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Quality Assurance in German Engineering Education against the Background of European Developments*

GÜNTER HEITMANN
Technical University Berlin, TU Berlin Institut für Berufliche Bildung, Hochschulbildung und Weiterbildungsforschung, Sekr. FR4-8, Franklinstr. 28/29, 10587 Berlin, Germany.
E-mail: heitmidd@sp.zrz.tu-berlin.de

Recently the question of accountability and quality assurance in higher education has become a serious matter of concern in Germany, as it happened in various other European States some years earlier. Engineering education is being and will be affected in different ways. In addition to quality assessment based on internal and external evaluation, program accreditation procedures are also going to be implemented very soon, initially applied to newly implemented bachelor and master degree programs. These developments have caused a controversial discussion about quality and standards, assessment procedures to be applied and authorities to be involved. Also raised is the question of international comparability and even the possibility of a transnational approach, e.g. a European approach or a European ABET, has started to be on the agenda. This contribution deals with the discussions and the various approaches of quality assurance in Germany with a focus on Engineering Education, and also refers to the European Union debate on these topics in general. Some examples of good practice from other European States which are further along in this process are described. Current developments as well as probable future perspectives are taken into consideration.

INTRODUCTION

HIGHER EDUCATION in Germany as a whole and engineering education in particular for a long time were not very much concerned by the increasing international debate about quality and quality assurance. Engineering education relied on traditions and experiences of a high quality education based on strong research and industrial links and an outstanding reputation among insiders, especially companies and employers, nationally and internationally. The only problem to be solved seemed to be how to ensure broad international academic and professional recognition of the German qualifications and degrees, as the German 'binary' system of engineering education based on parallel strands of the 5-year university programs and the 4-year Fachhochschule programs and especially the Diplom-Ingenieur degrees, did not and still do not compare to the Anglo-American structures, degree types and even concepts.

Recently, however, quality matters in Germany are also facing growing interest and respective actions by the Federal Government, the 16 Federal States (Bundesländer) responsible for all education matters and the higher education institutions including their organisations. With a steadily growing state financed higher education sector and an increasing lack of funding the question of accountability and value for money was also raised in Germany. The crucial issue is how to achieve or maintain high quality education whilst facing an immense overload of students with regard to the available places and suffering from a decreasing funding, at least per individual student. Secondly, a severe decline of attractiveness of the German educational system for foreign students has been registered. Strong political and governmental pressures were imposed on the Universities and Fachhochschulen to improve the global competitiveness of the system by structural and curricular changes and by internationally accepted measures of quality assurance like quality assessment and accreditation.

The providers of engineering education found themselves under even stronger demands: rapidly changing requirements from the employers and especially industry concerning the necessary qualifications of graduates on one hand and on the other a decreasing interest of potential students in engineering studies, starting from the early nineties and obviously reflecting bad employment and career prospects. Even if the issue of quality assurance and management may not cover the whole range of possible solutions of the mentioned problems it was considered that maintaining and improving the quality of engineering education could make a positive contribution. Among the faculty and engineers an above average amount of openness to these topics could be assumed as from

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research and industrial links they are much more familiar than other subject areas with concepts like total quality management (TQM) and ISO 9000.

Finally, experiences in other countries, mainly in the European Union and the USA, and the debate on transnational comparability and on qualification levels illustrated the advantages of elaborated quality assurance systems as well as the fact that Germany was far behind international developments. It may therefore be helpful to first describe and comment on some developments in Europe before going into details of recent German activities.

QUALITY ASSURANCE IN EUROPEAN HIGHER EDUCATION

Positions and strategies on the European Union level

According to the Treaty of Maastricht the European Government and the European Commission based on the principle of subsidiarity has only very limited and mainly stimulating and supportive responsibilities with regard to education and training. Nevertheless, contributing to the political aims of increasing integration and continuing economical growth the EU Commission repeatedly stressed the importance of high quality education, the advantages of diversity and, respectively, the need for transparency, mutual recognition and common actions for maintaining the quality of education.

Encouraged by experiences of some member states, namely the Netherlands, UK, France and Denmark, the EU in 1994 launched a European pilot project on quality assessment in higher education in order to disseminate, evaluate and improve concepts applied so far in the mentioned countries [1]. It was limited to a few disciplines and subject areas, among them mechanical engineering. Only a few universities and other higher education institutions of the member states could take part. In mechanical engineering one German university (TU Dresden) and one Fachhochschule (FH Osnabrück) have been involved. The main intention was to create familiarity with the approach itself encompassing internal self-evaluation, external evaluation by peers based on site visits and a final assessment and report. The focus was not on comparison and ranking. The pilot scheme was valued as successful and stimulating and raised the interest in further actions and detailed information about the approaches and experiences of other countries.

The German Rectors Conference (Hochschulrektorenkonferenz–HRK) as well as the Science Council (Wissenschaftsrat) in 1995 adopted recommendations for establishing a system of quality assurance in German higher education [2].

The Council of the European Union on February 26,1998, recommended that Member States (quote) 'support, and where necessary, establish transparent quality assurance systems with the following aims [3]:

- to safeguard the quality of higher education within the specific economic, social and cultural context of their countries while taking due account of the European dimension in a rapidly changing world;
- to encourage and help higher education institutions to use . . . quality assurance as a means of improving the quality of teaching and learning;
- to stimulate mutual exchanges of information on quality and quality assurance at Community and World level, and to encourage cooperation between higher educations in this area.'

Against the background of this recommendation it can be expected that the EU will continuously support projects for implementing quality assurance systems in the member states and document and exchange the experiences.

Quality assessment

As early as 1987 the Association of Dutch Universities, VSNU, started reviewing the quality of programs of study in a six-year cycle, following a governmental statement from the Dutch Ministry of Education of 1985 that the institutions themselves are responsible for the quality assurance of their educational programs. In 1992 the External Quality Assessment (EQA) was extended to all major university programs. Also cross-border evaluations, e.g. in the field of electrical engineering, have been performed. Thereby the Dutch model with its combination of self-evaluation and peer review and finally public reports inspired similar developments in other European countries [4].

The evaluation is related to subject fields and focuses on the departments providing respective courses of study. All programs offered in a certain subject field in the Netherlands are evaluated at the same time. But the central aim is not comparison and ranking but quality improvement. Consequently the programmes and departments are not assessed against certain external standards but against the mission and objectives of every single program and department in charge. Therefore the assessment is fairly open with regard to special profiles and approaches in teaching and learning. Nevertheless VSNU provides a questionnaire and a list of topics which have to be answered by the self-evaluation and which additionally may be stressed in the context of the on-site visit of the peers and the final report [5].

It turned out as one advantage of the assessment procedures that the self-evaluation process significantly raised the sensitivity for quality matters in education and led to changes even before arrival of the visiting committee. However, it should be emphasized that the evaluation, finally resulting in a report and certain recommendations, does not itself improve the quality but has to be a starting point of a process of continuous quality

management and constitutes only one part of a quality assurance system.

This leads to recent developments in the UK which represent a more comprehensive approach to quality assurance.

Quality assurance

Quality assurance as defined by the UK Quality Assurance Agency for Higher Education as 'the totality of systems, resources and information devoted to maintaining and improving the quality and standards of teaching, scholarship and research and of students' learning experience' [6].

Quality assessment in the UK started as early as 1984 with external reviews of university research activities and was later extended to teaching and learning in the framework of the now Higher Education Funding Council (HEFC). In addition to these activities, starting in 1991 the then Higher Education Quality Council (HEQC) has undertaken quality assurance audits of all institutions [7]. From August 1997 the HEQC was replaced by the Quality Assurance Agency (QAA) with an extended mission and the responsibility for a continuation audit with a focus on the 'general question of how individual institutions discharge their obligations and responsibilities for the academic standards and quality of their programs and awards' together with the evidence they use for this purpose. External quality assurance audits will be integrated with quality assessment concerned with the quality of teaching and learning. In addition, universities are expected to have their own internal quality assurance processes which will be also assessed by the external review and are essential if a good QAA report is to be obtained [6].

Pilot schemes are under way now to investigate how QAA procedures can be coordinated with additional external assessments in the context of accreditation procedures of Professional Institutions namely in the field of engineering. This applies not only to the procedures themselves but also to the intention of QAA to, in the midterm, establish benchmarks for threshold standards, which partly already is a common pattern within accreditation evaluations. The attempts for better coordination reflect a serious concern of the universities and departments especially in engineering, feeling themselves threatened by too many external assessments and questioning whether the results are in reasonable relation to the tremendous efforts necessary to run the procedures.

However, not only the overall quality assurance system looks to be qualified but also the internal systems have been improved with a range of different procedures in place including all kinds of data collection, special organisational provisions, terms of reference for the various bodies involved, internal benchmarking and performance indicators, performance assessment, students questionnaires, staff/student workshops and follow-up activities like for instance curriculum revisions and compulsory staff development courses on teaching. Like elsewhere in Europe many departments or universities were trying to apply methodologies well known in the business world like ISO 9000 and TQM. ISO 9001 provides the foundations of a quality management system but is no safeguard of educational excellence. It even became evident that the rigorous application of ISO 9001 may be dysfunctional, at least not worthwhile because of its mainly formal approach. Instead, some universities preferred TQM and a methodological approach based on the European Foundation for Quality Management (EFQM) model for Business Excellence [8].

Accreditation

Some European countries, namely the UK, Ireland, France and Portugal, for maintaining certain standards of professional qualification in engineering education and for ensuring professional recognition employ special procedures to accredit either programs of study or confer the right to award certain protected degrees to accredited higher education institutions. The most prominent example outside Europe are the accreditation procedures of ABET, the US Accreditation Board for Engineering and Technology. Whereas quality assurance is focused on systems and processes of quality management in general, quality assessment preferably deals with quality standards as defined by the educational institution itself. Accreditation procedures assess quality in terms of a minimum, better say necessary or acceptable, quality from the professional point of view, represented by a certain set of criteria and standards. Departments applying voluntarily for accreditation of their programs have to prove that they fulfil these criteria and standards. Increasingly accreditation procedures focus on outcome assessment instead of in-put indicators, like actually exercised by the new ABET Criteria 2000 [9].

Despite certain similarities of the criteria and the procedures of self-evaluation and external evaluation the standards in detail look fairly different depending on the national context and philosophy of professional qualification.

The Thematic Network 'Higher Engineering Education for Europe' (H3E), started in 1997 and funded by the EU Program SOCRATES, investigates the different approaches. Somehow in favour of a European approach to accreditation comparable to ABET the members of the respective working group 2 of the Thematic Network had to admit that for the moment transparency and mutual recognition of the various approaches of accreditation and quality assessment turns out to be more accessible than common standards and procedures [10]. As a consequence, countries like Germany, searching for appropriate and effective concepts of quality assurance cannot rely on European solutions in the near future but will have to establish there own system. Remarkable initiatives have been undertaken recently [11].

GERMAN APPROACHES TO QUALITY ASSURANCE IN ENGINEERING EDUCATION

How to maintain or achieve high quality engineering education? Recently this question is not only answered by pointing to the need for a continuous reform of education and training and the adaptation of the curricula and courses to new demands but also by stressing the need for elaborated quality assurance systems and effective quality management. The latter applies as well to the relations between the governmental level and the higher education institutions as to the internal shaping of quality assurance and management in every single institution.

Engineering education in Germany

Quality matters are to be discussed in the context of historical, societal, political and economical developments and against the current state of the art. Therefore a brief review may help in understanding the current German system of engineering education.

Two main types of higher education institutions in engineering exist in Germany: the Technische Universität (TU) or Technische Hochschule (TH) and the Fachhochschule (FH). To let the name 'Fachhochschule' be more comparable to the English speaking world it recently is officially translated by the term 'University of Applied Sciences' as to underline the profession-oriented education.

The standard admission requirement at the Technische Universität/Technische Hochschule is the Abitur, a certificate awarded by the general secondary schools (usually a gymnasium) after 13 years of general school education. The final degree awarded in engineering is the 'Diplom-Ingenieur' (Dipl.-Ing.). Universities offer five-year courses of study which are research oriented. The still very liberal system of studies in Germany permits the extension of the actual duration of studies; thus the average is about 13 semesters. As a prerequisite, half a year of internship has to be spent in industry, usually 13 weeks before entering university and 13 weeks during the semester breaks. The studies are theoretically and research oriented and therefore their awarded Dipl.-Ing. degrees are judged as being equivalent to the master of science degrees of high ranking foreign universities.

The courses of study at Fachhochschulen are geared to applied engineering and professional practice. The degree awarded is the 'Diplom-Ingenieur (FH)'. Fachhochschulen offer four-year courses of study i.e. eight semesters including at least one practical semester in industry. The average time for graduation is about nine semesters. Their Dipl.-Ing. degrees are so far felt to be equivalent to a bachelor level honours degree, or even the newly established MEng degrees in the UK. Admission requirements are either the Abitur (after 13 years of general schooling) and usually 13 weeks of practical experience as a prerequisite, or the Fachhochschulreife, a certificate issued after ten years of general school education plus two years of specialised education at an upper secondary vocational school (Fachoberschule). Alternatively the Fachhochschulreife can be awarded after ten years of general school education followed by an apprenticeship in a related technical field plus one additional year at an upper secondary school.

Traditionally the German system does not differentiate between undergraduate and postgraduate studies. Up to 1998 the only degree awarded in engineering was the 'Diplom-Ingenieur', its profile and level depending on the awarding institution, i.e. a University (five-year courses of study), a Fachhochschule (four-year courses of study) or – more recently – a Berufsakademie (three-year courses of study). The revised law of the Framework Act of Higher Education of 20 August 1998 grants in §19 Universities and Fachhochschulen to establish bachelor and master degree courses in parallel to existing diploma degree courses. These new courses can be offered in German and/or English language. The latter is to attract English speaking students holding a bachelors degree from a foreign country. The implementation of these new courses has already started. Master courses can be regarded as the beginning of a formalised postgraduate education in Germany. The newly implemented master courses supplement the so far existing postgraduate specialisation courses ('Aufbaustudiengänge') which do not award an advanced degree but rather state in a certificate the successful participation. Also more formalised studies for a doctorate degree may complement this newly launched system of post graduate education.

Only university-type institutions are entitled to award a doctorate in engineering (Dr.-Ing). It takes the form of a research project and does normally not involve taught courses of study. Doctoral candidates are usually not enrolled students, but are employed full- or part-time in the university or in industry. The period of time to finish a Dr.-Ing. degree is three to five years. A thesis has to be presented to the university and be defended in public. Prerequisite to register for a doctorate is a degree of Diplom-Ingenieur from an university-type institution. Recent new regulations also allow highly qualified graduates from a Fachhochschule to apply for a Dr.-Ing. degree.

Governmental policy and quality assurance

Higher education in Germany is nearly completely state financed, with the 16 States (Bundesländer) responsible for the overall costs of running the universities and other higher education institutions and the Federal Government contributing to the investment in buildings and equipment. Despite the autonomy of every single higher education institution the governmental authorities take a significant influence on ensuring the quality of

education and training and on the general functioning of universities and other institutions. This takes place by means like:

- legislation, framework regulation and directives;
- funding and budgeting;
- approval of study programs and examination regulations;
- appointment of professors based on proposals of the institutions.

By constitutional law (Grundgesetz) the Federal Government and the States are committed to avoid too big differences between the 16 States, e.g. guarantee certain common standards in education and training and thus allow mutual recognition of studies and degrees. In order not to erode the autonomy of the universities this general legal obligation according to study programs is pursued by framework regulations for the examinations which are regularly updated. These regulations are recommendations for the institutions, not governmental orders, but play an important role in the approval process of study programs forcing the departments as the provider of the programs to defend their positions in case of deviations from the recommendations.

As the framework regulations influence the quality of education and final degrees to quite an extent it has to be mentioned that the regulations are not a mere product of the government administration but the result of negotiations between governmental representatives and the respective faculties. In engineering also the associations of the employers and the professions and the unions, which are members also in the non-governmental German Commission on Engineering Education (Deutsche Kommission für Ingenieurausbildung – DKI) are invited to contribute to the process. For many years these associations, like VDI (Verein Deutscher Ingenieure), VDE (Verband der Elektrotechnik, Elektronik, Informationstechnik). VDMA (Verband Deutscher Maschinen- und Anlagenbau) and ZVEI (Zentralverband Elektrotechnik- und Elektronik-Industrie) and the IG Metall (Industriegewerkschaft Metall) have taken a serious interest in engineering education and published recently proposals on how to adapt engineering education to new demands and how to improve internationalisation [12].

The framework regulations neither go into details of aims and objectives or contents of courses nor do they tell anything about methods or educational settings or how to achieve the expected standards. This is up to the departments and faculties which also have their own national bodies, called Fakultätentage or Fachbereichstage, to discuss standards and quality matters in detail and influence the educational practice on an informal way. The framework regulations offer a reasonable freedom to the responsible departments to specify their curricula and organise their educational practice with regard to intended profiles or student interests, to demands of employers and society or to technological and scientific innovations [13].

Despite the inherent flexibility and adaptability of the system, criticism has increased continuously during the last years stressing the bureaucratic processes and the fairly slow reactions to new needs and the unsatisfactory educational quality in general terms. In engineering, complaints have been expressed concerning high drop-out rates, unacceptable extension of the duration of studies from scheduled 9 or 10 to an average of 14 semesters and the obvious preference of the scientific staff for research instead of teaching.

This situation has caused quite a range of political measures. As one element of a new governmental strategy regarding accountability and quality assurance, the higher education institutions were required to deliver annual reviews of their educational activities, so-called 'Lehrberichte' (teaching reports). They complement and detail the more general annual reports and reports of research activities which voluntarily have been published by many universities in previous years. 'Lehrberichte' have been perceived as a step forward into a comprehensive system of quality assessment because they provide most of the information needed for self-evaluation reports. But up to now systematic external evaluations by peers took place in few cases only, executed by regional bodies like ZEvA (Zentrale Evaluations-Agentur Niedersachsen) or the so called 'Nordverbund', or by specialized centres like HIS (Hochschulinformationssystem) or CHE (Centre of Higher Education Development). Only one of the 16 States – Niedersachsen/Lower Saxony – implemented a system of external evaluation covering all study programs offered in Lower Saxony. Nordrhein-Westfalen/North Rhine-Westfalia is going to follow and has established two evaluation agencies, one for Universities and another one for Fachhochschulen [14].

However, many universities or departments on a voluntary basis asked for external quality assessment by various national or international bodies. In some cases networks of universities were founded providing the possibility for comparative and cross-border evaluation, in engineering education for example an evaluation network of the universities of Darmstadt, Kaiserslautern, Karlsruhe and the ETH Zürich. The Technical University Karlsruhe also asked ABET for an evaluation on substantial equivalence.

The German Rectors Conference (HRK) since the beginning of 1998 executes a three-year national program to enhance the exchange of information and experiences in the field of quality improvement measures in German higher education (The Quality Assurance Project) across the Federal States [15]. The objectives of the project state that a crucial issue in quality assessment is not the evaluation itself but the outcome with regard to quality improvement.

Respective actions are envisaged by self-commitment or contracting and are often assessed by follow-up evaluations.

In 1998 a revised Higher Education Framework Act (Hochschulrahmengesetz) has been adopted which may well result in substantial changes in the relations between government bodies and higher education institutions and in new approaches to quality assurance. In due course the autonomy of Universities and Fachhochschulen is expected to be strengthened whereby the current state control and management of the higher education system will switch from explicit interventions to more implicit approaches, outcome orientation and management by objectives. Regarding the aim of quality improvement by specifying institutional profiles and promoting competition the most effective means in this direction will be:

- financing and budgeting, which will be partly based on either performance indicators or contracted 'global' budgets with a commitment to certain objectives;
- accreditation of programs of study;
- external quality assessment on a regularly and mandatory basis.

Accreditation

Accreditation of courses of study will be a new feature in the context of quality assurance in Germany and may in the future replace the current system of *ex ante* implementation and control of certain standards by approval of examination regulations. The establishment of an accreditation structure in the years to come and during a pilot phase will be restricted to the new bachelor and master programs. A central Accreditation Council was appointed in July 1999, and soon will itself authorise certain Accreditation Agencies. These agencies will then organise or undertake the necessary procedures for accreditation in the various subject fields.

In engineering education expectations have risen that Germany could rely on international standards while searching for appropriate quality levels for bachelor and master degrees. But from some investigations and case studies it soon became obvious that no common international standards exist [16]. Analysing in some detail the approaches of ABET in the USA, The Engineering Council in the UK and the CTI in France, it also turned out that even the accreditation procedures and bodies differ remarkably [17]. However, some essentials they have in common:

- Accreditation procedures are focused on programs of study but include evaluations of the providers of the programs and the adequate facilities.
- The main goal is the assurance of satisfactory minimum standards of the programs and outcomes, in the vast majority of undergraduate programs leading to a first degree.
- The procedures usually embrace a combination of self-evaluation, external peer review based on a site visit, recommendation by the visiting committee (peers) and the final decision of the responsible Accreditation Board or Institution.
- The Accreditation Bodies cover the whole range of engineering education in a certain country and demonstrate a predominant involvement of the professions.
- The application for accreditation is voluntary.
- Passing an accredited program of studies may enhance job perspectives but is – particularly in the UK and USA – felt as one step to professional qualification only which must be completed by structured professional experience before registration or licensing as a professional engineer can take place.

Some very recent developments also show a high degree of commonality:

- the extension of the objectives of accreditation procedures to the encouragement of quality improvement;
- the shift from in-put to outcome assessment;
- the widening of external assessment procedures granting greater flexibility for the peers to recognise special profiles instead of executing a rigid application of detailed standards;
- finally, the checking and proof of the existence of an internal quality assurance system as one of the evaluation criteria.

Against this international background the current German debate regarding accreditation in engineering education (as of October 1999) did not arrive at a final decision about accreditation bodies and procedures yet. Different proposals are under consideration and may seek recognition by the already mentioned Central Accreditation Council. Roughly they can be classified as:

- the quality label approach;
- the professional standards approach;
- the quality improvement approach.

Some of the traditional Technical Universities, already cooperating for some time in a voluntary working group, in autumn 1998 founded the 'Akkreditierungsverbund für Ingenieurstudiengänge e.V.' (AVI) in order to be involved in the new accreditation activities. Their first intention was not to cover the whole range of engineering education from Universities, Fachhochschulen and the Berufakademie but to take care of the maintenance of the high standards of scientific and research-related university programs. In a sense they want to create and promote their own quality label and try to get it internationally recognised. Consequently and in order to cover all different profiles of engineering education in Germany other quality labels would be needed e.g. one for more application-oriented programs of study. AVI meanwhile started to organise subject-related

commissions by asking the member universities to nominate experts of their faculties; in addition representatives of companies and professional organisation should be invited. These commissions will develop criteria and standards applicable in the future for the accreditation of high-level bachelor and master programs.

Professional and industrial organisations, like VDI, ZVEI and VDMA, but also the Fachhochschulen were not fond of this 'sectorial' approach. They also criticised the implicit tendency of academic self-accreditation instead of employing external assessment with a significant participation of the profession, even if there was no doubt that the envisaged quality label would easily fulfil the nationally expected or internationally known standards of accreditation. The VDI in November 1998 expressed its willingness 'to participate in the preparation of an internationally coordinated program-related criteria system for ensuring the (minimum) quality assurance for the engineering study program, and regards this as the most important prerequisite for preventing disadvantages for German engineering graduates in an increasingly internationalised job market.' The VDI also recommended a countrywide accreditation system for bachelor and master programs in order to ensure a high level of quality of all engineering courses, study programs and degrees throughout Germany.

Together with the previously mentioned associations from the mechanical and electrical industry and other professional organisations the VDI in the beginning of 1999 started the foundation of the German Accreditation Board for Engineering Education (GABEE) with the intention to cover the whole range of engineering education on the undergraduate level leading to a bachelor degree as well as on the postgraduate master degree level. Current discussions are centred on organisational questions of GABEE and also on the decision on criteria and standards. It can be expected that due to the strong links to the professional world, to FEANI and the Washington Accord member organisations and to ABET the envisaged criteria and standards will have a stronger bias to professional than to academic standards.

Finally, a third approach enhanced the debate as the ZevA: the Evaluation Agency of Lower Saxony, announced its interest to deal not only with quality assessment but also with accreditation. The Agency pointed to the great experience they had already gained from organising external assessments based on self-evaluation and referred to the need for coordination of the various assessment procedures to not overburden the higher education institutions with all types of evaluations and audits. In addition it was reminded that besides probable synergy effects the final idea in all the evaluation business should be continuous quality improvement and not merely the assurance of minimum standards.

Meanwhile the AVI and the VDI initiative merged. Together with industrial and professional organizations they founded in August 1999 the 'Akkreditierungsagentur für Studiengänge der Ingenieurwissenschaften und der Informatik (ASII)' – the Accreditation Agency for Programs in Engineering and Computer Science – to cope with the whole range of qualifications and degrees of all types of higher education institutions in these subject areas. Besides the assurance of quality and standards and the professional relevance of the qualifications on national and international level the support of a continuous improvement of engineering education will be an additional objective of the agency. It is expected that ASII as well as ZEvA will be authorised as Accreditation Agencies by the German Accreditation Council and that the first accreditation procedures of bachelor and master programs will start in the year 2000.

CURRENT INITIATIVES OF HIGHER EDUCATION INSTITUTIONS

Accreditation procedures – which as explained are not yet in operation in Germany and restricted to the new bachelor and master courses – are so far not the main issues of concern when quality assurance is discussed on the institutional level. With regard to research, well elaborated review and assessment patterns by the scientific community and in the framework of the German Science Council are established and working satisfactorily. Weaknesses besides the institutional management and administration have been registered, relating to the quality of teaching and learning. In addition to governmental measures individual Universities and Fachhochschulen on a voluntary basis started their own initiatives to develop quality assurance and implement quality assessment, but often these initiatives are restricted to assessments of teaching and the individual lectures or the teaching/learning environment in general by students [20]. In most cases these initiatives are not part of a comprehensive concept but represent special approaches or pilot schemes of even a single department or institute.

As far as quality assurance systems are concerned it also in Germany became somehow popular at official events to refer to industrial and commercial approaches, starting from the point that universities and other higher education institution must be perceived as being of large service enterprises determined to serve various external and internal customers, in particular the students, but also the employers. The most prominent ones are ISO 9001 and TQM. But on the institutional level they are either not well known or felt to be inappropriate, much too formal and cost and time consuming in application. This is in particular the case with ISO 9001. Apart from a few departments or institutes of business administration or economy no attempts can be registered to

implement ISO 9001 on a wide scale. TQM approaches on the other hand are felt more promising and applicable among providers of engineering education, of course only if they have been adapted to the special needs. They are more process instead of product oriented, focus on customers as well as on employee satisfaction and stimulate a continuous improvement of quality. SEFI, the European Society for Engineering Education, already in the eighties tried to make the concept known to engineering faculties and institutions [21]. CESAEER, the Conference of European Schools for Advanced Engineering Education, in 1995 and again in 1997 launched a discussion on quality and TQM and made it a central issue of there 8th General Assembly in November 1997, trying to initiate pilot applications in universities of different countries in order to allow comparisons of the advantages and constraints [22].

For Germany only a few examples of TQM experience can be quoted so far, one of them at the University of Kaiserslautern (at the Lehrstuhl für Industriebetriebslehre und Arbeitswissenschaft). Like other universities in Europe they refer to the concept of the European Society for Quality Management (EFQM) because it is oriented to the overall organisational quality and on 'business excellence'. In a recent review in the framework of the German Rectors Conference (HRK) Project on Quality Assurance the Kaiserslautern Institute reported that the self-assessment activities following the nine elements of the EFQM model turned out to be a successful experience but the partly very abstract descriptions of the concept needed a careful adaptation to the needs of the own organisation at first. To motivate and get all members of their institute familiar with the concept a comprehensive information phase marked the beginning of the application. After presentation of the results of the first self-assessment to all members of the institute a second round of self-assessment was initiated organised as a mediated workshop. It opened the way to the next step, the determination of improvement projects and the foundation of respective project teams. One of the most important projects was the development of a process model covering all kinds of processes of the institute in research, teaching, consultancy and the overall management and identifying the influencing factors and performance indicators. From the experiences it became obvious and was emphasised that the implementation of TQM takes time and therefore must be a long-term goal and not just a standalone assessment activity. Business excellence as a vision can not be an outcome of a certain time- and content-restricted project but must be a feature of the organisational culture [23].

In a broader range the theory and concepts of learning organisations and various approaches of external consultancy may for many departments be more promising to maintain quality than the quoted ISO 9001 and TQM concepts.

CONCLUSIONS

Germany – like other European States some years before – has recently increased its efforts to establish quality assurance in higher education and to promote effective quality management on both institutional and departmental levels. Since significant political and control responsibilities in the state-funded Higher Education system are still the responsibility of the 16 States of the Federal Republic, developments will continue to be somehow divergent and at different paces. Nevertheless, in the years to come internal and external evaluation in regular sequences will become mandatory and will embrace all fields of education, including engineering education. Still controversial is the question of public access to the evaluation outcomes. A totally new approach for Germany is the establishment of Accreditation Agencies and the introduction of accreditation procedures, initially to be run as a five-year pilot scheme and limited to the recently legislated and now strongly promoted bachelor and masters degree programs. In engineering the ASII the 'Accreditation Agency for Programs in Engineering and Computer Science' – founded in August 1999 – will probably be in charge of the accreditation procedures and will strengthen the influence of the professions in shaping engineering education and improving quality. It may well happen that in future years the more profession oriented assurance of minimum standards by accreditation procedures will replace the current administrative practice of state controlled approval of programs, curricula and examinations, which still applies to the vast majority of the German programs leading to Diplom-Ingenieur degrees after four or five years of study. Highly controversial, and therefore difficult to predict at this time, is whether in the future the traditional German parallel system of Universities and Fachhochschulen with their different missions and profiles will be totally replaced by a consecutive system of undergraduate and post-graduate studies in the tradition of the Anglo-American system. This direction was recently recommended in the so called Bologna-Declaration as a reference structure for the European Union higher education and supported by a statement of the German Science Council (Wissenschaftsrat) from January 2000 concerning the introduction of bachelor and master degree programs in Germany.

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Gunter Heitmann is senior researcher in the subject fields of engineering curriculum design, higher education teaching and learning and teaching staff development at the Technical University of Berlin. He earned his Diplom-Ingenieur degree in architectural engineering

from the Fachhochschule Oldenburg and an additional Diplom-Kaufmann degree in economics and business administration from the TU Berlin. In 1970 he was a founding member of the Institute for Didactics in Higher Education, now part of the Institute for Research into Vocational, Higher and Continuing Education at the TU Berlin. In addition to his research activities he has been involved as well in teaching, development, consultancy and assessment activities in engineering education, e.g. as a member of the German Commission for Engineering Education, various curriculum development bodies and international expert teams of quality assessment. As an active member of SEFI, the European Society for Engineering Education, he created the Curriculum Development Working Group and is currently a member of the European Union Socrates Thematic Network H3E, Higher Engineering Education for Europe, which among other issues is strongly promoting the establishment of a European Forum for Accreditation and Quality Assurance in Engineering Education.