



Study on the Impact of ASIIN's Programme Accreditation in the Field of Mechanical Engineering and Process Engineering

Verena Reiter, March 2021

Introduction

ASIIN e. V. was founded in 1999 as a non-profit association for the accreditation of study programmes in engineering, computer science, natural sciences, and mathematics. Since then, ASIIN has been conducting accreditation procedures as an international quality assurance agency in Germany as well as abroad. Its national and international objectives are to ensure and strengthen the quality of academic education and to create transparency regarding the quality achieved in higher education in order to promote academic and professional mobility. So far, ASIIN has conducted around 5500 accreditations in Germany and more than 700 accreditations internationally in 43 different countries.

To maintain and further the subject-specific focus of its work, ASIIN relies on a number of external partners and stakeholders, among them ASIIN's institutional members, its board, and its expert panels. As a unique feature, ASIIN has established fourteen Technical Committees (TC) that cover all fields of study in which ASIIN is active. These committees supervise all accreditation procedures and prepare the decisions of the ASIIN Accreditation Commission for degree programmes. In this capacity, they oversee all procedures of their subject area and ensure their equal treatment from a professional perspective. Similar to the composition of the peer groups, each technical committee is composed of representatives from universities, the professional practice, and a student member. The TC discusses all accreditation procedures that fall within its area of expertise. This includes in particular the discussion of the deficiencies mentioned in the accreditation report as well as a final recommendation of the accreditation decision.

The Technical Committees cover the following areas:

- TC 01 Mechanical Engineering / Process Engineering
- TC 02 Electrical Engineering / Information Technology
- TC 03 Civil Engineering, Geodesy and Architecture
- TC 04 Informatics / Computer Science
- TC 05 Physical Technologies, Materials and Processes
- TC 06 Engineering and Management, Economics

- TC 07 Business Informatics / Information Systems
- TC 08 Agriculture, Nutritional Sciences and Landscape Architecture
- TC 09 Chemistry, Pharmacy
- TC 10 Life Sciences
- TC 11 Geosciences
- TC 12 Mathematics
- TC 13 Physics
- TC 14 Medicine

This study will focus on the Technical Committee 01 (TC 01). As one of the seven founding technical committees, TC 01 has been active for over 20 years solely in the field of mechanical engineering and process engineering.

ASIIN is authorised to conduct the accreditation procedure for a number of different quality seals and labels within the scope of an accreditation procedure or to verify the underlying criteria. First, ASIIN is authorised to conduct the accreditation procedure for the seal of the German Accreditation Council (AC Seal) to study programmes at German universities. Furthermore, ASIIN has developed its own international subject-specific quality seal (ASIIN Seal) which confirms that a course of study meets the high-level requirements of science and professional practice of the involved disciplines. At the same time, it documents that secure framework conditions for good teaching and successful learning are in place. The award of the ASIIN Seal by our agency is based on subject-specific criteria (SSC) which have been developed by the fourteen technical committees of ASIIN in cooperation between partners from higher education and professional practice. The SSC reflect the international standard of their respective discipline area and comply with the European Qualifications Framework and the “European Standards and Guidelines.”

Higher Education Institutions (HEI) may also decide to be simultaneously assessed for one of ASIIN’s international subject-specific quality labels: In addition to its own seal, ASIIN is authorized by the European Network for Engineering Accreditation (ENAE) to award the EUR-ACE®-Label for engineering programmes, the Eurobachelor®/Euromaster®-Label on behalf of the European Chemistry Thematic Network (ECTN) for chemistry programmes, the Euro-Inf®-Label for computer science programmes administered by the European Quality Assurance Network for Informatics Education, the AMSE (Alliance of Medical Schools in Europe) label for medical programmes as well as the EQAS Food label for programmes in food science and technology on behalf of the International Food Association ISEKI. The awarding of these labels demonstrates the compatibility of the respective degree programme with internationally accepted quality standards and the subject specific criteria. At the same time, it also promotes the mobility of students and graduates.

Goal of this Study

As a quality assurance agency, ASIIN is eager to monitor its own progress and to not only contribute to the improvement of others but to also develop and grow as a provider of such

services. In addition, being a full member of ENQA and a member of the European Quality Assurance Register (EQAR), ASIIN carries out its manifold activities in accordance with the European Standards and Guidelines for Quality Assurance (ESG). As per § 3.4 ESG, European accreditation agencies must carry out thematic analyses to “describe and analyse the general findings of their external quality assurance activities.” To carry out such a thematic analysis as requested by the ESG in order to assess whether the results of ASIIN’s activities contributes to systematically improving quality assurance systems of higher education institutions and to identify areas of improvement.

In a study published in 2018, which analysed the impact of all ASIIN accreditation procedures carried out in 2017, evidence was provided that an ASIIN accreditation generally has a positive impact on the quality of the evaluated study programmes. As this pilot study did not distinguish between different subject areas, no subject-specific results could be drawn. For instance, the quality of laboratories and equipment is of specific important for the engineering disciplines and the natural sciences while they do not play such an important role in mathematics and informatics degree programmes. As a consequence, it was decided that follow-up studies should be implemented which analyse ASIIN’s impact from a subject-specific perspective. After a first impact study on the Technical Committee 06, this study assesses the impact of ASIIN’s accreditation procedures conducted within the field of mechanical engineering and process engineering under the responsibility of TC 01 in the timespan between September 2009 and September 2019.

This study follows a dual approach: (1) All accreditations from the field of mechanical engineering and process engineering in the defined ten-year period are analysed with regard to their accreditation results. This allows conclusions about the fundamental benefits of accreditation as well as a subject-specific evaluation of accreditation procedures and decisions undertaken in this field. The individual seals to be awarded (AC Seal, ASIIN Seal, EUR-ACE®-Label) are compared with each other. (2) The second part of the study deals with study programmes that were accredited twice by ASIIN within the period of the study. The longitudinal comparison between the results of the initial accreditation and the re-accreditation allows for a conclusion whether an ASIIN accreditation actually leads to a long-term improvement in the quality of the accredited study programmes. For this reason, not only the accreditation result as such is consulted, but especially the requirements, insofar assigned, are analysed. The requirements indicate the areas in which the individual accredited study programmes did not meet or not fully meet the criteria. An analysis of the requirements allows us to find out whether there are deficiencies across study programmes and HEIs, and to what extent these were addressed in the course of the re-accreditation. The comparison of the imposed requirements in the initial accreditation and the re-accreditation also makes possible to determine whether the deficiencies found in the initial accreditation were corrected in the long term, which would be proof of the positive impact of an accreditation with ASIIN.

Conceptual Basis and Definitions

The following analysis is based on the reports of the accreditation and re-accreditation procedures carried out by ASIIN in the field of mechanical engineering and process engineering between September 2009 and September 2019. This ten-year timeframe was chosen for different reasons: Primarily, this timeframe allows for the analysis of a large set of data that in turn enables specific conclusions about the impact of an ASIIN accreditation. Furthermore, the vast majority of accreditation procedures conducted after September 2019 for the award of the AC Seal fall under the premise of a so-called “new accreditation law.” Based on a resolution by the German Federal Constitutional Court on February 17, 2016, the German accreditation law was reformed in essential points, establishing a new legal basis. As a result, the accreditation agencies are no longer authorised to decide upon the accreditation for the AC Seal; instead, they continue to conduct the accreditation procedure but then compile a report to the Accreditation Council which makes the final decision. Contracts for accreditation procedures concluded between the university and the agency from January 1, 2018 onwards are subject to this new law. The old accreditation law was still valid for most accreditation procedures concluded until September 2019 as those contracts were signed before 2018; from September 2019 on, the “new law” is predominantly applicable. Since ASIIN does not pronounce the accreditation decision in cases of the “new law”, the impact of ASIIN on the quality of these study programmes cannot be measured. Thus, when referring to the AC Seal in this study, this applies to cases of the “old legislation.”

For clarification, the following definitions will be utilized throughout this study:

- **Accreditation:** Award of a seal/label for a study program after a successful accreditation process and thus a positive accreditation decision (This also includes suspensions, insofar as they subsequently led to a positive accreditation decision).
- **Initial Accreditation:** In the case of two successive accreditations of the same study programme, “initial accreditation” marks the first of these two.
- **Re-Accreditation:** In the case of two successive accreditations of the same study programme, “re-accreditation” marks the latter of these two.
- **Accreditation Procedure:** Assessment for accreditation per seal/label per degree programme (If a degree programme is awarded three individual seals/labels, e.g. AC, ASIIN, EUR[®]-ACE, this counts as three accreditation procedures).
- **Seals/labels awarded:** Seals/labels awarded to a degree programme upon a positive accreditation decision. (This also includes suspensions insofar as these subsequently led to a positive accreditation decision).

The first part of this study represents a quantitative assessment of all accreditation procedures in the field mechanical engineering and process engineering under the responsibility of TC 01. The second part of the study focuses on those procedures which have undergone re-

accreditation in the period under review. Particular attention is paid to the requirements imposed for the accreditation of the individual programmes. Since the AC and ASIIN seals are based upon different criteria, both procedures must be examined separately. The awarding of the EUR-ACE® Label depends on the awarding of the ASIIN Seal since they can only be awarded jointly.

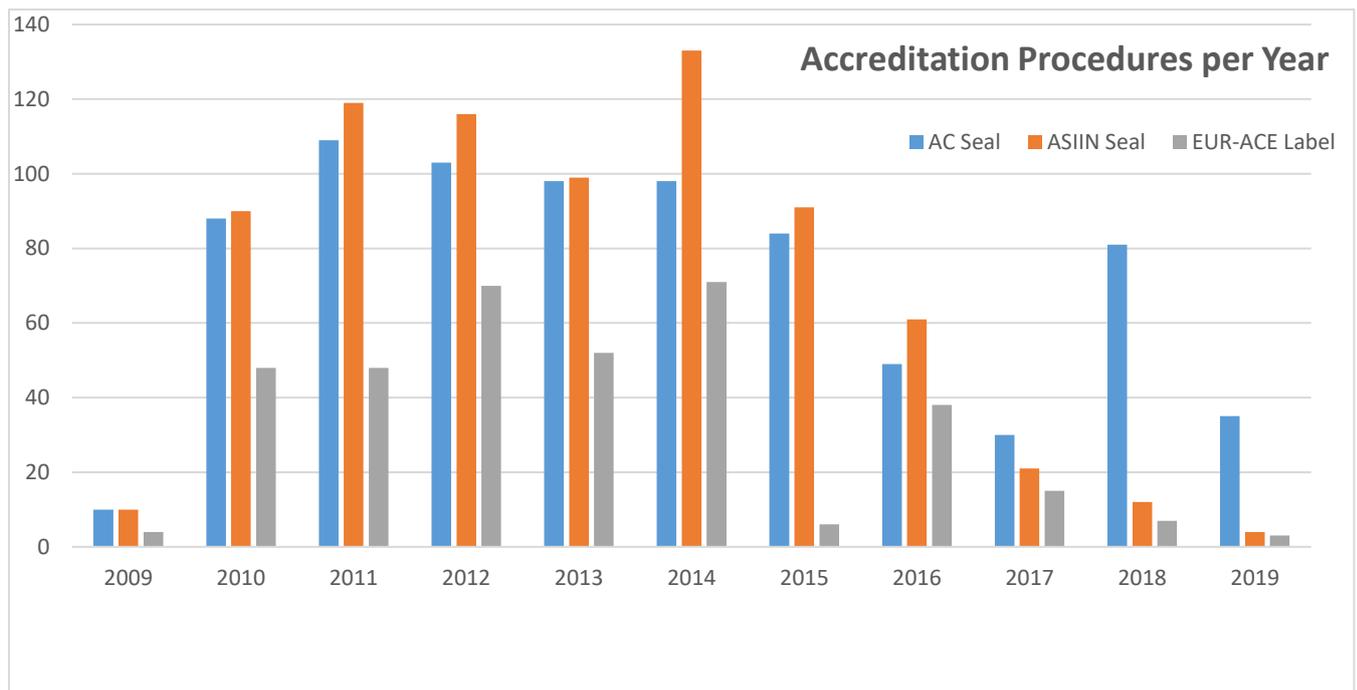
Since several topics are subsumed under each of the individual AC or ASIIN criteria, the criteria for this present analysis were expanded. The eleven criteria of the AC Seal were subsumed into a total of 26 sub-criteria; the six criteria of the ASIIN Seal were divided into 16 criteria. This consideration of sub-criteria is necessary in order to identify differentiated statements about the identified weaknesses and remedial action taken by HEIs.

Quantitative Analysis of Accreditation Procedures undertaken by Technical Committee 01 – Mechanical Engineering and Process Engineering

The investigation of the accreditations was carried out as a structured content analysis of the requirements issued by the ASIIN Accreditation Commission for Degree Programmes. This study is not based upon randomly selected samples but constitutes a complete survey of all degree programmes that have been assessed by ASIIN in the field of mechanical engineering and process engineering between September 2009 and September 2019.

	Total number of accreditations	Involvement of TC 01	in %
All Accreditations	3374	912	27.0
AC Seal only	633	156	24.6
ASIIN Seal only	751	127	16.9
AC and ASIIN Seal	1990	629	31.6
EUR-ACE Label	831	416	50.1

As the table above shows, during this ten-year timeframe, the Technical Committee 01 has been involved in 912 accreditation, a total of 27% of all 3374 ASIIN accreditation processes during this time, which makes it one of the most active technical committees within ASIIN.



These numbers can be further broken down into the individual seals: The TC 01 was involved in 24.6% of all accreditations of the AC Seal (156 individual accreditations), in 16.9% of all accreditations of the ASIIN Seal (127 individual accreditations), in 31.6% of accreditations of the AC and ASIIN Seal (629 individual accreditations) as well as in 50.1% of all EUR-ACE® accreditations (416 individual accreditations). With more than a quarter of all accreditations in this ten-year period involving the TC 01, there is a substantial amount of data in order to analyse the influence of the accreditation processes conducted by ASIIN in this area. The graph provided above outlines the number of accreditation procedures per year.

The seals and labels can be awarded either in a joint procedure or separately according to legal specifications which have seen several changes over the years. Until 2016, it was possible for ASIIN to award its own technical seal in a joint procedure with the award of the seal of the Accreditation Council. Afterwards, the joint awarding of the two seals was prohibited by the Accreditation Council and the so-called "seal separation" was implemented. The separation of seals meant a considerable additional effort for the HEIs since they could only apply for the ASIIN Seal after the AC Seal had been awarded, which led to a significantly lower demand for the ASIIN Seal from 2016 onwards. Since 2018, with the change of the German accreditation law, the conditions for the joint awarding of seals have improved, yet the demand for the ASIIN seal remains comparatively small.

The award of the EUR-ACE® Label, like the award of the other European labels, is linked to the award of the ASIIN label, i.e. the EUR-ACE® Label can never be applied for or awarded on its own. Thus, a decline in accreditation procedures for both, ASIIN Seal and EUR-ACE® Label can be noted in the period investigation. However, this trend is currently undergoing a reversal. The EUR-ACE® label, and therefore the ASIIN Seal as they are jointly awarded, enjoy a growing popularity, in particular with international HEIs.

Possible Outcomes of Accreditation Procedures

An accreditation procedure can lead to several possible outcomes. After the on-site visit is finished, the final assessment by the peers with a recommendation for the decision on accreditation are documented in the accreditation report. This report is then submitted to the relevant Technical Committees of ASIIN to comment on the assessment of the peer group and the suggested requirements and recommendations. Subsequently, the accreditation report is discussed by the ASIIN Accreditation Commission for Degree Programmes which decides on the outcome of the procedure and the award of the ASIIN and the European quality seals. Finally, a notification letter with the decision and a copy of the final accreditation report are sent to the university.

Accreditation of a degree programme is granted for a limited period. An initial accreditation with one of the aforementioned seals/labels is valid for five years; subsequent renewal is valid for seven years. An accreditation procedure with ASIIN may have the following outcomes:

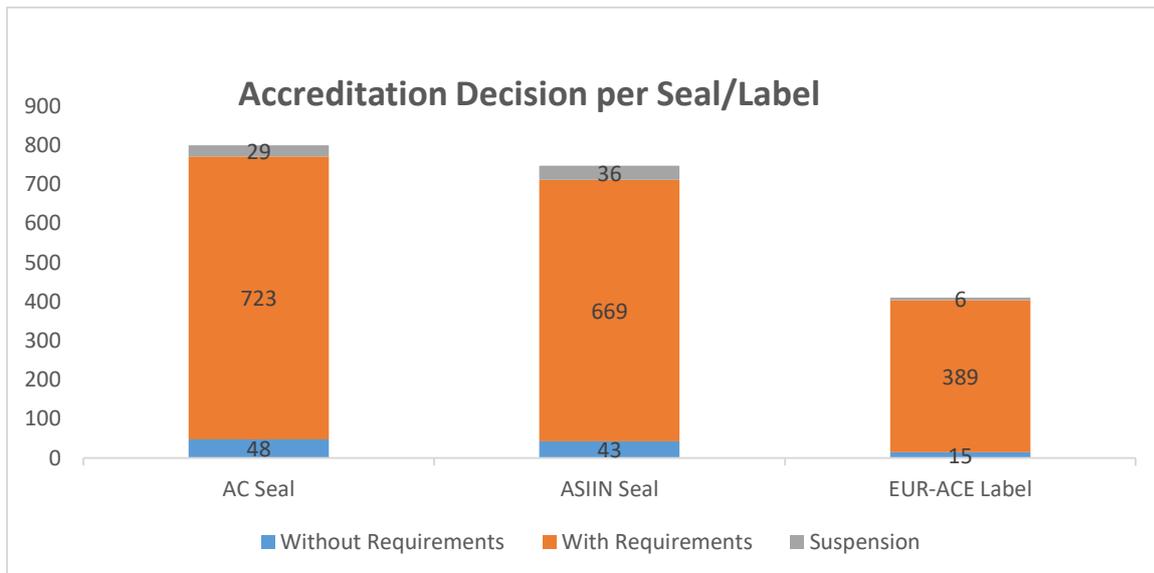
- **Accreditation without requirements** (unconditional accreditation) for the full accreditation period
- **Accreditation with requirements** and thus for a limited period (usually one year). The university has to submit documents for verifying the fulfilment of requirements in time.
- **Suspension** of the procedure. The procedure can be suspended once if the revealed deficits are so severe that it takes more than one year to resolve them and a limited accreditation cannot be awarded. The AC pronounces prerequisites that need to be met by the university before the procedure can be resumed.
- **Rejection** of the accreditation if the requirements for the award of a seal/label are not met and the problems identified are so serious that even a suspension of the procedure for a longer period does not seem promising.

Results of Accreditation Procedures

As mentioned above, all ASIIN accreditation procedures for degree programmes are discussed by the ASIIN Accreditation Commission for Degree Programmes which also decides on the outcome of the procedure and imposes prerequisites, requirements, and/or recommendations.

As the chart below shows, most of the accreditation procedures assessed during the allotted timeframe have been accredited with requirements for one year. Only 106 accreditation procedures have concluded in an accreditation without requirements (48 for the AC Seal, 43 for the ASIIN Seal and 15 for the EUR-ACE® Label). 71 procedures have concluded in a suspension and 21 have been rejected. These rejections often concern the EUR-ACE® label and were justified on the grounds that the respective study programmes do not train students to become engineers.

The following graph illustrates the accreditation decisions for the individual seals/label:



It becomes clear that the vast majority of accreditations are limited to one year (with requirements). The fact that over 90% of all accredited programmes are subject to requirements signals that they must improve in the identified critical areas in order to maintain accreditation. In this sense, ASIIN has made a positive impact on the quality of its accredited study programmes since it makes HEIs aware of problems in the study programs which they themselves might have overlooked or not paid sufficient attention to. The ASIIN expert teams thereby function as a third party, offering a view from the outside, and points out to the development potential of the study programs concerned.

In general, it is noticeable that the accreditation decisions for both the AC and the ASIIN Seal are generally speaking in line with each other. For both seals, over 90% of all study programmes are accredited with requirements and only around 5% are accredited without requirements. One reason for these similar numbers is that the formal criteria of both seals are more or less identical, for example with regard to modularisation or qualification objectives. However, the ASIIN seal also checks the subject-specificity of the study programmes on the basis of subject-specific criteria. The fact that both seals have a comparable decision-making practice in these areas seems to be due to the fact that the ASIIN also assigns subject-specific requirements for the AC Seal, albeit always under the premise of freedom of study and teaching.

In the case of suspension of procedures, prerequisites are laid down in addition to the requirements. These prerequisites must be met before the procedure can be resumed. Examples of such prerequisites show that they cover both formal and substantive deficiencies.

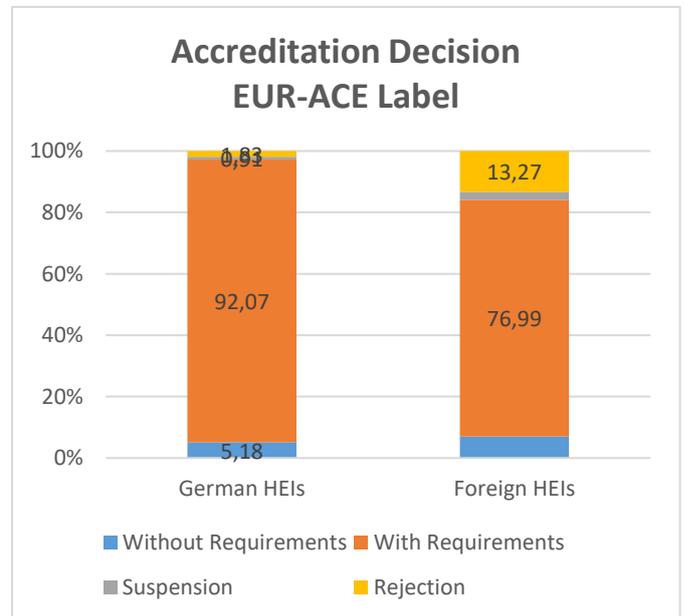
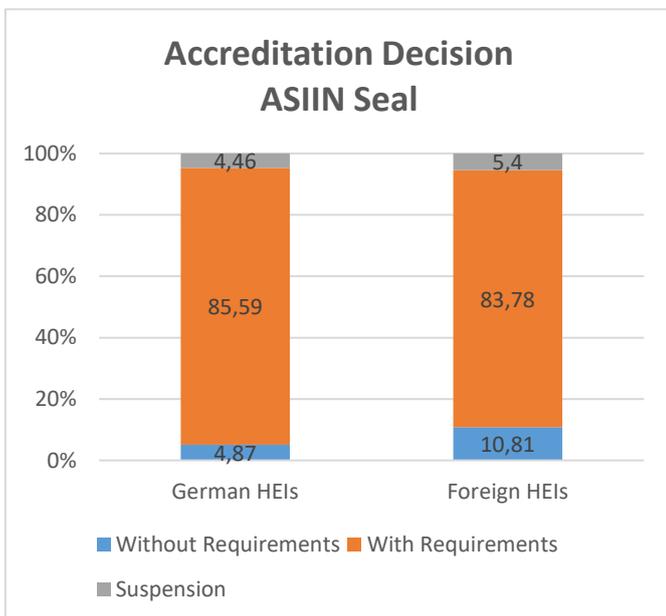
In comparison to the AC and ASIIN Seal, it is noticeable the EUR-ACE® Label has even less unconditional accreditations (without requirements). This is due to the fact that some programmes do not meet the minimum standards of an engineering degree programme as specified by the ENAEE. Although these study programmes train students to become industrial engineers, they focus predominantly on management competencies so that the engineering

competences in the programme are not high enough to train these students to become engineers as well. In those cases, the intended learning outcomes often do not comply with the engineering specific aspects.

Comparison German to International HEIs

ASIIN is very active internationally. As a consequence, we have awarded the ASIIN Seal and the EUR-ACE® Label in a number of accreditations in foreign countries. In the period under review (09/09 until 09/19), 105 study programs were accredited in ten countries for the ASIIN Seal and 85 study programs were accredited in nine countries for the EUR-ACE® Label.

Country	ASIIN Seals	EUR-ACE® Labels
Australia	18	18
Austria	1	
China	5	5
Finland	17	17
Indonesia	3	3
Kazakhstan	48	29
Peru	4	4
Serbia	3	3
Slovenia	4	4
Spain	2	2



As the graphs above show, the comparison between the accreditation results of German and foreign HEIs does not initially reveal too great a difference. For the ASIIN Seal, study programmes in Germany and abroad result in accreditation decisions with requirements in over 80% of cases. The only noticeable difference here is that foreign universities are accredited more frequently without requirements. This is rather surprising, as some would expect that in international procedures, especially given the variety of countries ASIIN has

been active in (among them some emerging nations such as Peru, Tunisia, and Kazakhstan), the quality of the accredited programmes would fall behind those of the German HEIs. Yet, data shows that the opposite is the case. In regard to the EUR-ACE® Label, the most notable difference is the comparatively high number of rejections at foreign HEIs. This can be attributed to the fact that some of the study programs, for which EUR-ACE® was requested, were not suitable for receiving the label as the program did not have enough engineering components in order to receive the label of the European Network for Accreditation of Engineering Education (ENAE). Foreign HEIs might sometimes be less aware of the necessary conditions for receiving this label. Regarding the requirements, the accreditation decisions are very similar at German and foreign HEIs if the rejections are subtracted out (92.07% for German HEIs and 88.78% for foreign HEIs).

A comparable study which was conducted for ASIIN's Technical Committee 06 (Engineering and Management, Economics) seemed to prove a concern voiced by the Technical Committees and the Accreditation Commission of ASIIN, namely that different standards are applied in international accreditation procedures. While the ASIIN criteria are the same for both national and international study programmes, the study for TC 06 suggests that the auditors judge international HEIs not as strictly as they review German ones. While they are motivated by aiding the development process of these HEIs, double standards must nonetheless be avoided. To counteract this, the study for TC 06 encourages auditors to apply the whole spectrum of possible accreditation decisions. For example, suspending an accreditation procedure gives the HEI the opportunity to better the quality of their study programmes over a longer period of time.

The data analysed for the present study of the Technical Committee 01 (mechanical engineering and process engineering) does not lead to the result that the reviewing peers judge foreign degree programmes differently. While there are more foreign degree programmes than German programmes which received the ASIIN Seal without requirements, the respective accreditations took place at just four different HEIs. Of those four HEIs, at least three are certainly on the same quality level as German HEIs (Australia, Finland, and Spain). Only one of them could be regarded as an HEI in an emerging country (Kazakhstan). As a consequence, a conclusion which indicates that foreign HEIs are treated less strictly than German HEIs is not justified on the basis of the available data. Nevertheless, this does not mean that the reviewing peers should not make certain that equal standards are applied worldwide and that foreign universities do not get a milder evaluation simply because they are situated in emerging countries.

Analysis of Re-Accreditation Procedures undertaken by Technical Committee 01 – Mechanical Engineering and Process Engineering

As outlined above, every accreditation has a certain duration: The first accreditation of a study programme, regardless of the seal/label to be awarded, is valid for five years; every further

accreditation has a duration of seven years. Upon expiration of the accreditation, a re-accreditation must take place if the seal/label is to be maintained. In order to measure the actual impact of an ASIIN accreditation on the quality of a study programme, it makes sense to assess the changes in the study programme over the period of accreditation. For this purpose, all study programmes have been analysed in the following with regard to both their accreditation decision and - if given - their requirements. This makes it possible to verify whether and to what extent ASIIN has secured and improved the quality of study and teaching in the long term and thus fulfilled its own aspirations.

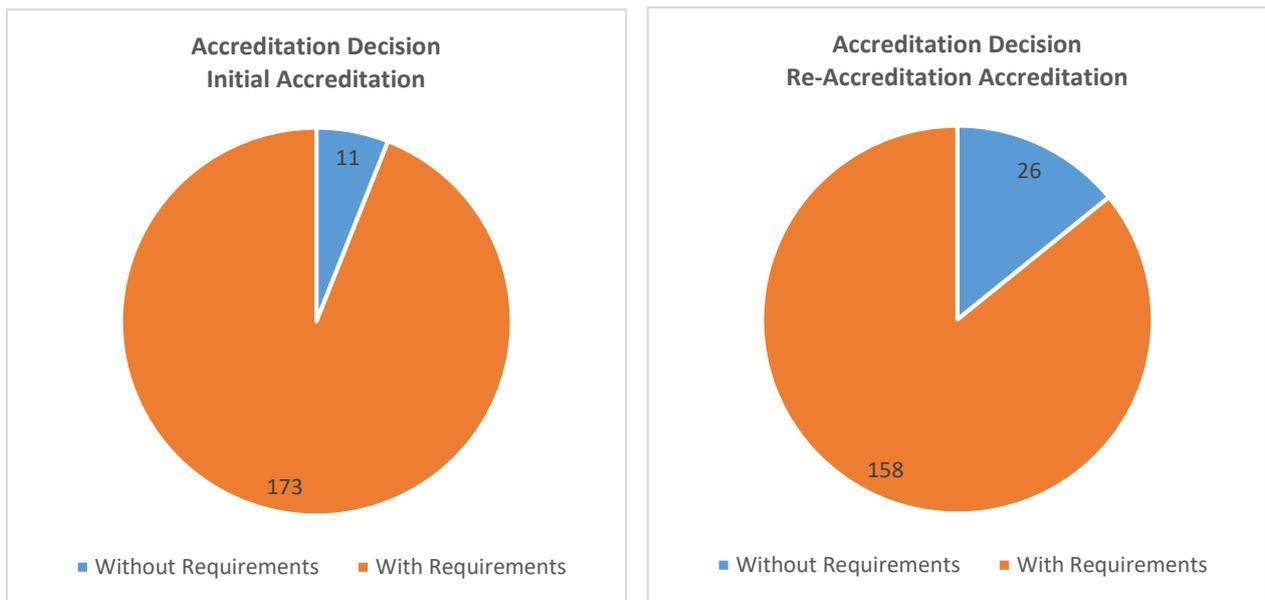
The following analysis for the field of mechanical engineering and process engineering thus concentrates on those 184 study programmes with AC Seal and 71 study programmes with ASIIN Seal that have undergone both an initial accreditation and a re-accreditation by ASIIN in the allotted timeframe of this study.

It should be mentioned that significantly fewer German study programmes have applied for a re-accreditation of the ASIIN Seal than of the AC Seal. 184 programmes have applied for a re-accreditation of the AC Seal while only 45 have applied for a re-accreditation of the ASIIN Seal. This can be explained by the already mentioned obligation to separate the seals, which makes it more difficult for HEIs to obtain the ASIIN Seal. Moreover, only seven international universities have so far undergone the re-accreditation of their study programmes. However, this is due to the fact that most of these study programmes have been accredited for the first time in 2016 or 2017, so their re-accreditation is not due until 2021/2022.

Since the seals each follow their own criteria, a separate analysis of the two seals is carried out below. As the award of the EUR-ACE® Label is linked to the award of the ASIIN label, this will not be dealt with separately but together with the ASIIN label.

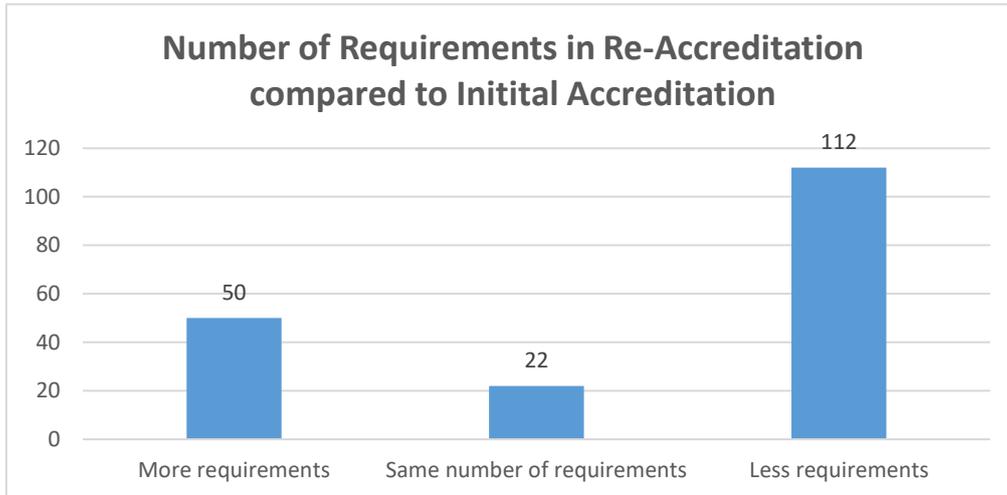
Analysis of Re-Accreditation Procedures – AC Seal

In the examined period, 184 study programmes have been re-assessed for the AC Seal. The following graphs compare the decision of both the initial and the re-accreditations:



It becomes apparent that the quality of the re-accredited study programmes has improved compared to their initial accreditation: The number of accreditations without requirements rose from 11 to 26.

Nevertheless, it is noticeable that by far the largest part of the study programmes is still accredited subject to requirements, i.e. there are still criteria that are not or only partially fulfilled. When analysing the data, it becomes clear that the number of given requirements is significantly lower in re-accreditation than in initial accreditations. To count the requirements, the conditions in case of a suspension were all treated as requirements. Having said this, during initial accreditations, 715 requirements were formulated whereas in re-accreditation 492 requirements were formulated; in absolute numbers a difference of -223. Study programmes received an average of 3.97 requirements in the first accreditation and an average of 2.72 requirements in the re-accreditation. As the graph below shows, 50 degree programmes have received more requirements in their re-accreditation than in their initial accreditation while 22 degree programmes received the same number of requirements. Yet for the majority of degree programmes, in 112 cases, the number of requirements has decreased.



The above findings generally suggest that an ASIIN accreditation improves the quality of an assessed degree programme in the majority of cases. However, it is even more revealing to assess which criteria these requirements refer to and to what extent the same criteria were found to be not fulfilled in the initial and the re-accreditation or whether a shift has taken place here.

For this purpose, an analysis of the requirements of all re-accredited study programmes that were issued during the initial and re-accreditation was carried out. The criteria for the award of the AC Seal were broken down into further criteria in order to be able to make as precise a statement as possible about the deficiencies that were found.

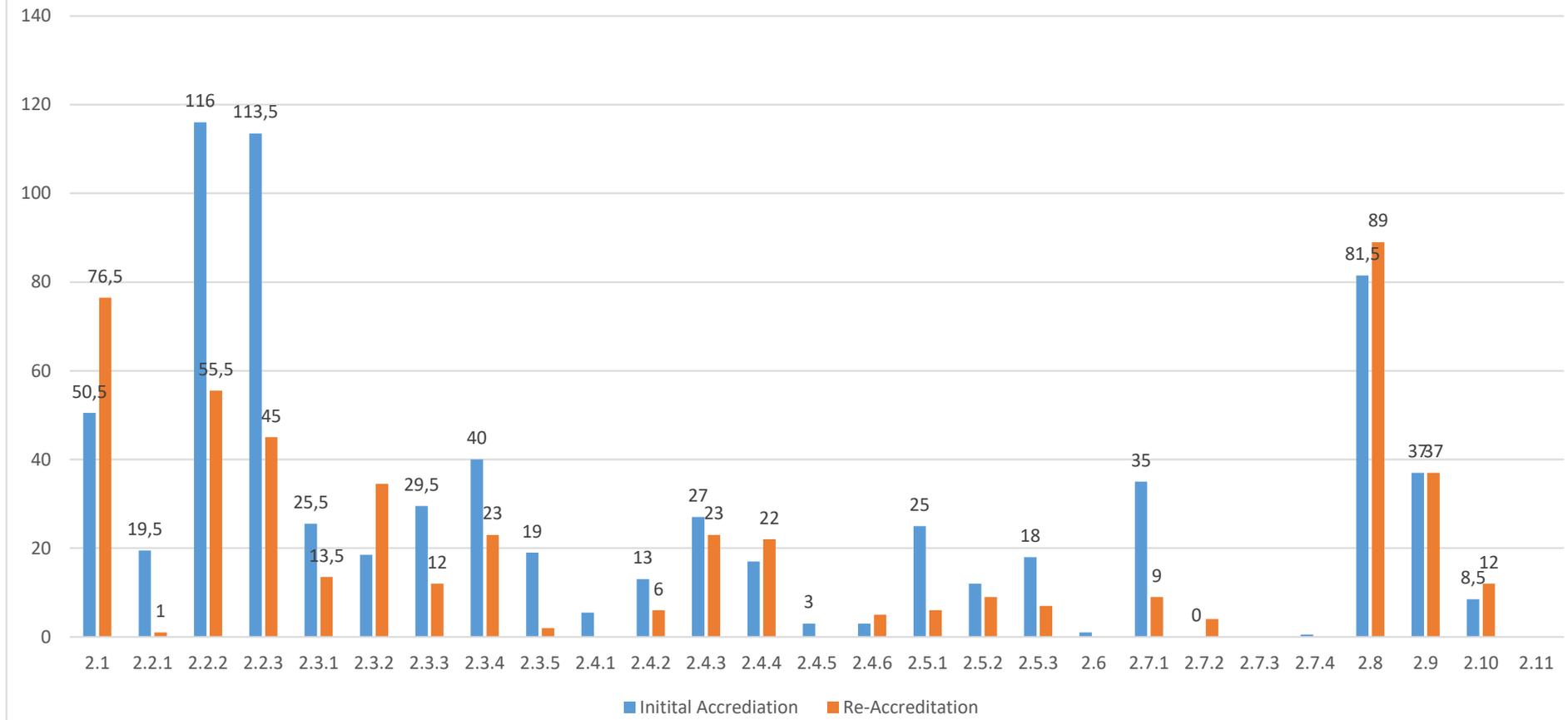
Below is an overview of the sub-criteria used for this analysis:

Main Criteria (as found in ASIIN documentation)	Sub-Criteria (where applicable)
Criterion 2.1 Qualification Objectives of the Study Programme Concept	
Criterion 2.2 Conceptual Integration of the Study Programme in the System of Studies	Criterion 2.2.1 Admission Requirements and Duration Criterion 2.2.2 Module Descriptions * Criterion 2.2.3 Other
Criterion 2.3 Study Programme Concept	Criterion 2.3.1 Curriculum/Implementation of Qualification Objectives Criterion 2.3.2 Module Descriptions * Criterion 2.3.3 Admission Requirements and Adequate Selection Process Criterion 2.3.4 Mobility Criterion 2.3.5 Other
Criterion 2.4 Academic Feasibility	Criterion 2.4.1 Consideration of the Expected Entry Qualifications Criterion 2.4.2 Appropriate Curriculum Design Criterion 2.4.3 Plausibility of Student Workload Criterion 2.4.4 Adequate Frequency and Organisation of Examination Criterion 2.4.5 Offers of Support / Course Guidance Criterion 2.4.6 Other
Criterion 2.5 Examination System	Criterion 2.5.1 Exams are knowledge and competence oriented Criterion 2.5.2 One exam per module Criterion 2.5.3 Other
Criterion 2.6	

Programme-related Cooperation	
Criterion 2.7 Facilities	Criterion 2.7.1 Qualitative and Quantitative Human Resources Criterion 2.7.2 Material and Spacial Resources Criterion 2.7.3 Measures for personnel development and qualifications
Criterion 2.8 Transparency and Documentation	
Criterion 2.9 Quality Assurance and Development	
Criterion 2.10 Special Profile Demand	
Criterion 2.11 Gender Justice and Equal Opportunities	

* The criterion "Module Description" appears both under criterion 2.2 and 2.3. For a better analysis, all the conditions relating to this criterion have been subsumed under sub-criterion 2.2.2; 2.3.2 therefore does not contain any conditions.

Number of Requirements: Initial vs. Re-Accreditation



Difference in Number of Requirements Initial vs. Re-Accreditation



Akk. 1	50,5	19,5	116	113,5	25,5	18,5	29,5	40	19	5,5	13	27	17	3	3	25	12	18	1	35	0	0	0,5	81,5	37	8,5	0
Akk. 2	76,5	1	55,5	45	13,5	34,5	12	23	2	0	6	23	22	0	5	6	9	7	0	9	4	0	0	89	37	12	0
Diff.	26	-18,5	-60,5	-68,5	-12	16	-17,5	-17	-17	-5,5	-7	-4	5	-3	2	-19	-3	-11	-1	-26	4	0	-0,5	7,5	0	3,5	0
Diff. %	51%	-95%	-52%	-60%	-47%	86%	-59%	-43%	-89%	-100%	-54%	-15%	29%	-100%	67%	-76%	-25%	-61%	-100%	-74%	#DIV/0!	#DIV/0!	-100%	9%	0%	41%	#DIV/0!

At first glance, it is clear that most requirements were imposed in the initial accreditation process for criterion 2.2.2 (Module Descriptions), criterion 2.2.3 (Other problems concerning the Conceptual Integration of the Study Programme in the System of Studies), and criterion 2.8 (Transparency). In all three cases, these are formal criteria, which can be remedied quite easily by the HEIs. The fact that there are still requirements for these three criteria in the re-accreditation process, albeit less, is due to the fact that modules and their descriptions as well as university rules and regulations are subject to frequent changes. During an accreditation period, modules are added to the curricula of study programmes or their content is adapted. These changes, however, are not always documented in the module descriptions. Regulations and rules of HEIs are also subject to changes. Here, oftentimes the HEIs initially only submit drafts of regulations for accreditation and the given requirement then targets their publication. Nevertheless, a difference of -60,5% for criterion 2.2.2 and -68,5 for criterion 2.2.3 is still recorded, showing that there is a considerable decrease in requirements and thus an overall evolvement in the quality.

If the calculated differences are added, it becomes clear that the number of requirements has increased for seven criteria in the re-accreditation while it has decreased for seventeen criteria. The difference has remained the same in those cases where no conditions were imposed for both initial and re-accreditation.

Criterion 2.1 (Qualification Objectives of the Study Programme Concept) shows an increase of 26 requirements (51% for initial accreditation). This may seem surprising, since the objectives of a study programme should have remained constant over the duration of the accreditation. If one looks at the wording of the imposed requirements, however, it is noticeable that nearly all requirements criticize that a “social commitment of the students” is not mentioned in the qualification objectives. According to the criteria of the Accreditation Council, students must not only be prepared for academic and professional qualification but also for a commitment to society as a whole as part of their personal development. The latter aspect has, however, only been intensively evaluated within the last four years. As the social commitment of students has not been a criterion in the initial accreditation, this explains the increase in requirements during re-accreditation. This change also had an effect on the module descriptions, which consequently resulted in a simultaneous increase of requirements regarding criterion 2.3.2 (Module descriptions) and a slight increase of requirements related to criterion 2.8 (Transparency and Documentation).

For all other criteria, the number of requirements in re-accreditation has been reduced. Particularly large reductions (70%-100%) can be observed for the following criteria (listed if data is representative, i.e. five or more requirements in ten years):

- Criterion 2.2.1 (Admission Requirements and Duration): Difference -95%
- Criterion 2.3.5 (“Other” in Study Program Concept): Difference -89%
- Criterion 2.4.1 (Consideration of the Expected Entry Qualifications): Difference -100%
- Criterion 2.5.1 (Exams are Knowledge- and Competence-oriented): Difference -76%

- Criterion 2.7.1 (Human Resources): Difference -74%

Areas where there has been a reduction in requirements but not a comparatively large one (50%-70%) are as follows (listed if data is representative, i.e. five or more requirements in ten years):

- Criterion 2.2.2 (Module Descriptions): Difference -52%
- Criterion 2.2.3 (“Other” in Conceptual Integration of the Study Programme in the System of Studies): Difference -60%
- Criterion 2.3.3. (Admission Requirements and Adequate Selection Process): Difference -59%
- Criterion 2.4.2 (Appropriate Curriculum Design): Difference -54%

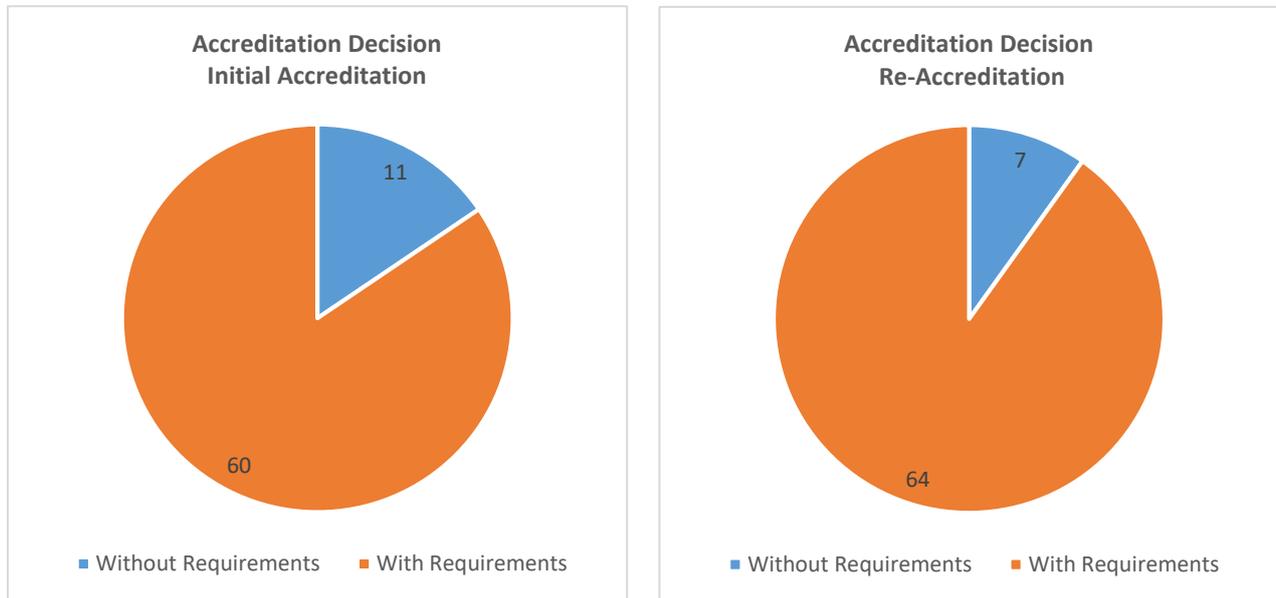
Similar to the module descriptions (criterion 2.2.1) and the university’s regulations, the student workload is also subject to changes over the course of an accreditation period. As certain topics are added or disposed, the workload of a model might increase or decrease. Even if the majority of the study programmes set up an adequate workload, in the course of restructuring the study concept there may be unsuitable workloads that are discovered and assigned a requirement by the peers evaluating the program.

Regarding criterion 2.9 (Quality Assurance), greater attention has been paid in recent years to the extent to which students are involved in the quality management cycle of their HEI and in particular their degree programme. It has become apparent that in some cases, no regular evaluations have been carried out or students have not been informed about the results of the evaluation. Since this is a relatively new criterion, it only comes into play at the time of re-accreditation - similar to the involvement of society as a whole (criterion 2.1).

Generally, analysing the re-accreditations in the field of mechanical engineering and process engineering for the AC Seal shows that accreditation procedures conducted by ASIIN have improved the quality of the evaluated study programmes in these areas in the long term.

Analysis of Re-Accreditation Procedures – ASIIN Seal

In the examined period, 71 study programmes have been re-assessed for the ASIIN Seal. The following graphs compare the decision of both the initial and the re-accreditations:

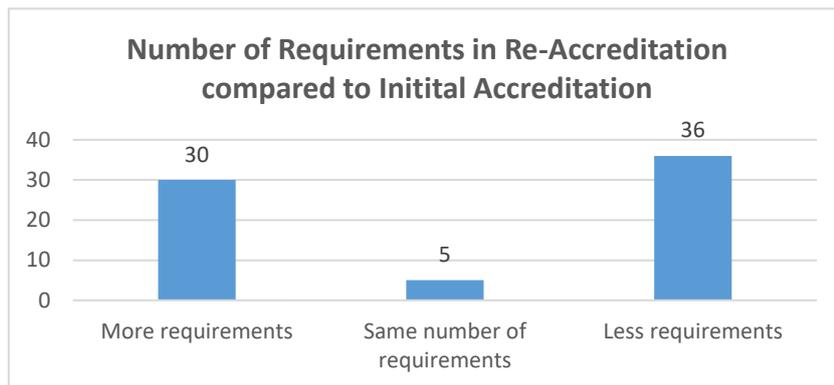


On first glance, it seems that the quality of the re-accredited study programmes has declined compared to their initial accreditation. If, however, one assesses the individual study programmes instead of the general result of their accreditations, it quickly becomes apparent that there were improvements between the results of the initial and re-accreditation.

When assessing the initial accreditations, eleven study programmes have been accredited without requirements while during re-accreditation this number fell to seven. In the latter case, the quality of the study programme seems to have deteriorated. However, the HEI states in its self-evaluation report that the study programme had been extensively revised during the course of the accreditation procedure so that eventually a new programme was re-accredited, which explains the increase in requirements.

Nevertheless, it is noticeable that by far the largest part of the study programmes is still accredited subject to conditions, i.e. there are still some criteria that are not or only partially fulfilled. When comparing the data it becomes clear that the number of given requirements is lower in re-accreditations than in initial accreditations. To count the requirements, the conditions in case of a suspension were treated as requirements. In this case, during initial accreditations, 198 requirements were given whereas in re-accreditation 182 requirements were given; a difference of -8%. As the graph below shows, 30 degree programmes have received more requirements in their re-accreditation than in their initial accreditation while five degree programmes received the same number. Yet, for a majority of degree programmes, namely for 36 programmes, the number of requirements has decreased during

their re-accreditation.



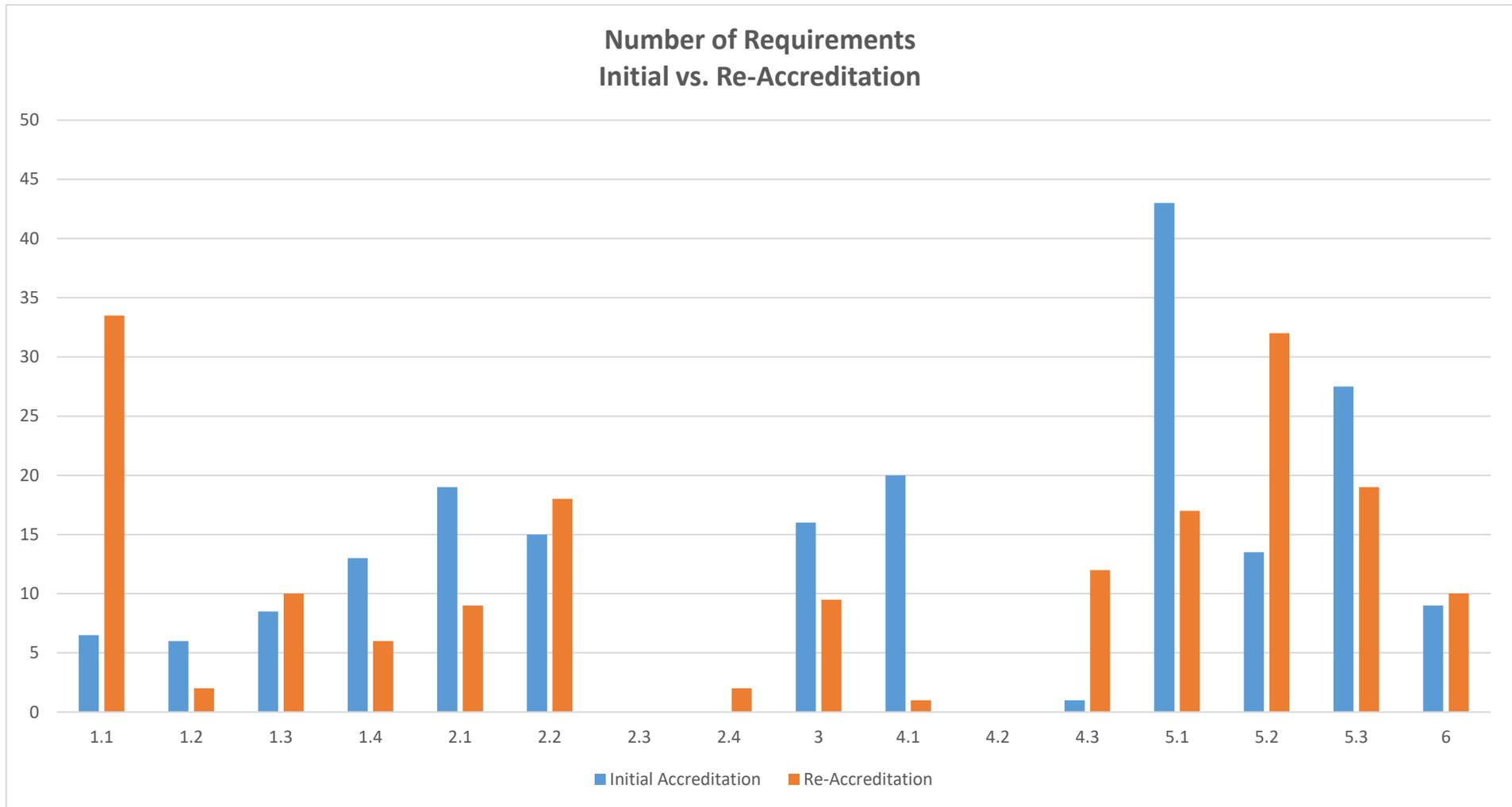
The above finding generally suggests that ASIIN accreditation does improve the quality of an assessed degree programme. In order to further inquire into the distribution of requirements in the accreditations in the period investigated, it needs to be assessed whether the given requirements were identical in both initial and re-accreditation or whether a shift has taken place. For this purpose, an analysis of the requirements of all re-accredited study programmes that were issued during the initial and re-accreditation was carried out.

Below is an overview of the ASIIN criteria used for this study:

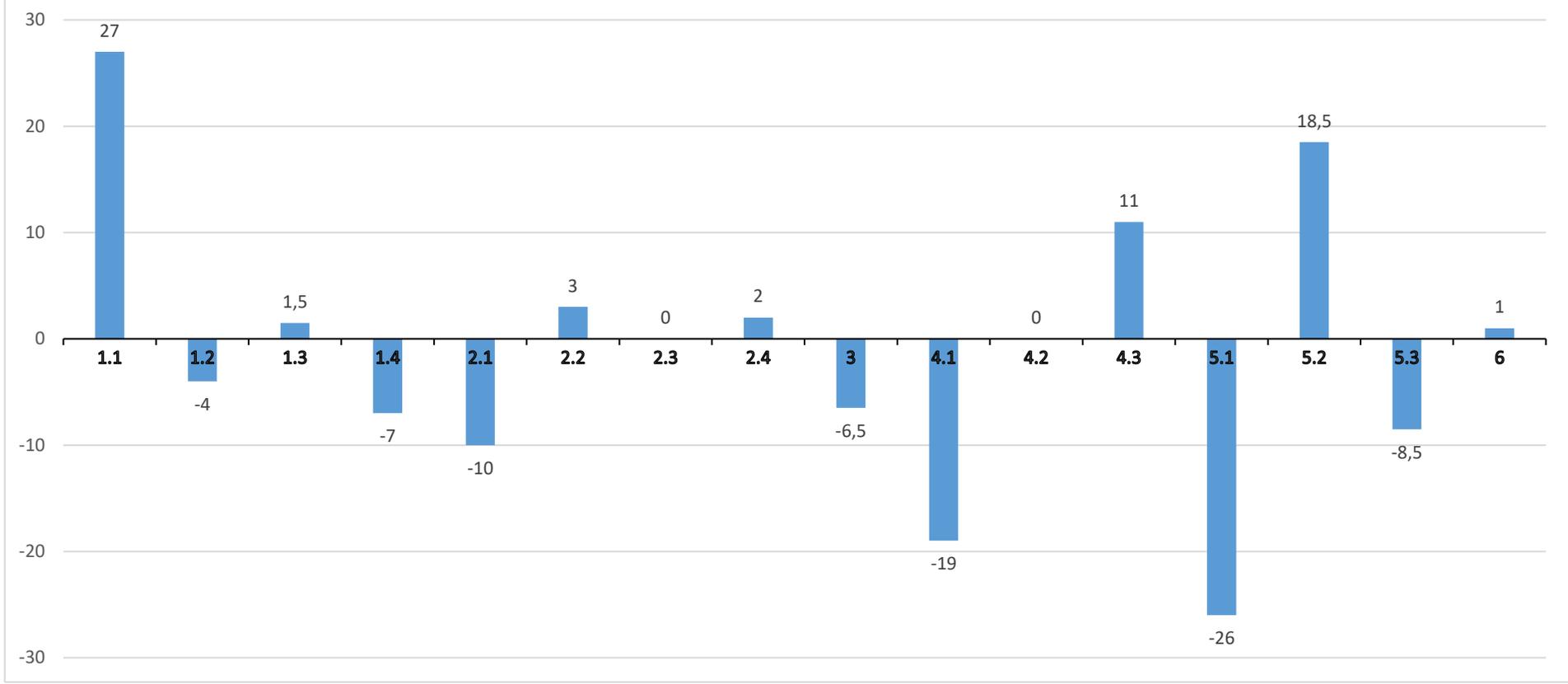
Criterion 1.1	Objectives and Learning Outcomes of a Degree Programme (Intended Qualification Profile)
Criterion 1.2	Title of the Degree Programme
Criterion 1.3	Curriculum
Criterion 1.4	Admission Requirements
Criterion 2.1	Structure and Modules
Criterion 2.2	Work Load and Credit
Criterion 2.3	Teaching Methodology
Criterion 2.4	Support and Assistance
Criterion 3	Exams: System, Concept and Organisation
Criterion 4.1	Staff
Criterion 4.2	Staff Development
Criterion 4.3	Funds and Equipment
Criterion 5.1	Module Descriptions
Criterion 5.2	Diploma and Diploma Supplement
Criterion 5.3	Relevant Rules
Criterion 6	Quality Management: Quality Assessment and Development

The graphs below show a list of all commissioned criteria for both initial accreditation and re-accreditation as well as the calculated difference in requirements.

**Number of Requirements
Initial vs. Re-Accreditation**



**Difference in Number of Requirements
Initial vs. Re-Accreditation**



Akk. 1	6,5	6	8,5	13	19	15	0	0	16	20	0	1	43	13,5	27,5	9
Akk. 2	33,5	2	10	6	9	18	0	2	9,5	1	0	12	17	32	19	10
Diff.	27	-4	1,5	-7	-10	3	0	2	-6,5	-19	0	11	-26	18,5	-8,5	1
Diff. %	415%	-67%	18%	-54%	-53%	20%	#DIV/0!	#DIV/0!	-41%	-95%	#DIV/0!	1100%	-60%	137%	-31%	11%

As the graphs show, the number of requirements has significantly increased mainly for three criteria, has slightly increased for four criteria, remained identical for three criteria, and decreased for seven criteria in the course of re-accreditation.

Criterion 4.3, which is the discussion of the funds and equipment of a HEI, saw a massive increase of eleven requirements (which translates into an increase of 1100%). This seems to be highly problematic at first glance; however, when having a detailed look at the specific cases in which the peers decided for requirements in the re-accreditation, it becomes clear that funds and equipment did not see a general decrease in quality. The surge in numbers is due to problems at mainly one international university, which accounts for eight of the eleven additional requirements for this criterion. In the initial accreditation, the review team decided that the equipment and the laboratory of this particular university is barely sufficient. However, since the university convinced them they would already work on improvements in this area, the peers decided against a requirement for the four study programmes under review. In the course of the re-accreditation, it became obvious that nothing had changed since the last on-site visit; a situation which consequently led to a total of eight requirements (two for each of the four study programmes). What this example demonstrates is that we do not have enough data for the period investigated in order to draw reliable conclusions for each criterion. In the case of this example, one accreditation can distort the results. As a consequence, such extreme surges in numbers need to be considered with caution and require both a closer look and a concise interpretation of the data.

Criterion 1.1, “Objectives and Learning Outcomes of a Degree Programme & Intended Qualification Profile” was subject to an increase of 27 additional requirements in the re-accreditation in comparison to the initial accreditation (a plus of 415%). In contrast to the additional requirements in regard to criterion 4.3, the surge regarding criterion 1.1 is evenly distributed across all study programs which were considered for this analysis. The rise in the field of objectives and learning outcomes of a degree program may seem surprising since the objectives of a study programme should have remained constant over the duration of the accreditation period. When examining the wording of the individual requirements for this criterion, it is noticeable that they overwhelmingly criticise the fact that the study objectives have not been formulated in a programme-specific manner or are not publicly accessible. It can be observed that the reviewing peers seem to be a slightly more lenient in the first accreditation, in particular if a HEI pledges to improve and to address the shortcomings of the program. If the HEI has not fulfilled the respective criteria by the time of the re-accreditation, the peers ultimately opt for a requirement.

Criterion 5.2. “Diploma and Diploma Supplement” saw a rise of 137% in assigned requirements, which also even distributes across the study programs concerned. Many peers criticise the fact that the programme objectives are not detailed in the Diploma Supplement. Besides, if problems arise with criterion 1.1 (objectives and learning outcomes) this usually has an effect on criterion 5.2 as well. Therefore, it does not come as a surprise that a rise in

requirements regarding criterion 5.2 is concomitant with additional requirements in the field of criterion 1.1.

For most other criteria, the number of requirements in re-accreditation has been reduced. Particularly large reductions (70%-100%) can be observed for the following criteria (listed if data is representative, i.e. five or more requirements in ten years):

- Criterion 4.1 (Staff): Difference -95%

Areas where there has been a reduction in requirements but not a comparatively large one (50%-70%) are as follows (listed if data is representative, i.e. five or more requirements in ten years):

- Criterion 1.2 (Title of the Degree Programme): Difference -67%
- Criterion 1.4 (Admission Requirements): Difference -54%
- Criterion 2.1 (Structure and Modules): Difference -53%
- Criterion 5.1 (Module Descriptions): Difference -60%

The decline in the number of requirements of these criteria but also the rise of requirements regarding the objectives and learning outcomes shows that an accreditation with ASIIN leads to a continuous and long-term improvement in the quality of the study programme. In particular, it should be noted that the greatest improvement is to be found in these criteria that focus on fundamentals of a study programme: title of the degree program, structure, modules and module descriptions, staff, and admission requirements.

Conclusion

The aim of this study was to evaluate the impact of ASIIN's accreditation procedures in the field of mechanical engineering and process engineering under the responsibility of ASIIN's Technical Committee 01 for the timeframe of September 2009 to September 2019. A special focus was placed on the various seals and labels as well as on the quality development of the study programmes in the course of re-accreditation. In summary, it can be said that accreditations conducted by ASIIN have a positive impact on the quality of the study programs under review since the appointed peers point out the weaknesses and problems of programs. Program coordinators are usually grateful for the input and feedback of the peers since an outside perspective reveals shortcomings which they tend to overlook after years of working with and in the program. The present study for the Technical Committee 01 certainly has its limitations, in particular since the amount of data is sometimes not sufficient in order to provide for a reliable discussion of hypotheses. This was especially the case with the analysis of the accreditations for the ASIIN Seal.

The present study leads to the following results:

1. More than 85% of all assessed programmes, independent of the seal/label to be awarded, were accredited with requirements. This shows that ASIIN fosters the continuous development of the quality of the degree programmes.
2. During the initial accreditation, most requirements addressed deficiencies with regard to the module descriptions and other documents, the concept of the study program, and transparency. This mostly affects the criterion regarding the "Conceptual Integration of the Study Programme in the System of Studies". This shows that many study programmes did not meet the criteria in these fundamental areas and that the ASIIN accreditation revealed these deficiencies in fundamental areas of the study program which were mostly remedied by the respective HEI before re-accreditation.
3. In comparison to the initial accreditations, the number of requirements (significantly) decreased in the re-accreditations, although the majority of degree programmes has still been re-accredited with requirements. For the AC Seal, 60.9% of accreditations received less requirements in their re-accreditation than during their initial accreditation. For the ASIIN Seal, the corresponding figure is 50.7%.
4. The quality of study programmes has improved significantly in the following areas, in particular with regard to the assessment of the AC Seal: admission requirements and duration, study program concept, consideration of the expected entry qualifications, knowledge- and competence-oriented exams, and staff.
5. During the re-accreditation most requirements concerned deficiencies in regard to transparency and documentation (mostly of changes to the program) and the conceptual integration of the study program in the system of studies.

6. Even though the different seals/labels are often assessed in a joint procedure, the individual underlying criteria are checked individually. Thus, in some cases the ASIIN Seal was awarded with requirements while the EUR-ACE® Label was suspended or even rejected, as certain subject-specific criteria were not fulfilled.
7. The re-accreditations for the AC Seal saw a 31% reduction of requirements whereas for the ASIIN Seal, we only witnessed an 8% reduction. This is surprising insofar as the criteria for the AC Seal and the ASIIN Seal are very similar. The aim should clearly be to achieve the same quality improvement for the ASIIN Seal as for the AC Seal.
8. No significant differences between German and foreign study programmes in the field of mechanical engineering and process engineering (TC 01) could be identified in regard to their assessment by the peers. However, as a study conducted for the Technical Committee 06 suggests that international study programmes, in particular in emerging countries, are sometimes evaluated less strictly than German ones, this problem should nevertheless be kept in mind.
9. The auditors should continue to make sure that they apply the whole spectrum of possible accreditation decisions, including the suspension of the procedure if necessary.

A point of criticism, which needs to be addressed, arises when looking at reports of accreditation and re-accreditations in comparison. The impression is created that the reviewing peers often try to give HEIs the opportunity to remedy problems on their own without a requirement during the initial accreditation. HEIs then often assure the peers that they are aware of the problem and have already started working on it. However, at the time of the re-accreditation, it becomes obvious that nothing has changed when the institutions are not obliged to do so in order to keep the accreditation for the full five years. As a result, the necessary requirement is then issued in the course of the re-accreditation. This impression is supported by the data provided during this study. Requirements for the AC Seal were reduced by 31% in the re-accreditation but for the ASIIN seal, the reduction was only a mere 8%. A detailed look at some specific examples shows that the HEI would have benefitted from a stricter evaluation (i.e. more requirements) in the first accreditation. Therefore, many problems would have already been addressed by the time of the re-accreditation. If peers are very hesitant to issue requirements in the first round, this often only unnecessarily prolongs the quality improvement process. This problem is particularly frequent regarding criteria in the context of learning objectives, the aim of the study program, and the intended qualification profile. For both the AC Seal and the ASIIN Seal, requirements increased considerably in the re-accreditation. In many cases, a requirement already issued in the initial accreditation would have encouraged a swifter improvement of the respective study program.

While this study has clearly the proven positive impact of an ASIIN accreditation procedure on a study program, there is room for improvement. One point certainly concerns the aforementioned problem that expert teams sometimes tend to give the HEIs the chance to enhance quality without imposing a requirement. However, this analysis has demonstrated that a mild judgement might actually slow down quality improvement process and delay the necessary remedy of a deficit until the re-accreditation five years later. Therefore, the peers should make sure to address all deficits by issuing a requirement or a recommendation in order emphasize the need of an improvement in a certain area of the degree program under review. Furthermore, the imposition of a requirement should not be understood as a patronizing instrument, but rather as an opportunity for the HEI to develop within a certain timeframe and have the improvements assessed and confirmed a year later.

Another aspect of the accreditation process, which deserves attention, is the accreditation of study programs in non-European countries, in particular since this is a rapidly growing market for ASIIN. Since the study of the TC 06 suggests that international study programmes, in particular in emerging countries, are sometimes evaluated less strictly, this is a concern which ASIIN peers should keep in mind. This is particularly important when keeping the problem mentioned in the above paragraph in mind. Non-European HEIs, which sometimes have little to no experience with an accreditation procedure, clearly benefit from a profound first review process which provides them with clear guidelines, detailing the areas of the study program which still require improvement.

As noted above, this study has its limitations, which is mostly due to an insufficient amount of data and consequently does not allow to draw far-reaching reliable conclusions. In particular in regard to the awarding of the ASIIN Seal, further analysis would be beneficial. In addition to that, it would be interesting to further explore why the reduction of requirements in regard to the ASIIN seal is only a mere 8% while it is 31% for the AC Seal. However, in order to scrutinize this difference, more data for the ASIIN Seal is needed in order to not let the result be distorted by the one or few HEIs which turned out problematic.

Further attention should also be on the EUR-ACE® Label awarded by the European Network for Accreditation of Engineering Education since this is of particular importance for the Technical Committee 01 as the representative of study programs in the field of mechanical engineering and process engineering. A more detailed analysis of this label would be of interest since the present study was only able to touch upon some aspects of EUR-ACE®. A comparison between accreditations in Germany, Europe and non-European countries would provide relevant information for the future work of the TC 01.