together with other scientific institutions in Munich. TUM plans the following activities:

➤ **Executive Board:**

- Target agreements with the faculties to fulfil the needs of gender mainstreaming
- Gender-oriented Consulting for all projects that include gender topics into their research field.

➤ **Quality Management:**

- Gender-oriented controlling to ensure the quality of the implementation of gender topics.

➤ **Personnel Development:**

- Gender-oriented recruitment of high potentials will be widened, to make sure that the target agreement of raising the number of female researchers will be fulfilled during project time. This recruitment will also be opened to other European countries, as it is known that in some other countries the ratio of female engineers is much higher than in Germany. Through this the competition for the best researchers will be strengthened.
- A Career Service Center for supporting especially women entering industrial careers will be invented at the University.
- Promoting of scientific dual-careers, e.g. with the Munich Dual Career Center working in cooperation with other academic institutions in the Munich area.

➤ **Faculties:**

- Fonds for supporting special programmes of gender orientation by the faculties are a possibility to strengthen the position of women working in the engineering faculties.
- **Research and Science:**
 - PhD-Mentoring for women during their first steps as researchers
 - Founding of new fellowships for excellent female scientists together with industry
 - Introduction of new forms of parental leave compensation
 - The already existing lecture series on “gender and diversity“ will be held continuously. It will be widened into a platform for all research results in relation to gender topics that are found inside the projects of excellence.
- **Employees:**
 - Upgrading of child care and family care for all employees of the university.

6. Gender and diversity in newly designed engineering study programs

The design and evaluation of a study program can be described as process traversing three major and interdependent phases. These phases correspond principally to the phases the education process itself passes through as soon as the study program is implemented: Phase 1 includes the definition of the overall organisational and educational goals for a study program, their translation into learning outcomes at a general level and at the level of single modules. Phase 2 includes the implementation of the program and the planning and allocation of all the inputs needed for this step (e. g. staff resources, equipment, curricula, teaching methods, regulations). Also the concepts, methods and instruments as well as the resources set aside for the implementation of internal evaluation/quality assurance measures belong to the input factors helping to implement a program. Phase 3 consists of the effective implementation of evaluation/quality assurance measures and of the utilization of the deriving results for continuous improvements with respect to the defined goals of the study program and of the check-up and eventual revision of the goals themselves.

Quality assurance for study programs always includes two perspectives: The internal approach deriving from the quality assurance system and management within the HEI and the external approach deriving from the activities of accreditation agencies or – additionally – from external reviewers conducting evaluations with another aim than conceding or not conceding a certificate (which is the outcome of accreditation procedures). The combination of the two approaches results in an overall quality management system that has to be governed by the respective HEI – as the HEI itself accounts for the quality of its products in the end.

Consequently for each study program first of all educational goals must be defined for the entire program as well as for each individual module. In the internal and external quality reviews, these goals are tested also against the desired graduate profile developed by stakeholders/organisations from outside the HEI. Also, the auditors check whether the educational goals of the entire program and of individual modules are internally consistent

and how they contribute to the achievement of the desired learning outcomes. From the outside perspective of an accreditation agency great emphasis is placed on the existence of a systematic and effective quality assurance system as internal measure to ensure that the educational goals of the program are met and its output is regularly reviewed.

From the point of view of an accreditation agency educational quality derives from the coherent functioning of the educational process itself and especially from the level of achievement of its objectives. In addition to this neutral perspective on educational quality external reviewers might also compare the objectives, implementation-inputs and the outcomes of an educational process set by an HEI itself to standards defined by groups of the outside world. Nevertheless, the basic juridical and methodological assumption in Germany is that the freedom to define its own goals and the responsibility for the quality of its performance has to be borne by an HEI itself. Externally defined standards/requirements for educational quality therefore in most of the cases can only serve as point of reference, not as unalterable rules for those responsible for HEIs and for the outside reviewers during an accreditation procedure.

A first conclusion from the above said is, that the concepts of diversity and gender mainstreaming can be included into the design of study programs at two levels: First at the level of overall organisational goals and measures for their achievement of the unit responsible for a study program and second at the level of the educational goals of the study program itself by defining learning outcomes that reflect diversity- and gender-oriented competencies.

Two major questions arise at this point: By which means (instruments) HEIs can embody the concepts of diversity and gender mainstreaming when designing new study programs? Which impacts have the concepts on the criteria and or procedures of internal quality management systems and external quality assurance organisations – such as accreditation agencies?

One possibility is the gender-oriented distinction especially of primary stakeholders that are to be included in the designing and evaluating of a study program. Generally speaking, the addressing of different target groups in a differentiated way belongs to the goal setting phase when designing a study program. On the organisational level the responsible unit can define gender-specific operating figures, describe the starting point and the target figures.

From a structural point of view an HEI can show if and in which dimension they integrate specific measures for implementing gender mainstreaming as means of quality assurance. Inside study program structures gender relevant criteria of quality assurance can be evaluated. A department can set formal conditions for a study program that makes gender specific analysis possible. This includes gender-specific interpretation of data about students, the possibility of part-time studies, the consideration of gender-separated teaching and specific master programs to re-enter the labour market.

Nevertheless, in the ongoing re-design of study programs in natural and engineering sciences “gender” cannot be limited to the quantitative participation of women and men in the study programs, but has to be integrated into the educational aims of the courses or modules, for which especially women show interest and where companies see a growing

relevance when they employ job entrants. In this context the didactic approaches of “conceptual understanding” and “exemplary learning” have to be mentioned, which help students to not only have technical knowledge, but to put it in a broader context, to reproduce it with their own words and find solutions themselves.

Through a change and qualitative improvement of study modules, didactics and contents, more women might be attracted to take engineering courses at university level. This has to be flanked by considerations of women’s career development in engineering in order to achieve the overall goal of better employability through bachelor- and master-programs. The present situation shows that female engineers do not work in their field of study more often than male, but leave engineering for sales departments or entirely different fields of work.⁸

At least on the level of a master program, which is preparing students for leading professions, application-oriented knowledge of diversity in product development, communication- and cooperation-processes, fitting to the target group, needs to be taught. Thus, future tasks of technical leaders do no longer include the gender topic only. It is moreover important, due to globalisation, demographic changes, the development and optimisation of products for new groups of consumers, to be able to develop diversity strategies in specific working environments.⁹ This is also true since more engineers will face human resources departments with strong diversity focus when recruiting future personnel.

When talking about how to measure the results of endeavours to include diversity management and gender mainstreaming in the design, implementation and quality assurance of study programs, one source of information for both – internal and external reviewers – are percentages of male and female students entering or leaving (with or without a degree) a study program and – even more significant – qualitative data about their reasons for entering and leaving or remaining. With regard to the effects of diversity itself, information about nationality and social or cultural backgrounds of students could also be collected and put into relation to gender-related data.

Concerning the upcoming outcome-orientation of internal and external quality assurance measures, the need of data providing information about and allowing conclusions on the effective achievement of learning outcomes and competencies aimed at within a study program becomes pressing. Such data can for example be transferred from statistics and interviews of (female) alumni about their professional career and about the impact of their former education on it. Such research has already been started at many HEIs (e.g. alumni-offices, women’s representatives), but by far not enough. At present the availability of outcome-related data – even of concepts, methods and instruments to get it – for those

⁸ See e.g. the Returners Campaign of the UK Resource Center for Women in SET, <http://www.setwomenresource.org.uk/>

⁹ This approach includes directly noticeable differences (gender, age, Colour, language, status, function) and indirectly ones (religion, desire, values, personality, income). Comp. Vedder 2003.

responsible within HEIs and within accreditation agencies is far from being developed sufficiently.

One major obstacle for including such data in internal quality reviews and in accreditation processes over the last years in Germany was the fact that almost no data on effective outcomes and implementation results was available because the major part of accredited programs was just started at the point of certification or had not yet produced alumni. As empirical data and their qualitative assessment will – hopefully – only be available for the re-accreditation procedures after five years, proposals will show effects in five years only – unless the responsible HEI is able to reach a status of continuous improvement with the help of internal quality measures before this date.

For the future, to evaluate the success of the policy-measures, an EU-wide benchmarking of comparable gender-criteria is under discussion. Within internal and external review processes the following four criteria could be under evaluation:

- Do curricula, didactic methods, structure and regulations (used or not used) reflect gender- and diversity-related elements?
- Are differentiations of the professional identification of different target groups/stakeholders recognised and taken into consideration?
- Do those responsible for a study program consider that different target groups/stakeholders act differently in the development of their individual potentials? How are these findings transferred into the educational process?
- Are there resources available to train gender and diversity competencies of the students?

7. Challenges for the management of HEI

HEI in Germany have taken significant steps leaving the status of a subordinated agency to reach the level of a scientific, economically successful institution, competing with others. They do not only widen their study opportunities to reach an international target group, but also check their structures, whether they are fit for the future. This includes the question if they, as institutions, give the same chances to men and women, and how to integrate more women in technical subjects. This discussion, some years ago the task of women's representatives only, nowadays belongs to the core management tasks for the leaders in many HEIs.

Analysing the structures it becomes clear, that approaches to change the institution in the case of German HEIs are only successful when they are established and kept – compared to private companies – as a top-down management strategy. This includes target agreements and regular result-checks (cf. Ihsen 2006b). But do HEIs and their departments

have common goals, from which measurable targets can be derived? Will heads of boards become leaders with adequate competences? Do recruiting and personnel development concepts exist for academic and non-academic personnel? How can change-processes be combined with the culture of “freedom of research and teaching”?

Arguments for the introduction of management elements under gender and diversity aspects are:

- Business level: HEIs hope for competitive advantages. Especially in recruiting this should be reached through an open, constructive and scientific climate of motivated colleagues including different target groups/stakeholders.
- Economic level: through demographic change and too small student numbers in engineering, the need for technical professionals raises and can become negatively influential on the economic cycle.
- Technical level: due to technical developments, for example in optical and, micro-system technology, nanotechnology and energy technology, new markets for new products arise. Based on the awareness, that products can be developed for a broader customer’s diversification, if the development teams are diverse, new technologies can define diversity benchmarks and specifications early in the development process and avoid later improvement.

8. Perspectives

The shown processes of change lead to a continuous participation of women in engineering sciences and professions on the long run. HEIs have to make arrangements in interdisciplinary cooperation towards future requirements regarding new target groups, including the field of further education. “Gender mainstreaming” is just one step towards a necessary structural change when addressing future target groups, professional necessities and ensuring that the own organisation or institution belongs to the ones defining technical progress.

The introduction of gender criteria in university education can help implementing the growing diversity of societies, companies and educational institutions, to meet future needs of the markets. These criteria have to be developed by the institutions themselves. Processes of quality assurance in Germany are not used to set norms themselves, but evaluate according to standards of the scientific community. Problems appear if no defined criteria exist. It is thus necessary that technical communities or HEIs define measures and instruments to support gender issues. The implementation of these measures can than be evaluated during accreditation procedures.

Study and research topics are primarily in the responsibilities of faculties, what makes them – in natural and engineering sciences – hard to change. The presented approaches to integrate gender-and diversity-management, and to measure change and quality shows, that

the inclusion of gender –oriented criteria and requirements in the standard-catalogues of the outside world (e. g. politics, scientific organisations, accreditation agencies) can be beneficial. The introduction of gender mainstreaming is not at all revolutionary: The mentioned methods and measures remain in the borders of data-collection and data-analysis that has to be done in order to prove the achievement of educational goals anyway.

To embed gender and diversity-oriented requirements for educational quality in the educational processes of single study programs and with this in the internal and external quality review, the past years have shown that the following questions have to be answered methodically and in practical work:

- What are gender- and diversity-related competencies of alumni and what does this mean for competence profiles of job entrants?
- Which data can give valid information whether gender and diversity education effectively produces the competencies aimed at and how can this data be collected in an efficient way?

The changes in the profession of engineers and their world of work anticipate the steps HEIs have to go if they want to remain successful in the education of engineers. The Technical University Munich includes the concept of gender mainstreaming consequently on all organisational (leadership, management) and human (opportunities dealing with studying and working) levels. Further measures for research, teaching and studying are on the run and part of the question how to be competitive in the future.

The introduction of gender criteria in university education can help implementing the growing diversity of societies, companies and educational institutions, to meet future needs of the markets. These criteria have to be developed by the institutions themselves. Processes of quality assurance in Germany are not used to set norms themselves, but evaluate according to standards of the scientific community. Problems appear if no defined criteria exist or where set criteria are not gender neutral, as has been shown in chapter 3. It is thus necessary that technical communities or HEIs define measures and instruments to support gender issues. The implementation of these measures can then be evaluated during accreditation procedures.

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