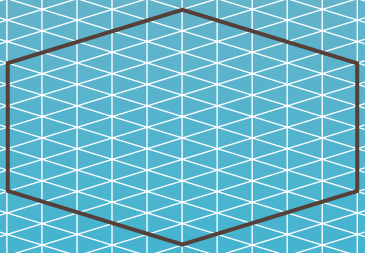
Domain description
Bachelor of ICT



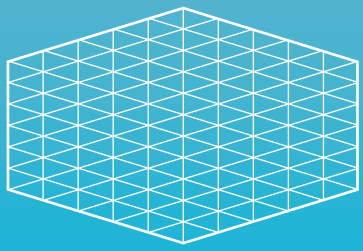
HIGHER PROFESSIONAL EDUCATION
ICT – BACHELOR PROGRAMMES

Contents

1 Introduction

This Bachelor of ICT domain description offers a functional qualification framework for universities of applied science, and is aimed at the competency level of Bachelor ICT graduates, the future ICT professionals. Almost every area of society nowadays, whether it is business, social or personal, is dependent on ICT. ICT not only is an important economic sector in its own right, it also constitutes an indispensable driving force for innovation in society's knowledge-intensive areas. There is a great need in the Netherlands for highly qualified ICT professionals.

As the ICT domain is expanding and developing continuously, the demand for new and specific types of ICT professionals increases. In order to anticipate new applications, job market related issues, innovations and hypes, the Bachelor of ICT domain description requires regular updates.



1.1 Definition

The Bachelor of ICT domain description comprises a national qualifications framework for Bachelor graduates of Dutch HBO study programmes in the ICT domain. HBO-I maintains and periodically updates the domain description and does so in close cooperation with the business sector. The description is laid down by the Association of Universities of Applied Sciences.

1.2 Target audience

From 1 September 2015 onward, HBO-ICT, Informatics and Computer Engineering (Applied Computer Science) make up the ICT domain. The domain description offers the **ICT study programmes** a framework in which their respective profiles, learning goals and curricula are laid down. Content and level of the study programmes are guaranteed by the exclusive linking of each training profile to its respective domain description.

For **companies** the domain description offers insight into the ICT graduates' intended final level. Due to the variety of ICT study programmes, a generic domain description provides companies with a clear image of the current skills of the professionals they are about to recruit.

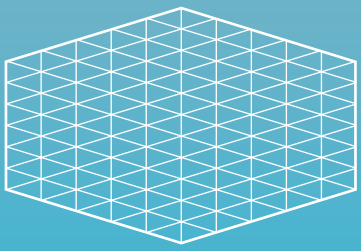
The domain description offers **students** and potential students information regarding job content and various study programmes. The boundaries of the Bachelor of ICT domain description indicate where neighbouring affiliate Bachelor domains start, such as the Bachelor of Engineering, the Bachelor of Creative Technology and the Bachelor of Business Administration.

1.3 About HBO-I

The HBO-I foundation is the umbrella organisation of all the HBO ICT study programmes in the Netherlands. The foundation is committed to the exchange of knowledge and the transfer of information between professional and educational study programmes. By launching mutual activities and products, the foundation encourages and promotes the intake of new talent. One of the products of HBO-I is the Bachelor of ICT domain description.

2 Accountability

This description has been achieved through an intensive collaboration with employers. Contributions have been made by the HBO-I Council, the HBO-I Advisory Board[1], representatives of trade associations and expert groups, and members of professional field committees of the study programs participating in the HBO-I foundation.



[1] *For the formation of the Advisory Board, please see www.hbo-i.nl/organisatie*

2.1 Coordination and support

When updating the Bachelor of ICT domain description acquiring a broad support has been a leading principle. The domain description was developed in cooperation with representatives from the business sector, trade associations, expert groups and education. In 2012 and 2013 review session were put into place, in order to update the domain description. A large number of organizations participated in these sessions (Appendix 2).

2.2 International references

In the ICT domain, the international character of the labour market is an important aspect in the education of professionals, in staff recruitment and in career planning. In the past decade, a wide range of initiatives has been developed in Europe and worldwide, aimed at improving transparency of the descriptions of the ICT profession. These initiatives differ in terminology, principles and application. For the Bachelor of ICT domain description especially the following documents are of relevance.

Bachelor Level
With the introduction of the Treaty of Bologna Accord in 2005, European higher education acknowledges three consecutive degrees: Bachelor, Master and Doctor. The Dublin descriptors describe the internationally accepted level of bachelor (Appendix 3). The national Bachelor level is described in the HBO standard (Appendix 4). Educational profiles based on the domain description, include the Dublin descriptors and the HBO standard. When meeting the educational profile, students automatically meet the internationally and nationally accepted level of the bachelor's degree. The European Qualifications Framework (EQF) describes learning outcomes in terms of knowledge, skills and competences, in order to compare qualifications and qualification levels within a European context. The EQF indicates the range of complexity and depth, and it distinguishes eight levels; level 6 corresponds to the Bachelor level. The descriptions correspond to the skill levels 2 and 3 of the Bachelor of ICT.

European e-Competence Framework

In 2001, a number of large ICT companies expressed their concern about the shortage of qualified ICT professionals on the job market. It led to the creation of the CEN ICT Skills Workshop in 2003. In 2006, a detailed inventory of ICT profiles in Europe was compiled, which proved how much profile descriptions differed with regard to fundamentals, model and goal; for example Sfia (United Kingdom), AITTS (Germany) and CIGREF (France). This gave rise to the development of the European e-Competence Framework (e-CF), which was first published in September 2008. In 2013, the third version appeared.

The e-CF is developed for businesses and human resource management, and it uses levels of proficiency for the whole of the ICT professional field. The e-CF consists of four dimensions:

- dimension 1: five e-skills areas, derived from the ICT business processes 'plan', 'build', 'run', 'enable' and 'manage'
- dimension 2: a set of 32 e-competencies
- dimension 3: five levels of skill, related to the 6 highest EQF levels
- dimension 4: examples of knowledge and skills related to e-competencies

The e-CF defines five levels of competence in the workplace and integrates three facets into the competency definition in that capacity:

a) Autonomy: ranges from 'carrying out instructions' to 'making personal choices'.
b) Behaviour: represents the perceptible result of an attitude and ranges from 'the ability to use' to 'the ability to understand'.
c) Context: ranges from 'structured – predictable' situations to 'unpredictable – unstructured' situations.

The Bachelor of ICT levels of skill are in line with dimension 3 of the European e-Competence Framework (e-CF).

2.3 Realization of the domain description

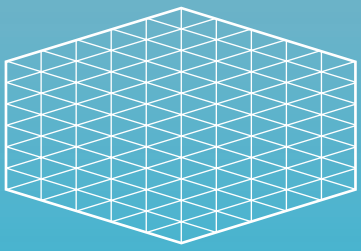
In 1994, for the first time, HBO-I drew up collective final qualifications (intended learning goals). These qualifications were described according to educational guidelines. Updates on the final qualifications were published in 1997 and 2000.
In 2005, HBO-I designed a competency-based profile description, characterized by five building blocks from the lifecycle of information systems, describing the competences of a Bachelor of ICT. This method proved very useful for the HBO ICT study programme and was adopted by other HBO domains.
To enable a study programme to position itself clearly within the overall ICT domain, and to respond to the increasing pace of development and acceptance of new technologies, extra dimensions were added in 2009 by means of architectural layers and levels of skill.

In 2014 this '3D model' was reassessed and updated. A limited number of aspects of the model is now modified. The lifecycle phases are maintained, but have to be viewed explicitly as 'activities'. After all, in an agile development environment these activities do take place, however not like the 'stages' to be found in the waterfall model.
The architectural layer 'Infrastructure' switched positions with 'Software'. Software nowadays uses existing infrastructure, rather than that it has an effect on it.
The phase or activity 'manage' showed a high degree of differences in interpretation. In order to emphasize the importance of the manageability and maintainability of the process, the position of the activity 'manage' has been brought forward.

The definitions of the architectural layers and lifecycle activities have been modified as well, and the professional tasks – the contents of the matrix cells – have been updated in close collaboration with the professional field. This edition of the HBO-I foundation offers both higher vocational education and professional field a framework for the description of ICT study programmes, with explicit attention for the international context, due to a growing internationalization.

3 The model

The model offers a systematic description of the Bachelor of ICT domain. This provides the study programmes with an opportunity to position their courses within the model. The three dimensional model consists of activities (choice of the ICT professional), ICT architectural layers (context relevant aspects) and the level of skill (level of complexity).



3.1 Lifecycle activities

The first dimension consists of five lifecycle activities – ‘manage’, ‘analyse’, ‘advise’, ‘design’ and ‘implement’, derived from the lifecycle of information systems. Each Bachelor of ICT should be able to execute these activities within the context of their profession. Quality aspects such as security, budget and available time, are very important for each of the five lifecycle activities.

Activity	Explanation
Manage	Management and control of all activities aimed at the process of development and deployment of ICT systems and of ICT service management.
Analyse	The analysis of relationships between processes, products and data flows within the context of the environment.
Advise	Advice regarding the reorganisation of processes and / or data flows. Advise on new ICT systems to be developed or purchased on the basis of an analysis and in consultation with stakeholders.
Design	Design of an ICT system on the basis of set specifications, and within predefined frameworks.
Implement	Build an ICT system on the basis of a specific design and within a set framework.

3.2 Architectural layers

The second dimension consists of five architectural layers. The lifecycle activities certainly can have direct bearing on different aspects of ICT systems causing specific content-related activities to differ from one another. The deployment of architectural layers is aimed at visualizing substantive differentiation and at delivering a detailed description of the Bachelor of ICT profile.

The five architectural layers are arranged according to a particular sequence. Each layer adds a certain functionality and value to the previous layer and builds on the ‘services’ of the subsequent layer. User Interaction retrieves ICT facilitated business

processes, which are based on a configured hardware and software infrastructure. This infrastructure is constructed of (programmed) hardware and software components which are connected to hardware systems through hardware interfaces.

Architectural layer	Description
User interaction	Relates to the communication of the (end) user with the ICT system. User interaction during the creation and realization of an ICT system is explicitly excluded from this, as this is a recurring issue in each architectural layer.
Business processes	Relate to facilitating organisational processes using ICT systems. These processes deal with the functionality of the overall system (automated and non-automated components) within the context of organisational objectives to be achieved.
Infrastructure	This concerns the full range of ICT systems deployed to facilitate business processes. Emphasis lies on creating and maintaining availability of both the traditional hardware infrastructure and the software infrastructure, and the configuring thereof.
Software	This concerns the development of various software that is incorporated in an ICT infrastructure after delivery.
Hardware interfacing	This applies when software interacts with available hardware, and when situations occur whereby the software explicitly has to take into account both the possibilities and the limitations of the available hardware.

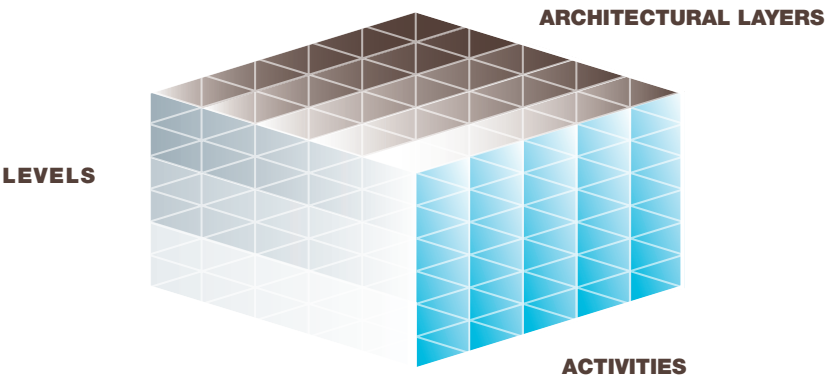
The term computersystem has been chosen as an overall generic term. Depending on the context, this can be further specified as ‘embedded system’, industrial automation, ‘virtual system’, and so forth.

3.3 Levels of skill

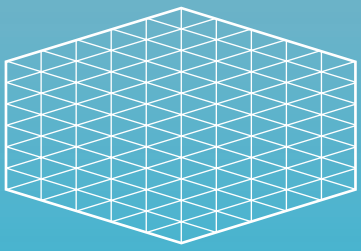
The third dimension regards the level of skill, and with it the domain description offers a guarantee for the HBO level. Within the Bachelor of ICT domain, both courses and students alike can place an emphasis on various areas, thus causing multiple levels

at which subareas should be managed. In order to facilitate comparability within this diversity of levels, we can distinguish three levels of skill.
Within the various study programmes the highest level of complexity will not always be achieved at the third level of skill for all of the facets. In certain cases, the descriptions of the third skill level will indicate that autonomy and behaviour will have the highest form of complexity, whilst the context will be predictable. On the other hand, context and behaviour can have the highest complexity as well, but still with a certain degree of guidance. The characterization of the skill levels in the overview below is in line with the description of levels in dimension 3 of the European e-Competence Framework (e-CF).

Level	Autonomy	Behaviour	Context
1	Able to apply knowledge and skills to elementary problems.	Bear responsibility for one's own actions.	Stable.
2	Behave independently during identified activities.	Manage others within set boundaries. Has a capacity for conceptual thinking and modelling, using creative thinking.	Predictable and at times unpredictable.
3	Able to use innovative methods and to show initiative.	Innovative, leadership, responsibility for teams.	Unpredictable environment.



4 BOKS



4.1 BOKS

The model offers a systematic Bachelor of ICT domain description. The two dimensions ‘activities’ and ‘architectural layers’ together constitute a matrix which represents the overall Bachelor of ICT domain. As such, the study programmes are provided with an opportunity to position their courses within the model. The professional duties of the trained Bachelor of ICT are included in the matrix cells. Together these constitute the Body of Knowledge and Skills (BOKS).

	Manage	Analyse	Advise	Design	Implement
User interaction					
Business processes					
Infrastructure					
Software					
Hardware interfacing					

4.2 Relationship with Dublin descriptors

For successful implementation every professional task described requires extensive knowledge and understanding of the field. In many cases it concerns tasks in line with current developments in the field of study, for which required knowledge can be found in specialized literature. As the description is based on professional tasks, besides knowledge and understanding this also implies professional application.
The professional tasks concerning ‘advise’ in many instances explicitly require competences regarding accountability and reasoning. For most of the professional tasks these competences are more implicitly required in the fields of ‘analyse’ and design’. Results from analysis and design always require a justification.
Competences regarding judgments and communication are mainly needed to perform the professional tasks of the lifecycle activities ‘analyse’, ‘advise’, ‘design’ and ‘manage’.

The implementation of almost all professional tasks requires substantial new knowledge and skills and mostly focusses on highly innovative domains. In combination with an increasing autonomy at higher levels of skill, this requires extensive learning skills of the Bachelor of ICT.

4.3 Relationship with the HBO standard

The HBO standard has been drawn up in 2009 (HBO council, 2009).All HBO study programmes have to ensure that by the end of the programme students will have a solid theoretical basis, investigative abilities, professional expertise, and adequate professional ethics and social orientation.

During the first years of their study, graduates of the Bachelor of ICT study programmes acquire a sound theoretical basis. This is demonstrated in the architecture layers of levels 1 and 2, and includes knowledge of standard tools, standard methods for testing, design techniques, modelling techniques, architectures and business processes. The theoretical basis can be expanded to include elements relevant to a specific direction selected to broaden or deepen knowledge.

The investigative abilities of graduates are to be found in the activity ‘analyse’ of every architectural layer. Research skills and an investigative attitude are absolutely indispensable with regards all aspects of substance. In the ICT domain, it is of the utmost importance that professionals operate methodically, properly interpret all relevant data and are able to recognize their value. During their study, graduates get acquainted with various forms of research and learn how to apply these; for example usability testing, information analysis, identification of requirements, risk analysis, drawing up acceptance test criteria, specifying functional and non-functional requirements, and performance testing and protocol analysis.

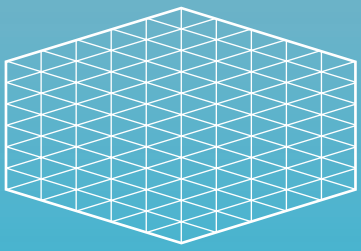
Graduates make a substantial contribution to the further professionalization of the field. Consequently, students acquire the knowledge, skills and professional attitude to be able to operate in the (inter) national field. The architectural layers include professional tasks drawn up in close collaboration with the professional field. During their study programme students perform realistic and genuine practical assignments.

Like all other HBO bachelors, ICT specialists are professionals who will have to establish links with social and ethical issues. ICT is not just about organizing and accessing information, but increasingly also about privacy, security and sustainability. Critical reflection and morality are essential elements for graduates in the ICT domain. For example, performance requirements of an ICT system are directly linked to security. In other words, the more secure and efficient the system, the slower it operates. During their studies, students learn to deal with the sometimes conflicting customer needs, interests and requirements in terms of functionality and technology.

4.4 Professional tasks

The professional tasks are listed per architectural layer.

5 Matrices



USER INTERACTION

Level	Manage	Analyse
3	As soon as a product or service development is initiated, always take into account product accounting, product context, continuity and transfer to the client and/or user environment.	Indentify communication trends and developments in design repertoire regarding ICT and/or digital media products. Draw up an analysis report (target group, goal, context, information and communication requirements, visualisation, usability and usage); relate this to ICT and/or digital media products trends.
2	Apply version management and layout and configure a collaboration environment through the implementation of ICT and/or digital media products, taking into account maintainability and available resources.	Analyse ICT and/or digital media products, target groups and goals, based on an overview of current culture and developments concerning the inventory of customer and user needs. Analyse interface, usage and communication, including usability and user experience.
1	Layout and maintain a personal working environment for analysis, design and implementation of ICT and/or digital media products, using a standard tool. Transfer an outlined version of the finished product, including product accounting, to the client.	Catalogue the design repertoire (shape, colour, stylistic features) and describe the brand or product identity of a current ICT and/or digital media product. Identify target groups and objectives and link these to user behaviour and interaction.
	Manage	Analyse

Advise	Design	Implement
Draw up an advice, covering social trends and branch trends, on the actual deployment of media and resources concerning the development of ICT and/or digital media products – taking into account planning and budgeting.	Design an ICT and/or digital media product, based on a personally designed (innovative) functionality, interactivity, style and/or service, including user experience, usability tests and innovative technology.	Implement and test dynamic ICT and/or digital media products, applying innovative technologies.
Advise on the actual deployment of media and resources, taking into account (communication) objectives, target groups, planning and budgeting.	Design a coherent and dynamic ICT and/or digital media product, applying partly self-selected techniques, such as scripts, storyboards, navigation structure and matching usability tests.	Implement and test dynamic ICT and/or digital media products, applying relevant graphical elements, sound, vision and animations.
Advise on the means of interaction, communication and visualisation concerning deployment during communication and interface development. Make recommendations for the design of an ICT and/or digital media product, based on a given usability analysis.	Design a static and dynamically limited ICT and/or digital media product, applying given techniques, such as scenarios, storyboards and wire frames, and matching usability tests.	Implement and test static ICT and/or digital media products, using standard tools, a range of suitable (media) formats, and a limited usage of stylistic devices.
Advise	**Design**	**Implement**

BUSINESS PROCESSES

Level	Manage	Analyse
3	Layout and update principles, business rules and process-architecture models, partly based on quantitative and qualitative analysis. Proactively identify the need for change and activate corresponding processes.	Identify the consequences of a (strategic) reorientation in business processes and related information provision. Perform a quantitative and qualitative analysis of the current and future situation in areas such as policy, strategy, alignment and architecture, using conventional methods.
2	Layout, maintain and update functional management. Identify and catalogue the need for process changes, partly based on data from quantitative and qualitative analysis.	Analyse business processes, organisation, data flows, data requirements and process control (at tactical/operational level), and describe bottlenecks and cause-effect relationships from the perspective of information provision.
1	Maintain and update process documentation. Describe the need for modifications during a process, based on data from quantitative and qualitative analysis.	Record the data flows and information provision of a business process. Analyse the bottlenecks within a business process and describe cause-effect relationships.
	Manage	Analyse

Advise	Design	Implement
Advise on the internal and external attunement between business and ICT (alignment en governance), based on the (network) organizational strategy and objectives.	(Re) design the architecture of business proccesses and control models, including related management, information provision and process of change.	Implement the introduction and acceptance of revised business management, based on a process of change.
Advise on bottlenecks in the field of organisation structure (and roles), of the structure and coherence in business processes, and of informative provision. Advise on new possibilities/ opportunities for the organisation based on ICT developments.	(Re) design related business processes, a data structure (model), the process management of business processes, the functional organisation structure and/or the information provision, taking into account all ICT facilities and data integrity assurance.	Implement the introduction and acceptance of procedures in conjunction with new or revised information provision and control.
Formulate improvements regarding organisation (structure), (business) process structure and/ or information provision, based on bottlenecks analysed within a business process whilst taking ICT facilities into account. Advise on the applicability of an ICT development for a specific organisation.	(Re) design and/or digitise a business process, various data flows, an organisation unit and/or part of the information provision.	Describe and draft job instructions, job and role descriptions, and procedures for an (adapted) process.
Advise	**Design**	**Implement**

INFRASTRUCTURE

Level	Manage	Analyse
3	Horizontal synchronisation of ICT management (suppliers, third-party) and vertical synchronization (alignment). Set up and implement a cloud-based public or private infrastructure.	Conduct trend research in the field of ICT infrastructure, based on (international) technological, economic en social developments and innovations. Execute a company infrastructure requirements analysis in order to identify functional and non-functional requirements.
2	To incorporate management of new technological developments into the infrastructure, including user devices. Implement management processes. Set up a control environment to ensure ICT services quality audits, including receiving and responding to client requests, and to produce service level reports.	Analyse the quality of the infrastructure environment and services, on the basis of standard models and methods. Analyse infrastructure related incidents, problems and security threats.
1	Create and document an authentication and authorisation structure, and both system and network configurations aimed at a local infrastructure. Document standard management processes and standard operating procedures for the purpose of infrastructure management.	Analyse an infrastructure according to a standard method and on the basis of predetermined functional requirements.
	Manage	Analyse

Advise	Design	Implement
Provide advice on infrastructure, including management and security, with reference to information architecture, ICT governance, innovation, and social and international developments.	Design a cloud-based infrastructure in compliance with all requirements. Design an incident response organisation and procedure, so as to be able to respond adequately to incidents of any nature and scope.	Implement public or private cloud-based infrastructure and services, in compliance with all requirements. Set up an integrated multi-level ICT environment in order to implement central monitoring of the quality and security of ICT services.
Advise on the infrastructure layout and management, providing informed choices based on functional and non-functional requirements, on available technology, and on management models and methods. Propose measures for the benefit of information security within the infrastructure.	Describe management processes and agreements concerning the delivery of services. Set up a functional design aimed at automating infrastructure management in a specific business environment. Set up a technical design for the use of an infrastructure, including related security measures based on functional and non-functional requirements.	Layout an infrastructure which meets the requirements in the areas of performance, usability, security and compliance. Establish basic monitoring of the infrastructure. Prepare and implement a test plan for an infrastructure quality test on the basis of a developed functional and non-functional design.
Provide recommendations on setting up a local infrastructure.	Draw up specifications for a local infrastructure according to a standard method.	Layout and test a local infrastructure and make it available.
Advise	**Design**	**Implement**

SOFTWARE

Level	Manage	Analyse
3	Implement configuration, change and release management.	Carry out a requirement analysis for a software system with various stakeholders, in the context of existing systems. Identify integration and migration issues. Define acceptance criteria on the basis of quality characteristics and a performed risk analysis.
2	Layout, manage and use a software factory to support software development within teams. Apply principles to manage and monitor a software development process.	Carry out a requirement analysis for a software system with various stakeholders, taking into account the quality characteristics. Perform an analysis to formulate and validate functionality, design, interfaces and the like, of an existing system or component. Set up an acceptance test on the basis of quality characteristics.
1	Layout and use a management system to support software development within a team setting.	Collect and validate functional requirements for a software system with one stockholder and according to a standard method. Define acceptance criteria for the above-mentioned functional requirements.
	Manage	Analyse

Advise	Design	Implement
Advise on the choice of software architecture or software frameworks, in which cost and quality aspects such as availability, performance, security and scalability play a part. Advise on the layout of a software development process, including the test process.	Set up a software architecture for a software system, consisting of both existing and new systems, taking into account both quality aspects and stockholders. Draw up a test strategy for system tests.	Build and make available a software system in line with existing systems and on the basis of the designed architecture, using existing frameworks. Using test automation when performing tests.
Advise on possible purchases and subsequent selection of existing software or components when developing software systems in which the cost aspect features. Advise on an architecture component of a limited software system. Advise on the use of prototypes when validating requirements.	Set up a functional design for a software system, taking into account the existing components and libraries, and using quality criteria of design. Determine the quality of the design, for example by testing or prototyping, taking into account the formulated quality characteristics. Draw up test designs according to a predetermined test strategy.	Build and make available a software system consisting of multiple subsystems, and using existing components. Integrate software components within an existing system, whilst monitoring the integrity and system performance. Perform regression tests. Perform and report on unit, integration and system tests.
Provide recommendations regarding specific requirements of a software system, on the basis of research into existing, similar systems.	Design a software system with modelling techniques using a standard method.	Build and test an elementary software system and make it available.
Advise	**Design**	**Implement**

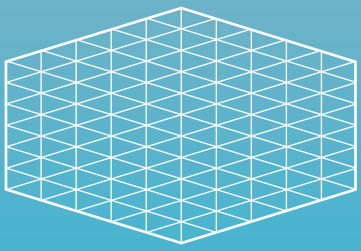
HARDWARE INTERFACING

Level	Manage	Analyse
3	Set up a development and test platform for hardware/software (HW/SW) co-design, including tools like virtualisation. Establish a management test environment for a computer system.	Specify a distributed computer system, including timing, resource utilization and performance. Describe security aspects of computer systems linked to or through (public) networks. Set up an acceptance test plan and an integration test plan
2	Set up a (cross platform) development environment including tools, both software and hardware related. Assess a given development environment for quality and performance.	Identify aspects of monitoring and control within a computer system environment. Methodically specify a computer system. Perform a protocol analysis. Set up an acceptance test for a computer system.
1	Set up and use a control environment to support the development of a computer system, e.g. an embedded or IA system, within a team.	Describe the architecture of a computer system. Describe de operation of actuators and sensors, and perform measurements. Draw up functional and non-functional requirements for a computer system, e.g. an embedded or IA system, and establish acceptance criteria.
	Manage	Analyse

Advise	Design	Implement
Offer a technical advice on a deliverable (distributed) computer system, including hardware and software components and interfaces.	Design a distributed computer system, including the assignment of actuators, sensors, timing, resource utilization and performance.	Implement a complete computer system, including network, hardware and system software. Set up and implement an acceptance procedure, e.g. in a virtual environment, including such aspects as timing, resource utilization and performance.
Offer a technical advice on the architecture of a computer system, including hardware and software components. Offer advice on linking systems.	Methodically design a computer system, based on self-selected hardware components. Set up a driver design. Design a protocol.	Layout an elementary computer system and establish the interfaces with hardware components through software. Write and test driver software. Implement and test a protocol.
Verify and substantiate a specific technical advice. Verify and describe an initial architecture, and the functionality of a specific system configuration (microprocessor, memory or other building blocks).	Design an elementary computer system, e.g. an embedded or IA system, based on specific hardware	Write software for an elementary predetermined computer system, equipped with actuators and sensors.
Advise	**Design**	**Implement**

6 Application

The model and the professional tasks described therein involve the complete ICT domain. As such it is not a description of specific study programmes, majors or specializations. This particular task rests with the study programmes and offers a marketing opportunity for profiles, viewed from the supply of educational programs and the demand from individual students and employers.

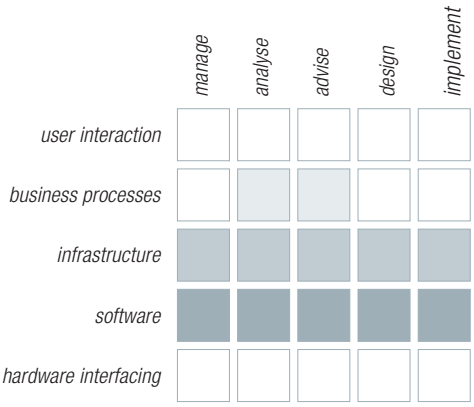


6.1 Purpose and scope

The domain description provides ICT study programmes with a framework and a de facto standard to describe their content, tasks and competences, to position their study programme within the domain, and to set up, layout and validate their education. The model provides a possibility to offer either a more general or a more specific study programme, with a serious window allowing for specialisations and responding to current developments, maintaining both position and profile. Students and employers alike thus know what can be expected of a fresh Bachelor of ICT graduate. Based on this specific framework, the study programmes should then provide the descriptions of the specific knowledge, skills and behaviour within a context, in order to arrive at competencies and a Body of Knowledge and Skills (BOKS).

6.2 Competency profile

The domain description offers the possibility to display a competency profile in an orderly fashion. Furthermore it is a tool to show how this translates into specific content of curriculum components. The study programmes determine the competency profile of their graduates, including their intrinsic width, depth and respective choices, based on the domain description. Study programmes have some room to manoeuvre as to how strictly to adhere to the relationship of their competencies with the matrix.



Profile example Informatics

Profile example Computer Science

The main HBO ICT study programme focuses on several architectural layers and, therefore, it is characterized by differentiation; this implies a certain extent of variation within the competency profiles of graduates. With Informatics and Computer Science the emphasis lies on one of the architectural layers in specific. Informatics focuses mainly on the architectural layer 'Software'; Computer Science it mainly concerned with the architectural layer 'Hardware Interfacing'. In addition to this type of profiling, the study programmes can also be enriched over the architectural layers. Two possible elaborations of the model for Informatics and Computer Science are added below, by way of example. Similar images can be created for the differentiations of the HBO ICT study programme.

The architectural layer model plays an important part in the accountability of a curriculum. Regardless of how institutions use the model in order to characterise their study programmes, additional specification of the content will be necessary. This can be done by using performance indicators to define aspects of required knowledge, skills and attitude. This substantive display offers the added possibility, in relation to the content of the matrix, to go into more detail on aspects of the HBO qualification. Furthermore, the more detailed content can also be linked to specific curriculum components.

6.3 Educational practice

In educational practice, the matrix can play a role in the curriculum, the selections by the students and the assessment process. The curriculum can range from a standard programme to learning outcomes in combination with complete demand-driven education. The reality is usually somewhere between these two extremes. The model can also be used in assessments, especially in the assessment of individual study paths and prior learning (CAA's). This can be achieved on the basis of criteria related to the model, e.g. through referencing to professional tasks and associated performance indicators.

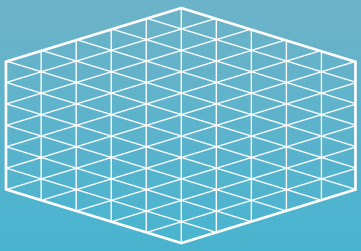
6.4 Application from the professional field

Critical review from within the professional field has provided input for the development of the professional tasks, which may be of use in the recruitment and selection of new employees and professionalization projects. In the process of recruitment and selection a vacancy profile can be generated on the basis of the matrix. Monitoring the match between the study programme domain and the vacancy profile offers a means by which to then control professionalisation content wise.

6.5 Examples of professional situations

The HBO-I website offers examples of professional situations typical for young ICT professionals. The examples serve as illustrations of various elements from the model and demonstrate the relation with the professional practice

Appendices



Appendix 1 Sources

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- EQF, http://ec.europa.eu/education/policies/educ/eqf
- European Commission. (2008). The European Qualifications Framework for Lifelong Learning (EQF).
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- HBO-I Foundation (2009), Bachelor of ICT, domain description. ISBN: 978-90-814684-1-1.
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Appendix 2 Consulted organisations

Atos
Bartosz
CGI
CIMSolutions
Cjlb
DAF
Deloitte
e-tunity
Everest
Finalist
Haga Hospital
The State
Info Support BV
Laurens Simonse Groep
Linux Professional
Institute
LogicaCMG
Océ
OWASP
Procam
Rabobank
Ripe NCC
SNS Reaal
Sogeti
Tass
Unit 4
Whiptail
Van Oord NV
Capgemini
Philips Healthcare
Nederland ICT

Appendix 3 Dublin descriptors

In 2004 the qualifications for the HBO Bachelor level have been described, in general terms, in the Dublin descriptors.

Knowledge and understanding
Has proven knowledge and understanding of a field of study, building on and surpassing the attained level of secondary education; typically operates at a level supported by advanced textbooks, which requires knowledge of the latest developments in the field.

Application of knowledge and understanding
Is able to apply his / her knowledge and understanding in such a manner, it indicates a professional approach to his / her work or profession. Furthermore, he / she possesses competences for building up and elaborating on arguments, and for problem-solving in the field of study.

Making judgement
Is able to collect and interpret relevant data (generally in the field of study) with the aim to form an opinion partly based on considering all relevant social, scientific or ethical issues.

Communication
Is able to communicate information, ideas and solutions to an audience consisting of specialists and non-specialists.

Learning skills
Has the necessary learning skills to embark on a follow-up study requiring a high level of autonomy.

Appendix 4 HBO standard

A solid theoretical basis: Each standard involves a certain amount of basic knowledge. For new students knowledge on subjects such as Dutch, English and arithmetic / mathematics is required and should increase during the study programme. In addition the main focus lies on subject-specific knowledge of the professional domain of the study programme. Establishing and securing such knowledge base is of the utmost importance. Competency-based education is an important innovation in higher education, but its introduction sometimes has been accompanied by the undervaluation of knowledge. Integration of knowledge, skills and attitudes suits the training of professionals qualified to start. Due to an increased focus on knowledge, competency-based education shall acquire a new and different content in comparison with a few years ago. Students need to have the theoretical knowledge which provides them with the opportunity to critically and creatively reflect on their own field of study. This knowledge is inextricably linked to the HBO bachelor level.

Investigative abilities: For professional bachelors it is not just about translating acquired high level knowledge to a practical situation. In today's modern society, it is crucial for HBO bachelors to have investigative abilities which lead to reflection, evidence-based practice, and innovation. 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 expertise: Expertise is inextricably linked to the study programmes provided by the universities of applied science. For many students the professional bachelor study programme is the highest form of professional education. Therefore, our bachelor study programmes need to ensure that students acquire the knowledge and skills specific to a professional in a particular field. A good connection between the study programme and professional practice is a prerequisite. Instructors with current and practical experience as well as the use of guest lecturers provide the proper

context. Internships offer students a setting in which knowledge and exercises can be compared to the reality of the professional practice. Expertise also includes having an international outlook, as well as an entrepreneurial attitude.

Professional ethics and social orientation: HBO bachelors are not unilateral operators, but professionals who have to establish relationships with social and, at times, ethical issues, who possess certain cultural baggage, and who - in the true sense of the word - have received academic training. It is becoming increasingly important to train healthcare professionals who can entertain a critical reflection on the dignity of life; to train economists who will question the relationship between profit maximization in the short term and confidence in the economic system in the longer term; and to prepare engineers for a working life in which sustainability will become the focal point of attention. The aim here is awareness of the significance of acquired knowledge and skills in their social context. Students may be expected to have the ability to critically evaluate knowledge on the basis of moral values.

Colophon

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