FINNISH EDUCATION
EVALUATION CENTRE

ACCREDITATION OF THE DEGREE PROGRAMME IN INFORMATION AND COMMUNICATIONS TECHNOLOGY AT JAMK UNIVERSITY OF APPLIED SCIENCES

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1 Description of the accreditation process and of the programme

1.1 Aim of the accreditation

The aim of FINEEC's Engineering Programme Accreditations is to support the enhancement of quality in engineering programmes and to provide higher education institutions with the means of deciding whether an engineering study programme provides its graduates with the academic qualifications necessary for a career in the engineering profession.

The accreditation assesses the way an engineering degree programme is planned, delivered and developed to ensure that the students reach the programme outcomes and how the programme outcomes align with the reference programme outcomes set in the FINEEC Engineering Programme Accreditations manual. The reference programme outcomes describe the knowledge, skills and competencies that engineering students should have acquired by the time they have completed a degree programme in engineering.

The accreditation evaluates the extent to which the set standards for programme's planning, implementation, resources and quality management are met.

1.2 Degree Programme in Information and Communications Technology

The engineering programme under review was the Degree Programme in Information and Communications Technology at JAMK University of Applied Sciences (JAMK), located in the city of Jyväskylä in central Finland.

The degree awarded from the programme is a Bachelor of Engineering of 240 European Credit Transfer System (ECTS) credits. The programme is delivered over 4 years of full-time study, including 30 ECTS credits of practical training. The main language of tuition in the programme is Finnish. The expected intake for the programme is 115 students.

The programme was formed in 2015 by combining three separate programmes: programming, media engineering and information technology. The programme is run by the Institute of Information Technology, which is part of the School of Technology of JAMK.

According to the self-evaluation report, the overall aim of the programme is that it provides the students with the readiness to act in specialist tasks in the field of ICT in a constantly changing and internationalising society. The programme has four specialisation areas:

- cyber security,
- data network engineering,
- media engineering and
- software engineering.

1.3 The accreditation process

The accreditation was conducted in accordance with the principles set in the *FINEEC standards and procedures for engineering programme accreditation* document. The schedule of the accreditation was the following:

- The accreditation team was appointed by the FINEEC Committee for Engineering Education on 2 February 2017.
- JAMK University of Applied Sciences submitted the self-evaluation report on 1 March 2017.
- A site visit to the programme was conducted on 4–5 April 2017. The programme of the visit is given in table 1.
- Decision making meeting of FINEEC Committee for Engineering Education on 14 June 2017

Table 1: Schedule of the site visit

First visit day		Second visit day	
8.45–9.00	Short presentation of the evidence room		
9.00–10.15	Study of evidence provided by the programme	9.00–09.50	Interview of external stakeholders
10.15–11.15	Interview of the management of the HEI and of the programme	10.00–10.40	Interview of alumni
11.30–12.30	Interview of academic staff of the programme	10.45–12.00	Study of evidence provided by the programme
13.30–14.15	Interview of support staff	13.00–13.50	Interview of students
14.30–15.45	Evaluation visit to the relevant facilities	14.00–15.30	Study of evidence provided by the programme and private meeting of the accreditation team
15.45–17.00	Study of evidence provided by the programme	15.30–16.00	Preliminary feedback to the management

1.4 The accreditation team

Chair of the accreditation team:

Peeter Normak, Professor of Informatics, director of the School of Digital Technologies of Tallinn University, Estonia.

Members of the accreditation team:

Hermann Blum, Master's student in Electrical Engineering and Information Technology at ETH Zürich, Switzerland.

Riitta Rontu, Senior Lecturer and Head of Degree Program in Information Technology at Oulu University of Applied Sciences, Finland.

Jenni Tyynelä, Software Developer and Testing professional at Tieto Finland.

Senior advisor **Touko Apajalahti** from the Finnish Education Evaluation Centre acted as the project manager of the accreditation.

1.5 Evidence used in the accreditation

The results of the accreditation and the analysis in the accreditation report are based on the following evidence:

- Self-evaluation report of the programme, including the following appendices:

    1. Composition of the Advisory board of Institute of Information Technology 2016
    2. Description of the project portfolio of the Institute
    3. Description of education services provided for customers
    4. Example feedback document of the education services
    5. ICT programme structure
    6. Courses vs competences matrix
    7. Curriculum of the programme
    8. Quality Guide of the JAMK School of Technology
    9. Degree regulations of JAMK University of Applied Sciences
    10. Applicant's Guide of JAMK
    11. List of the staff of the Institute
    12. Recruitment process of JAMK
    13. Cooperation agreements of the Institute
    14. Quality manual of JAMK
    15. Summary of the periodic evaluation of the programme in 2015

16. Summary of the resulting action points of the periodic evaluation for years 2016 and 2017
17. List of MOOCs in the ICT programme
18. Example of a course feedback analysis
19. Learning levels / grade analysis of the academic year 2015–2016
20. Analysis of various statistics

- Additional material requested by the accreditation team

1. Admissions criteria
2. Statistics on drop-outs
3. Strategy of JAMK
4. Statistics on the educational background of students in the programme
5. Examples on recognition of prior learning and personal study plans
6. Information on practical training
7. Budget of the Institute
8. Minutes of the quality team of the Institute
9. Management review of the Institute in 2016
10. Statistics on student international mobility
11. Information and examples regarding elective studies in the programme

- JAMK UAS online study guide and the Optima study administration environment
- CV's of teaching staff
- Evidence gathered by the programme to the evidence room during the site visit, which included course material, thesis works and project works among other things
- Tour of the relevant facilities: library; RDI services, environments & laboratories; cyber training centre; RGCE (Realistic Global Cyber Environment); IoT & Electronics laboratory and Physics Laboratory
- Interviews with management, teaching staff, support staff, students, alumni and external stakeholders

2 Evaluation of the fulfilment of the accreditation standards

2.1 Planning of the programme

Standard 1: The programme aims, which describe the educational task and purpose of the programme, are consistent with the mission of the higher education institution and reflect the identified needs of employers and other stakeholders.

The general aim of studies leading to a Bachelor's degree in JAMK is that the student acquires, based on the demands and development of working life, the necessary knowledge and skills for working in a professional specialist position.

The ICT knowledge is expanded in specialisation options: *cyber security*, *media engineering*, *software engineering* and *data network engineering*. The target of the programme is that the students gain:

- extensive practical basic knowledge and skills and their theoretical foundations for working in a specialist position in the field;
- ability to follow developments in the field;
- skills for self-improvement and continuous training;
- sufficient communication and language skills; and
- skills required for international activities in the field.

The programme aims have been developed as a result of extensive discussions with stakeholders, including teaching staff, support staff and potential employers from the local area. These discussions are ongoing, in a carefully planned manner, giving ample opportunity for the institution to response to changing conditions. It is evident that considerable effort has gone in to the planning process at programme level.

The programme aims fit well to the profile of JAMK, as these are directly linked with two out of five focus areas of JAMK: *Applied Cybersecurity* and *Rising Industry: Automation and Robotics*. The accreditation team sees that the study programme as a whole is balanced and offers specialisations in topical and important areas. Moreover, both the employers and graduates were very positive about the study programme.

Based on the team's assessment, the programme meets ***standard 1 fully.***

Standard 2: The programme learning outcomes, which describe the knowledge, understanding, skills and abilities that the programme enables graduates to demonstrate, are consistent with the programme aims, with relevant national qualifications frameworks (if applicable) and with the FINEEC reference programme learning outcomes.

The overall description of the programme that is also available on JAMK's website includes a description of the targeted competence of the programme, which presents the outcomes on an overall level, making direct references to the programme outcomes of the EUR-ACE standard.

The actual programme learning outcomes are divided into two categories: JAMK's common learning outcomes and professional learning outcomes. The latter are the programme outcomes of the EUR-ACE standard.

The topics of JAMK's common learning outcomes are:

- Learning Skills
- Information management skills
- Entrepreneurship skills
- Working Life skills
- Internationality skills
- Communication skills

The topics of professional learning outcomes are

- EUR-ACE Knowledge and Understanding
- EUR-ACE Engineering Analysis
- EUR-ACE Engineering Design
- EUR-ACE Investigations
- EUR-ACE Making Judgements
- EUR-ACE Communication and Team-working
- EUR-ACE Lifelong Learning

The learning outcomes are grouped slightly differently than those of the FINEEC reference programme learning outcomes, but as there is a direct mapping also between FINEEC's outcomes and the EUR-ACE outcomes, the learning outcomes are also consistent with the FINEEC reference programme learning outcomes.

At the time of the self-evaluation phase, the national qualifications framework (NQF) of Finland had not yet come into force. However, JAMK had used the draft version as an unofficial recommendation, and placed the degree to level 6 of the draft NQF, which compares to level 6 in the European Qualifications Framework.

Based on the team's assessment, the programme meets ***standard 2 fully.***

Standard 3: The course level learning outcomes, including thesis work and possible practical training, aggregate to the programme's learning outcomes.

The curriculum of the programme is presented as a mapping between courses and JAMK common learning outcomes and professional learning outcomes (see standard 2 above). Correspondingly, each course description includes references to the programme learning outcomes it contributes to. However, as a general finding, the accreditation team has to note that course level learning outcomes for some of the courses were presented in very general terms and described the acquired competences only partly, making it in some cases hard to see the exact ways the courses learning outcomes aggregate to the programme level learning outcomes. Attention should be paid to the definition of the learning outcomes on the module and course level of the programme (see standard 4).

Based on the self-evaluation report, on the course descriptions, and evidence presented during the site-visit, it can be concluded that the programme provides students with the necessary knowledge and understanding for successful studies in ICT. All courses in the Natural Sciences module and of the Common Basic Studies module as well as about half of the courses in the remaining modules contribute to achieving the learning outcomes under the topic of knowledge and understanding. As an example, this is explained regarding the first learning outcome ("knowledge and understanding of mathematics and other basic sciences …").

The study programme contains two compulsory (10 credits) and six elective (18 credits) courses in mathematics and four compulsory courses in physics (12 credits). A part of the studies in mathematics and other basic sciences is contained in other courses. For example, Boolean algebra and number systems are covered in the course TTZC0500 *Digital Technology*. The majority of courses are taught by the faculty members of the Institute of Information Technology, and only two courses in mathematics by teachers from another institute. However, the content of these two courses are negotiated with other teachers of the Institute.

In the accreditation team's opinion there is still some room for improvement regarding the topics under knowledge and understanding, especially in teaching mathematics. Namely, the two compulsory courses in mathematics (*Mathematics* I and *Mathematics* II) that are

compulsory in all bachelor's programmes of the School of Technology take more into account the needs of general engineering programmes and not so much those of the ICT engineering study programme: these courses are mainly devoted to continuous mathematics while the topics of discrete mathematics are nearly missing. The necessary topics in discrete mathematics are distributed between other courses. The fact that the courses in mathematics did not have a clear link to subsequent courses in ICT was also mentioned during discussions in the site visit.

Moreover, the course content and learning outcomes are described in many cases in very general terms in the course descriptions. For example, the course content description of the course *Software Project* only states that "the course contents cover the basics of planning and implementing a software project" which is not saying much about the actual course content, even if combined with the learning outcomes of the course: "The student manages the concepts and practices of the software projects. The student can apply those skills in a software project."

Following the provided course overview table, competences in the area of *Engineering Analysis* are acquired in the common basic courses and the Applied Mathematics module, as well as in some specific courses in different areas of specialisation. As all other courses are not mandatory and as it may be possible that a student does not choose any other course contributing to his/her analytical abilities, elective courses do not necessarily contribute to the programme learning outcomes. However, the accreditation team notes that all areas of specialisation have at least two courses recommended that contribute to the competences in Engineering Analysis. Thus it is concluded that there is a small, but sufficient number of courses over different areas that contribute to the learning outcomes regarding engineering analysis.

Engineering design competences are mainly included in the core studies of each specialisation. This is natural, because basic competences have to be learned before starting to design complex systems. In every specialisation, there are several courses where these competencies are marked in the curriculum mapping and as a whole there is a sufficient amount of courses contributing to engineering design studies.

Engineering design competence practice is also developed in small engineering tasks and projects in the first and second study years and then expanded in larger projects in the third and fourth study years. The design competences are not, however, always precisely described in the course descriptions. In the project-based larger courses in particular, a major part of students' work is done in this field of competence.

Skills in information handling and data analysis are basically obtained through a course called *Research and Development* that runs in the second and third years, and there is also an elective course in data analysis. Although there is no compulsory course dedicated specifically to information handling and data analysis, these are sufficiently covered in other courses of the programme. Research methods and academic writing are considered on the thesis project in the fourth year (courses *Thesis Part* 1 and *Thesis Part* 2).

Concerning the ability to work in a laboratory/workshop setting, the information in course descriptions is very scarce. Sometimes, student workload is divided into four (lectures, exercises, assignments, independent work), sometimes into three (for example, lectures, exercises, independent work) and sometimes even into two (lectures, independent work). The courses in mathematics serve as examples of the latter – the amount of hours for exercises and assignments is not given, the hours are divided just into lectures and independent work! Moreover, the term "face-to-face lessons" is used only in the descriptions of the courses in physics.

Communication and teamwork skills as well as other multidisciplinary competences are part of different modules throughout the studies at JAMK. They are well developed in the 24 ECTS transferable skills module, but also in project-based courses, practical training periods and the thesis process. As a part of the transferable skills module, all JAMK programs contain a 3 ECTS credit course on *Communication Skills* which provides the students with knowledge of communication models and an understanding of different communicative situations and methods of communication. The *Innovation Week* in the first year of studies challenges the students with an intensive teamwork situation where they have to collaborate with others effectively and present their work at the end. Project work in different modules such as *Game Development* contains working in groups as studies progress further. In the fourth year, the students can both develop their communication skills in a work environment during the practical training as well as an expert during the thesis work.

Based on the team's assessment, the programme meets ***standard 3 fully.***

Standard 4: The curriculum gives comprehensive information on all the individual courses of the programme, including thesis work and possible practical training, and is accessible to students.

The curriculum of the programme is presented as a publicly available website. The main page of the curriculum includes general information on the programme, such as an overall description of the programme, number of ECTS credits, level in the EQF, and the structure of studies. It also describes the targeted competence of the programme and of its specialisations, as well as the profile of the degree.

The modules and courses within the programme are presented as a matrix where the user can see which courses are in which modules, and to which programme level learning outcomes they contribute to. Following links from this view, one can get to the individual course descriptions, or to the descriptions of the modules. The module descriptions only contain a short description of the learning outcomes of the module. The module level learning outcomes should be developed, as they were not in all cases described in terms of what students are able to do after completing the modules.

In principle, the course descriptions give comprehensive information on all relevant aspects of a course: credits, learning outcomes of the course, related programme level learning outcomes, course contents, assessment methods and assessment criteria, workload etc. However, in practice the quality of these descriptions varied significantly. The course level learning outcomes were often not written very clearly in terms of what students are able to do after the completion of the course. Especially as there is a significant amount of choices possible for students in the programme, the programme should ensure that there is comprehensive information available regarding all courses in the curriculum.

From student's point of view, the Optima learning platform that is used during the implementation of courses included extra information about courses. This extra information was for some courses remarkable and included a lot of the information that was missing from the publicly available course descriptions. However, as this information is not available until shortly before the implementation of the courses, it cannot be said to fully compensate for the missing information in the curriculum.

Based on the team's assessment, the programme meets ***standard 4 fully only after the following conditions are met:***

- Learning outcomes of all modules and courses should be described in terms of competences students are able to demonstrate after completion.
- The course descriptions should provide comprehensive information (in particular learning outcomes, content, teaching methods/activities, assessment of students' learning) about all the courses in the curriculum.

Standard 5: The curriculum and the course timetable enable students to graduate in the expected time.

The programme is designed in a very flexible way with many electives and nearly no compulsory courses apart from those in the first year. However, students are supported by recommendations of courses related to each area of specialisation. The timetables are optimised in order to prevent overlaps between the recommended courses of each area of specialisation.

A student's choice of courses is discussed and planned together with a tutor to create an individual learning plan. During the interviews, the accreditation team could validate its impression that these individual learning plans are created in a way to assist graduation in the shortest time possible.

Based on the team's assessment, the programme meets ***standard 5 fully.***

Standard 6: The criteria and process for student admission and transfer are clearly specified and published. Students should be informed of the qualifications necessary to enter the programme.

The admissions process to universities of applied sciences in Finland is regulated and specified in detail and therefore standardised. In addition to this, the institution provides different sources of information for interested students:

- The JAMK Website offers documents such as the *Study Guide* and How to *Apply* as well as making the criteria for admission publicly accessible
- Physical flyers for prospective applicants that list all the details and web links regarding admission
- The Admission Coordinator answers any further questions prospective applicants may have.

The accreditation team could find no problems or complaints with the admission process – it is clear and fair.

Based on the team's assessment, the programme meets ***standard 6 fully.***

Standard 7: Students are informed of regulations and guidelines that concern recognition of prior learning, progress of studies and graduation.

Procedures for recognition of prior learning are defined at the JAMK level in the JAMK Degree Regulations and Study guide, which are available online. Further advice on procedures of recognition of prior learning is available through the study affairs office and the programme coordinators. Also, the course descriptions for individual courses in the study guide include a field regarding prior learning recognition procedures, however typically this field only refers to the JAMK level guidelines and states that course-specific arrangements are available from a course tutor. Thus, in general, information about recognition of prior learning regarding individual courses is given in the first lecture of the course. The information regarding recognition of prior learning in this way can be hard to access for students in the phase of exploring courses and choosing their individual learning path.

From the interviews, the accreditation team got the impression that the recognition of prior learning is working properly for practical experiences such as work placements or military service. However, regarding transfer of courses from studies at other institutions, the situation seemed to be more mixed and the accreditation team could find both examples where recognition of prior learning did work and where it was not without problems. Better and earlier information regarding the possibilities for recognition of prior learning could have helped in such cases.

The students are aware of how they can progress in their studies by their individual learning plans that are updated and discussed every year. This discussion also covers graduation. An information system enables the study counsellors to follow up the students' progress. This follow-up is at least done once a year when the individual learning plan is updated. The accreditation team has found all involved parties to be satisfied with this procedure.

Based on the team's assessment, the programme meets ***standard 7 fully.***

Strengths, good practice and areas for further development regarding section 2.1: planning of the programme.

The team notes the following strengths and good practice in this section:

- The study programme is balanced and offers specialisations in topical and important areas (cyber security, media engineering, software engineering, data network engineering).
- The learning outcomes of the study programme correspond well to the FINEEC reference outcomes.
- Both the employers and graduates were very positive about the study programme.
- The admission process is clear and fair.
- Practice of using Individual Learning Plans is very well executed and offering many opportunities for the students on their different learning paths.
- The course related information of the courses that are present in *Optima* learning management system is comprehensive.

The team sees the following as areas for further development in this section:

- The information in module and course descriptions is given in very general terms in some cases and therefore does not describe the courses adequately enough.
- The compulsory mathematics studies in the programme should be revised, to take better into account the needs of an ICT engineering study programme.
- Information on the criteria for recognition of prior learning should be accessible in the course information system.

2.2. Implementation of teaching and learning

Standard 8: The teaching and learning process, including the assessment of students, enables students to demonstrate that they have achieved the intended course and programme level learning outcomes. Students have an active role in co-creating the learning process and the assessment of students reflects this approach

Because the whole updated curriculum has not yet been implemented, the accreditation team's evaluation of this standard is not based on an analysis of implemented versions of all individual courses. In these cases, the accreditation team had to base the evaluation only on the course descriptions, although the missing level of detail in some of the course descriptions (see standard 4 above) hindered this approach. Nevertheless, the accreditation team could find sufficient information to assess the teaching and learning process as a whole regarding the different areas of learning outcomes. When planning the full implementation of the rest of the curriculum, attention should be paid in particular to aligning teaching and assessment methods with the learning outcomes and to make this visible in the course descriptions.

The role of students in the implementation of the learning process was seen as functional. Many courses make use of project work and other types of teaching methods where the students have an active role and, for example, peer and self-assessment were used in some cases. Also, the feedback system supports the active role of students. The mid-course feedback allows for changes to be made already during the implementation and the so-called grumble week organised by the student union is an established practice that lets students openly express their thoughts. Based on the interviews, student feedback is taken seriously and leads to changes when needed.

Knowledge and understanding

- knowledge and understanding of mathematics and other basic sciences underlying their engineering specialisation, at a level necessary to achieve the other programme learning outcomes;
- knowledge and understanding of engineering disciplines underlying their specialisation, at a level necessary to achieve the other programme learning outcomes, including some awareness at the forefront;
- knowledge and understanding of applicable materials, equipment and tools, engineering technologies and processes, and of their limitations, in their specialisation
- knowledge and understanding of applicable techniques and methods of analysis, design and investigation, and of their limitations, in their specialisation;

Based on the interviews, the role of mathematics and other basic sciences was in general considered important – these contribute to the development of analytical thinking. At the same time, it was stressed that these courses should satisfy the conditions that the total volume of mathematics and other basic sciences should not be much bigger than in similar study programmes of traditional universities and that the content of these courses should be purposeful and justified. Positive changes in this respect have also been obvious in recent years. For example, the course in chemistry that was considered unnecessary in terms of the programme's learning outcomes has been removed from the curriculum.

During the site visit, interviewed students were asked to name courses that they found the most problematic. No student mentioned courses in mathematics and other basic sciences. On the contrary, for example, the courses in mathematics were rated difficult, but of good quality. However, concerning knowledge and understanding in the discipline of ICT, one aspect of possible improvement was mentioned: there was sometimes a lack of meta-level knowledge about linkage and dependence between different subfields and topics. Even where separate courses are on a very high level in their topic, the holistic picture can remain hidden. In the development of the curricula, the understanding of links between topics could be further emphasised.

Overall, the fact that the students have far-reaching freedom to compose their own individual study plans, deciding on specialisation, modules and individual courses, supports acquiring knowledge and forming understanding in their specialisation. In general, the learning outcomes in this category are well-addressed.

Engineering practice

- ability to analyse complex engineering products, processes and systems, and to correctly interpret the outcomes of such analyses, by being able to select and having the practical skills to apply the relevant established analytical, computational and experimental techniques and methods
- ability to identify, formulate and solve complex engineering problems, by being able to select and having the practical skills to apply relevant established analytical, computational and experimental techniques and methods
- ability to develop and design complex products (devices, artefacts, etc.), processes and systems to meet established requirements that can include societal, health and safety, environmental, economic and industrial constraints, by being able to select and having the practical skills to apply relevant design methodologies
- practical skills for realising complex engineering designs
- ability to use the awareness of the forefront of their engineering specialisation in design and development
- ability to apply norms of engineering practice in their engineering specialisation;
- ability to consult and apply codes of practice and safety regulations in their engineering specialisation

Courses *Basics of Physics*, *Physics Laboratory Work*, *Introduction into Internet Technologies*, *Digital Technology* and *Data Structures and Algorithms* all list and assess analytical skills to a sufficient extent, and are the mandatory analytical basis for every JAMK graduate.

Based on the evidence provided for the accreditation team, the basic courses on mathematics do not teach analytical competencies per se. In the provided curriculum analysis, analytical competencies in the context of mathematical concepts are only listed in the module *Applied Mathematics*, out of which a student has to choose at least two courses. However, not all of these courses list analysis in their assessment criteria, as only *Analytic Geometry* lists it explicitly. In addition, based on the discussions on the site visit, also *Cryptology* is assessing and teaching analytical competencies. In the other four courses, only the knowledge and application of mathematical methods are assessed.

As not all other courses are mandatory and it may be possible that a student does not choose any other course contributing to his/her analytical abilities, other elective courses do not necessarily contribute to the programme learning outcomes in this category.

Students are required in different stages of their studies to work on real engineering problems (*JAMK Innovation Week*, *Bachelor's Thesis*, *Optional Professional Modules*). Each of these projects may, depending on the individual task, require and train analytical competencies,

but may also only train design skills. For example, in the offered options of Professional Modules, the module *Game Development* includes analysis of different techniques, whereas the module *Health Technology Applications* does not include any training of analytical skills.

We therefore conclude that the program lacks some education of mathematical-analytical competencies, but has an acceptable basis of analytical competencies for the application area of Information and Communication Technology.

Practical training periods and project works to employers give good hands-on experience to students with practical engineering problems and their problem solving. During interviews, it became clear that employer representatives, alumni and students were all satisfied with the skills students learned during their studies. Also, laboratory practice enhances students' skills to identify, formulate and solve complex engineering problems.

There are lots of design tasks and assignments in the later years of courses. Also, smaller design tasks are assigned already in the earlier phases of studies. Most of the courses include design tasks or project work as the main basis of the assessment. In every specialisation, it seems that the competences for designing are well developed.

The combining of different courses into one larger project-like task also deepens the ability to design complex entities. When the design task is broad enough, it will develop students' abilities to handle products that are more complex. Also, interviewed students had the opinion that they develop design competences best when doing larger project based tasks, even in the first two years of their studies.

As an area for improvement, the area of electronics and embedded systems did not have many courses marked to contribute to engineering design competencies; still there were engineering design tasks in the course descriptions, e.g. building and programming a robot, which according to the description, demands design skills.

Overall, the university has good facilities and competent staff to enable high level practical engineering education. The teaching methods have strong engineering focus with practical examples, exercises and laboratory practice on top of normal theoretical lecturing. The interviews with alumni and employers confirmed that the programme gives strong practical engineering skills to the graduates. Based on the interviews, students were satisfied with skills they attained during training periods.

Investigations and information retrieval

- ability to conduct searches of literature, to consult and to critically use scientific databases and other appropriate sources of information, and to carry out simulation and analysis, in order to pursue detailed investigations and research of technical issues
- ability and practical skills to design and conduct experimental investigations, interpret data and draw conclusions
- ability to work in a laboratory/workshop setting

Although the study programme does not contain a course focusing specifically on information retrieval, the students confirmed that they do not have problems with finding information and that they get enough support from the teachers during the courses when necessary.

Group work is extensively used in many courses where students conduct small projects. Bigger projects can be completed during different targeted courses (*Project*, *Software Project*, *Mobile Project etc.*) or in *Challenge Factory* (working as a summer trainee for a project together with industry experts). Students mentioned repeatedly projects as the favoured form of studies, and the *Challenge Factory* as the most enjoyable and useful academic activity. Although the project work has a significant role in the studies, the students expressed interest to have more big projects with full-cycle development and intensive project work could be started already earlier on in the study programme.

Academic staff mentioned studyfication as a method used for closing the gap between education and the world of work. The majority of project work is conducted on the topics and problems provided by local companies. The students will therefore experience real-life situations already during their studies, although most of the students are also recruited already during their studies.

Multidisciplinary competences

- awareness of the wider multidisciplinary context of engineering
- awareness of societal, health and safety, environmental, economic and industrial implications of engineering practice and recognition of the constraints that they pose
- awareness of economic, organisational and managerial issues (such as project management, risk and change management) in the industrial and business context
- ability to gather and interpret relevant data and handle complexity to inform judgements that include reflection on relevant social and ethical issues;
- ability to manage complex technical or professional activities or projects, taking responsibility for decision making
- ability to recognise the need for and to engage in independent life-long learning
- ability to follow developments in science and technology

There are several courses that develop these competencies. Most of these courses are mandatory and common for all students of the JAMK University of Applied Sciences. These courses are *Development as an Expert*, *ICT Skills*, *Entrepreneurship*, *JAMK Innovation Week*, *English for Working Life*, *Swedish for Working life* and *Communication Skills*. In addition to this, there is a special *Entrepreneurship and Innovation* module, from where students can choose 15 ECTS credits of studies.

Professional courses also include these competencies. According to students, these courses develop their multidisciplinary skills even better than theoretical courses.

One major finding was that practical training is developing these competences in many ways. This was mentioned not only by current students, but also by alumni and external stakeholders. Some comments suggested that even more practical studies and project-based learning be added to the programme, but on the other hand the majority of interviewed alumni had graduated quite a long time ago and did not have experience of the current curriculum. In any case, also the alumni saw that the multidisciplinary competences have steadily improved.

Communication and team-working

- ability to communicate effectively information, ideas, problems and solutions with the engineering community
- ability to communicate effectively information, ideas, problems and solutions with the society at large;
- ability to function effectively in a national and an international context;
- ability to function effectively as an individual and as a member of a team;
- ability to cooperate effectively with engineers and non-engineers.

All JAMK programs contain a 3 ECTS course on *Communication Skills* which provides the students with knowledge of communication models and understanding for different situations and ways of communication.

Building upon this, teamwork and presentations are part of different modules throughout the studies at JAMK. The *Innovation Week* in the first year of studies challenges the students with an intensive teamwork situation, where they have to collaborate with others effectively and present their work at the end.

Around 30 students every year make use of exchange programmes where they learn to study in an international context. It was indicated that the student union creates different occasions for students that made use of these programmes to get in touch with incoming visiting students. However, the accreditation team could not find evidence that the university was making any efforts itself to challenge more than the outgoing students with intercultural experiences.

Communication and information sharing tools such as *Slack* and *Optima* enable the students to communicate with each other and the teachers in various informal contexts around university life.

Project work in different Modules such as *Game Development* contain project work in groups during the further progress of studies. In the fourth year, the student can both develop his/her communication skills in a work environment during the practical training as well as an expert during the thesis.

Communication with non-engineers may typically occur in project work where students have to talk to a client or during practical training.

Team working is usually assessed through different measures such as contact hours with a supervisor, peer-assessment and presentation of the projects. From the perspective of resources, the accreditation team got the impression that team-work could be supported by having places for students to work and communicate in teams, i.e. small rooms for small project teams that allow open communication without distracting others.

The accreditation team concludes that the curriculum contains different situations and methods to develop communication and team-working skills of students. However, this is an area where the interviewed alumni and employers feel that still further emphasis would be good.

Based on the team's assessment, the programme meets ***standard 8 fully.***

Strengths, good practice and areas for further development regarding section 2.2: implementation of teaching and learning

The team notes the following strengths and good practice in this section:

- Project work successfully aids the development of hard- and soft skills and is liked by students and valued and supported by employers.
- A devoted team of teachers who are committed to the learning of students as well as guidance and tutoring.
- Student feedback matters. Through mid-course feedback, students can affect teaching even during courses.
- Several experts from the companies are involved in teaching for supervising students and offering lectures in topical problems.
- The academic staff members have good contacts to companies and use real-life problems of the companies in students' projects.
- The university has some very good practices: grumble week, use of Slack, Challenge Factory.

The team sees the following as areas for further development in this section:

- Make use of the incoming exchange students to provide all students with international experience
- When planning the full implementation of the rest of the curriculum, attention should be paid especially to aligning teaching and assessment methods with the learning outcomes, and to make this visible in the course descriptions.

2.3. Resources

Standard 9: The academic staff are sufficient in number and qualification to enable students to achieve the programme learning outcomes. There are arrangements in place to keep the pedagogical and professional competence of the academic staff up to date.

Teaching staff are appointed according to pre-defined recruitment criteria. The creation of academic posts and recruitment of academic staff is explicitly described in the *Process Manual* of the university. Key actors in the decision-making are the director of unit and the rector of the university. Although officially no collegial body is involved in it, quite often the head of department gathers colleagues with the needed expertise to carry out interviews.

There are 30 academic staff members and 553 students in the School of Technology. The student-teacher ratio of 18.3 is acceptable. In addition, some teachers from other institutes are involved in teaching some modules (for example, *Transferable Skills*) and separate courses (for example *Mathematics* I and II). According to the CVs submitted to the accreditation team, the academic staff has the required competences. The responsibility of teachers on the courses is divided quite unevenly: while some teachers are responsible on a big number of courses, some academic staff have only one or no courses assigned to them. However, even though a teacher is named responsible for the course, actual teaching can still in some cases be conducted by another teacher. The workload of staff is planned on an annual basis, in the development discussions between staff and their superiors, and the teaching load of an individual teacher also depends on their planned R&D work for the coming year. It also turned out that four courses were assigned to two part-time teachers who do not have master's degrees. The good relationship staff have with companies is also noteworthy.

Academic staff members have personal development plans that are discussed during development discussions. Improving the competences of teachers and their teaching load belong to the topics of the development discussions and every teacher has at least 40 hours a year reserved for improving their skills. The teaching load can vary over the years, depending on the amount of R&D activities. Although no specific innovative instructional strategy – like flipped classroom – was mentioned during the discussions, academic staff were open-minded and pedagogically competent.

The academic staff is actively involved in conducting R&D projects, especially in the specialist areas of cyber security and software development. Some have publications in international peer-reviewed journals. However, the teaching load of some academic staff is relatively high, which makes it harder to conduct R&D projects.

Based on the team's assessment, the programme meets ***standard 9 fully.***

Standard 10: An effective team of technical and administrative staff supports the programme. There are arrangements in place to keep the competence of the support staff up to date.

Support staff has a three-level administrative division: university level, school level and institute level. The *Quality Manager* and *Educational Development Manager* are examples of the university level support staff. The Quality Manager is responsible for the whole quality system and ensures that it works. He also provides support in planning and implementing services that are foreseen in the quality system (feedback, evaluations *etc.*) and ensures that the PDCA-cycle rolls on in all study programmes. He works closely with the Educational Development Manager and the quality officers of schools who handle all the information that the quality system produces and follows the recommendations for the programmes. The Educational Development Manager is responsible for implementing in practice those principles defined in the strategy of the university. He is also responsible in developing the framework of curriculum design.

The *Administrative Planner* is an example of school level support staff. Her main role is to act as the quality officer of the school: work with the quality team of the school in assuring daily improvement (collecting feedback and development proposals, passing recommendations to the management team of the school *etc.*).

Students' tutor is an example of the institute level support staff. The scope of her duties is very broad and goes beyond direct academic activities: helping students in career planning, solving problems in their personal lives (though there is also a psychologist in the university) *etc.*

Every member of the support staff goes through development discussions once a year with the superior where competence development is the major topic.

Professional networks were considered as important tools for staff development. For example, the Educational Development Manager is connected to the forum of vice-rectors and educational development managers that was formed by ARENE, the rector's conference. They get together twice a year. Although the quality managers of universities of applied sciences do not have an official network, they also meet once or twice a year. *Admissions Coordinators* of the universities have online meetings on a weekly basis to share information and discuss common problems.

Based on the documents provided to the accreditation team and on the discussions with the teaching staff, students and support staff during the site visit, an understanding was formed that the support staff is competent and effective.

Based on the team's assessment, the programme meets ***standard 10 fully.***

Standard 11: The students are provided adequate and accessible support services to enable the achievement of the programme learning outcomes.

Support services can also be divided into three levels: university level, school level and institute level.

Key persons offering university level support is the *Student Services Secretary*. Student services are normally the first contact point for students. There they can get guidance about the studies, information about the services, study certificates etc. There are also university level support services in ICT matters as well as in psychological and health problems.

Four senior lecturers and one specialist of the institute act as *students' tutors*, one for every specialisation. The tutors introduce the students to university studies and monitor them throughout the studies. Students will also get career advice, study counselling and, if necessary, psychic support.

The tutoring in the institute is in fact teamwork where other staff members (especially *programme coordinators* and *supervisors*) contribute. There are also *internship coordinators* who help students with internship issues. Based on the interviews, the tutoring works well and is valued by the students.

Students have also a number of online services including thorough the ASIO *Student Portal* for study information, *Optima* learning environment, *Slack* instant communication tool, helpdesk and others.

Based on the team's assessment, the programme meets ***standard 11 fully.***

Standard 12: The classrooms, computing facilities, software, laboratories, workshops, libraries and associated equipment and services are sufficient and accessible to enable students to achieve the programme learning outcomes.

The School of Technology has in general high-level facilities. The schools can propose new investments and the costs for approved investments come straight from the administration.

A study network *LabraNet* and infrastructure for cyber security are extraordinary. LabraNet is a flexible learning environment that allows conducting laboratory tasks, with about 300 workstations. Students have free access to the labs from 8:00 am to 10 pm. The fact that the access is not around the clock can sometimes cause problems, especially when deadlines for submitting project work approach. Also, the share of computer labs with the newest technology could be bigger. Some students also expressed a wish to have administrator's rights for some computers. These issues should be considered when updating the infrastructure.

For cyber security, an integrated *Realistic Global Cyber Environment* (RGCE) for conducting research, development and training has been created. As RGCE is an isolated network, it can be used for simulating cyber-attacks without the risks of affecting real production and service environments.

The campus has its own library, which is a part of JAMK's library, with all necessary library services. Although there was no institutional access to ACM or IEEE digital libraries, there is access to some other digital full-text databases in ICT. Services of the University of Jyväskylä are also available to the students and staff of JAMK.

There is a restaurant and lounges for students' independent studies and independent work on campus. The accreditation team got the impression that the structure of classrooms is not quite optimal: there are plenty of big classrooms and relatively few smaller classrooms. During the tour, we witnessed in many cases that a class with less than ten students was conducted in a room with 20 or more seats. Taking into account the amount of teamwork in the studies, more spaces suitable for small teams could be useful.

The *Dynamo* campus where the Institute of Information Technology operates has also passed the *Green Office audit* organised by the WWF.

Based on the team's assessment, the programme meets ***standard 12 fully.***

Standard 13: The HEI and the programme have external partnerships that are adequate to the achievement of the programme learning outcomes.

JAMK has several hundred external partnerships. There are more than 200 universities in JAMK's network and over 100 employer contacts every year, if thesis co-operation is also counted. There are different ways of doing co-operation with these partnerships. These include training, internships, theses, the advisory board, projects and different kinds of course-related exercises with external partners.

The advisory board is formed from a group of people with employer status. However, there are no public sector representatives in the board at the moment. This issue should be considered when inviting new people to the advisory board in the future.

Based on interviews with students, it became clear that training periods outside university are very much valued and students would even increase the amount of these periods.

JAMK has good international co-operation and 30 % of students are participating in international study mobility periods.

Based on the team's assessment, the programme meets ***standard 13 fully.***

Standard 14: The financial resources are sufficient to implement the learning process as planned and to further develop it.

The Institute of Information Technology has an independent budget. The revenues come from the funding by the Ministry of Education and Culture (53 %), RDI income (27 %), from sales and services (11 %) and from other income. The funding that comes from the Ministry is distributed to the faculties using the same indicators the ministry uses. Study programmes do not have separate budgets. The total budget of the Institute is increasing slightly (2016 – 4.4 M€; 2017 – 4.5 M€) while the budget of the whole university has been on a decreasing trend. From RDI income, the university takes about 9 % in overheads and the rest remains for the school itself. A big part of the RDI income comes from EU programmes.

Expenditure is divided into personnel costs (67 %), rental costs (14 %) and purchases (19 %). Costs for running and upgrading the facilities of the Institute are included in the budget of JAMK. In general, the division of income and expenditure is reasonable and allows the implementation of the programme as planned.

There is no separate item for RDI costs in the expenditure part of the budget – the RDI costs will be covered from the projects only. Because of this, teachers' possibilities to participate in conferences or visit partner universities abroad for initiating new projects are limited to topics that suit the projects that are currently running. The accreditation team proposes considering the possibility of forming a scheme for supporting RDI activities (for example, by setting up an RDI fund) in cases where there are no other means for supporting strategically important activities. This would also contribute to the development of the competences of teachers.

Based on the team's assessment, the programme meets ***standard 14 fully.***

Strengths, good practice and areas for further development regarding section 2.3: resources

The team notes the following strengths and good practices in this section:

- Active participation on R&D projects in cyber security and software engineering is an indicator of intense cooperation with the industrial and academic partners and provides significant contribution to the budget of the Institute of Information Technology.
- The Institute of Information Technology possesses exemplary laboratory environments *LabraNet* and *Realistic Global Cyber Environment*.

The team sees the following as areas for further development in this section:

- Provision of sufficient team-working spaces in the building.
- Considering the possibility of forming a scheme for supporting RDI activities (for example, by setting up an RDI fund) in cases where there are no other means for supporting strategically important activities. This would also contribute to the development of the competences of teachers.
- Consider the possibility of including representatives from the public sector in the Advisory Board.

2.4. Quality management

Standard 15: The quality management procedures of the programme are consistent with the quality policy of the higher education institution.

The JAMK Quality manual steers the different processes in JAMK and it is used in the development of the programme, supported by the JAMK Process Manual. In addition, quality guides for each school are used in everyday work. Based on the interviews, there is a sufficient amount of resources allocated to quality work. High quality and continuous improvement seem to be essential in planning the programme.

The institutional quality system of JAMK passed an international audit organised by FINEEC in 2013. In the previous audits, there have been good assessments regarding the commitment of the whole organisation to the JAMK quality system and based on the site-visit, it is the case also in this programme.

Based on the team's assessment, the programme meets ***standard 15 fully.***

Standard 16: The organisation and decision-making processes of the programme are fit for effective management.

The Director of the School of Technology is responsible for the quality and productiveness of education and RDI activities. In quality matters, the director is supported by the Quality Officer. The Head of Department is responsible in their own departments for these matters and they report to the Director of the School. In the School of Technology, there is also a Quality Team that comprises of the Quality Officer, the department quality officers and a student representative. During the assessment process, the accreditation team saw some good examples of effective and responsive way of making decisions. Based on the accreditation material and the interviews, there was no evidence of any severe problems related to the decision-making capability of the programme.

Based on the team's assessment, the programme meets ***standard 16 fully.***

Standard 17: The programme reviews and develops the programme aims, curriculum, teaching and learning process, resources and partnerships and quality management in a systematic and regular manner, taking into account analysis of results of student admissions, students' study progress, achieved learning levels, student, graduate and employer feedback and graduate's employment data.

The programme is updated on a yearly basis; a thorough renovation is done every five years or more often if needed. The planning of the programme is done according to basic principles given by the JAMK curriculum planning office. The actual planning is done by expert teams

in the Institute of Information Technology, but feedback from ICT Advisory board is taken into account. This seems to be a functioning concept.

One lack in this process is that there are no students directly involved in the actual curriculum planning process. Individual course feedback from students is taken into account by teachers, but it is filtered by teachers themselves. It is recommended that students be included in the curriculum updating process, for example, by presenting the curriculum draft to the students and discussing it openly during the preparation process.

The programme provided evidence of the following results of student admissions, study progress and achieved learning levels, although the ways of analysing and using these in the review and development process were not clearly described. The accreditation team was convinced that they are followed and if something in the results needs attention, it is taken into account. However, the role of analysing different evidence to back the curriculum review process could be made clearer in the process descriptions.

The follow-up-survey one year after graduation seems to be a good practice. It gives information about graduates' employment and opinions concerning their acquired competences.

Employer feedback is gathered in continuous cooperation with the companies. There is not an official feedback system for this, but informal discussion seems to be ongoing. The Advisory board is having meetings 1–3 times a year and their discussions are taken into account when planning the curriculum and individual courses. The interviewed members of the Advisory board thought that their feedback has been taken seriously and it has affected development in many ways.

Student feedback is gathered in two major ways: mid-course feedback in every course and Grumble Week organised by the Student Union. Mid-course feedback gives the teacher current information about ongoing courses and there is still time to make corrections if things are not going well. Students were happy about this practice and were able to give examples of changes made following the mid-course feedback. However, the accreditation team sees that this practice relies quite strongly on the responsibility of the teachers themselves which poses the risk that corrective action is sometimes not made.

All in all, the feedback system works well when it comes to individual courses. The accreditation team recommends that it could be expanded by gathering regular feedback from the stakeholders also regarding the whole curriculum.

Based on the team's assessment, the programme meets ***standard 17 fully.***

Standard 18: The programme provides public, up to date information about its objectives, teaching and learning process, resources, quality management procedures and results.

Precise information about the programme can be found in JAMK's own webpages. The curriculum of the programme is publicly available on the website and includes information regarding the objectives and teaching methods, although at the course level, some of the information needs improvement (see standard 4). The most important public information for the applicants is published on the website Opintopolku.fi, the information channel common to all universities in Finland. The objectives and structure of the programme are well described also there.

JAMK publishes information regarding its quality management and results on the section on quality on its public website. Statistics or other information concerning quantitative and qualitative measures of education in this programme are, however, harder to find. In Finland, the Ministry of Education and Culture publishes many kinds of qualitative data concerning Universities of Applied Sciences in Finland through the data portal Vipunen[1]. This information is gathered and published from every university and as such gives a good opportunity to compare different universities. Some of the results of this programme can be thus followed through that site. However, this information can be quite difficult to find for the general public. The accreditation team recommends the programme to consider what kind of information related to results would be useful to publish or link to on its own website.

Based on the team's assessment, the programme meets ***the standard 18 fully.***

Strengths, good practice and areas for further development regarding section 2.4: quality management

The team notes the following strengths and good practice in this section:

- The staff is committed to quality issues and continuous improving is the main attitude.
- There is an informal and natural relationship between JAMK staff and students.
- Also, the relationship between the local IT industry and JAMK is functioning and feedback is gathered from external stakeholders on a very informal basis.

The team sees the following as areas for further development in this section:

- The students should be included more in the curriculum development process.

1 https://vipunen.fi/en-gb/university-of-applied-sciences-(uas)-education

3
Overall evaluation of the programme

The team recommends that the programme is **accredited with the following conditions:**

- Learning outcomes of all modules and courses should be described in terms of competences students are able to demonstrate after completion.
- The course descriptions should provide comprehensive information (in particular learning outcomes, content, teaching methods/activities, assessment of students' learning) about all the courses in the curriculum.

Upon reviewing the programme, the team highlights the following **key strengths and good practice**:

- The study programme is balanced and offers specialisations in topical and important areas (cyber security, media engineering, software engineering, data network engineering).
- The Institute of Information Technology possesses exemplary laboratory environments *LabraNet* and *Realistic Global Cyber Environment*.
- Good contact with companies, which are visible in how topical the programme is and in active guest lecturers, projects and thesis co-operation.
- A devoted team of teachers and support staff who are committed to the learning of students and guidance and tutoring.
- Mid-course feedback lets students affect teaching even during courses.
- Both employers and graduates are positive of the programme.
- Flexibility of studies support student centeredness.
- Project works are an integral part of the curriculum and give possibilities to students to get real-life experience.
- Good practices: grumble week, use of Slack, Challenge Factory.

The team sees the following as **main areas for further development** of the programme:

- The compulsory mathematics studies in the programme should be revised, to take better into account the needs of an ICT engineering study programme.
- It would be good to have also public sector representatives in the advisory board.
- Students' participation in curriculum development is only indirect and should be stronger.

4
FINEEC Committee for Engineering Education's decision

In its meeting on 14 June 2017, the FINEEC Committee for Engineering Education decided, based on the proposal and report of the accreditation team, that the Degree programme in Information and Communications Technology at JAMK University of Applied Sciences is accredited conditionally.

Learning outcomes of all modules and courses should be described in terms of competences students are able to demonstrate after completion, and the course descriptions should provide comprehensive information (in particular learning outcomes, content, teaching methods/activities, assessment of students' learning) about all the courses in the curriculum.

The accreditation is valid until 31 December 2017 by which JAMK University of Applied Sciences should report to the Finnish Education Evaluation Centre on how they have met the set conditions. If the FINEEC Committee for Engineering Education then finds that the conditions have been successfully met, the validity of the accreditation will be extended until 14 June 2023.

The Finnish Education Evaluation Centre (FINEEC) is an independent, national evaluation agency responsible for the external evaluations of education from early childhood education to higher education in Finland. It implements system and thematic evaluations, learning outcome evaluations and field-specific evaluations. Moreover, FINEEC supports providers of education and training and higher education institutions in matters related to evaluation and quality assurance, as well as advances the evaluation of education.

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Engineering programme accreditation is a degree programme specific evaluation that can lead to the European EUR-ACE® Label. The accreditation aims to support the enhancement of quality in engineering degree programmes and increase the international comparability and recognition of engineering degrees within Europe. The accreditation is voluntary for Finnish higher education institutions and degree programmes. This report presents the process and results of the accreditation of the Degree Programme in Information and Communications Technology at JAMK University of Applied Sciences in Jyväskylä, Finland.

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