Creative Technology

**Faculty of Electrical Engineering,
Mathematics and Computer Science**

University of Twente

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CONTENTS

This report was finalised on 24 February 2015.

Report on the bachelor's programme Creative Technology of the University of Twente

This report considers the NVAO's Assessment Framework for Limited Programme Assessments as a departing point.

Administrative data regarding the programme

Bachelor's programme Creative Technology

Name of the programme:	Creative Technology
CROHO number:	50447
Level of the programme:	bachelor's
Orientation of the programme:	academic
Number of credits:	180 EC
Specialisations or tracks:	-
Location(s):	Enschede
Mode(s) of study:	full time
Expiration of accreditation:	22-03-2016

The visit of the assessment panel Creative Technology to the Faculty of Electrical Engineering, Mathematics and Computer Science of the University of Twente took place on 15 and 16 December 2014.

Administrative data regarding the institution

Name of the institution:	University of Twente
Status of the institution:	publicly funded institution
Result institutional quality assurance assessment:	positive

Quantitative data regarding the programme

The required quantitative data regarding the programme are included in Appendix 5.

Composition of the assessment panel

The panel that assessed the bachelor's programme Creative Technology consisted of:

- Prof. dr. ir. B.J.A. (Ben) Kröse, chairman, Professor Ambient Intelligence at the University of Amsterdam and Scientific Manager Create-IT Applied Research at the Amsterdam University of Applied Sciences;
- Ing. R. (Rik) Leenknegt, MSc, Strategic Director of the educational programme Digital Arts and Entertainment at Howest, University College West Flanders;
- Mrs. D.M. (Daphne) Heeroma, Director/Dean at the Academy for Digital Entertainment at the NHTV Breda University of Applied Sciences;

- Mrs. dr. ir. M.S. (Maaike) Kleinsmann, Associate Professor Product Innovation Management at Delft University of Technology;
- P. (Pepijn) Verburg, BSc, student member, student of the master's programme Industrial Design at Eindhoven University of Technology.

The panel was supported by Mrs J.J. (Jasne) Krooneman, MSc, who acted as secretary and project manager.

Appendix 1 contains the curricula vitae of the members of the panel.

Brief description of the procedures

Preparation
The management of the bachelor's programme Creative Technology provided a critical reflection as part of the preparation for the assessment. The project manager forwarded the document to the members of the assessment panel, who formulated questions based on its content.

Taking a variation in grading into account, fifteen theses were carefully selected by the project manager, in consultation with the chair of the panel (see Appendix 7 for a list of theses and documents studied by the panel). Each panel member had to review three theses.

The project manager prepared a timetable for the visit, which was discussed with the programme director of the bachelor's programme Creative Technology and the chair of the panel. Preparations for the site visit continued only after an agreement on the timetable was reached.

Site visit
During the preparatory meeting held at the start of the site visit, the panel received instructions regarding the NVAO's assessment frameworks for the higher education accreditation system. It discussed its working method, the findings from the evaluation of the critical reflection and theses, and its perception of the domain-specific framework of reference. The panel also studied additional information on the content of several courses, such as reference books and other learning material, and read reports on consultations in relevant committees/bodies. It analysed important management information and documentation regarding teacher and student satisfaction. Its members did not find it necessary to request any additional theses.

Immediately after the preparatory meeting, interviews were held with representatives of the management and the dean, students, lecturers, alumni, the Programme Committee, the Board of Examiners, the Advisory Board, tutors, and finally (again) with the dean and the management team. One person attended the open office hour, when people involved in the programme had the opportunity to speak freely to the panel. For information/clarification purposes, a few additional interviews were held during the site visit.

The site visit concluded with an oral presentation of the preliminary findings by the chair of the panel, consisting of a general assessment and several specific observations and impressions.

Report
After the site visit, the secretary wrote a draft report based on the panel's findings. Subsequently, this draft was sent to the panel for feedback. After processing the feedback of the panel members, the draft report was delivered to the programme management to check for factual irregularities. Any suggestions made by the management were discussed with the chair of the panel. The draft report was then sent to the panel members, who had the opportunity to review the changes in the draft report. A few days later, the report was finalised.

Decision rules
In accordance with the NVAO's Assessment Framework for Limited Programme Assessments (as of 22 November 2011), the panel used the following definitions for the assessment of both the standards and the programme as a whole.

Generic quality
The quality that can reasonably be expected in an international perspective from a higher education bachelor's or master's programme.

Unsatisfactory
The programme does not meet the current generic quality standards and shows serious shortcomings in several areas.

Satisfactory
The programme meets the current generic quality standards and shows an acceptable level across its entire spectrum.

Good
The programme systematically surpasses the current generic quality standards across its entire spectrum.

Excellent
The programme systematically well surpasses the current generic quality standards across its entire spectrum and is regarded as an (inter)national example.

Summary judgement

This report provides an overview of the assessment panel's findings and considerations regarding the bachelor's programme Creative Technology of the University of Twente. The panel based its judgement on information acquired from the critical reflection, a number of selected theses, the interviews held during the site visit and additional reading material which was available during the site visit. The panel found positive aspects as well as points for improvement. After careful consideration, it concluded that the bachelor's programme Creative Technology satisfies the requirements for accreditation.

Standard 1 Inteded learning outcomes
The current domain-specific framework of reference as presented in the critical reflection, is too long and complicated and therefore unsuitable as an exploration of the domain. The panel suggests that the programme develops a T-shape model as its basis, in which creativity and technology are on the x-axis and y-axis. By drawing a T-shape model, the positioning of Creative Technology within the academic and educational domain can be explained in a visual and comprehensible manner.

The bachelor's programme Creative Technology wants to challenge students to use the latest technology to develop interactive applications geared towards users' health, convenience and enjoyment. Its aim is for students to learn to understand and use smart technology, new media and creative thinking to influence people and improve their everyday lives. The panel is keen on the profile of the programme as it describes the essence of the education provided. In addition, it allows all students to further define their identity as a creative technologist.

Students are familiarised with research methodology and the panel considers this of crucial importance to the academic nature of the programme. It therefore advises the programme management to closely guard its research orientation. The panel states that the intended learning outcomes are well described at the correct academic bachelor's level.

Standard 2 Teaching-learning environment
According to the panel, the majority of the intended learning outcomes is adequately embedded in the modules and it particularly appreciates the way in which project work is applied. Project oriented education directly results from the TOM (Twents Onderwijsmodel/Twents Educational Model) principle that students should have freedom to follow their own interests and to acquire knowledge independently. The panel encourages the programme management to further implement and optimise TOM. It finds the four pillars of the Creative Technology teaching concept well defined and adequately carried out. The teaching methods match the teaching concept as well as the TOM principles, and the measures against 'free-riding' in group assignments are proven to be effective.

Due to the introduction of TOM, the curriculum of Creative Technology had to be restructured. At the moment of writing, the details of the third year of the new curriculum have yet to be concretised. The first and second year of the curriculum however, consist of relevant and coherent modules covering a broad range of disciplines. Although the panel is enthusiastic regarding the new curriculum, it advises the programme management to emphasise its research orientation and user-focus.

From 2009 onwards, the student intake grew rapidly. Since 2014, matching activities (to investigate the match between the programme and the talents and motivation of prospective students) are obligatory and primarily conducted by tutors. The tutor guides students the first

two years of the programme. The panel is particularly pleased with these matching and tutoring activities. The feasibility of the programme is ensured by the monitoring and guidance of tutors, the student advisor and student assistants.

The programme management is advised to develop a perception on internationalisation and ventilate it clearly. Although the bachelor's programme is taught in English and has an international student population, an explicit internationalisation strategy is absent. The panel recommends to actively stimulate students to participate in internships, conferences and minors abroad.

Quality wise, the panel believes that the programme houses excellent teaching staff. Quantity wise however, the panel finds the situation worrying. Currently, the programme has a shortage of core teaching staff members and deals with a fragmentation of the total number of available fte (6.8 fte spread over 54 staff members). The panel urges the programme management to carry out its plans to expand the core teaching staff and to identify the staff-student ratio as its priority concern.

The panel finds the programme-specific quality control adequate. The Programme Committee is well-informed and involved in educational affairs. It communicates with the CREative technology Evaluation Committee (CREEC) and the Director of Education. The panel advises to further formalise the quality control procedures and to systematically implement feedback sessions. It is enthusiastic about the participation of students in the quality control cycle.

Standard 3 Assessment and achieved learning outcomes
The panel is pleased with the diversity of assessments, such as assignments, multiple choice assessments, essays, papers, et cetera. However, the panel observes three areas for improvement regarding the current assessment system. First, oral feedback has to be conducted systematically to ensure that sufficient feedback is provided. Second, students should include in-depth reflections in their project-based work and final project reports. Third, the Board of Examiners should adopt a more proactive attitude.

The panel concludes that the overall level of the theses is what one would expect of an academic bachelor's programme. According to the panel, a clear and transparent thesis assessment procedure is missing and consequently it graded the majority of the theses lower than the examiners did. Nevertheless, there was no doubt that all productions were of sufficient quality. In most of the selected theses, there was a logical and consistent line of reasoning, the work contained a demonstration of adequate knowledge of literature in the field, and there was innovative input from the author. The panel argues that the majority of the theses was well written.

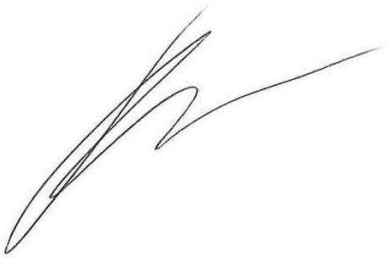
From the interview with alumni, the panel observed an admirable positivism regarding the bachelor's programme. The majority of the graduates continue their education at the University of Twente. Creative Technology also allows students to enter the labour market upon graduation. The panel confirms that students of the bachelor's programme Creative Technology achieve the intended learning outcomes upon graduation.

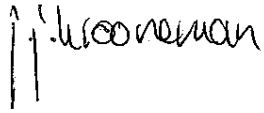
The panel assesses the standards from the *Assessment framework for limited programme assessments* in the following way:

Standard 1: Intended learning outcomes	satisfactory
Standard 2: Teaching-learning environment	satisfactory
Standard 3: Assessment and achieved learning outcomes	satisfactory
General conclusion	satisfactory

The chair and the secretary of the panel hereby declare that all members of the panel have studied this report and that they agree with the judgements laid down in the report. They confirm that the assessment has been conducted in accordance with the demands relating to independence.

Date: 24 February 2015





Prof. dr. ir. B.J.A. (Ben) Kröse

Mrs. J.J. (Jasne) Krooneman, MSc

Description of the standards from the Assessment framework for limited programme assessments

Standard 1: Intended learning outcomes

The intended learning outcomes of the programme have been concretised with regard to content, level and orientation; they meet international requirements.

Explanation:
As for level and orientation (bachelor's or master's; professional or academic), the intended learning outcomes fit into the Dutch qualifications framework. In addition, they tie in with the international perspective of the requirements currently set by the professional field and the discipline with regard to the contents of the programme.

Findings

The assessment panel conducted a limited programme assessment for the bachelor's programme Creative Technology at the Faculty Electrical Engineering, Mathematics and Computer Science. This standard first provides an insight into the assessment panel's findings regarding the domain-specific framework of reference (1.1), the programme's profile and orientation (1.2) and the intended learning outcomes and their level (1.3).

1.1 Domain-specific framework of reference
In the domain-specific framework of reference (see Appendix 2), the programme management argues that the scope of the creative technology domain includes Computer Sciences, Electrical Engineering and other technology areas, as well as Phsychology, Communication Sciences and aspects of the humanities. In addition, topics related to creativity are taken from Design Sciences.

The panel advises the programme management to re-write the domain-specific framework of reference and keep its content short and clear-cut. The current document is too long and complicated and therefore unsuitable as an exploration of the domain. The panel also suggests to further discuss the programme's position to similar national and international programmes and to phrase this position clearly. During the site visit, the programme management elaborated on the differences between the bachelor's programme in Creative Technology and other national and international educational programmes, but the panel believes that this positioning can be further explored and described. According to its Advisory Body, the bachelor's programme has a clearly defined technological character. The panel stresses that the social sciences, especially the user focus, could play a more central role. The panel suggests that the programme develops a T-shape model as its basis, in which creativity and technology are on the x-axis and y-axis. This would reflect the "T-shaped professional" as defined in TOM (Twents onderwijsmodel/Twents Educational Model). According to TOM, a "T-shaped professional" is an expert who is sufficiently embedded within the discipline in order to add knowledge or skills to it, and who has ample understanding of the context in order to reflect on the constraints of his/her own expertise and is also able to translate expertise to other disciplines. By drawing a T-shape model, the positioning of Creative Technology within the academic and educational domain can be explained in a visual and comprehensible manner.

1.2 Profile and orientation
The bachelor's programme Creative Technology wants to challenge students to use the latest technology to develop interactive applications geared towards users' health, convenience and

enjoyment. Its aim is for students to learn to understand and use smart technology, new media (e.g. media technology, electronics and computer/tablet/smartphone applications, videos, sound) and creative thinking to influence people and improve their everyday lives.

The panel finds the profile description an adequate one: it describes the essence of the education provided. In addition, it allows all students to further define their identity as a creative technologist. Alumni explained during the site visit that the programme offers knowledge and skills from a variety of disciplines (such as computer engineering, electrical engineering, business, et cetera) and hence turns students into 'builders of bridges'. The programme management confirmed that its students are particularly context aware and even the Advisory Body expressed appreciation of this creation of 'builders of bridges'. Students illustrated that the overarching profile provides sufficient room to include several types of creative technologists. For example, a creative technologist who is primarily business oriented or a creative technologist who excells in programming. The panel applauds the range of creative technologists that can be 'produced' by the programme. Furthermore, it appreciates the match between the programme's profile and TOM. The University of Twente aims to not approach technology in isolation, but in the context of behavioural, managerial and social sciences. The university claims that by combining high tech with a human touch, science is renewed and people are schooled in order to make a difference in society and to solve big and confronting issues.

The bachelor's programme Creative Technology has an academic orientation. Students are familiarised with research methodology. They learn how to find and assess relevant scientific literature and they acquire skills to write academic texts, particularly in order to justify their design approach and design decisions in front of experts. The panel argues that the academic orientation of the programme is of crucial importance and that the programme management should closely guard its research orientation. During the site visit, the management also explained that it would like to provide students with so-called 21st century skills that refer to a high knowledge level and the students' ability to oversee complex situations.

1.3 Intended learning outcomes and academic level

In the critical reflection, the programme management states that the programme aims to deliver graduates who are context-driven problem-solvers. This, in combination with the aim to provide students with 21st century skills, requires clearly formulated intended learning outcomes. In total, the management has formulated eleven intended learning outcomes and several sub-intended learning outcomes (see Appendix 3). These intended learning outcomes are related to five areas in which graduates should acquire knowledge and skills:

1. self-management of the designer's process of creation;
2. understanding and use of technology;
3. designing for interaction, expression, impact and experience;
4. societal and economic value;
5. academic and professional skills.

To ensure that the correct and internationally accepted academic bachelor's level is reached upon graduation, the programme management also measures the intended learning outcomes against the Dublin Descriptors. The panel studied the intended learning outcomes and concluded that they are described well at the correct (academic bachelor's) level.

Considerations

The assessment panel studied the domain-specific framework of reference and concludes that the document is currently unsuitable to serve its purpose. It therefore advises the programme management to re-write the document and make use of a T-shape model in order to explain the programme's positioning in a more comprehensible and visual manner. Nevertheless, the profile of the programme is well defined and the panel appreciates the fact that it allows for a diverse range of creative technologists. The academic orientation is adequate, although the panel believes it should be carefully guarded. The intended learning outcomes are of bachelor's level and they are formulated well.

Conclusion

Bachelor's programme Creative Technology : the panel assesses Standard 1 as 'satisfactory'.

Standard 2: Teaching-learning environment

The curriculum, staff and programme-specific services and facilities enable the incoming students to achieve the intended learning outcomes.

Explanation:
The contents and structure of the curriculum enable the students admitted to achieve the intended learning outcomes. The quality of the staff and of the programme-specific services and facilities is essential to that end. Curriculum, staff, services and facilities constitute a coherent teaching-learning environment for the students.

Findings

This standard provides an insight into the teaching concept and formats (2.1) and the curriculum (2.2) of the bachelor's programme Creative Technology. Special attention is paid to the relation between the intended learning outcomes and the curriculum in section 2.3. Then the programme-specific services (2.4) and the feasibility (2.5) of the bachelor's programme are analysed. In section 2.6 the quality and quantity of the teaching staff are discussed. This standard concludes with an analysis of the programme-specific quality control (2.7).

2.1 Teaching concept and formats
Creative Technology considers TOM (Twents Onderwijsmodel/Twents Educational Model) as point of departure. TOM embodies the university's vision on education and includes a number of principles to structure the curricula of all offered programmes. One of these principles includes freedom for students to follow their own interests and to acquire knowledge independently. The most important teaching formats related to this principle are problem- and project oriented education. Next to this university wide approach to education, Creative Technology has its own teaching concept and formats. As indicated in the critical reflection, the implemented teaching concept rests on four pillars:

1. Students should learn by doing, exploring, tinkering;
2. Students should learn, and not wait to get taught;
3. Students should stick together, they learn best in a group;
4. Students should show and not hide.

The programme management aims to direct its students through a self-directing learning cycle:

To explore – to get feedback – to focus on learning objectives – to account for reaching these objectives.

In the teaching practice however, a shorter cycle, the teacher directed cycle, is applied:

To get instruction and explanation – to practice and exercise – to account for reaching the learning objectives.

Teaching methods used in both cycles include lecturing, tutorial classes, practical sessions, (homework) assignments and project work. Tutoring also employs individual feedback sessions between tutor and student. In order to prevent students from 'free-riding' in groupwork, two measures are in place:

1. The group process is monitored and teachers intervene when they receive signals of 'free-riding';
2. A system of peer assessment is applied: students can signal inadequate contributions of fellow group members by using red, yellow and green cards.

The panel appreciates the four pillars of the teaching concept and argues that they are clear and well formulated. It would like to see these pillars implemented in a more explicit manner throughout the curriculum. One of the best ways of doing this is to optimise TOM. Problem- and project-oriented education is highly appreciated by the panel. During the site visit, the panel requested additional information on project work and it was pleasantly surprised by the innovative and daring projects that students work on. Projects last on average ten weeks and some examples include a 'slow listening' installation (forcing people to listen songs from beginning to end) and a 'cradle moving when baby cries'. The latter project also offered an excellent opportunity to include ethics in the scientific discussion. *Final Project Bachelor* work comprised of even bigger installations, such a floorprinter which creates artistic images and a led floor game which supports rehabilitation.

Students reported that they are satisfied with the teaching methods and that the measures against 'free-riding' are effective. The lecturers also confirmed the effectiveness of the system in place. It also said to be favourable of the problem- and project-oriented approach.

2.2 Curriculum

The English taught bachelor's programme consists of 180 EC, and the modules are spread over three years (see Appendix 4). Each academic year has two semesters that each consists of two blocks.

Year 1

The first year comprises of solely mandatory modules of 15 EC each. In the module *We Create Identity* students will explore the breath of creative technology topics and issues, and will reflect on their own roles and goals. In addition, they will obtain their first knowledge and skills in the various thematic subfields underlying the creative technology domain. And finally students engage in their first project-based work in this module. Students will also follow the module *Smart Environments* which aims to teach students various techniques from different disciplines that are needed to invent, design and realise a (prototype of a) smart environment.

The second semester of the first year begins with a module *Living and Working Tomorrow, Ideation and Explorative Design*. According to the information in the critical reflection, it is necessary for students to develop skills in generating ideas (ideation), exploring and tinkering and subsequently imagining, realising and presenting and evaluating these ideas in the context of an external assignment. These topics are bundled under the theme 'Living and Working Tomorrow'. The first year is concluded with a module *Art, Impact and Technology*, in which students design and realise an interactive installation for the GOGBOT festival, using and integrating methods and techniques from previous modules.

Year 2

Deepening of knowledge and skills is an overall characteristic of the second year of the programme. No matter which specific module students attend, each module is 15 EC. The first block begins with the module *Smart Technology* or the module *New Media*, depending on the student's preference. *Smart Technology* is a so-called "tool-module" that focusses on providing fundamental knowledge of frequently used tools. Physical (mostly electrical or mechanical) systems like electronics, telecommunication systems, sensors, controlled systems and the interfacing of such systems to the digital world are highlighted in this module. *New Media* is another "tool-module", which aims at building various skills, learning theory and understanding techniques for new media production. All students attend *Intelligent Interaction*

Design, which is about designing, realising and evaluating the interaction between people and technical systems, in particular intelligent systems.

In the second semester, *Innovation and Entrepreneurship for CREA* is first on the students' agenda. The goal of this module is to provide students insight into questions like: How can organisations manage their innovation processes?; How do entrepreneurs start their business after they got a great business idea?; What are professional ethics with regard to deploying new and emergent technology to improve quality of life? The last module of the second academic year is *Hybrid Worlds*. In this module, students from the *New Media* module and the *Smart Technology* module work together in a larger group, showing that they are able to combine their skills in the design and realisation of a meaningful installation.

Year 3

In the third year students will establish a *Personal Profile* (30 EC). During this module, students choose a standard university minor programme, a bridging programme towards a master's programme (pre-master's programme), or an international exchange programme. The personal profile needs approval of the student's tutor on behalf of the Board of Examiners.

The second half of the final year includes a *Final Module* (15 EC), which runs parallel with the *Final Project Bachelor* (15 EC). The *Final Module* offers a choice of topics with the common characteristic that they consider design issues from a user viewpoint and include theory regarding human behaviour and use of technology in a specific context. The *Final Project Bachelor* is a project executed with a third party.

The programme had a different curriculum until September 2013. It existed of thirty-five to fourty different courses, varying in a study load between 2 and 15 EC. During the last year, the programme management has worked on introducing TOM which started with the cohort of 2013-2014 when the original curriculum was rearranged. The details of the third year of the new curriculum have yet to be concretised.

The panel concludes that the first and second year of the new curriculum consist of relevant and coherent modules covering a broad range of disciplines. Although the panel is enthusiastic regarding the new curriculum, it advises the programme management to emphasise its research orientation and user-focus.

The panel discussed the programme management's intentions for the third year. From the site visit it became clear that there are still discussions on how to connect the *Final Project Bachelor* to the *Final Module*. The panel suggests to formulate a clear goal and aim (i.e. a learning objective) for the third year to facilitate the connection between these two modules.

The transition to TOM has a limited impact on the new curriculum since many of the existing courses have been combined to create the new and bigger modules. The panel is enthusiastic regarding TOM which centres education around project work. By placing projects in a central position, the pre-TOM courses can be better integrated in the new modules, the panel believes. During the site visit students explained why they appreciate the project work: "We are free in the projects, we get a broad concept and we can brainstorm within this concept". Students further elaborated that there are certain themes within the project work that guide them, and that they should always include solid argumentation for choices they make. The panel is positive regarding the freedom students experience during project work: it encourages independence and stimulates creativity.

The Advisory Body meets once every year and functions as a soundboard of the programme management. It reflects on the programme's profile, its future strategy and curriculum. Members of the Advisory Body indicated that their contribution is appreciated, and that the yearly meetings are highly efficient.

2.3 Relation between learning outcomes and the curriculum
The assessment panel analysed the relation between the learning outcomes and the curriculum. It also focussed on the cohesion and composition within the curriculum.

The programme management included a table in the critical reflection which indicates the relationship between the intended learning outcome and module. According to the panel, the majority of the intended learning outcomes is adequately embedded in the modules. In *We Create Identity*, all except two intended learning outcomes are enclosed. For example, students are introduced to project work in which self-managing the designer's process of creation is crucial (covering intended learning outcome one, two and three). Students are also acquinted with the understanding and use of technology (covering intended learning outcome four and five).

The panel appreciates the way in which project work is used to achieve the learning outcomes. However, it also sees room for improvement. Intended learning outcome eleven, which covers requirements such as knowledge of research methods, critical reflection and critical evaluation, could and should be further crystallised and accentuated in project work. This fits with the earlier suggestion to give prominence to its research orientation (see section 2.2). During the site visit, the programme management shared its ambition to connect every module to a chair. The panel is convinced that this would increase the visibility of the research component in the curriculum. Another option would be to stimulate the lecturers to connect their own research experience to theory and project work in the modules.

User focus (focus on user in the process of creating interactive applications) and the process of creativity (steps taken and documentation during the development of an application) could benefit from more consideration. In project work in particular, these two subjects should receive sufficient attention according to the panel. However, the panel remarks that user focus and creativity also require theoretical attention – i.e. provide sufficient literature. It greatly appreciates the embeddedness of intended learning outcome eight, which stimulates students to acquire knowledge and skills to bring creative technology to the market:

a. they have the knowledge to perform a market analysis;
b. they are familiar with attracting capital and financing;
c. they understand intellectual property rights;
d. they can write a business plan.

During the interviews, the panel noticed a strong drive among several students to become creative technologists with a business focus. From the thirty graduates of Creative Technology, two have been successful in start-ups. The panel considers the cohesion and composition of intended learning outcome eight within a variety of modules as the underlying factor which enabled these students to become successful entrepreneurs.

2.4 Programme-specific services
When it comes to the programme specific facilities, Creative Technology students have access to the SmartXp Theatre Hall, which is used for project groups, workshops, presentations and occasionally also for lectures and tutorial sessions. In addition, the programmes shares facilities with other bachelor's and master's programmes of the university. Lecture and

tutorial rooms, the library and internet access are examples of shared facilities. The programme also shares the electronics lab with Electrical Engineering.

During the site visit, the panel was guided through the building. It finds that the programme specific services are adequate. It was pleased to see available lockers to store project work safely and the presence of a supporting staff member at the SmartXP Theatre Hall – providing students with equipment and help whenever needed.

2.5 Feasibility
The quantitative data regarding intake numbers, transfers and graduates, the achieved staff-student ratio, and the average amount of face-to-face instruction per stage of the study programme can be found in Appendix 5. Below, not only the intake numbers, course load and feasibility, but also the internationalisation of the programme and the guidance offered to foreign students are discussed.

Intake numbers, course load and feasibility
From 2009 to 2011, the intake grew from thirteen to ninety-two students. In 2012 and 2013 the intake was seventy and seventy-seven students respectively. The majority of the student population is Dutch, but since 2011 the programme attracts around thirty international students on a yearly basis.

Students are admissible to Creative Technology if they meet the diploma requirements and if they have proven their English profiency. From the start of the programme, matching activities are organised in order to investigate the match between Creative Technology and the talents and motivation of prospective students. Since 2014, these matching activities are obligatory. Students who are unable to attend matching activities on campus will be interviewed over Skype. Lecturers stressed that one of the most important messages to send across to prospective students is that Creative Technology really concerns technology, and is not just "creative". Students argued that they applied for this programme because of its interdisciplinary character and its managerial perspective. In addition, some also clarified that they preferred the Twente region, the campus, the mindset and the fact that it is a young university.

The panel notes that the admission policy has improved since the start of the programme. During the site visit, tutors explained that the fundamental idea is that they themselves conduct the intake interviews with prospective students. On average eight to ten students are assigned to one tutor who will guide them during the first two years of the programme. If necessary students will receive tutoring from the same person in the third year as well. Tutors hold monthly discussions, as the panel concluded from the information available during the site visit. Students are accountable to their tutors in matters like the exposure of their progress and achievements, the development of their professional skills and their self-directed learning. As one of the tutors explained: "We are teachers of personal development. Creative Technology is a very broad educational programme. […] As a student you have to find your strength. We help them to [discover and] develop their strengths". The panel supports these matching and tutoring activities. It considers the numbers of dropouts and the flow of students adequate.

The tutor has the competencies of a teacher and acts as a supervisor and examiner on the basis of these competencies. The study advisor has the competencies of a counsellor and also monitors students' progress. Next to advising students regarding choices in the curriculum, the study advisor provides extra guidance for students with disabilities. During the site visit,

the study advisor explained that among the Creative Technology student population, a number of students is preoccupied with professional sport activities. These students also receive extra guidance from the study advisor. The alumni pointed out that informal guidance played an important role as well during their studies. "You can simply walk into the room of the lecturer and ask questions", an alumnus explained. In addition, there is a system of student assistants in place, who carry information from student to lecturer. Student assistants also support students with difficult subjects such as mathematics or programming.

At the end of the first year of the programme, students receive a recommendation regarding the continuation of their studies. Students who complete 45 EC of their first year modules obtain a positive recommendation. This policy applies to all university bachelor's programmes.

Students argued that they spend around sixty hours per week on their studies. "If you are enthusiastic about a project, you put more hours in it", one of them explained. "Since it is not required [to spend this many hours on a project], it does not feel that hard", another added. According to the alumni, they did not study sixty hours per week. "We had two assignments and a final assignment, but now they have seven assignments", an alumnus argued, pointing at the pre-TOM curriculum. The panel considers the course load adequate, but advises the programme management to guard that it will remain feasible and not increase any further.

Internationalisation
Although Creative Technology is taught in English and attracts foreign (predominantly German) students, there is no clear and documented vision on internationalisation. The panel acknowledges the fact that there are opportunities for students to study abroad during the programme, but advises the programme management to develop a perception on internationalisation and ventilate it clearly. The panel advises the programme management to actively stimulate students to participate in internships, conferences and minors abroad.

Foreign students receive a warm welcome by the programme. The first session of the curriculum starts with a cultural awareness course, in which all students write a reflection on their own cultural biases. Tutors guide this activity, which challenges students to explore the boundaries of studying in an international environment. During the site visit, a foreign alumnus stated: "The international atmosphere is very friendly".

2.6 Teaching staff
The asessment panel focussed on the quality and quantity of the teaching staff at the bachelor's programme Creative Technology.

Quality
In total, fourty-four teaching staff members are involved in Creative Technology, of which nine are considered core staff. The teaching capacity of the programme includes: nine professors, one part-time professor, six assiociate professors, twenty-two assistant professors and four lecturers. In addition, twelve other staff members are involved in the programme, resulting in a total of fifty-four staff members spread over 6.8 fte.

According to the assessment policy, every lecturer must achieve the University Teaching Qualification (UTQ) within three years after employment. Currently, five lecturers have achieved the UTQ and ten are working towards qualification. The panel appreciates this policy and encourages the increase of UTQs among teaching staff members.

During the site visit, the panel spoke to several excellent and highly motivated lecturers. Of course, it was difficult to confirm the didactical skills and academic knowledge of those who have their teaching priority at other faculties/programmes. The panel noticed that since the teaching staff is so fragmented, it is hard to get all involved lecturers at the same level of enthusiasm. However, it is confident that the quality and dedication of the core staff members is adequate. The programme management argued that it particularly values the research capacity of the teaching staff as it provides up to date knowledge, which can be applied in the curriculum.

Quantity
In the critical reflection, the programme management calculated that the current staff-student ratio is 1:29. As mentioned in section 2.5, intake numbers grew rapidly from 2009. For 2014-2015 the intake numbers increase again and the ratio is expected to be 1:33.

During the site visit, several parties have shared their concern regarding the shortage of core teaching staff members and the fragmentation of the total number of fte (6.8 fte spread over fifty-four staff members). For lecturers, the situation directly results in a high workload. Students complained that the communication between staff members and between staff members and students is rather poor: lecturers are unaware of their colleagues' courses and students have difficulties finding the correct information. The Programme Committee has also addressed the issue and signaled it as its priority concern.

The management confirmed that the staff-student ratio at Creative Technology deviates from other educational programmes at the Faculty. The dean guaranteed that the management currently searches new teaching staff members and that five vacancies have been created. The panel strongly encourages the search for new lecturers as it considers the current state of affairs as worrying and certainly vulnerable. During the site visit, the panel came across a number of weaknesses in the educational programme. After elaborate discussions, it came to the conclusion that the majority of these weaknesses can directly be related to the shortage of core lecturers. The panel argues that the staff-student ratio disturbs communication between lecturers and students, it negatively influences uniformity and possibly threatens the sustainability of the programme. It can only agree with the Programme Committee that the staff-student ratio requires priority concern.

2.7 Programme-specific quality control
The Programme Committee consists of four teaching and four student staff members from the bachelor's programme Creative Technology and the master's programme Human Media Interaction. The panel studied the Programme Committee reports and confirms that it holds monthly meetings to discuss evaluations. Together with the CREative technology Evaluation Committee (CREEC), an active student body promoted by the programme management, the Programme Committee processes student and teaching staff evaluations. CREEC-organised panel discussions form an important role in the quality control. At the end of each block, CREEC organises a lunch to evaluate several modules. The Programme Committee also communicates with the Director of Education and tries to get student information through its student members, who are active in PROTO, the Creative Technology study association. The panel welcomes the direct link to students through CREEC and PROTO, but also notes that the quality control cycle relies heavily on student participation. Only through PROTO, students receive feedback from the Programme Committee.

Student members of the Programme Committee explained during the site visit that the transition to TOM has been a core issue to students and staff. Some were positive, others

rather negative regarding the introduction of TOM. In the first phase of its introduction, TOM resulted in an abundance of assessments and consequently in a lot of complaints from students. The Programme Committee tried to inform students about the transition period, and answered questions. Particularly the student members have played an important role in the information process.

The panel finds the programme-specific quality control adequate. Due to the informal relationship between students and lecturers, problems can easily be addressed. Nevertheless, it is advisable to further formalise the quality control procedures and to systematically implement feedback sessions. The panel is enthusiastic about the participation of students in the quality control cycle.

Considerations

The panel is positive regarding the freedom students experience during project work: it encourages independence and stimulates creativity. It therefore advises the programme management to entirely implement TOM in the new modules. The four pillars of the teaching concept of Creative Technology are appreciated by the panel. Teaching methods used include lecturing, tutorial classes, practical sessions, (homework) assignments and project work. They match the teaching concept and principles of TOM and are successfully applied.

The panel studied the new curriculum and concludes that for the third year, not all details have been worked out yet. The first and second year however, consist of relevant and coherent modules covering a broad range of disciplines. The curriculum could be improved if the programme management would emphasise its research orientation and user-focus. The majority of the intended learning outcomes is adequately embedded in the modules.

The admission policy has improved since the start of the programme. The panel particularly appreciates the matching procedure and tutoring activities. Tutors, the study advisor and student assistants contribute to the feasibility of the programme. The panel finds the course load adequate, but advises the programme management to guard that it will remain feasible and not increase any further.

According to the panel, the programme management should develop a perception on internationalisation and ventilate it clearly. Although the bachelor's programme is taught in English and has an international student population, an explicit internationalisation strategy is absent. The panel advises the programme management to actively stimulate students to participate in internships, conferences and minors abroad.

The panel met excellent and highly motivated teaching staff members during the site visit. When it comes to the staff-student ratio however, it has some serious worries. Currently, the programme copes with a shortage of core teaching staff members and a severe fragmentation of the total number of available fte (6.8 fte spread over fifty-four staff members). This directly disturbs communication between lecturers and students, it negatively influences uniformity and possibly threatens the sustainability of the programme. The panel stresses that the staff-student ratio should remain priority concern of the programme management.

The programme-specific quality control is adequate. Due to the informal relationship between students and lecturers, problems can easily be addressed. Nevertheless it is advisable to further formalise the quality control procedures and to systematically implement feedback

sessions. The panel is enthusiastic about the participation of students in the quality control cycle.

Conclusion
Bachelor's programme Creative Technology : the panel assesses Standard 2 as 'satisfactory'.

Standard 3: Assessment and achieved learning outcomes

The programme has an adequate assessment system in place and demonstrates that the intended learning outcomes are achieved.

Explanation:
The level achieved is demonstrated by interim and final tests, final projects and the performance of graduates in actual practice or in post-graduate programmes. The tests and assessments are valid, reliable and transparent to the students.

Findings

This standard considers the findings regarding the assessment system (3.1) and subsequently deals with the question of whether the graduates have achieved the intended learning outcomes (3.2).

3.1 Assessment system
The assessment panel analysed the assessment system of the bachelor's programme Creative Technology and focussed on the assessment policy, including the functioning of the Board of Examiners, the examinations and the thesis procedure.

Assessment policy
A university-wide framework for assessment policy (2013) requires that every Faculty has an explicit assessment policy. The Faculty Electrical Engineering, Mathematics and Computer Science has a core assessment policy, with slight adaptations for its programmes. The assessment policy Creative Technology was available during the site visit. The document covers various topics, such as formative and summative assessments, individual and group assessments, the analysis of test results, improvement of tests, et cetera. Another issue discussed in this document is the required qualification for lecturers in order to conduct and supervise an exam. The Board of Examiners appoints examiners, partly based on their UTQ. During the site visit, the Board of Examiners explained that they check the list of examiners once a year and consider whether all information is still up to date.

The programme management also has an assessment plan. The underlying idea is that the assessment policy deals with the assessment practice while the assessment plan looks at the assessment system and two major questions:

1. How does the system of assessment match with the curriculum and the educational view?
2. How is the system of assessment "designed" to guarantee that the intended learning outcomes are reached?

The panel studied the assessment plan and noted that it includes a view on the curriculum and discusses the teaching concept. It then moves on to connect these points of departure to the assessment plan: stressing the types and focus of assessments. Furthermore, the document shares the programme's perception on the connection between assessments and the intended learning outcomes.

The Faculty is currently changing the organisation of its Boards of Examiners. Currently, there are different boards for individual educational programmes or groups of programmes. Chairs of the boards meet at regular intervals to maintain a common Faculty policy in certain

matters. However, the plan is to install a single Board of Examiners for the entire Faculty, with separate sections for educational programmes or groups of programmes. The Board of Examiners of Creative Technology already functions as a section in a Faculty wide board. It consists of three members of Faculty staff. From the available reports, the panel concludes that its members hold monthly meetings. Based on the documentation and the interview with the Board of Examiners, the panel argues that the board should adopt a more proactive attitude.

The panel is pleased with the diversity of assessments, such as assignments, multiple choice assessments, essays, papers, et cetera. However, the panel observes two additional areas for improvement regarding the current assessment system. First, the feedback from examiner to student needs to be improved. During the site visit, the panel studied several assignments and corresponding assessments and noticed the limited feedback students receive. Apparently, there are only a few standardised assessment forms and the feedback is often orally arranged. Oral feedback is not necessarily an obstacle, but the panel underlines that it has to be conducted systematically to ensure that sufficient feedback is provided. If this is not an option, it suggests that the Board of Examiners searches for new ways of providing formal feedback to students. Second, solid reflection reports are missing in project-based work and the final projects (theses). The majority of the students include observations in their reports, but the panel noted that in-depth reflections were left out.

Final project procedure
During the site visit, the panel received a document which contained an overview of the structure of the final project (thesis). According to this document, the thesis should include: a summary of the thesis, a statement of the research question, ideation and product idea, product specification, product realisation, an evaluation and conclusion. It also analysed the assessment form, which urges examiners to judge the thesis along several criteria: content of the report, structure of the report, quality of work, process, oral presentation and defense. These criteria are split into several sub-criteria, ranging from clarity and relevance to independency and planning. According to the alumni, students are always informed about the criteria prior to the start of the final project.

Students may pick a final project topic from a database that is maintained by a final project coordinator. They may also suggest their own topic. Students who plan to start their graduation work meet with the final project coordinator for an intake. The coordinator has to validate students' research proposals before they can start their project. The coordinator also ensures that supervisors in the companies are aware of the requirements for the assessment of final projects. The final project may only last one semester. While working on their final project, students meet in groups of eight to ten students to discuss their progress with their supervisors and fellow students.

An additional interview was arranged during the site visit to clarify the assessment of the thesis. Since the panel did not receive sufficient information regarding the thesis procedure prior to the site visit, it had difficulties assessing the work of fifteen graduates. The grades given by the panel were structurally lower than the grades provided by the examiners. Although a recent calibration session at the Faculty reveiled that in 80% of the theses the grades given by other lecturers did not deviate more than one point from the original grade, the panel argues that the assessment system requires more transparency. The Board of Examiners admitted that for outsiders it is a challenging task to trace back the construction of the grade. The panel is also of the opinion that the programme management and Board of Examiners should consider the identity of a thesis: what makes the report a Creative

Technology thesis? The panel is enthusiastic about the four-eyes principle, which departs from the idea that every thesis has to be checked by at least two supervisors.

3.2 Achieved learning outcomes

The assessment panel studied fifteen theses and states that the overall level is what one would expect of an academic bachelor's programme. According to the panel, a clear and transparent thesis assessment procedure is missing and consequently it graded the majority of the theses lower than the examiners did. Nevertheless, there was no doubt that all productions were of sufficient quality. In most of the selected theses, there was a logical and consistent line of reasoning, the work contained a demonstration of adequate knowledge of literature in the field, and there was innovative input from the author. However, as the panel already stated in section 3.1, the objective of the thesis requires further attention: how do you make sure that it can be identified as a Creative Technology production? Due to the broad nature of the programme, its characteristics should be guarded carefully. Furthermore, the presentation and application of the research methodology can be improved. In some theses, a deeper scientific analysis was lacking and, as mentioned earlier, in all theses an in-depth student reflection was missing. In addition, in many of the theses a well executed user evaluation was either missing or executed minimally. Nevertheless, the panel states that the majority of the theses were well written.

From the interview with alumni, the panel observed an admirable positivism regarding the bachelor's programme. The majority of graduates continues their education at the University of Twente. Examples of master's programmes that graduates opt for are the master's programme Computer Science, the master's programme Human Media Interaction and the master's programme Electrical Engineering. Not only does the bachelor's programme Creative Technology prepare students for a master's programme, it also allows them to enter the labour market upon graduation. Among the total of thirty graduates, two have successfully founded their own company. As an alumnus explained: "Our company derives from a course. We had to take a new technology and write a business plan for it. […] We learned to look at the market, IP, distribution, et cetera. […] From the course we saw the potential of our business. Hence, we did our bachelor's project on this topic. […] During the bachelor's programme you learn to look at the bigger picture first, I find that very useful".

During the site visit, alumni pointed out that they remain members of the study association. In addition, they were included into the alumni portal through which companies have access to new graduates.

Based on the content of the selected theses and the connection with several master's programmes and the labour market, the panel argues that students of the bachelor's programme Creative Technology achieve the intended learning outcomes upon graduation.

Considerations

The panel is pleased with the diversity of assessments, such as assignments, multiple choice assessments, essays, papers, et cetera. However, the panel observes three areas for improvement regarding the current assessment system. First, oral feedback has to be conducted systematically to ensure sufficient feedback is provided. Second, students should include in-depth reflections in their project-based work and final project reports. Third, the Board of Examiners should adopt a more proactive attitude.

Since the panel did not receive sufficient information regarding the thesis procedure prior to the site visit, it had difficulties assessing the work of fifteen graduates. It argues that the assessment system requires more transparency. The panel also states that the programme management and Board of Examiners should consider the identity of a thesis: what makes the report a Creative Technology thesis? The panel is enthusiastic about the four-eyes principle, which departs from the idea that every thesis has to be checked by at least two supervisors.

The assessment panel studied fifteen theses and states that the overall level is what one would expect of an academic bachelor's programme. It prepares students adequately to continue a master's programme or to enter the labour market. The panel was keen to see an example of how the programme even produces young entrepreneurs. It is confident that students of the bachelor's programme Creative Technology achieve the intended learning outcomes upon graduation.

Conclusion

Bachelor's programme Creative Technology : the panel assesses Standard 3 as 'satisfactory'.

General conclusion

The panel was pleased to assess the bachelor's programme Creative Technology. Based on the critical reflection, it initially had concerns regarding the content and structure of programme. However, during the site visit the panel discovered that many protocol documents were available on the spot, and it was pleasantly surprised by the variety and content of projects. In addition, it met a group of highly motivated and dedicated lecturers and students, who truly embody the soul of the programme. The study association PROTO has an important role in providing substance to the curriculum and is crucial to the functioning of the quality control cycle. The programme has an internationally appealing profile, and the panel points out that the Faculty basically possesses a diamond in the rough: the content of the programme has a tremendous future potential. It hopes that the programme will be valued by the Faculty for its interdisciplinary character and excellent focus on societal relevance. The panel describes the bachelor's programme Creative Technology as a precious programme of which its management should be proud. However, the panel notes that it is also quite vulnerable. In order to maintain the programme's quality and unique identity and character, its management should closely guard and express its vision, and urgently invest in additional teaching staff.

Conclusion
The panel assesses the *bachelor's programme Creative Technology* as 'satisfactory'.

Appendices

Appendix 1: Curricula vitae of the members of the assessment panel

Prof. dr. ir. B.J.A. (Ben) Kröse is professor at the Amsterdam University of Applied Science and at the University of Amsterdam in the Informatics Institute. He has a PhD from Delft University of Technology, and worked as a postdoc at the California Institute of Technology, USA. His research focuses on the technology and usability of smart devices and sensor systems that are able to recognise the activities of humans. Such systems are expected to be widely applied for smart services in health, safety, wellbeing, security and comfort. With his group of about 12 researchers at UvA and HvA he published 33 papers in scientific journals, edited 5 books and special issues and more than 100 conference papers. He is member of IEEE, ACM, Dutch Pattern Recognition Association and Dutch AI Association.

Ing. R. (Rik) Leenknegt, Msc is currently employed at the University College of West Flanders (Howest) in the Digital Arts and Entertainment curriculum which he founded in 2006. After being Academic Director of this curriculum for 7 year, he is currently active as Strategic Advisor for the DAE degree. In this function writes the future vision and mission of the DAE curriculum, he is performing research towards the valorisation and incubation potential within the creative entertainment industry and he is researching new forms of education that are better suited to educate the current generation of youngsters to the future professional employees for the international entertainment sector. Leenknegt is also lector applied Math and Physics in the DAE curriculum. In the past he has been teaching programming courses at Howest in the Multimedia and Communication Technologie (MCT) curriculum. In MCT he has also been project and IT coordinator. Before Howest he was employed in the field of automation and power electronics, the field of study in which he graduated.

Mrs. D.M. (Daphne) Heeroma is a Director/Dean of the Academy for Digital Entertainment of NHTV University of Applied Sciences Breda. She is also a member of the executive board of NHTV and is co-responsible for the strategy of NHTV. Heeroma's educational experience started in 1996. Before this she fulfilled various management positions in the field of facility management and real estate. During that period Heeroma was also involved in several accreditation processes and panels on behalf of IFMA. In 2013 she made the switch from Facility Management to Digital Entertainment. In her position as chair of the national domain creative technologies (HBO level) she takes the responsibility to enhance the collaboration between education and entrepreneurs within the creative industries. In her position as a academy Director/Dean Heeroma is active in networking, not only nationally, but also internationally. She is an active member of European Media Management Association and next to the intensive contacts with international partner universities, she also is participating at international conferences like GDC in San Francisco.

Dr. ir. M.S. (Maaike) Kleinsmann is associate professor in the Department of Product Innovation Management at the Faculty of Industrial Design Engineering at Delft University of Technology in Delft, The Netherlands. Her research focuses on design driven innovation, design thinking and collaborative design. Her work is published in several academic (design) journals. Furthermore, she is the doctoral education coordinator of the Graduate School of Industrial Design Engineering and teaches courses and supervises individual students in the Master Strategic Product Design of the same Faculty. Besides her academic work, she advises companies on innovation management and collaborative design.

P. (Pepijn) Verburg, BSc is a master student Industrial Design at the Eindhoven University of Technology. Verburg has studied Psychology for half a year, but his current academic

specialisation lies within the field of Design, Psychology and Computer Sciences. Next to this Verburg works on web development where he designs and builds custom frameworks and interfaces with web-based products. Furthermore, Verburg has been Commissioner of Education of the study association Industrial Design Lucid 2013-2014 and since September 2014, Verburg is the Student Advisor of the Departmental Board of Industrial Design.

Appendix 2: Domain-specific framework of reference

Hans van den Berg, Mannes Poel, Gerrit van der Hoeven, 29 September 2014

Introduction

This document proposes a DSFR for *Creative Technology*. It addresses the domain-based requirements for graduates and for programmes. It was drafted in preparation for the external peer assessment – for reaccreditation – of the University of Twente's BSc programme with the same name, in 2014.

We weren't able to find an authoritative domain description in the literature. Therefore, we have developed this DSFR, primarily based on literature sources plus interviews with the members of the programme's Advisory Board.

Creative Technology as an educational domain is rather new, and intrinsically interdisciplinary by nature[1]. Whereas the domain, in a broader sense, can contain 'Music and Technology' or 'Advertising and Technology' or 'Education and Technology', we have chosen a more focused scope. Our scope includes Computer Sciences and Electrical Engineering as technology areas, and Psychology and Communication Sciences as areas from humaniora. The creativity topics are part of design sciences. (For the UT, this is from Industrial Design Engineering.)

Descriptions for the *subjects* that constitute Creative Technology as we have scoped it *are* available, e.g. from QAA (UK) and ASIIN (Germany). Quinlan has pointed out that subject-specific descriptions have limitations for interdisciplinary programmes[2].

An authoritative *definition* of Creative Technology is also not available, and there's much debate[3]. For the purpose of drafting this DSFR, we will use the following definition:

> **Definition of Creative Technology:**
>
> ***Adapting state-of-the-art technology or new media in an original/appealing way to create interaction with or between users[4].***

1 E.g. Elizabeth F. Churchill, Anne Bowser and Jennifer Preece, Teaching and Learning Human-Computer Interaction: Past, Present, and Future. Interactions (ACM) March + April 2013, 44

2 Kathleen Quinlan [www.srhe.ac.uk/downloads/events/77_Quinlan.docx, retr. 3 July 2014]

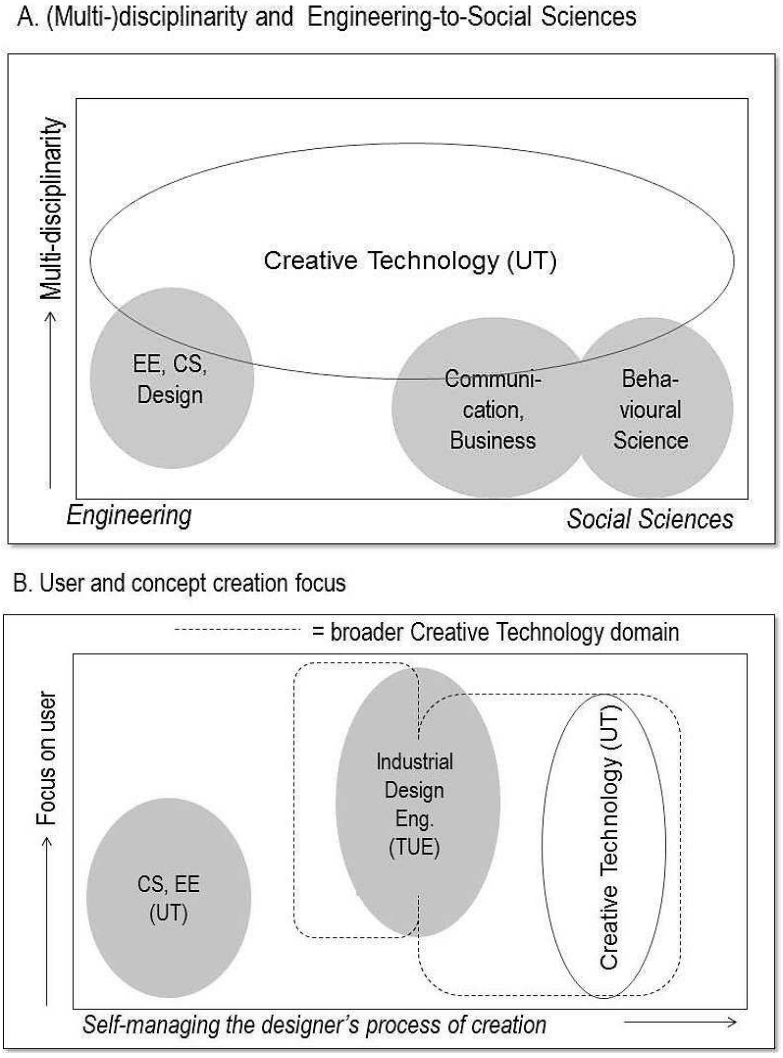
3 Northern Periphery Programme, EU Regional Development Fund, Defining the Creative Industries www.northernperiphery.eu/.../Defining_the_Creative... [Retrieved July 3, 2014]

4 www.Educationfair.nl/bachelor/university-of-twente [Retrieved July 3, 2014]

Overview of the domain

Figure 1.1 presents the position of a number of educational programmes in the (scoped) domain. Please note that these are qualitative, conceptual diagrams.

Figure 1.1. Domain overview



In Figure 1.1, both the UT Creative Technology BSc programme and 'nearby' benchmark programmes have been mapped out. 'Nearby' indicates that these programmes are considered to be most relevant. One aspect which is not explicitly plotted in Figure 1.1 is creativity. According to Richard Florida's 2002 *The Rise of the Creative Class,* the economic function of 'creative workers' is to "create new ideas, new technologies, and/or creative content".[5]

In order to develop the actual domain-specific requirements that are presented in section 3 various sources were used. An overview of these sources is presented in Table 1. Details are provided in the appendices.

[5] Tuning, Towards a European SQF for the Creative and Performing Disciplines and the Humanities (2012)

Table 1.1. Overview of main sources used for this DSFR

Topics		*Source category*	*National sources*	*International sources*
Requirements for graduates	*Requirements for programme*	*Academia*		• European Institute of Technology, EIT • Creative Digital Media BA U Worcester • Malcolm Shaw, *Indicators of Creativity in 18 QAA Subject Benchmark Statements.* HEA (UK) [no date]
		Professional field	Art and technology[6]	Advisory Board of UT Creative Technology BSc
		Both, i.e. accreditation agencies	Dutch-Flemish Accreditation Organisation (NVAO)	**QAA** SBS[7] *Art and design (2008); Engineering (2010); Psychology (2007); Communication, Media, Film and Cultural Studies (2008)* ***ASIIN*** *SSC[8] EE and IT (TC02, 2011); Informatics (TC04, 2011); Industrial Engineering (TC06, 2011); Mathematics (TC12, 2011)* ***ABET*** *Criteria for Computing programs (2012)*

Requirements from academia

2.1. Academic requirements for graduates

EQF, the European Qualification Framework, provided initial guidance. Figure 2.1 shows a picture of the EQF for the creative and performing disciplines. EQF level 6 is the bachelor's level.

Figure 2.1. European Qualification Framework for bachelor graduates in the creative and performing disciplines

[6] In Dutch: Kunst en Techniek. These are two University of Applied Sciences programmes, from HKU and Saxion

[7] QAA SBS = UK Quality Assurance Agency – Subject Benchmark Statement.

[8] ASIIN SSC = ASIIN Subject-Specific Criteria. ASIIN is a German Association for certification and accreditation.

LEVEL: 6		CREATIVE & PERFORMING DISCIPLINES		
EQF CATEGORIES →		KNOWLEDGE	SKILLS	COMPETENCE
		Creation & Creativity		
	7 DIMENSIONS	STUDENTS IN THE CREATIVE & PERFORMING DISCIPLINES ARE EXPECTED TO:		
Creation & Creativity	Making, Performing, Designing, Conceptualising	Have advanced knowledge of the processes and concepts underlying creation and/or performance in their specific discipline	Have the advanced skills necessary to create, realise and express their own creative concepts	Be able to draw upon the knowledge and skills gained within their studies to act and respond creatively in different situations
	Re-thinking, Considering and Interpreting the Human	Appreciate how the practice and/or creation generated within their discipline both stems from, and shapes, our humanity	Demonstrate interpretative skill and a reflection of the human dimension in their creative practice	Be able to draw upon experience gained within their studies to operate with an ethical awareness and to encourage the development and foster the well-being of other individuals and groups
	Experimenting, Innovating & Researching	Be aware of the research dimension inherent in the artistic practice and/or creation relevant to their discipline	Experiment in their creative practice and to demonstrate an emerging ability to handle complexity and unpredictability	Be able to draw upon experience gained within their studies to respond with curiosity and an enquiring outlook to the world around them
	Theories, Histories & Cultures	Have advanced knowledge and critical understanding of the main theories, principles, patterns and core body of works of their discipline	Be able to access the information necessary to develop their knowledge, using all appropriate media and sources, and to apply this knowledge to their creative processes	Be able to draw upon experience gained within their studies to access knowledge and exercise critical judgement outside their discipline
	Technical, Environmental & Contextual Issues	Have advanced knowledge of the range of materials, techniques, environments and contexts which underlie the act of creation and/or performance in their discipline	Demonstrate the necessary technical mastery to achieve their creative goals	Be able to draw upon contextual awareness gained within their studies and apply this in different situations
	Communication, Collaboration & Interdisciplinarity	Be aware of disciplines outside their own and of the dynamic ways in which the creative & performing disciplines interact	Demonstrate the capacity to work collaboratively in their discipline and communicate it effectively to others	Be able to contribute to the execution and management of activities or projects in an open and communicative manner
	Initiative & Enterprise	Be aware of how their discipline functions as a profession and as part of the creative industries	Be pro-active in generating artefacts, events and opportunities for work within their discipline	Be able to act resourcefully, initiating certain projects and contributing decisively to the success of others

For engineering, Tuning and Ahelo have produced a 'Conceptual Framework of Expected/ Desired Learning Outcomes in Engineering' in 2009[9]. Please refer to appendix A for a Table of Learning Outcomes. Also, Tuning has produced a list of Generic Competences (appendix B).

Next, twelve authoritative international academic sources were selected to establish the requirements for graduates. Four are from ASIIN (Germany), one from ABET (USA), four from QAA (UK), one based on an analysis of creativity as a subject in QAA Subject Benchmark Statements, one from the European Institute of Technology and one from the University of Worcester (UK). The disciplinary range of sources covers the multi-disciplinarity of Creative Technology. We have copied the aggregate Table from appendix C as Table 2.1:

Table 2.1. Aggregate requirements from the 12 sources, after selection of specifics

ACBMP 3 groups	ACBMP 7 areas of competence	Aggregate requirements ('the graduate …')	Comments (with reference to UT's programme)
Domain	1. Competent in disciplines	1.1 has command of basic engineering and natural science; can apply these 1.2 can apply mathematical methods 1.3 has an understanding of the broader (multidisciplinary) context and can integrate his competences in that context 1.4 is competent in creativity to generate ideas	

[9] Tuning Association, *A Tuning-Ahelo Conceptual Framework Of Expected/Desired Learning Outcomes In Engineering*. OECD, 23 June 2009

		1.5 is aware of current developments and uses current techniques, tools and concepts; understands best practices 1.6 is aware of project management and business practices; has entrepreneuring skills	
	2. Competent in doing research	2.1 has research competences, including information skills, literature researching, analysis, carrying out empirical studies, and academic writing 2.2 is capable of independently complementing and deepening his knowledge and competences	
	3. Competent in designing	3.1 is capable of problem finding, using ideation (this strongly resembles the 'Delft design method')	The sources appear to focus on more classical 'waterfall'-type design methods
Method	4. A scientific approach	*[comment: apart from the research approach as in 2.1 a scientific design method could be relevant. We've not found this in the sources]*	Creative Technology graduates do know how to design
	5. Basic intellectual skills	5.1 is capable of self-management, including personal planning, organizing his own learning and self-evaluation 5.2 is capable to form and to formulate arguments, views and interpretations. Can take different perspectives 5.3 has analytical, abstract, conceptual, logical and critical reflection competences that form the basis for 5.2 5.4 demonstrates enthusiasm for enquiry	Point 5.1 is considered key for Creative Technology
	6. Competent in co-operating and communicating	6.1 can effectively work with others, in teams 6.2 can communicate effectively with experts and non-experts 6.3 is able to integrate into a working environment	
Context	7. Takes account of temporal and social context	7.1 is able to make value judgments, on contextual aspects, also based on ethical considerations 7.2 understands legal aspects, especially IP 7.3 has a view on his personal societal responsibility 7.4 is aware of safety, environmental and health aspects	

2.2. Academic requirements for a programme

Information was fairly limited. EIT has developed general learning outcomes for its Master's and doctoral programmes. The requirements for creativity, entrepreneurship and research were considered to be relevant, as are the didactics (learning by doing) and the cross-disciplinarity.
In its Strategic Agenda, the Dutch platform IIP/Create has formulated general requirements for educational programmes in this domain. The essence of these is that multi-disciplinarity is required.

Requirements of the professional field

3.1. Professional requirements for graduates

In the literature search, the professional field proved to be varied. Finding relevant professional requirements for creative technology graduates from the literature was not trivial. Partly, this is due to the apparent role of advertising and other industries in shaping this domain. UNCTAD and UNESCO reports also seem to have a blind spot concerning creative technology as meant in this DSFR.
Some rather general information was found in an IIP/Create document from 2008.[10] A lateral move towards the domain of Interaction Design was found to be too far off target, since it deals more with usability than with user experience.
A relevant Higher Education source are the final qualifications in Dutch Arts and Technology. This is not an academic, but a higher professional domain directly targeted towards the professional field. Thus, the final qualifications should voice professional requirements. Table 3.1 provides a summary:

Table 3.1. Professional requirements from Arts and Technology

Type of final qualification	Competences (key words)
Directive	To manage team members
	To acquire, set-up and execute projects
	To develop a realistic project definition with client
	To communicate
Reflective	'Reflective practitioner'
	Aware of ethical issues
	To keep up to speed with developments in the domain
Design	Solid basic skills in relevant software
	Systematic problem analysis and definition
	Independent problem solving
	Pro-active inquisitive attitude in pre-investigation and evaluation
	Repertoire of relevant research skills and capable of selecting the right methods

[10] http://www.iipcreate.com/

	Exhibits vision, innovation and creativity in concept creation and free experimentation
	Innovative and creative attitude
	Artistic personal positioning
Collegial	Productive collaboration
	Professional presentation to 3rd parties

The outcomes of the interviews with the Advisory Board members of UT's Creative Technology programme are summarised in Table 3.2. Individual Advisory Board member specifications were aggregated and listed next to the academic requirements from Table 2.1. The full report is in Appendix D.

Table 3.2. Aggregate programme requirements (Table 2.1) with professional requirements added

ACBMP 3 groups	**ACBMP 7 areas of competence**	**Aggregate requirements ('the graduate …')**	**Specifications by Advisory Board members (aggregated)**
Domain	1. Competent in disciplines	1.1 has command of basic engineering and natural science; can apply these 1.2 can apply mathematical methods 1.3 has an understanding of the broader (multidisciplinary) context and can integrate his competences in that context 1.4 is competent in creativity to generate ideas 1.5 is aware of current developments and uses current techniques, tools and concepts; understands best practices 1.6 is aware of project management and business practices; has entrepreneuring skills	1.1 aware of constraints and possibilities; of hardware (e.g. mobile); can do UI/UX; choose IT tool and makes sure to deliver 1.2 Big Data skills 1.3 user-centricity and co-creation; customer requirements; user experience, usability, empathy 1.4 Functional creativity, 'loose thinking', independent attitude, originality, applied curiosity 1.5 Open for new tech possibilities; up to date 1.6 Entrepreneurial skills 1.7 History of Art (some)
	2. Competent in doing research	2.1 has research competences, including information skills, literature researching, analysis, carrying out empirical studies, and academic writing 2.2 is capable of independently complementing and deepening his knowledge and competences	2.1 Analytical skills 2.2 Learning to learn
	3. Competent in designing	3.1 is capable of problem finding, using ideation (this strongly resembles the 'Delft design method')	3.1 able to rapidly work towards prototypes; methodological designing; 'do first, investigate later';

			fail-proof designing; Imagineering; multiple perspectives; aesthetics and visual quality; tech for designing
Method	4. A scientific approach	*[comment: apart from the research approach as in 2.1 a scientific design method could be relevant. We've not found this in the sources]*	
	5. Basic intellectual skills	5.1 is capable of self-management, including personal planning, organizing his own learning and self-evaluation 5.2 is capable to form and to formulate arguments, views and interpretations. Can take different perspectives 5.3 has analytical, abstract, conceptual, logical and critical reflection competences that form the basis for 5.2 5.4 demonstrates enthusiasm for enquiry	5.1Self-starting
	6. Competent in co-operating and communicating	6.1 can effectively work with others, in teams 6.2 can communicate effectively with experts and non-experts 6.3 is able to integrate into a working environment	6.1 'Reverse coaching'; X-functional team work 6.2 'sell oneself'; engage in deep Q&A; X-disciplines; very important; portfolio must be striking; tech for presenting designs
Context	7. Takes account of temporal and social context	7.1 is able to make value judgments, on contextual aspects, also based on ethical considerations 7.2 understands legal aspects, especially IP 7.3 has a view on his personal societal responsibility 7.4 is aware of safety, environmental and health aspects	

3.2. Professional requirements for a programme

The main source for programme-specific professional requirements were the interviews that were conducted with the members of Creative Technology's Advisory Board[11]. In summary:

[11] See also Appendix D for the report. Details are available on request.

- Balance:
    - Good balance between depth and width
    - a massive (technical) skills range to cover
- Didactics:
    - Student-Centred Learning and Project-Based Learning
    - T shaped education. Strong in one of the subfields … and open to problems of society
- Scope:
    - Create is looking for students who can think disruptive but on the other hand in the end the students must develop something which is easy to use. There is a tension between the two and the challenge is to find a balance. The risks are that students lose the disruptive thinking or do not have enough skills in designing easy to use artefacts. *Sprezzatura*
    - The medical domain (BMT) and nanotechnology. The programme has to anticipate on multidisciplinary technology conversion.

Consolidation of findings

In sections 2 and 3, academic and professional sources have been utilised to develop criteria sets for the requirements for graduates of, and a programme in, the domain of creative technology.
Here, we will consolidate these findings. Our starting point for the graduates' requirements is Table 2.1, which is based on a comprehensive set of mostly accreditation-related criteria documents. Please note that the professional requirements typically are included in accreditation documents of this kind.

Our conclusion regarding the confrontation – regarding professional requirements – of Tables 3.1 and 2.1 is that Table 2.1 covers Table 3.1 - albeit in a different way of organising criteria and in different wordings. The wording in Table 2.1 is somewhat more general, and this aligns well with similar criteria sets.

Table 3.2 summarises the outcomes of the Advisory Board interviews. In our view, the outcomes generally corroborate the findings in Table 2.1. It seems evident that the Advisory Board members have included specific requirements. Here, it would be worthwhile to note that Table 2.1 results from a large body of consensus work, whereas with the Advisory Board members one-on-one interviews were conducted; so, consensus development was not a part of this process.

Also interesting to note is that the (anonymous) digital ILO survey conducted with the same group have resulted in all ILOs of UT's Creative Technology programme receiving good scores [full report in Appendix E].
We consider the outcomes of the interviews as more detailed views on specifications. For future reference we include them here separately, as Table 4.2.

Table 4.2. Detailed graduate specifications from the Advisory Board interviews

ACBMP 3 groups	ACBMP 7 areas of competence	Specifications by Advisory Board members (aggregated)
Domain	1. Competent	1.1 aware of constraints and possibilities; of hardware (e.g. mobile); can do UI/UX; choose IT tool and makes sure

	in disciplines	to deliver 1.2 Big Data skills 1.3 user-centricity and co-creation; customer requirements; user experience, usability, empathy 1.4 Functional creativity, 'loose thinking', independent attitude, originality, applied curiosity 1.5 Open for new tech possibilities; up to date 1.6 Entrepreneurial skills 1.7 History of Art (some)
	2. Competent in doing research	2.1 Analytical skills 2.2 Learning to learn
	3. Competent in designing	3.1 able to rapidly work towards prototypes; methodological designing; 'do first, investigate later'; fail-proof designing; Imagineering; multiple perspectives; aesthetics and visual quality; tech for designing
Method	4. A scientific approach	
	5. Basic intellectual skills	5.1Self-starting
	6. Competent in co-operating and communicating	6.1 'Reverse coaching'; X-functional team work 6.2 'sell oneself'; engage in deep Q&A; X-disciplines; very important; portfolio must be striking; tech for presenting designs
Context	7. Takes account of temporal and social context	

The consolidated requirements for a programme have been assembled in Table 4.3.

Table 4.3. Consolidated programme specifications

Key word	Indication of specification	Source(s)
Balance	Finding a proper balance between breadth and depth for a programme in the interdisciplinary domain of creative technology – which is not trivial	Advisory Board interviews; EIT; IIP/Create; Churchill et al.;
T shaped	The programme should develop graduates who possess both a broad set of competences and in-depth competences in a specific topic or topics	Advisory Board interviews
Didactics	Learning-by doing, Student-centred Learning and Project-Based Learning	EIT; Advisory Board interviews
Scope	The programme should anticipate on multidisciplinary technology convergence (Bio, Info, Cogno and Nano, i.e. NBIC)	Advisory Board interview

These outcomes have a more anecdotal character. It should be noted, however, that a number of the requirements are supported by different sources and by large bodies of educational research.

One requirement is specific to an interdisciplinary programme: the required balance between depth and broadness. Educational programmes in this domain could pursue different approaches to find this balance.

Confrontation of ILOs of Creative Technology with this DSFR

The aforementioned 2013 HCI paper by Churchill et al. was used as an additional source to support the argumentation for the profile chosen for UT's Creative Technology programme. This aspect, though on the outskirts of a DSFR, is included in this section.
Previous sections have generated two sets of requirements: for graduates of, and for programmes in, the domain of creative technology. Here, we will cover the match between the DSFR and the ILOs and programme of the UT Creative Technology.

Requirements for graduates

The starting point is Table 2.1 from the DSFR. We include it here, and have added the way in which the ILOs match with the DSFR requirements.

Table 5.1. Aggregate programme requirements (Table 2.1) and UT Creative Technology ILOs

ACBMP 3 groups	**ACBMP 7 areas of competence**	**Aggregate (academic) requirements ('the graduate …')**	**UT Creative Technology ILOs** (x.x are the codes of the aggregate requirements)[12]
Domain	1. Competent in disciplines	1.1 has command of basic engineering and natural science; can apply these 1.2 can apply mathematical methods 1.3 has an understanding of the broader (multidisciplinary) context and can integrate his competences in that context 1.4 is competent in creativity to generate ideas 1.5 is aware of current developments and uses current techniques, tools and concepts; understands best practices 1.6 is aware of project management and business practices; has entrepreneuring skills	1.1 4a; 4b; 4c; 4d; 4e; 6 1.2 5 1.3 7 1.4 2 1.5 10; (6) 1.6 8
	2. Competent in doing research	2.1 has research competences, including information skills, literature researching, analysis, carrying out empirical studies, and academic writing 2.2 is capable of independently complementing and deepening his knowledge and competences	2.1 11 2.2 11
	3. Competent in designing	3.3 is capable of problem finding, using ideation (this strongly resembles the 'Delft design method')	3.1 1; 3; 11
Method	4. A scientific approach	*[comment: apart from the research approach as in 2.1 a scientific design method could be relevant. We've not found this in the sources]*	
	5. Basic intellectual skills	5.1 is capable of self-management, including personal planning, organizing his own learning and self-evaluation 5.2 is capable to form and to formulate arguments, views and interpretations. Can take different perspectives 5.3 has analytical, abstract, conceptual, logical and critical reflection	5.1 11[13] 5.2 10 5.3 11 5.4 11

[12] Please refer to the appendices of the Self-Assessment Report for a list of ILOs

[13] Considered to be key for CreativeTechnology. Its importance may require additional attention in the ILOs

		competences that form the basis for 5.2 5.4 demonstrates enthusiasm for enquiry	
	6. Competent in co-operating and communicating	6.1 can effectively work with others, in teams 6.2 can communicate effectively with experts and non-experts 6.3 is able to integrate into a working environment	6.1 3; 11 6.2 6 (story telling); 10 6.3 not yet addressed[14]
Context	7. Takes account of temporal and social context	7.1 is able to make value judgments, on contextual aspects, also based on ethical considerations 7.2 understands legal aspects, especially IP 7.3 has a view on his personal societal responsibility 7.4 is aware of safety, environmental and health aspects	7.1 9 7.2 8 7.3 9 7.4 not in ILOs; it depends on the choice of electives[15]

Table 5.2 provides a summary of the correspondences. The top two lines cover the correspondence from the perspective of the ILOs to the DSFR. The lowest four lines of Table 5.2 cover the correspondence from the perspective of the DSFR.

Table 5.2. Summary of correspondences between ILOs and DSFR

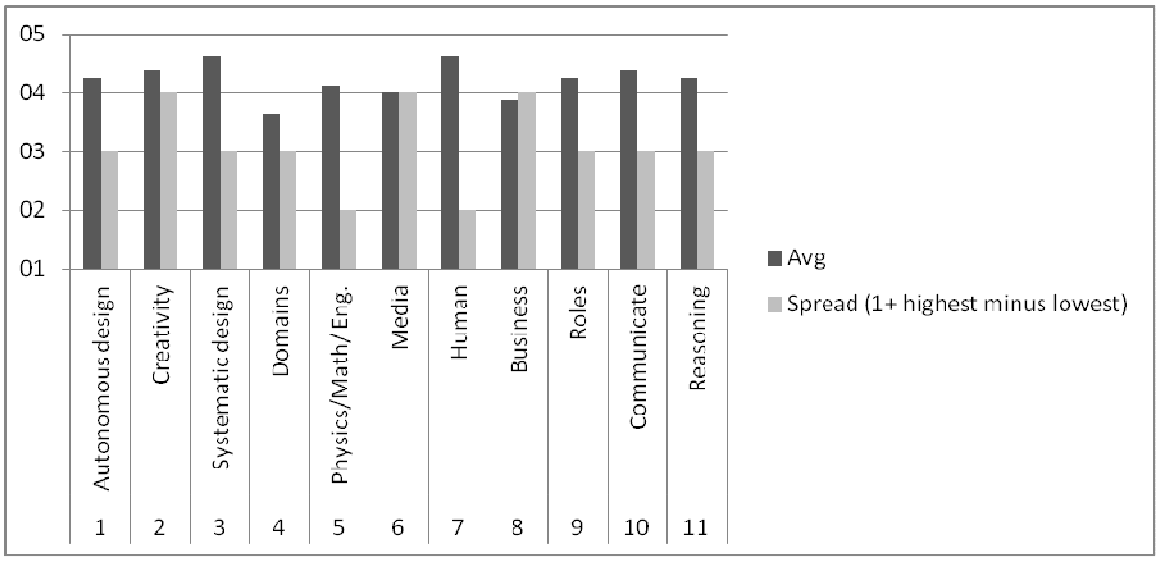
ILO	1	2	3	4	5	6	7	8	9	10	11
OK?	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
DSFR	1.1	1.2	1.3	1.4	1.5	1.6	2.1	2.2	3.1	5.1	5.2
OK?	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
DSFR	5.3	5.4	6.1	6.2	6.3	7.1	7.2	7.3	7.4		
OK?	ok	ok	ok	ok		ok	ok	ok	(ok)		

Table 5.2 shows that all ILOs connect to requirements of the DSFR. Two requirements, i.e. 6.3 (integrate in working environment) and 7.4 (safety, health and environment) are not covered by the ILOs. As reported in the SAR, most students do an external graduation project, during which they are made aware of (business) settings. As to 7.4 the coverage depends on the choice of electives.
In addition, the outcomes of the Advisory Board Survey are provided in Figure 5.1. [The full report is provided in Appendix E.]

Figure 5.1. Results from Creative Technology Advisory Board members ILO survey, September 2014 (vertical axis: Likert scale with 5 as 'very relevant')

[14] This is a matter of consideration for the educational management. It currently is not considered to be a top priority

[15] E.g. Cyber Security, Healthcare and Ethics courses focus on this requirement



We conclude from Tables 5.1 and 5.2 and Figure 5.1 that there is a good match between the DSFR and the ILOs.

Requirements for a programme

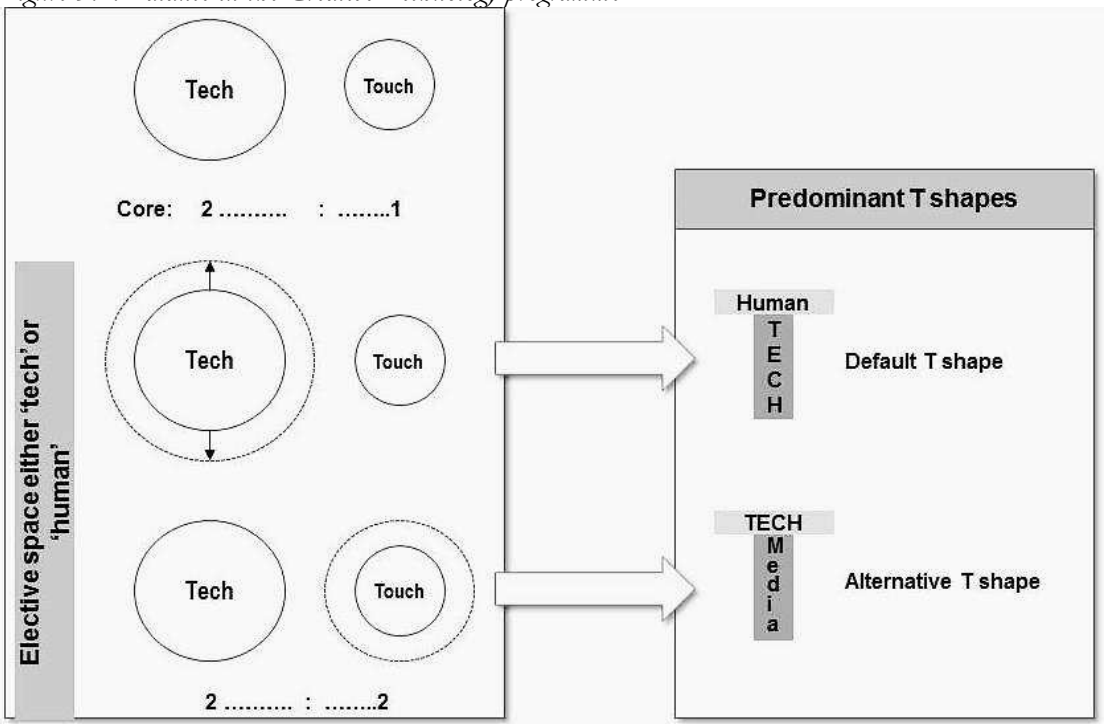
Table 5.3 presents the programme requirements from the DSFR (building on Table 4.3); the actual programme features are provided in summarised form as well.

Table 5.3. Consolidated programme specifications (Table 4.3) and Creative Technology features

Key word	Indication of specification	Creative Technology Features
Balance	Finding a proper balance between breadth and depth for a programme in the interdisciplinary domain of creative technology – which is not trivial	Specialisation strategy. Please refer to Figure 5.2
T shaped	The programme should develop graduates who possess both a broad set of competences and in-depth competences in a specific topic or topics	Specialisation strategy. Please refer to Figure 5.2
Didactics	Learning-by-doing, Student-centred Learning (SCL) and Project-Based Learning (PBL)	Learning-by-doing, combined with SCL, makes up approximately 50% of the programme. Learn Together, in a Group, i.e. PBL, accounts for at least 10%.
Scope	The programme should anticipate on multidisciplinary technology convergence (Nano Bio, Info, and Cogno, i.e. NBIC)	Currently not in scope. There's a risk of 'scope implosion' when adding NBIC in full. See 'Balance'. Expanding to include Bio is an opportunity-driven option. Establishing a new programme, 'Creative NIBC' could become an option for UT.

As to the specific criterion of balance for an inherently interdisciplinary programme in this domain, we refer to some of the Advisory Board interviews stating that the Twente approach is 'the way to go' (the report on the interviews is in Appendix D). With reference to the core Self-Assessment Report, and to summarise the approach, we've included Figure 5.2.

Figure 5.2. Balance in the Creative Technology programme



The essence of the approach is a combination of the following:

- To have a broad foundational year
- To provide students with a choice of specialisation. This could be either science or social science.

Through this approach, students may graduate with different T profiles. The horizontal, broad, part of the 'T' is a result of the foundation, whereas the vertical, depth, part is one of the profiles.

From Table 5.3 and Figure 5.2 we conclude that there is good match.

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Appendix 3: Intended learning outcomes

(1) *Self-managing the designer's process of creation:*

1. Graduates understand autonomous design, and have the skills and knowledge to act as an autonomous designer, so
    a. they can identify and choose projects;
    b. they can explain and justify ideas in context;
    c. they have developed personality and a personal style.
2. Graduates understand and are skilled in creative thinking and creative acting, so
    a. they know and can apply creative thinking techniques;
    b. they know and can apply divergent and convergent thinking;
    c. they know and can apply tinkering.
3. Graduates understand and have the knowledge to employ multidisciplinary design methods, so
    a. they understand and can apply phasing in the systematic design process;
    b. they understand and can apply demand driven and explorative design;
    c. they can design in a team, and invoke help of experts;
    d. they have the knowledge and skills to document and report;
    e. they have the knowledge and skills to incorporate the user in the design process;
    f. they have the knowledge and skills to evaluate design options and take design decisions.

(2) *Understanding and use of technology*

4. Graduates understand and can use technology in the following domains:
    a. software, algorithms, physical interaction;
    b. web technology, web services and data management
    c. behaviour of physical systems (especially in the electrical domain);
    d. sensing, implicit interaction;
    e. telecommunication.
5. Graduates can rely on a basic knowledge of physics, mathematics and engineering in support of their understanding and use of technology.

(3) *Designing for interaction, expression, impact and experience*

6. The graduates understand and can use expressive technology, so
    a. they have knowledge and skills in expressive media, like stills and moving images, sound and 3d-modelling;
    b. they have knowledge and skills in storytelling, story worlds, and messaging.
7. The graduates
    a. have knowledge of and can investigate human technology relationship and human design relationship;
    b. are familiar with arts and culture;
    c. are aware of human factors, and of social patterns and societal structures.

(4) *Societal and economic value*

8. The graduates have knowledge and skills to bring creative technology to the market, so

a. they have the knowledge to perform a market analysis;
b. they are familiar with attracting capital and financing;
c. they understand intellectual property rights;
d. they can write a business plan.

9. Graduates are aware of the roles of designers in society, and the standards (ethically and legally) for professional behaviour.

(5) *Academic and professional skills*

10. Graduates can communicate with experts and non-experts about all aspects of their field, this communication covers
    a. presentation;
    b. justification;
    c. documentation;
    d. scientific debate (to a limited extent) in this communication the graduate knows how to employ modern media.
11. Graduates are
    a. capable of logical reasoning;
    b. inquisitive and capable of posing proper questions;
    c. they have knowledge of research methods;
    d. they can set up their own research (to a limited extent);
    e. they can critically evaluate results obtained (by themselves and others);
    f. they can work in a team;
    g. they are capable of critical reflection and can adapt their behaviour on the basis of that reflection;
    h. they are aware of gaps in their own knowledge and skills;
    i. they are prepared to learn and capable of learning.

Appendix 4: Overview of the curriculum

	block 1A	block 1B	block 2A	block 2B
yr. 1	(15EC) We Create Identity	(15EC) Smart Environments	(15EC) Living and Working Tomorrow, Ideation and Explorative Design	(15EC) Art, Impact and Technology
yr. 2	(15EC) Smart Technology or	(15EC)	(15EC)	(15EC)
	New Media	Intelligent Interaction Design	Innovation and Entrepreneurship for CREA	Hybrid Worlds
yr. 3	(30EC)	Personal Profile	(15EC)	Final Module
			(15EC)	Final Project Bachelor

The picture above shows the current curriculum floor plan. (For students who were enrolled in September 2013 or later). The picture on the opposite page shows the pre-TOM curriculum. The comparison of the two amounts to the following.

Year 1

The first three modules of the current programme correspond largely to the first three blocks of the pre-TOM curriculum, i.e. we glued the three or four courses in these blocks together with the project (projects are in the top row of the table) into modules.
The last module combines contents of the original course Human Factors with the project Have Fun and Play!, and has a programming component, and contains statistics.

So there have been shifts in attention which we implemented in the transition to TOM. We established more continuity in developing programming skills in module 4. We moved statistics from the second to the first year, to align it with the Human Factors component. And we reconsidered the build-up of the "understanding and use of technology" component. We added an elementary introduction to engineering component in the first two modules
To compensate for the additions, we reduced an (animated) image creation component, and an introduction to physical systems component. The physical systems component returns in year 2 in the Smart Technology module only. The image creation component had two parts. Firstly it was about tools for image creation; they are still taught and explored. The other part was about working with an external client; that part has been abandoned. Working for clients is becoming a standard part of the Living and Working module, in block 2A.

Year 2

Year 2 had two large units of 15EC which stretched over the entire year: Smart Technology and New Media. The contents of these units now appear as modules, in the first block of the

second year. But the modules 5a and 5b in block 2.1A do not also incorporate contents from the original Smart Technology and New Media courses; they also have an individual research assignment, and a mathematics component: Systems and Signals. As a consequence, the treatment of subjects of the original courses is more condensed but also more shallow in these modules. Moreover, there has been a swap in contents: Animated Narration of block 2.2A pre-TOM is now a component of the New Media module, while Dynamic Data Visualization, which was a component of the original New Media course, now is a component of module 8 (in block 2.2B).

	block 1A	block 1B	block 2A	block 2B
yr. 1	(5EC) We Create Identity	(5EC) Smart Environments	(5EC) Living and Working Tomorrow	(5EC) Have Fun and Play!
	(4EC) Visual Communication	(3EC) Sketching	(3EC) Designing in Context	(3EC) Human Factors
	(3EC) Programming and Physical Computing(1)	(4EC) Programming and Physical Computing(2)	(1EC) Interactive Visualization(1)	(3EC) Interactive Visualization(2)
	(2EC) Introduction to Computer Science	(3EC) Introduction to Mathematics and Modelling(1)	(3EC) Introduction to Mathematics and Modelling(2)	
			(2EC) Introduction to Physical Systems and their Dynamic Behaviour(1)	(3EC) Introduction to Physical Systems and their Dynamic Behaviour(2)
		(4EC) First Year Portfolio		
yr. 2	(5EC) Programming with Structures	(5EC) Ambient Screens	(4EC) Web Services and Data-driven Applications	(5EC) Hybrid Worlds
	(3EC) Introduction to Statistics and Probability	(2EC) Research Methodology	(3EC) Innovation and Entrepreneurship for CREA	(5EC) Startrix for CreaTe
	(3EC) Systems and Signals	(3EC) Strategies and Protocols or	(3EC) Animated Narration	

		Queues and Logistics		
	(3.5EC) Smart Technology(1) or	(4.5EC) Smart Technology(2) or	(3.5EC) Smart Technology(3) or	(3.5EC) Smart Technology(4) or
	New Media (1)	New Media (2)	New Media (3)	New Media (4)
			(2EC) Creative Exploration in	Art, Science and Technology
		(2EC) Second Year Portfolio		
yr. 3	(6EC) Cyber Crime Science, and/or (30EC) Profileringsruimte		(5EC) Remote Care Nearby for CreaTe, and/or (5EC) Ethics for CreaTe, and/or *substitute electives*	(5EC) Communication Technology for Global Work, and/or (5EC) Entertainment Education for CreaTe, and/or *substitute electives*
			(15EC) Final Project Bachelor	

Ambient Screens (a project) and Research Methodology were courses in block.2.1B pre-TOM, they return as components in module 6 in the same block. They are combined in module 6 with programming (originally in block 2.1A), and Artificial Intelligence (new), and some extra Statistics (new)
Module 7 is still under construction, but the two original courses Innovation and Entrepreneurship (block 2.2A pre-TOM) and Startrix (block 2.2B pre-TOM) will be core components. Discussion is about a combination with Ethics, Technology Management, and maybe mathematics.
Module 8 centres around the original Hybrid Worlds project, but it will contain also Dynamic Data Visualization (originally part of New Media), Data-driven applications (originally in block 2.2A), an introduction to Protocols (originally only in the Smart Technology course), and a little extra item of choice between Smart Technology and New Media (to make up to some extent for the more shallow modules at the start of the year)
The individual Creative Explorations project of the second year has disappeared in the transition to the TOM paradigm.

The portfolio courses of the first and the second year disappeared as well.
The First Year Portfolio course was a unit where reflection on studying, showing personal progress, and working on weaker and challenging stronger points found their place, as well as

the creation and maintenance of the personal showcase portfolio. It included taking extra mathematics and physics classes by students who have little background in these subjects.
The Second Year Portfolio course continued the first one (but on a smaller scale), with special attention for the choice of a personal profile in the third year.
The goals of these courses have been incorporated into module goals.

Year 3

In the pre-TOM situation Year 3 had a first semester for personal profile. The transition top TOM makes no difference here.
The second semester of year 3 was for one half for the Final Project, which it still is.

The main difference in the Tom situation is that the other half of the final semester now has a Final Module, where pre-TOM had a choice of electives. But the final module will incorporate the learning objectives of the electives (and still offer students options to choose between).

Appendix 5: Quantitative data regarding the programme

Data on intake, transfers and graduates

Intake

	2009	2010	2011	2012	2013	2014
non-Dutch	3	14	35	30	25	
hbo		1	1	1		
hbo-p			4	1	2	
unknown			8			
other		1	1		1	
vwo	10	25	43	38	49	
Total	13	41	92	70	77	
Female%	23.1%	24.4%	25.0%	27.1%	39.0%	

Dropout rates

Percentages (cumulative) of students who dropped out (after 1, 2 or 3 years). Between brackets are the absolute numbers. The corresponding numbers for just the intake with a Dutch VWO diploma are included in italics.

	2009	2010	2011	2012	2013	2014
Population *Dutch VWO intake*	(13) (*10*)	(41) (*25*)	(92) (*43*)	(70) (*38*)	(77) (*49*)	
% dropout after 1 yr *among Dutch VWO intake*	38.5 (5) *40.0* (*4*)	22.0 (9) *8.0* (*2*)	18.5 (17) *11.6* (*5*)	12.9 (9) *13.2* (*5*)		
% dropout after 2 yrs *among Dutch VWO intake*	53.8 (7) *50.0* (5)	26.8 (11) *12.0* (3)	22.8(21) *16.3* (7)			
% dropout after 3 yrs *among Dutch VWO intake*	53.8 (7) *50.0* (*5*)	31.7 (13) *16.0* (*4*)				

Dropouts' destinations

Percentage of total intake continuing their careers in various ways after their first year (in another BSc programme at our university, in a BSc programme at another university, in a Bachelor's programme at HBO, or otherwise). Between brackets are the absolute numbers. The corresponding numbers for just the intake with a Dutch VWO diploma are included in italics.

	2009	2010	2011	2012	2013	2014
% dropouts after year 1 *among Dutch VWO intake*	38.5 (5) *40.0* (*4*)	22.0 (9) *8.0* (*2*)	18.5 (17) *11.6* (*5*)	12.9 (9) *13.2* (*5*)		
% switch to BSc at UT *among Dutch VWO intake*	7.7 (1) *10.0* (*1*)		2.2 (2) *2.3* (*1*)	8.6 (6) *10.5* (*4*)		
% switch to BSc not at UT *among Dutch VWO intake*			2.2(2) *2.3*(*1*)			
% switch to HBO *among Dutch VWO intake*	23.1 (3) *30.0 (3*)	4.9 (2) *8.0* (*2*)	3.3 (3) *4.7* (*2*)	1.4 (1) *2.6* (*1*)		
% otherwise (not HO) *among Dutch VWO intake*	7.7 (1)	17.1 (7)	10.9 (10) *2.3* (*1*)	2.9 (2)		

Study success rates

Percentages of students re-enrolled for their second year successfully completing the Creative Technology programme, taking the degree after 3, 4 or more years. Between brackets are the absolute numbers. The corresponding numbers for just the intake with a Dutch VWO diploma are included in italics.

	2009	2010	2011	2012	2013	2014
Population enrolled for yr 2 *Dutch VWO re-enrolments*	(8) (*6*)	(32) (*23*)	(75) (*38*)	(61) (*33*)		
% degree after 3rd year *Dutch VWO re-enrolments*	12.5 (1)	12.5 (4) *4.3* (*1*)				
% degree after 4th year *Dutch VWO re-enrolments*	25.0 (2) *16.7* (*1*)					
% degree after 5th year *Dutch VWO re-enrolments*						

Teacher-student ratio achieved

The number of enrolled students for 2013-2014 was 236. The available capacity for teaching is 6.8 fte. In this capacity we did not count the capacity for teaching personal profile modules/courses. So the capacity we count is available for the teaching and learning activities of 10 (out of 12) quarters of the students' enrolment in Creative Technology.

We conclude that the staff to student ratio for Creative Technology is 6.8/197=1:29.
Note however that we "hire" more than 1 fte "other personnel" on a temporary basis to assist in teaching activities.
Note also that the number of students for 2014-2015 will grow to about 290. The staff to student ratio is moving towards 1:33.

Average amount of face-to-face instruction per stage of the study programme

Table of contact hours

The table shows scheduled hours for students, where staff is present for interaction. Scheduled hours consist of 45 mins time for activity, and 15 mins time for a break. The numbers in italics indicate the net hours for activity. (On a weekly basis the average number of contact hours will 1/10 of the hours in the table.)

	year 1	year 2	year 3
quarter 1	229 (*171.75*)	232 (*174*)	external
quarter 2	264 (*198*)	226 (*169.5*)	external
quarter 3	241 (*180.75*)	168 (*126*)	60-80
quarter 4	232 (*174*)	249 (*186.75*)	60-80

The hours of quarters 3 and 4 are very rough estimates (a student will take on average 1,5 course per quarter, and work at his/her final project at the same time; contact hours with the external supervisor for the final project are not included.

Appendix 6: Programme of the site visit

Visiting timetable Creative Technology – University of Twente **Room 2042 (Zilverling)**		
Monday 15 December 2014		
12.00	**12.30**	**Lunch**
12.30	**12.45**	**Guided tour** By Beerend Gerats (chairman Study Association: Proto)
12.45	**15.00**	**Preparatory meeting (critical reflection + theses), reading additional documentation**
15.00	**15.45**	**Interview with the management** Dr. G.F. van der Hoeven, programme director Dr.ir. E.J. (Erik) Faber, bachelor coordinator Prof.dr. P.M.G. (Peter) Apers, dean Faculty of EEMCS
15.45	**16.00**	**Break**
16.00	**16.45**	**Interview with students *(in English)*** T.S.L. (Thérèse) Bergsma, 1st year student R.W. (Reint) Dijkstra, 1st year student C.N. (Carmen) Burghardt, 2nd year student J.F. (Jason) van Eunen, 2nd year student M.H. (Maaike) Dokter, 3rd year student J. (Johannes) Jacubasch, 3rd year student A. (Alexandra) Szabó, 4th year student J.A.J. (Jonathan) Juursema, 4th year student
16.45	**17.00**	**Break**
17.00	**17.45**	**Interview with teaching staff** Dr. A.H. (Angelika) Mader Dr.ir. E.C. (Edwin) Dertien Dr.ir. D. (Dennis) Reidsma Dr. A.H. (Rik) van Reekum Dr.ir. M.J. (Mark) Bentum Ir. T.M.J. (Dick) Meijer C.H. (Chris) Vermaas
17.45	**18.30**	**Interview with alumni *(in English)*** T.M. (Tom) van den Berg, BSc W. (Wouter) Deenik, BSc

		D. (David) Goedicke, BSc M.A. (Mike) Kriele, BSc S. (Stephan) Witkamp, BSc
Tuesday 16 December 2014		
09.00	**09.15**	**Additional interview with the management** Dr. G.F. van der Hoeven, programme director Prof.dr. P.M.G. (Peter) Apers, dean Faculty of EEMCS
09.15	**10.00**	**Interview with Programme Committee (students + teaching staff)** Dr. M. (Mannes) Poel (teacher) Dr.ir. C. (Cora) Salm (teacher) Dr.ir. H.J.A. (Rieks) op den Akker (teacher) F.G. (Frank) Lammers (student Creative Technology) M. (Martijn) Bruinenberg (student Creative Technology) V. (Vincent) Nibbelke (student Human Media Interaction) S. (Sophie) de Haan (student Creative Technology)
10.00	**10.15**	**Open office hour**
10.15	**10.30**	**Additional interview regarding thesis assessment** Dr. A.H. (Angelika) Mader Dr.ir. E.C. (Edwin) Dertien Ir. J. (Hans) Scholten
10.30	**11.30**	**Board of Examiners + study advisor/coordinator** Prof.dr. D.K.J. (Dirk) Heylen Dr.ir. G.D.S. (Geke) Ludden Ir. J. (Hans) Scholten T.H. (Thea) de Kluijver MA (study advisor)
11.30	**11.45**	**Break**
11.45	**12.15**	**Interview with the Advisory Body *(in English)*** Ing. M. (Marco) Strijks, MEd (in person) *Business Developer at Saxion, University of Applied Sciences. Marco is involved in the Saxion Innovation Team and the Saxion Centre of Entrepreneurship* Prof.dr.ir. J.H. (Berry) Eggen (skype) *Head of the User Centered Engineering group at the Department of Industrial Design, Technical University of Eindhoven* H. (Hans) Mulder (skype) *Munisense (munisense.nl)*

12.15	**13.15**	**Lunch and additional presentation regarding project work** Dr.ir. D. (Dennis) Reidsma
13.15	**13.45**	**Interview with tutors *(in English)*** Dr. R. (Robin) Aly Ir. E.L. (Eddy) de Weerd Dr. N. (Nelly) Litvak Ing. P.P.E. (Pollus) Fornerod
13.45	**14.15**	**Break**
14.15	**15.45**	**Internal meeting panel**
15.45	**16.00**	**Interview with the management (including the dean)** Dr. G.F. (Gerrit) van der Hoeven (programme director) Dr.ir. E.J. (Erik) Faber (bachelor coordinator) Prof.dr. P.M.G. Apers (dean EEMCS)
16.00	**16.15**	**Internal meeting panel**
16.15	**16.30**	**Presentation of preliminary findings (in Smart XP)**

Appendix 7: Theses and documents studied by the assessment panel

Prior to the site visit, the panel studied the theses of the students with the following student numbers:

1009346
1086456
1118595
1119095
1188976
1198920
1200135
1217291
1221140
1233440
1236997
1244027
1248820
1249118
1252631

During the site visit, the audit panel studied, among other things, the following documents (partly as hard copies, partly via the institute's electronic learning environment):

- Subject-specific reference framework and the learning outcomes of the programme;
- Overview of the curriculum;
- Outline description of the curriculum components;
- Teaching and examination regulations;
- Overview of allocated staff;
- List of the last 25 final projects or the final projects of the past two years;
- Overview of the contacts maintained with the professional field;
- Report on the institutional quality assurance assessment;
- Reports on consultations in relevant committees/bodies;
- Test questions with corresponding assessment criteria and requirements and a selection of actual administered tests and assessments;
- Selection of final projects with corresponding assessment criteria and requirements;
- Reference books and other learning materials;
- Summary and analysis of recent evaluation results and relevant management information;
- Documentation regarding teacher and student satisfaction.