HBO-Engineering

DOMAIN DESCRIPTION

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FOREWORD

HBO Engineering's Connected-Engineering project has updated the domain description to the present. Not only have the Universities of Applied Sciences involved contributed to the creation of this updated version, but also a large number of representatives from industry, government agencies, trade associations and professional societies.

The existing system of competencies has been further refined and developed. It is a workable model, within which students can develop and the final level achieved can be determined. So it is not about decimal numbers in micrometres because it is not a calibrated measurement system, but a conceptual framework and language system within which lecturers and students can communicate about professional talents and personal development points.

In addition to the principle of continuity, a conscious decision has been taken to allow more freedom, more responsibility and more recognition. The freedom and responsibility are condensed in greater flexibility of the competency system, in which the competency points can be determined lower down the educa- tional chain. The recognition of technical higher professional education is reflected in the advocacy of using more professional products and making applied research more results-oriented.

HBO Engineering has a great sense of social responsibility. It is a fixed truth that engineers make an important contribution to the future. Students, teachers, researchers, training managers and execu- tives in the Engineering domain — together with the field and government — will help shape the future working shoulder to shoulder.

on behalf of the executive board
Ynte van der Meer
president

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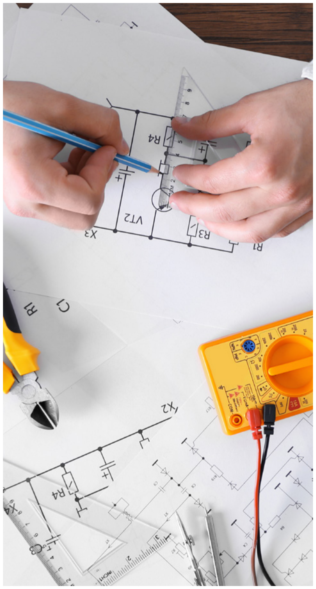


1 INTRODUCTION

The Engineering domain description serves as a functional qualification framework for Universities of Applied Sciences, focusing on the entry-level skills of engineering professionals of the future. In order to respond to new applications, job market demands, wishes and innovations, regular updating of the domain description is essential. In addition to the developments in the domain, the educational field is also developing. For example, there is an increasing focus on associate degrees and professional masters.

The previous domain description dates from 2016 and is a revised version of the 2012 bachelor profile. The revision in 2016 was necessary because of the reduction in the number of CROHO-registered courses, with the Engineering domain going from 36 to 13 root cluster programmes. The minimum competency level has been determined for each programme and the 13 root cluster programmes have their own national competency profile derived from the domain description.

The need for flexibility raised the question of whether separate root cluster profiles (between generic domain description and programme profiles) are still necessary. The current domain description is therefore designed so that programmes can relate to it directly, without an intermediate layer of a national root profile. National alignment in root clusters remains desirable, of course, and a common root profile optional.

In collaboration with industry, the domain description is periodically updated and tested, taking into account (inter)national developments and trends in the field and education. It is then approved by the Association of Universities of Applied Sciences.

1.1 WHAT IS IT?

The Engineering domain description is a national framework for the final qualifications for graduates of Dutch higher professional education programmes in the Engineering domain. The domain description was primarily prepared as a framework document for higher professional education programmes within the domain.

1.2 FOR WHOM IS IT INTENDED?

The domain description was prepared for various audiences.

Education

It is primarily a framework document for courses within the Engineering domain in higher professional education. Programmes can derive their own programme profile, learning goals and curricula from the domain description. Explicit linkage of one's own programme profile to the domain description assures content and final level of the degree programme.

Companies

For companies, the document provides insight into the graduates' final level. The generic domain description provides guidance for identifying the current competencies of graduates.

Students

For (prospective) students, the domain description provides information about the content of programmes and how they position themselves in the entire domain.

Domains

For adjacent domains, the edges of this domain description mark boundaries of the engineering domain. At these edges there is a connection with other, especially Sience, domains. Technical higher professional education has six domains: in addition to Engineering, they are Applied Science, Built Environment, Creative Technologies, ICT and Maritime Operations.

Some examples of adjacent or cross-boundary fields: at the boundaries of Engineering and ICT lies the field of Embedded Systems. Between Engineering and Built Environment are the fields of Installation Technology and (sustainable) Energy Technology. Health care technology and nanotechnology, for example, link Engineering and Applied Science.

1.3 ABOUT HBO ENGINEERING

The Engineering domain is one of six engineering domains in higher professional education, established by the Association of Universities of Applied Sciences. HBO Engineering is the umbrella organization for programmes within this domain. By working together, knowledge exchange takes place in the field of subject matter and education. One of the joint products is this domain description.

Programmes within the Domain sharing the same root are clustered. These root clusters may further specify the domain profile by mutual agreement. As of 1 September 2015, the domain has the following root cluster programmes at the bachelor level in the Central Register of Higher Education Programmes (CROHO): Aeronautical Engineering, Applied Mathematics, Automotive, Aviation, Electrical and Electronic Engineering, Engineering, Health Technology, Industrial Design Engineering, Industrial Engineering and Management, Logistics Engineering, Maritime Technology, Mechanical Engineering and Mechatronics.

A number of Universities of Applied Sciences also offer associate degree programmes and/or professional masters here. These offerings are still in development. Annex 6 contains a current list of programmes (associate degree, bachelor's and master's) within the Engineering domain.

2 ACCOUNTABILITY

The domain description is in a context of national and international reference frames, frameworks, models and descriptions. Some of these describe levels of education and functioning, while others map out the demand side of the field. Programme profiles derived from the domain description include these established level provisions. Accordingly, when students meet the programme profile, they also meet both the internationally and nationally accepted level.

This domain description has come about through intensive cooperation between Universities of Applied Sciences, employers, representatives of industry organizations and expert groups and members of professional field committees of the programmes participating in the Engineering domain.

2.1 CREATION OF THE DOMAIN DESCRIPTION

This publication is the updated version of the domain description that appeared in 2016. The 2016 publication was a partially revised version of the 2012 publication, which in turn replaced the 2006 Engineering Competency Model.

By 2022, the domain description has changed in the following areas:

1. The domain description has been updated using recent and/or updated standards and references
2. To the previous model, consisting of competencies and levels, an "application areas" dimension was added to indicate context and content.

These are illustrated through examples of professional products and professional tasks
3. The eight domain competencies have been retained; the explanations have been rewritten, modernized and/or simplified
4. The level of the associate degree is explicitly named
5. Because of the need for more flexibility, the domain description was designed so that programmes can relate to it directly, without an intermediate layer of a national master profile.

2.2 STANDARDS AND FRAMES OF REFERENCE

In recent years, a variety of initiatives aimed at transparency with respect to educational attainment and profession have been undertaken. These initiatives differ in terminology, principles and areas of application, in particular. The standards and reference frames listed below have been incorporated into the domain description, particularly in the explanations of the domain competencies (Section 3.1), in the areas of application (Section 3.2) and in the professional tasks (Chapter 4).

Dublin descriptors

The Bologna Declaration in 1999 kicked off the process of making higher education in Europe transparent and comparable in order to promote mobility, cooperation and exchange. This resulted, in particular, in the introduction of the bachelor-master structure in the Netherlands (2002) and in the Dublin descriptors (2004), which describe the internationally accepted level of bachelor, master and Phd. The associate degree level was added shortly thereafter under the name *Dublin Short Cycle descriptors.* Annex 4 contains the Dublin descriptors for the associate degree, bachelor's and master's levels.

EQF and NLQF

In 2008, the European Qualification Framework (EQF) was adopted, incorporating the Dublin descriptors and also describing the other levels of education. The EQF describes learning outcomes in terms of knowledge, skills and competences, in order to be able to compare qualifications and qualification levels in a European context. It gives an indication of complexity and depth and distinguishes eight levels; level 6 corresponds to the bachelor's level. The descriptions correspond to proficiency levels 2 and 3. Level 5 corresponds to the associate degree level and level 7 to the professional master's degree.

The EQF is expressly intended as a meta-framework: it is up to each country to develop its own national qualifications framework derived from and related to the EQF. Since 2011, the Netherlands has had the Dutch Qualification Framework (NLQF). In the NLQF, learning outcomes are described in terms of knowledge, skills, independence and responsibility, all within a defined context. For the Engineering domain description, levels 5, 6 and 7 are relevant, describing associate degree, bachelor's and master's levels, respectively. Annex 4 contains an overview of these three levels.

HBO Standard

In 2009, the Universities of Applied Sciences of higher education in the Netherlands decided to jointly establish a standard for the professional bachelor's degree (Annex 5). This standard was not a replacement for the Dublin descriptors or accreditation criteria, but serves as making explicit the master of the University of Applied Sciences bachelor's degree. It is a guide for the development of national programme profiles and for their interpretation in the individual curricula of programmes.

The hbo-standard implies that an hbo-bachelor programme should ensure that students obtain a solid theoretical basis, that they acquire the research skills that enable them to contribute to the development of the profession, that they have sufficient professional skills and finally, that they develop the professional ethics and social orientation appropriate to a responsible professional. Needless to say, the international dimension forms part of every component of this standard.

EUR-ACE

In 2007, the European Network for Accreditation of Engineering Education (ENAEE) established European guidelines. The *Standards for the Accreditation of Engineering Programmes* (EUR-ACE) focus on facilitating academic and professional mobility within all engineering disciplines, setting a quality standard for accredited engineering programmes with recognizable final qualifications. In addition to curricular and content areas, this standard also distinguishes skills and attitudinal aspects.

NL-SPEC

The professional association of engineers in the Netherlands, KIVI, describes in *Chartered Engineer Structure* the standards for professional engineers at different levels and updates them regularly. This NL-SPEC complies with the regulations of the International Engineering Alliance (IEA).

2.3 SOCIAL MISSION

Higher education has an important social mission in the face of current and future economic and environmental challenges. Engineering is not just about developing a product or process, but increasingly about sustainability, ethics, security and circular economy, in particular. This aligns with the clusters of “climate and environment,” “demographic shifts,” “health and society,” and “safety” identified in the 2020 meta-analysis commissioned by the Association of Universities of Applied Sciences of Applied Sciences on relevant social issues.

Global challenges and social problems have long ceased to be solved from one discipline and require an integrated approach. Consider, for example, climate change and the far-reaching effects of global warming. Coping with them will require not only technological innovations, but also changes in the demographic, economic, socio-cultural, technological, environmental and political-legal domains. Engineers must accordingly not only master their profession, but also be able to practice it in connection with their environment.

Sustainability and digitalization often go hand in hand. For example, engineers can contribute to the reduction of CO_2 by measuring and optimizing water and energy consumption during production processes. Simulation techniques, robotization and artificial intelligence can optimize design, manufacturing and maintenance of machines and production lines.

In 2011, the formation of top sectors was initiated, partly to promote innovation and economic growth and partly because major societal challenges call for robust solutions and cooperation between companies, knowledge institutions and government. In 2019, the top sector approach was further developed into ambitious but concrete goals. Think about affordable and accessible health care, sustainable food production and a climate-proof Holland. In the publication *Missions for the Future*, major societal challenges are translated into twenty-five concrete, thematically elaborated missions.

Engineers play an important role here. After all, innovation, sustainability and economic growth are

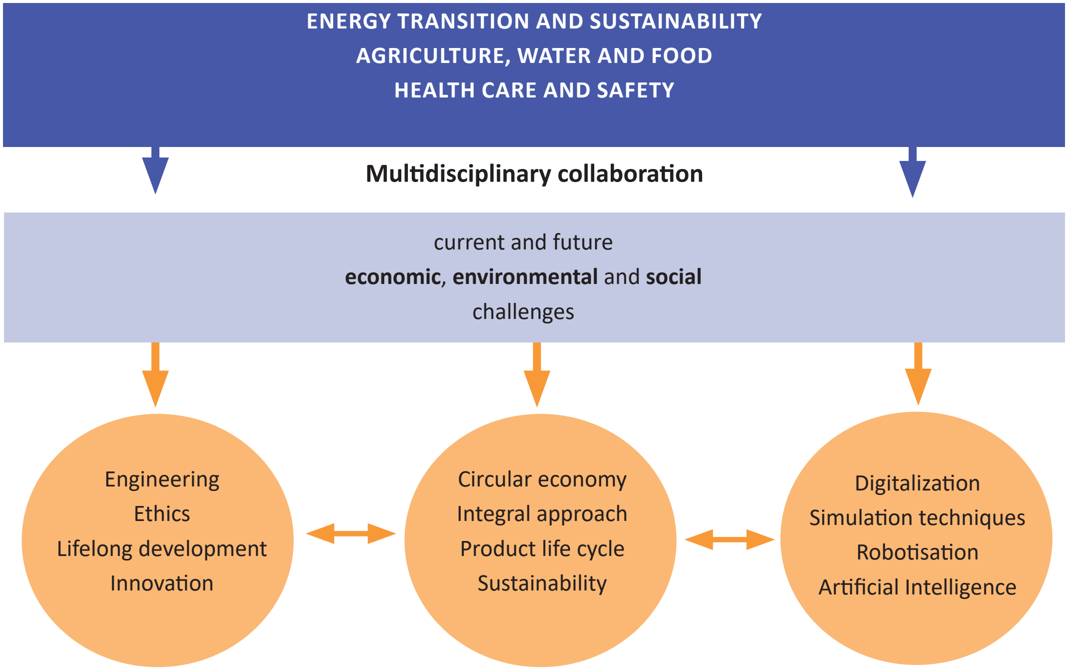


Figure 2.1 The societal mission for Engineering domain

unthinkable without the use of ICT and technology. Accordingly, connecting technology to society is as important as the technology itself and key enabling technologies are an important part of mission-driven top sector and innovation policies. This requires engineers to be able to work in a multidisciplinary manner, collaborate and communicate with other (non-technical) professionals and have an open, inquisitive attitude.

Given the rapid developments, especially in the field of digitalization, knowledge quickly becomes outdated. Engineers must continue to educate themselves on this and be able to adapt to an environment that is constantly changing. It is the task of education to prepare students for this. A critical professional attitude in which lifelong development, adaptability, agility and resilience are central is crucial for engineers.

The knowledge and skills engineers need for this are incorporated in the competencies (section 3.1) and in the professional tasks (section 4). In the "control" competency, the product creation process has been replaced by the entire product life cycle. Aspects such as energy, circularity and reuse thus belong as a matter of course to the master of the technical competences

2.4 DEVELOPMENTS IN EDUCATION

From the HTNO sector, in addition to the above development, the HTNO Roadmap 2025 has been developed. This roadmap focuses primarily on providing tools for shaping future-proof Sience education. In the process, we examined what the future needs will be and how education can best meet them. This has resulted in a set of attitude aspects that should not be seen as add-ons or nice supplements, but essential components to which engineers must relate. For example, "learning to learn" and "lifelong learning" are indispensable skills: engineers must increasingly be able to acquire new knowledge and skills to adequately solve future issues.

After the turn of the century, a need arose in various industries and professional organizations for graduates with a higher level of education than mbo-4, but for whom the hbo-bachelor is not necessary. Accordingly, beginning in 2006, associate degrees were started on a limited scale. The level of this was described in the Dublin Short Cycle descriptors. Since 1 September 2013, the associate degree, in addition to the master's and bachelor's degrees, has a permanent place in higher professional education. Since 1 January 2018, the associate degree has been legally an independent programme within higher professional education. Level 5 of the NLQF describes the associate degree.

Within higher professional education, examination and assessment are increasingly taking place on the basis of authentic professional assignments. This fits perfectly with competency-based training. This also includes and implies more attention to cooperation with companies, which also contributes to a better professional image. It also leads to a greater focus on social issues, where technology is explicitly positioned as a means to an end rather than an end in itself. In addition, the recent corona pandemic has given the trend of *blended learning* a strongmboost and accelerated its development.

2.5 ALIGNMENT AND SUPPORT

This domain description has been prepared by representatives of the programmes affiliated with the Engineering domain. Feedup, feedforward and feedback has been provided from programmes, companies, industry organizations, expert groups and professional field committees of the programmes participating in the Engineering domain.

These employer and professional organizations also play an important role in the development of engineering functions in companies and their alignment with both international technological developments and the international context of companies.

3 THE MODEL

The model is a systematic description of the Engineering domain and provides space for programmes to position themselves. There are three dimensions: competencies (what does an engineer know, what can he/she do and what does he/she do), scopes (within what context?) and mastery levels (how complex?).

3.1 COMPETENCIES

The first dimension consists of the domain competencies. A competency is defined as a combination of knowledge, skill and attitude in a job-specific context.

The eight competencies for the Engineering domain are divided into two categories: technical competencies and generic higher professional education competencies. The four technical competencies are derived from the product life cycle. It describes the activities in the creation, management and decommissioning of a product or service. Engineers can perform these activities within their own professional context. The descriptions apply to entry-level professionals at the bachelor's level.

TECHNICAL COMPETENCIES

1. Analyse

Engineers are able to identify problem or customer need, weigh possible design strategies or solution approaches and identify requirements, objectives and parameters. They may use a variety of methods to do so, including mathematical analysis, computer modelling, simulations and experiments.

2.Design

Engineers have knowledge of (digital) design methodologies and can apply them. Working with others, they can create an engineering design for a device, process, or method. They know how to assess its impact on society, health, safety, environment, sustainability, ethics and commercial consequences.

3. Realize

Engineers can realize and deliver a product, service, or process implementation according to predetermined requirements. They use their knowledge of materials, computer simulation models, engineering processes and equipment. They also know how to consult technical literature and sources of information.

4. Control

Engineers know how a product, service or process functions optimally in the application context or work environment. In doing so, they take into account the full life cycle and aspects such as security, (digital) vulnerability, sustainability, longevity, decommissioning and disposal.

GENERIC HIGHER PROFESSIONAL EDUCATION COMPETENCIES

5. Manage

Engineers give direction and guidance to organizational processes and the employees involved in them, in order to achieve the goals of the organizational unit or project they lead.

6. Advise

Engineers provide well-reasoned advice on the design, improvement, or application of products, processes and/or methods.

7. Research

Engineers have a critically inquisitive attitude and use appropriate methods and techniques to gather and assess information and conduct applied research. These include source research, the design and execution of experiments, the interpretation of data and computer simulations and the consultation of databases, users, standards and (safety) norms.

8. Professionalize

Engineering graduates have and maintain the professional attitudes and skills necessary to effectively carry out their engineering competencies. This includes having an international orientation and being able to place new developments and develop their own (learning) results through self-reflection and self-assessment.

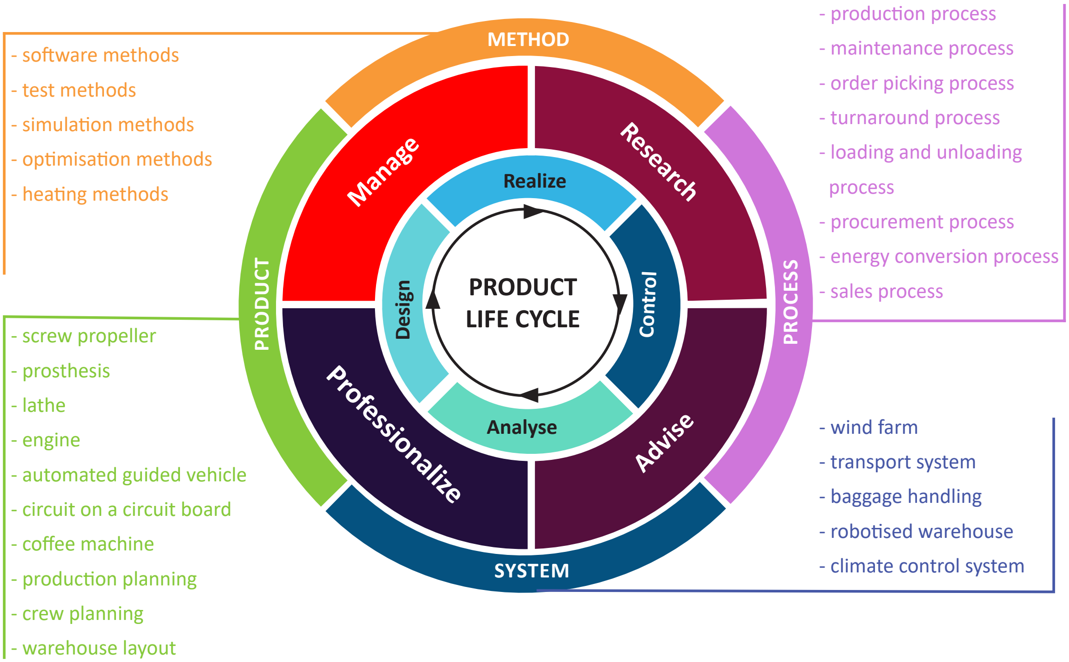


Figure 3.1 Figurative representation of the model; the four technical competencies, the four generic higher professional education competencies and the four areas op application. From inside to outside, from technical design process, through generic higher professional education competencies to application areas. The interfaces between the different parts are arbitrary and have no meaning.

3.2 AREAS OF APPLICATION

The second dimension consists of areas of application, which within this context means categories of professional products. The professional context of the engineer always involves physical products and/or the processes and methods involved in the technical development and construction of products and systems. The boundaries are sometimes not always easy to distinguish, for example, the difference between a product and a system. By definition, a system is more complex and composed. A bicycle is a product, but it also includes subsystems. Specific content activities may also be different. The examples of professional products reveal this content differentiation and the of the Engineering domain.

Method

A method is a description of the necessary steps to be taken to achieve a desired result. A method is thus prescriptive.
Examples: software methods, testing methods, simulation methods, optimization methods, heating methods, oil cracking and algorithms.

Process

A process includes all related activities in (and around) a system that make the system work.
Examples: production process, maintenance process, order picking process, turnaround process, loading and unloading process, purchasing process, oil refining process and sales process.

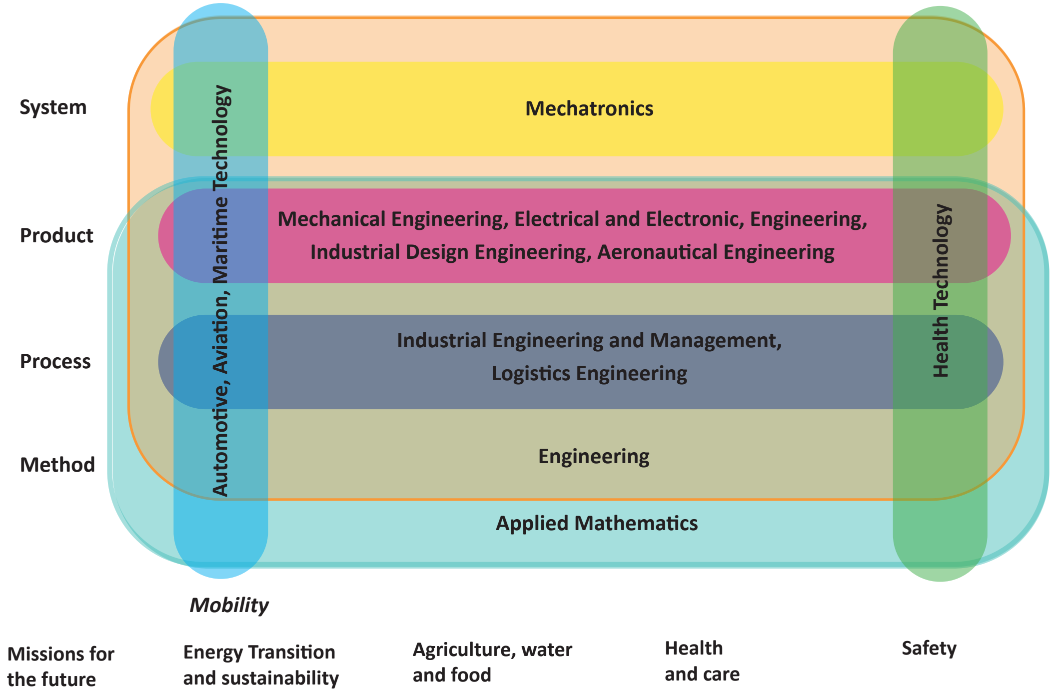


Figure 3.2 An indicative view of the possible positioning of training courses within the different application areas

Product

A product is the result of a production process and has social utility. A product can also be a service.
Examples: ship propeller, prosthesis, lathe, engine, automated guided vehicle, circuit on a circuit board, coffee machine, production planning, crew planning and warehouse layout.

System

A system is a collection of elements or components organised for an overarching purpose. A system is always part of a super-system and includes sub-systems.
Examples: climate control system, wind farm, transportation system, baggage handling and robotic warehouse.

The focus varies by (master) programme. For example, Industrial Engineering and Management tends to focus on processes and systems, while Industrial Design Engineering tends to focus on a specific and physical product. Other courses, on the other hand, focus on different levels within a specific sector or industry, such as Aviation, Automotive and Maritime Engineering within the mobility sector. Figure 3.2, which also shows the themes of the top sectors, is intended to be indicative and illustrative.

3.3 MASTERY LEVELS

The third dimension concerns the mastery level. In doing so, the domain description provides a guarantee for the higher professional education level. Within the Engineering domain, programmes and students can place different emphases. As a result, there is variation in the level at which subareas are (or should be) mastered.

Level 1 refers to basic knowledge and/or behaviour, where students master the competency under supervision and in a defined context. At level 2, students apply the competency independently in relatively simple overview situations. Level 3 assumes independent application of the competency in complex situations. In doing so, students are able to evaluate the competency and support others in its application.

Within the different courses, the highest mastery level is not achieved on all facets. Thus, descriptions at the third proficiency level may mean that, for example, independence and behaviour have the highest complexity, while the context is predictable. It may also be intended that the context and behaviour have the highest complexity, while still providing some guidance. The characterisation of the proficiency level in the overview below is consistent with the level description in dimension 3 of the e-CF.

3.4 RELATION TO NLQF AND DUBLIN DESCRIPTORS

Successful performance of professional tasks requires extensive knowledge and understanding of the field. In many cases, these are tasks that tie in with current developments in the field, for which the required knowledge can be found in the specialist technical literature. In addition to knowledge and understanding, professional application is indispensable. Professional tasks in "advise" explicitly require competencies related to accountability and argumentation in many places. More implicitly, these competencies are also involved in "analyse" and "design" in most professional tasks. Results of analysis and design always require justification.

Competencies related to judgement and communication are especially needed to perform professional tasks in "analyse," "advise," "design", and "control".
The performance of almost all professional tasks requires the acquisition of new knowledge and skills.

Level	Nature of the task	Nature of the context	Degree of independence	Behaviour
1	Simple, structured, applies known methods directly according to existing standards	Known, simple, monodisciplinary	Able to apply knowledge and skills to simple problems	Responsible for own actions
2	Complex, structured, adapts familiar methods to changing situations	Known, complex, monodisciplinary, in practice under supervision	Independently within specified actions	Shared responsibility for activities with others
3	Complex, unstructured, improves methods and adapts standards to situations	Unknown, complex, multidisciplinary in practice	Uses innovative methods and shows initiative	Responsible for results of own work and study and the result of the work of others. Shared responsibility for directing processes and professional development of individuals and groups

Combined with increasing independence at higher mastery levels, this requires extensive learning, development and information skills from engineers.

The final qualifications explicitly relate to knowledge and understanding regarding current theories and research/design/implementation methodologies and presuppose the ability to handle specialist manuals in those content areas. The application of knowledge is not about prescription application, but situational and original approaches. The final qualifications also relate to being able to substantiate and justify choices made in the use of methods and techniques.

Judgement-forming and problem-solving skills are critical in interpreting and weighing research data, in translating it into choices in application or design. Central to this is also the ability to make ethical trade-offs.

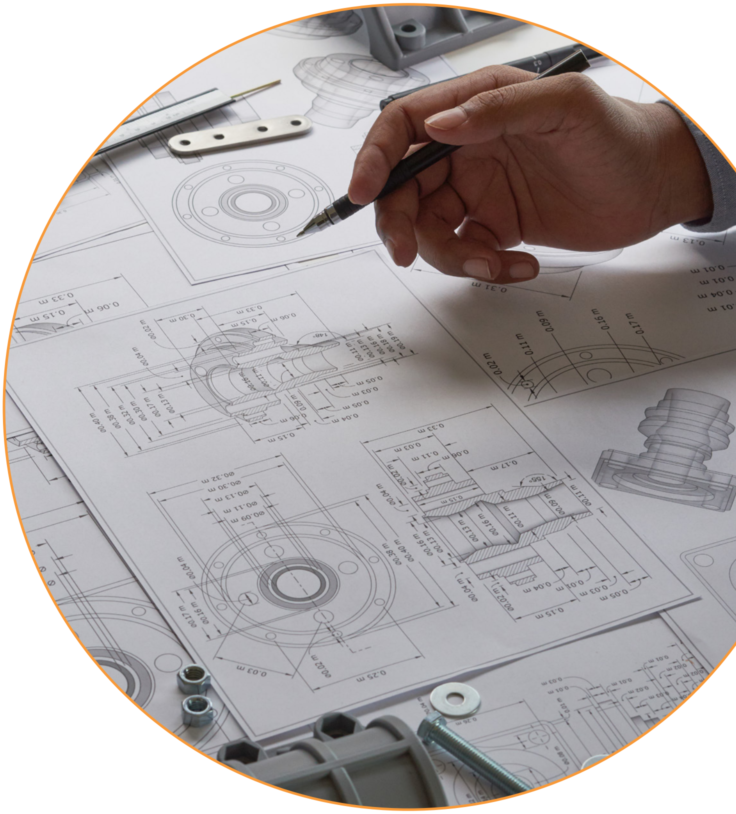
The final qualifications refer explicitly to communication skills. This specifies different ways of communicating and different target groups (clients, colleagues/employees, stakeholders, users and so on).

The emphasis in the final qualifications on (also independent) research relates to an inquisitive attitude and research skills that are indispensable for graduates. Research within the Engineering domain should be accountable, reproducible and transparent. In addition, research skills equip students in part for subsequent study. The same is true for keeping up with current technical literature.

3.5 RELATIONSHIP TO THE HIGHER PROFESSIONAL EDUCATION STANDARD

All higher professional education must ensure that students have a solid theoretical foundation, research skills, professional craftsmanship, professional ethics and social orientation by the end of their studies.

Graduates of programmes within the Engineering domain acquire a solid theoretical foundation in the first years of their studies. Within the domain, this includes knowledge of common tools, methods and standards. Depending on the depth or broadening chosen, the theoretical foundation is expanded to include components relevant to that particular direction.



The research ability of graduates is visible in all technical competencies "Analyse", "Design", "Realize" and "Control". Indeed, research skills and an inquisitive attitude are indispensable in any content area. Within the Engineering domain, it is important that professionals work methodically and know and interpret relevant data appropriately. Graduates are introduced to various forms of research during their studies and learn to apply them. Examples include: source research, designing and conducts experiments and interpreting data and computer simulations. To do this, they consult databases, standards and (safety) norms.

Graduates make a substantial contribution to the continued professionalization of the field. Students accordingly acquire the knowledge, skills and pro fessional attitude to function later in the (inter) national work field. During their education, students work on realistic and real-world assignments. The introduction to the realities of professional practice is greatest during internship and graduation.

Engineers are professionals who, like all higher professional education bachelors, must make connections to social and ethical issues. Engineering is not only about developing a product or process, but increasingly also about issues such as sustainability, ethics, security and circular economy. Critical reflection and moral awareness are essential aspects for graduates. Students learn during their studies to deal with sometimes conflicting customer wishes, interests and requirements in terms of functionality and technical (im)possibilities.

4 PROFESSIONAL TASKS

The schematic model in the previous section serves as a tool for programmes to position themselves and determine their BoKS based on their positioning. The examples of professional tasks in the chart below are for inspiration.

EXAMPLES OF PROFESSIONAL TASKS

1. Analyse

- Selecting relevant aspects related to the question
- Indicate the potential impact on business, social and field-related
- issues
- Formulate a clear problem statement, objective and assignment based on the client's requirements
- Drafting a programme of (technical and non-technical) requirements and being able to record this
- Modelling an existing product, process or service.
- Identifying connections between different criteria and resolve inconsistencies.

2. Design

- From the established requirements, devise and choose a concept solution (architecture)
- Creation of detailed designs based on the chosen concept solution (architecture)
- Taking into account the manufacturability and testability of the design
- Verifying the design against the programme of requirements
- Selecting the right design tools
- Preparation of documentation for the benefit of the product, service or process.

3. Realize

- Appropriate use of materials, production techniques and processes, methods, norms and standards
- Assemble components into an integral product, service or process
- Verify and validate the product, service or process according to the set requirements
- Documenting the realization process.

4. Control

- Implement, test, integrate and commission a new product,
- service or process
- Contribute to management systems and/or maintenance plans, both correctively (monitoring, identifying and optimizing) and preventively (anticipating)
- Assessing the performance of a product, service or process against quality criteria
- Providing feedback in response to changed circumstances and/or performance of a product, service or process
- Dismantling and reusing (parts of) a product or system.

5. Manage

- Setting up a (sub) project: quantifying time and money, weighing and quantifying risks, setting up project documentation and organizing resources (people and means)
- Monitoring and adjusting activities in terms of time, money, quality, information and organization
- Task- and process-oriented communication
- Supervising employees, encourage cooperation and be able to delegate
- Communicating and collaborating with others in a multicultural, international and/or multidisciplinary environment and meet the demands of participating in a work organization
- Taking the initiative
- Steering change management.

6. Advise

- Empathizing with the position of the (internal or external)
- customer
- Clarifying the client's needs
- In consultation with relevant parties, translating customer needs into technically and economically feasible solutions
- Substantiating an advice and convincing the customer of this advice
- Maintaining customer relationships appropriately.

7. Research

- Selecting and obtaining sources of information to delve further into the question, validating the reliability and usefulness of those various sources
- Summarizing, structuring and interpreting the results and drawing conclusions in relation to the research question
- Reporting results according to the standard prevailing in the field
- Based on the results obtained, critically evaluating the approach taken and make recommendations for the next step.

8. Professionalize

- Independently determining and implementing a learning goal and strategy and relate the result back to the learning goal
- Being flexible in a variety of professional situations
- When faced with professional and ethical dilemmas, weighing up the issues and making a decision, taking into account accepted norms and values
- Giving and receiving feedback constructively, both on behaviour
- and content
- Reflecting on own actions, thinking and results
- Using various communication forms and tools to communicate
- Using various communication forms and tools to communicate effectively in Dutch and English
- Applying digital professional skills and master new technologies.

5 APPLICATION

The model and the professional tasks described cover the entire Engineering domain. It is not a description of specific courses, majors, or specializations. That is a job for the programmes. The model gives them room for profiling, as seen from the range of educational programmes, regional activity and demand from individual students and employers.

5.1 PURPOSE AND SCOPE

The domain description provides programmes with a framework and a de facto standard with which they can describe their content, tasks and competencies, position themselves in the domain and design, organize and validate their programme. The model offers the possibility to set up the programme broadly or specifically, with a solid basis and room to offer specializations and respond to current developments while maintaining position and profile. This allows students and employers to know what can be expected of an Engineer newly graduated from that programme. It is up to the programmes themselves to use the framework to describe specific knowledge, skills and behaviours within a context.

5.2 COMPETENCY PROFILE

The domain description provides the opportunity to display a competency profile in an organized manner. It is also a tool to show how this has been translated into specific content of curriculum units. Based on the domain description, programmes determine the competency profile of their graduates and thereby the content width, depth and choices.

Programme profiles

Root cluster programmes may choose to establish a common profile at the national level. Programmes may also choose to relate directly to the domain description and derive their programme profile from it. They can raise their profile by providing focus, often prompted by specific regional activity.

A root cluster programme that focuses on more application areas is usually characterized by differentiations; this implies variation in the competency profile of graduates. Programmes can also focus specifically on one of the application areas. In addition to this profiling, programmes can further enrich themselves across application areas.

Profiling and accentuation

The domain description plays an important role in the accountability of a curriculum. Regardless of how institutions use them to characterize their courses, there is always a need to further specify the content. This can be done by specifying required knowledge, skill and attitude aspects in performance indicators. This further representation of content also provides an opportunity to go into more detail about aspects of the University of Applied Sciences qualification. It is also possible to link the more detailed content to specific curriculum areas.

Associate degree

An associate degree (Ad) is a job-specific task-oriented education at the operational-tactical level. A corresponding programme profile in the Engineering domain will accordingly usually find its content focus in an application area at level two. Typically, Ads are developed in collaboration with the (regional) business community. Compared to the first two years of an undergraduate programme, there is a more specialist-subject orientation and a more specific-task orientation.

5.3 ESTABLISHING THE LEVELS

The minimum level of the eight domain competencies is described for each course that forms part of the Engineering domain. In addition, programmes are responsible for further defining the competency profile by determining which competencies they want to achieve at which proficiency level.

The following principles and guidelines apply when establishing a competency profile with corresponding mastery levels by training programmes:

1. For a mastery level to be achieved, at least two factors must have that level, for example, the “nature of the task” and the “degree of independence“.
2. The number of points a course secures is the number of eight competencies multiplied by the corresponding mastery levels.
    a. A bachelor's level course has a sum of 18 credits
    b. The level of an associate degree has a sum of 12 credits
3. The minimum level of the eight competencies is level 1. In other words, no competency should be at 0.

Programmes can agree within their root cluster how the competency points will be distributed and agree on a base that allows for their own colouring, with the base per root cluster being a minimum of 15 points.

As an illustration, a random competency pin is shown below, along with the opportunities provided by the updated domain description.

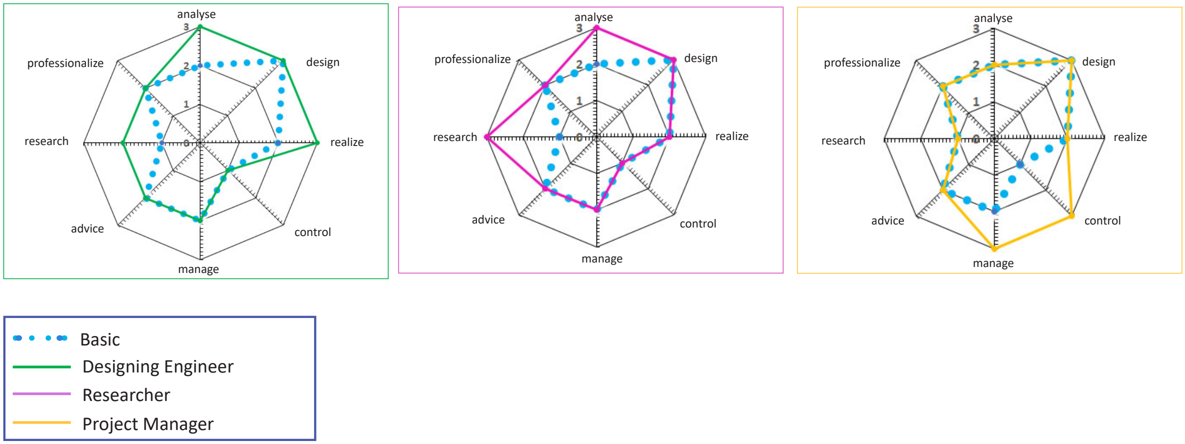


Figure 5.1 Illustration of a basic 15-point master, with 3 elaborations of own colouring up to 18 points from a course or student.

5.4 EDUCATIONAL PRACTICE

In educational practice, the model can play a role in the educational offerings, the choice of students within them and the assessment process. The educational offerings can range from a standard programme to end-of-course modules combined with fully demand-driven instruction. Practice usually lies between these two extremes. This model can also serve in assessment, especially for the assessment of individual paths of study and competencies acquired elsewhere (EVCs). This can be done using criteria related to the model, for example by reference to professional tasks and related performance indicators.

5.5 APPLICATION FROM THE PROFESSIONAL FIELD

Input was provided from the professional field through critical review in the creation of the model. This can play a role in recruitment and selection of new employees and in professionalization projects. In recruitment and selection, the profile of a vacancy can be created using the model. Monitoring the match between the training domain and the profile of the vacancy is a way of then directing professionalization in terms of content.

6 RECOMMENDATIONS

1. The domain description is originally a description of the undergraduate level. This version explicitly includes the associate degree level. In the next version, the level of the professional master can be described more explicitly. A professional master's degree prepares for complex professional practice, multidisciplinary work, coordination and direction for the purpose of innovation of the profession and functioning at the strategic level. The corresponding programme profile shows deepening to proficiency level four for this purpose. In addition, there may be explicit deepening in a specific area of applicationn.

2. The number of competencies in this version is unchanged from the previous version. It is recommended to critically examine whether the number of competencies can be reduced. The technical competency “Analyse” and the generic competency “Research” show some overlap. Tightening this up is desirable. It is also advisable to consider whether the competency names still cover the scope. For example, a competency “Initiate” would better indicate that engineers also act as drivers of new developments.

3. The choice has been taken to place the Dublin descriptors and the NLQF standard side by side. Since the Dublin descriptors are actually already incorporated into the NLQF, it is recommended to work towards using one standard, namely NLQF.

4. There is a growing need for guidance on how professional products can be linked to learning outcomes. In the coming years, programmes can examine together how this can be given shape. A good start is sharing experiences and best practices.

ANNEXES

ANNEX 1. TERMS AND DEFINITIONS

Bachelor profile A professional profile for one or more (higher) bachelor programmes within a domain

BoKS The *Body of Knowledge and Skills* (BoKS) is a description of the specific elements of knowledge and skills by course that define the theoretical basis and practical actions of a professional field. Or: the set of knowledge components and skills that students must master in an engineering course in order to become competent for an engineering profession or job

Competency A cluster of knowledge, skills and attitude that is 1) necessary to perform a particular occupation/job, 2) can be measured and tested against accepted standards in a particular context and 3) can be improved through training and development

Competency profile A collection of (partial) competencies and associated behavioural indicators required to perform a particular job

CROHO The Central Register of Higher Education Study Programmes (CROHO) contains all higher education study programmes funded by the Ministry of Education, Culture and Science in the Netherlands

Curriculum-independent assessment Examination and marking aimed at assessing learning outcomes realized by students, where the methods used and instruments used for examining and are generic and not specifically tailored to the are tailored to the specific (flexible) educational pathway of the student

Domain competencies The common competencies of novice practitioners within the domain for which the programme is training

Engineer The engineer at the University of Applied Sciences level

Field of work See professional field

Final qualification A competency with a specific level designation that someone must meet at the end of the (higher professional) study, as a starting professional (see also qualification)

Function A collection of activities, performed by individuals working in a particular context to contribute to a product or service

Intersection training A course that combines engineering with another industry

Learning goal The description of the intended outcome of a part of the education, e.g., a specific educational module and how this outcome will be measured

Learning outcome The description of what a learner knows, understands and can do upon completion of a learning process

Programme profile Description of the way in which the individual programmes give shape to a higher education curriculum, which aims to ensure that students develop the competencies mentioned in the professional profile at higher education level

Professional domain A part of a context characterized by a distinctive word (or short word combination)

Professional field The collection of all professions and jobs in which graduates of bachelors of engineering are generally employed

Professional product The result of a professional assignment performed by students, intended to demonstrate their competence in relation to a core task of the profession. A professional product has different manifestations, such as a design, final product, action , research or advice

Professional profile A (national) description of the set of competencies that professionals must possess in order to adequately perform their profession or function. Programmes can be expected to aim for competency development in students to the level of novice practitioner

Qualification A competency that has a level designation and that someone must meet at a certain point in time (see also end qualification)

Training Course entered in the CROHO register and offered at a University of Applied Sciences, not to be confused with master's degree programme

Root cluster The set of programmes that have the same CROHO code in the CROHO register

Root profile Description of the common basis for courses belonging to the same master

ANNEX 2. CONSULTED SOURCES

Bachelor of Engineering programmes, competency-based profile description 2016.

Description level 5 Associate Degree, Consultation Platform Ad Association of Universities of Applied Sciences, 2018 http://www.deassociatedegree.nl/wp-content/uploads/181001-Beschrijving-niveau-5-v5.0-2018.pdf

BOOST Industry Compass East of the Netherlands, 2021 https://onlinetouch.nl/e-dsign/boost-industrie-kompas-2030?html=true#/0/

Conversations for Tomorrow #3 Intelligent Industry:The Next Era of Transformation, Capgemini Research Institute, 2021 https://www.capgemini.com/wp-content/uploads/2021/12/Final-Report-Converstations-for-Tomorrow-3.pdf

Digital CompetencePeiler, Acceleration Plan for Educational Innovation with ICT, 2021 https://www.versnellingsplan.nl/Kennisbank/digitale-competentiepeiler/

EUR-ACE: Framework standard for the Accreditation of Engineering Programmes

Guide to drafting testable final qualifications, Rotterdam University of Applied Sciences , Sep. 2011.

HTNO Roadmap 2025, see https://www.hbo-engineering.nl/_asset/_public/HTNO-Roadmap-2025-vs-6-juni-2016.pdf

KIVI:THE CHARTERED ENGINEER STRUCTURE, April 2016, see https://www.kivi.nl/uploads/media/57b1cb2e9f055/2016-08%20Chartered%20Engineer%20Structure.pdf

Quality as a Mission, HBO Council, 2009.

Meta-analysis social tasks relevant to the hbo, Association of Universities of Applied Sciences, 12 May 2020, see https://www.vereniginghogescholen.nl/system/knowledge_base/attachments/files/000/001/117/original/Meta-analyse_maatschappelijke_opgaven_relevant_voor_het_hbo.pdf?1590661284

Missions for the future, see https://www.topsectoren.nl/missiesvoordetoekomst

To 4 out of 10. More technology talent for the Netherlands. Master Plan for STEM. Van Pernis Committee Report, February 2012 (commissioned by the Top Sectors, Platform Bèta Techniek, Green Knowledge Cooperative).

NLQF Levels, National Coordination Point, https://www.nlqf.nl/nlqf-niveaus

Procedure for establishing and approving national profiles for bachelor's programmes at Universities of Applied Sciences, see http://www.vereniginghogescholen.nl/profielenbank/

Procedure for establishing national training profiles https://www.vereniginghogescholen.nl/system/knowledge_base/attachments/files/000/000/994/original/2018-12_BIJLAGE_Verheldering_procedure_landelijke_opleidingsprofielen.pdf?1550072825, Association of Universities of Applied Sciences, 2018.

Space in Rules, Ministry of Education, Culture and Science, July 8, 2021 https://www.rijksoverheid.nl/documenten/publicaties/2021/07/14/ruimte-in-regels-suggesties-voor-een-betere-balans-tussen-kwaliteit-en-regeldruk-in-het-hoger-onderwijs

Table comparison NLQF levels 5 to 8 and Dublin descriptors, Annex V of the advice of the NLQF -EQF Committee, see https://www.nlqf.nl/images/downloads/NLQF/g_Tabel_vergelijking_NLQF-niveaus_5-8_Dublin_descriptoren.pdf

The European Qualifications framework for lifelong learning, see http://ec.europa.eu/dgs/education_culture Explaining the European Qualifications Framework for lifelong learning, European Commission, 2009, see https://europa.eu/europass/system/files/2020-05/EQF-Archives-NL.pdf

Website Top Sectors, see https://www.topsectoren.nl

ANNEX 3. CONSULTED ORGANISATIONS

All Universities of Applied Sciences and programmes within the Engineering domain particpated in this domain description. In addition, representatives from industry, government agencies, trade associations and professional societies contributed. Below is a list of organizations consulted at some point in the process.

ACE Mobility; Automotive Centre of Expertise Mobility
Adaelta
AYYA
Boost Smart Industry
Center of Expertise Tech for Future
Feadship|Royal Dutch Shipyards
FME
Fokker Technologies | GKN Aerospace
HBO-I Foundation
KD Solutions
KIVI, Royal Institute of Engineers
Koninklijke Metaalunie
Professor HU Learning & Innovation
MaromeTech
Medus
NPI
Panteia
SAC HTNO
Suplacon Plaatbewerking
Techniek Nederland
Transavia
TVVL
Van Raam
Vereniging Hogescholen
(Association of Universities of Applied Sciences)
VMI Group

ANNEX 4. NLQF AND DUBLIN DESCRIPTORS

As part of the Bologna , qualifications for the undergraduate and graduate levels, known as Dublin descriptors, were described in 2004. For the associate degree, the *Dublin Short Cycle descriptors* has been established. In 2008, the European Qualification Framework (EQF) was adopted, incorporating the Dublin descriptors and also describing the other levels of education. Since 2011, the Netherlands has had the Dutch Qualification Framework (NLQF), which is derived from the EQF. Level 5 describes the associate degree, level 6 the bachelor's and levels 7 the master.

Both the Dublin descriptors and the NLQF are used within higher education as standards to determine level. This annex provides an overview of both standards for each level – associate degree, bachelor's and master.

ASSOCIATE DEGREE

	NLQF level 5	Dublin Short Cycle descriptors	
Context	An unfamiliar, changing living and working environment, including internationally		
Knowledge	Possesses broad, in-depth, or specialist knowledge of a profession and field of knowledge Possesses detailed knowledge of some professional and knowledge domains and understanding of a limited set of basic theories, principles and concepts Possesses limited knowledge and understanding of some important current topics and specialties related to the profession and domain of knowledge	Has demonstrated knowledge and understanding of a subject area that builds on general secondary education, typically functions at the advanced textbook level, has a knowledge base for a professional field or profession, for personal development and for further study to complete the first cycle (bachelor's)	**Knowledge and understanding**
Applying knowledge	Reproduces and analyses knowledge and applies it, including in other contexts, to answer problems related to a profession and domain of knowledge Uses procedures flexibly and inventively	Is able to apply knowledge and understanding in professional contexts	**Application of knowledge and understanding**
	Identifies limitations of existing knowledge in professional practice and in the knowledge domain and takes action Analyses and performs complex (professional) tasks	Has the ability to identify and use data to determine a response to clearly defined, concrete and abstract problems	**Judgement-forming**
Problem solving skills	Recognizes and analyses complex problems in professional practice and in the knowledge domain and solves them creatively by identifying and using data		
Learning and development skills	Develops through reflection and assessment of own (learning) outcomes	Possesses the learning skills to engage in advanced training that requires a certain degree of autonomy	**Learning skills**
Information skills	Obtains, processes, combines and analyses broad, in-depth and detailed information about a limited set of basic theories, principles and concepts, of and related to a profession and knowledge domain as well as limited information about some important current topics and specialties, related to the profession and knowledge domain and presents this information		
Communication skills	Communicates purposefully on the basis of conventions applicable in the context and professional practice with peers, supervisors and clients	Can communicate with peers, supervisors and clients about understanding, skills and work activities	**Communication**
Responsibility and independence	Works collaboratively with peers, supervisors and clients Bears responsibility for results of own activities, work and study Bears shared responsibility for the outcome of activities and work of others and for directing processes		

BACHELOR

	NLQF level 6	Dublin descriptors bachelor	
Context	An unfamiliar, changing living and working environment, including internationally		
Knowledge	Possesses advanced specialist knowledge and critical understanding of theories and principles of a profession and field of knowledge and broad area of science Possesses broad, integrated knowledge and understanding of the scope, major areas and boundaries of a profession, field of knowledge and broad area of science Possesses knowledge and understanding of some important current topics and specialties related to the profession or field of knowledge and broad field of science	Has demonstrated knowledge and understanding of a subject area, building on and exceeding the level achieved in secondary education; generally functions at a level at which, with the support of specialist textbooks, some aspects occur that require knowledge of the latest developments in the field	**Knowledge and understanding**
Applying knowledge	Reproduces and analyses knowledge and applies it, including in other contexts in such a way that it demonstrates a professional and scientific approach in profession and knowledge domain Applies complex specialist skills to research outcomes Brings a practice-based research project to a successful conclusion with guidance based on methodological knowledge Drafts and deepens arguments Critically evaluates and combines knowledge and insights from a specific domain Identifies limitations of existing knowledge in professional practice and in the knowledge domain and takes action Analyses and performs complex professional and scientific tasks	Is able to apply his/her knowledge and understanding in such a way that it demonstrates a professional approach to his/her work or profession and further possesses competencies in drafting and deepening arguments and in solving problems in the field of study Is able to gather and interpret relevant data (usually in the field of study) with the goal of forming a judgment based in part on weighing relevant social, scientific, or ethical aspects	**Application of knowledge and understanding** **Judgement-forming**
Problem solving skills	Recognizes and analyses complex problems in professional practice and in the knowledge domain and solves them tactically, strategically and creatively by identifying and using data		
Learning and development skills	Develops through self-reflection and self-assessment of own (learning) results	Possesses the learning skills necessary to engage in advanced study that assumes a high level of autonomy	**Learning skills**
Information skills	Responsibly and critically collects and analyses broad, in-depth and detailed professional or scientific information on a limited range of basic theories, principles and concepts of and related to a profession or knowledge domain, as well as limited information on some important current topics and specialties related to the profession and knowledge domain and presents this information		
Communication skills	Communicates purposefully on the basis of conventions applicable in the context and professional practice with peers, specialists and non-specialists, supervisors and clients	Is able to convey information, ideas and solutions to audience consisting of specialists or non-specialists	**Communication**
Responsibility and independence	Works collaboratively with peers, specialists and non-specialists, supervisors and clients Bears responsibility for results of own work and study and the result of the work of others Assumes shared responsibility for directing processes and professional development of individuals and groups Collects and interprets relevant data for the purpose of forming a judgement based in part on the consideration of relevant social, professional, scientific, or ethical aspects		

MASTER

	NLQF level 7	Dublin descriptors master	
Context	An unfamiliar, changing living and working environment with a high degree of uncertainty, including internationally		
Knowledge	Possesses particularly specialist advanced knowledge of a profession, field of knowledge and area of science and at the interface between different professions, fields of knowledge and areas of science Possesses critical understanding of a range of theories, principles and concepts, including the major ones of a profession, field of knowledge and area of science Possesses extensive, detailed knowledge and critical understanding of some important current topics and specialties related to the profession or field of knowledge and areas of science	Has demonstrable knowledge and understanding, based on the knowledge and understanding at the Bachelor's level and that exceeds and/or deepens it, as well as providing a basis or opportunity to make an original contribution to the development and/or application of ideas, often in a research setting	**Knowledge and understanding**
Applying knowledge	RReproduces, analyses and integrates knowledge and applies it, including in other contexts and deals with complex subject matter This knowledge forms the basis for original ideas and research Uses knowledge gained at a higher level of abstraction Thinks conceptually Drafts and deepens arguments On the basis of methodological knowledge, independently brings a fundamental research project to a successful conclusion Makes an original contribution to the development and application of ideas, often in research settings Identifies limitations of existing knowledge in professional practice and in the knowledge domain at the interface between different professional practices and knowledge domains takes action Analyses and performs complex professional and scientific tasks	Is able to apply knowledge and insight and problem-solving abilities in new or unfamiliar circumstances within a broader (or multidisciplinary) context related to the field of study; is able to integrate knowledge and deal with complex subject matter Is able to make judgements based on incomplete or limited information while taking into account social and ethical responsibilities, which are associated with applying one's own knowledge and judgements	**Application of knowledge and understanding** **Judgement-forming**
Problem solving skills	Recognizes and analyses complex problems in professional practice and in the knowledge domain and solves them tactically, strategically and creatively Contributes to professional practice and in the knowledge domain to the (scientific) solution of complex problems by identifying and using data		
Learning and development skills	Develops largely autonomously	Possesses the learning skills that will enable him or her to engage in advanced study of a largely self-directed or autonomous nature	**Learning skills**
Information skills	Responsibly and critically collects and analyses broad, in-depth and detailed professional or scientific information on a range of basic theories, principles and concepts of and related to a profession or knowledge domain, as well as limited information on some important current topics and specialties related to the profession and knowledge domain and presents this information		
Communication skills	Communicates purposefully on the basis of conventions applicable in the context and professional practice with peers, specialists and non-specialists, supervisors and clients	Is able to clearly and unambiguously communicate conclusions, as well as the knowledge, motives and considerations underlying them, to an audience of specialists or non-specialists	**Communication**
Responsibility and independence	Works collaboratively with specialists and non-specialists, peers, supervisors and clients Bears responsibility for results of own work and study and the result of the work of others Assumes responsibility for directing complex processes and the professional development of individuals and groups Formulates judgements based on incomplete or limited information, taking into account societal, scientific and ethical responsibilities associated with applying their own knowledge and judgements		

ANNEX 5. HBO STANDARD

In 2009, the Association of Universities of Applied Sciences published the memo *Quality as a Mission*. In it, the Universities of Applied Sciences have, in particular, jointly established a standard of the professional bachelor's degree. This standard serves as a framework and provides direction for all higher professional education programmes.

A solid theoretical foundation

With each standard comes a certain amount of basic knowledge. For the intake, knowledge in subject areas such as Dutch, English and numeracy/mathematics is a requirement. This knowledge should increase throughout the training. In addition, it is mainly about the subject-specific knowledge of the professional field for which training is being performed. The establishment and assurance of such a knowledge base by training programmes is of paramount importance. Competency-based education is a major innovation in higher education, but its introduction has sometimes been accompanied by an undervaluation of knowledge. Integration of knowledge, skills and attitude is appropriate in training entry-level professionals. With an enhanced emphasis on knowledge, competency-based education will have a different content than it did a few years ago. This is about the need for students to have the theoretical baggage that will provide them with the foundation to be able to look critically and creatively at their own field of study. This knowledge base is thus inextricably linked to the University of Applied Sciences bachelor's level.

The inquisitive mind

Professional bachelors are not just about translating high-level knowledge learned into a practical situation. In our modern society, it is crucial that University of Applied Sciences bachelors have an investigative capacity that leads to reflection, to evidence-based practice and to innovation. Thus, the Abrahamsen Committee states: " ... the abilities to analyse problems, to synthesize, to propose solutions and to communicate about various challenges (...), also in a multidisciplinary environment, are becoming more and more important. These abilities are not only important in research environments but also in industry and the society at large. This, in combination with the knowledge and the understanding of real life processes in industry, will give industry additional innovative power. Practical and professional experience of students, by preference from the start of their study in combination with applied research, will allow these competences to develop." (*Bridging the gap between theory and practice, possible degrees for a binary system*, Report Committee Review Degrees for the Dutch Ministry of Education, Culture and Science, 2005, p. 48.)

Professional craftsmanship

Craftsmanship is inextricably linked to the programmes that Universities of Applied Sciences provide. For many, the professional bachelor's degree is the highest form of professional education they pursue. This means that our undergraduate programmes must ensure that students learn the knowledge and skills specific to the role of the professional in a field of work. A good connection between training and professional practice is a necessary condition for this. Teachers with current practical experience and the use of guest lecturers provide the right context for this. The internships provide students with the confrontation of the knowledge and exercises gained with the reality of actual professional practice. Having an international orientation is also part of the skill set, as is having an entrepreneurial attitude.

Professional ethics and social orientation

HBO bachelors are not one-sided applicators, but professionals who have to establish relationships with social and sometimes ethical issues, who have a cultural baggage, who have received – in the true sense of the word – academic training. It is increasingly important to train health professionals who can reflect critically on the dignity of life, to train economists who ask themselves questions about the relationship between short-term profit maximization and longer-term confidence in the economic system and to make engineers for a working life where attention to sustainability becomes more central. It involves awareness of the meaning of learned knowledge and skills in their social context. Students should be expected to have the ability to critically evaluate knowledge against moral values.

ANNEX 6. OVERVIEW OF ASSOCIATE DEGREES, BACHELORS AND PROFESSIONAL MASTERS

Reference date: 10 December 2021

OVERVIEW OF UNDERGRADUATE PROGRAMMES WITHIN THE DOMAIN

1. Aeronautical Engineering
2. Applied Mathematics
3. Automotive
4. Aviation
5. Electrical and Electronic Engineering
6. Engineering
7. Health Technology
8. Industrial Design Engineering
9. Industrial Engineering and Management
10. Logistics Engineering
11. Maritime Technology
12. Mechanical Egineering
13. Mechatronics

See https://www.hbo-engineering.nl/thema-s/overzicht-stamopleidingen for Universities of Applied Sciences that offer these master courses.

OFFER OF ASSOCIATE DEGREE PROGRAMMES WITHIN THE DOMAIN

Rotterdam University of Applied Sciences	Ad Engineering Ad Maintenance & Mechanics
Windesheim University of Applied Sciences	Ad Industrial Automation and Robotics Ad Logistics Ad Technical Business Administration
University of Applied Sciences of Arnhem and Nijmegen	Ad Embedded Systems Engineering Ad Electrical Engineering Ad Technical Business Administration/Smart Industry Ad Structural Engineer Mechanical Engineering Ad System Specialist Automotive
Hanze University of Applied Sciences Groningen	Ad Project Leader Engineering Ad System Specialist Automotive Ad Mechatronics in the Smart Industry
Saxion University of Applied Sciences	Ad Engineering Ad Construction Ad Software development
Zeeland University of Applied Sciences	Ad Technical Business Administration Ad Energy Transition Engineer Ad Logistics
Utrecht University of Applied Sciences	Ad Engineering

Avans University of Applied Sciences	Ad Engineering Ad Logistics Ad Mechatronics
NHL Stenden	Ad Industrial Automation & Robotics Ad Maritime Engineering
Fontys University of Applied Sciences	Ad Technical Business Administration Ad Mechanical Engineering Ad Electrical Engineering Ad Engineering
Inholland University of Applied Sciences	Ad Maintenance (in demand)
Zuyd University of Applied Sciences	Ad Engineering
Amsterdam University of Applied Sciences	Ad Logistics

OFFER OF PROFESSIONAL MASTERS WITHIN THE DOMAIN

Windesheim University of Applied Sciences	Master Polymer Engineering (with NHL Stenden)
University of Applied Sciences of Arnhem and Nijmegen	Master Control Systems Engineering Graduations: Automotive Systems, Control Systems, Embedded Systems, Lean Engineering and Sustainable Energy.
Hanze University of Applied Sciences	Master Smart System Engineering European Master Sustainable System Management European Master Renewable Energy Master Energy for Society (E4S)
Saxion University of Applied Sciences	Master Applied Nanotechnology Master Innovative Textile Development Master Health Care & Social Work (with study route Technology & Innovation) Master Robotics Systems Engineering
Utrecht University of Applied Sciences	Master of Engineering (unfunded) Master Next Level Engineering
NHL Stenden	Master Polymer Engineering (with Windesheim) Master Computer Vision & Data Science (in application)

ANNEX 7. PROCESS

In December 2020, the Executive Board of the Engineering domain formulated the task of updating the domain description as follows:

- Update the domain description in the areas of circular economy, sustainability, ethics, digitalization and Lifelong Learning
- Provide flexibility in root cluster profiles so that programmes can relate directly to the domain profile
- Retain current competencies; necessary or desirable rewording is permitted
- Expand the current model, consisting of competencies and levels, to include a third dimension "areas of application"
- Add the associate degree level
- Describe learning outcomes and professional products, which provide insight into the link between Body of Knowledge and Skills (BoKS) and competencies in the model.

Preconditions

- The domain description complies with relevant laws and regulations
- The domain description is consistent with international developments
- In the creation of the updated domain description, relevant elements are incorporated from current and valid national guidelines, agreements, research results and insights
- In updating, existing knowledge and materials are used as much as possible
- The domain description identifies what root clusters have in common and provides opportunities for local colouring
- The domain description provides programmes with the necessary and desired flexibility to base their curricula on now and in the near future
- The domain description has been coordinated with stakeholders: companies, industry associations, educational institutions and relevant national consultations and partnerships.

Method

The process that led to the creation of this updated domain description roughly consisted of four phases:

1. The first phase involved a reconnaissance for **the purpose of task delineation**. This exploration resulted in the terms of reference.
2. Phase two began with research into relevant sources, guidelines and frameworks. Also at this stage (preliminary) choices were made regarding extensions and modifications of the domain description. This phase was called the **preliminary work**.
3. This preliminary work partly paralleled and provided guidance for the third, **the substantive inventory** phase, in which stakeholders were consulted, suggestions and advice were collected and incorporated and choices were made. This phase led to the (draft) version of the updated domain description.
4. The fourth and final stage was **the determination procedure**.

Phase 1. Terms of reference

Before the Executive Board commissioned the update of the domain description, over twenty interviews were held with representatives from affiliated programmes, adjacent domains, the field and interest groups. Based on their input, the brief was formulated.

Phase 2. Framing and guiding preliminary work

After the assignment was formulated, work began on researching relevant sources, guidelines and frameworks. Consider (inter)national developments and trends in education and the professional field and (national and European) standards and references. During this preliminary study, we also looked at description and positioning of the associate degree level and orientation took place on requested modifications and extensions of the model. Interviews with representatives from the field were also conducted during this phase.

Phase 3. Content Inventory

From the beginning, stakeholders were involved in the process. In the third phase, which was partly parallel to the previous phase, a content inventory took place, during which stakeholders were consulted. In a written survey, educations, industry organizations, companies, sounding board and expert groups indicated the areas in which the domain description needed updating. The project group incorporated these results into partial results and intermediate concepts that were supplemented and refined by means of various feedback rounds and field consultations with representatives of the professional field of study. A major challenge proved to be the degree of abstraction versus concreteness: for example, the domain description must be abstract enough to be sustainable and to provide flexibility and concrete enough to serve as a tool for teaching and curriculum development.

It was an iterative process: inputs from previous consultations were carried over to the next. This eventually led to a first draft version, which was then presented to the master leaders, Advisory Board, curriculum and professional field committees. Their input, as well as input from various workshops, theme days and individual responses, was incorporated into the version presented for approval in the fourth and final phase.

Phase 4. Adoption process

During the final phase, the adoption process, a draft version was submitted to the Advisory Board and General Board of Engineering and to the Sectoral Advisory Committee HTNO (SAC HTNO). Their feedback ultimately resulted in the final version which, after approval by SAC HTNO, was submitted to the Association of Universities of Applied Sciences for adoption.