# Bachelor of ICT

***A description of the competency-based profile***




HBO
hoger beroepsonderwijs in opleidingen

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***A description of the competency-based profile***

# Colophon


Bachelor of ICT Profile

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# FOREWORD

The Bachelor – Master structure was introduced into the Dutch educational system on 1 September 2002. The introduction of this Anglo-Saxon educational system was the result of a European Union agreement called the Bologna Declaration. As a result, the educational path followed by a student has become more important, and extensive diploma supplements now provide employers and others with an overview of a graduate's competencies.

A national profile of the domain of the Bachelor of ICT in higher professional education is also desirable in a more individualised educational environment. This would be contradictory if the profile were very detailed and compulsory, but this is not the case. In close cooperation with industry, the cooperative ICT programmes in higher professional education (HBO), the HBO-I, have formulated fifteen building blocks for competencies. These form the basis of the competencies a recent Bachelor of ICT graduate should minimally possess, both in a national and international context.

Competencies become meaningful in context. Therefore, this profile contains a number of characteristic and realistic professional situations which a recent Bachelor of ICT graduate might face in practice.

I believe this profile is an important document that is also a reference framework. It is a reference for individual universities of professional education to design the educational pathways for the individual students that lead to the Bachelor of ICT degree. Furthermore, it provides potential employers information about the competencies of someone possessing this degree.

It is also a reference work that allows future students, deans and education consultants to become more acquainted with the domain of ICT professionals and the educational pathways that lead to it. It might be advisable to the HBO-I to produce separate 'translations' of the profile for the labour market as well as for the future student.

In conclusion, I would like to congratulate the HBO-I on this profile of the Bachelor of ICT. I hope this document will be an inspiration to the Bachelor programmes in other professional fields.

Professor F.Leijnse
Chairman, HBO Council

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# 1. INTRODUCTION

The introduction of the Bachelor-Master structure in higher education in the Netherlands and Europe was the reason for the HBO-I Foundation (HBO-I)1 to review its educational and professional profiles [13]. The HBO-I has adapted its profiles to new developments in higher education. In this profile description the HBO-I has formulated fifteen building blocks for competencies. These building blocks form the basis of the competencies a recent Bachelor of ICT graduate should have.

This document consists of a main text divided into seven chapters, illustrations and appendices. Chapters 2 to 7 comprise the main part of the document. Chapter 2 focuses on the context of national and international developments in higher education and discusses the aim and reach of this document. Chapter 3 pictures the development of the professional and educational profiles within the HBO-I and gives an overview of the relevant HBO-I setting. Chapter 4 deals with the manner in which the competencies are formulated in this document. Chapter 5 describes the fifteen building blocks for the competencies of the new Bachelor of ICT graduate and form the core of this profile description. Chapter 6 places this profile description in an international perspective, and chapter 7 ends the main text with a conclusion.

The second part of this document describes a number of characteristic professional situations in which a recent bachelor of ICT graduate will work. These illustrations portray the possible future professional practice of a young Bachelor of ICT.

The HBO-I is a cooperation of ICT programmes within Higher Professional Education in the Netherlands (formerly known as "HBO-I platform")

# 2. DESCRIPTION OF SITUATION, CAUSE AND AIM

## 2.1 European developments

In Bologna (19 July 1999) [15], European Education Ministers agreed on the creation of one European educational system. This had far-reaching consequences because this agreement led to the need for a comparable educational model in all member states. The Anglo-Saxon Bachelor – Master model was chosen to fulfil this need, resulting in flexible, international educational pathways by which graduates obtain degrees that are internationally recognisable. These graduates can easily be deployed in a global economy. A European credit system was introduced, the European Credit Transfer System or ECTS. One ECTS credit is equal to 28 hours of studying and is valid throughout Europe. A system of validation guarantees that all European programmes for Higher Education meet a minimum set of basic requirements.

## 2.2 Implementation in the Netherlands

The Dutch Education Ministers quickly introduced the necessary adaptations to the educational system. Legislation governing higher education has therefore undergone a number of essential changes, but the differentiation between the higher professional education institutes and the regular universities has been maintained. Within this binary system, the Bachelor – and Master programmes have been introduced. This combination of old and new has led to four types of programmes (Table 1). A short description of these four types of programmes can be found in Appendix 2.

**Table 1: types of study programmes in Higher Education in the Bachelor – Master model**

| | |
|---|---|
| Professional Bachelor programme | University Bachelor programme |
| Professional Master programme | University Master programme |

After this restructuring, universities of professional education (higher professional education institutes) and regular universities only award Bachelor and Master titles, signifying the abolition of Dutch titles such as Doctorandus, Ingenieur and Meester (there is no English equivalent for these titles). Universities of professional education can extend the Bachelor or Master title any way they like. The technical sector of higher professional education has opted for four Bachelor titles [16].[2]

This document focuses on the Bachelor of ICT in higher professional education. A similar document for the other types of programmes is not to be expected soon. The term "Bachelor of ICT" in this document indicates Professional Bachelor. In the technical sector, many universities of professional education have grouped their programmes around these four new Bachelor titles. As a consequence, schools for ICT have arisen in different places with programmes for information technology, business information technology and computer science that sometimes overlap. Students can chose from a wide variety of programmes that are not necessarily restricted to the three above-mentioned programmes. A common name for such a broadly-based curriculum is the broad-based Bachelor's programme. Parallel to the introduction of the Bachelor-Master model a system of quality assurance for validation was introduced. The Dutch and Flemish Validation Body (NVAO) is responsible for awarding quality hallmarks to all institutes of higher education. Validation is a necessary legal condition for each programme in higher education, in order to be allowed to award Bachelor or Master titles to its graduates and to receive government funding. The NVAO evaluates programmes according to the "validation reference", which states the requirements a programme must meet.[3]

## 2.3 Aim of this document

As the representative body of all ICT programmes in higher professional education, the HBO-I has taken the initiative to describe the profile of the Bachelor of ICT[4]. This document describes the building blocks for the competencies that form the basis of the competencies that Bachelors of ICT must acquire during their studies. With this, the HBO-I wishes to provide a description of what the work field can expect of a recent Bachelor of ICT graduate. This document may help design ICT programmes in higher professional education. Section 4.2 discusses the target groups of this document in more detail.

The Bachelor of ICT comes in many forms, and the profile description should reflect this. The main text does not mention specific competencies in any sub-domain of the entire ICT domain. However, it must be generic enough to cover all Bachelors of ICT. Detailed lists of qualifications and extensive descriptions of levels are therefore not included in this profile description. Although the specific competencies are of course part of the different programmes, designers of programmes are free to choose the way in which the specific competencies are acquired.

This document describes the collection of building blocks for the competencies that each Bachelor of ICT student should acquire. Each graduate of a validated programme does this, in principle, on the level of higher professional education. This profile description does not pretend to shorten job application procedures for the work field, nor does it pretend to turn the design of a new programme into a simple "fill in the blanks" exercise, nor does it state how the described competencies can or must be tested. It is the responsibility of the educational institutes to guarantee sufficient inclusion of the competencies in their Bachelor of ICT programmes. It is up to the validation body (NVAO) to make sure that all these programmes deliver graduates who meet the following profile description.

[2]Bachelor of Engineering, Bachelor of Built Environment, Bachelor of Applied Science and Bachelor of ICT.

[3]The reference for validation can be found at the NVAO website: www.nvao.net. The six fields in which the NVAO evaluates the programmes are: aims of programme, programme, deployablity of staff, services, internal quality assurance and results.

[4]The position paper of the HBO-I can be found in Appendix 3.

# 3. HBO-I AND PROFILES

## 3.1 History

In the past ten years, the HBO-I has worked on the definition of the qualifications of graduates possessing a Bachelor of ICT Degree:
- HBO-I on the way to professional profiles (1994) [17]
- HBO-I programme profiles (1997) [9]
- Professional profiles and programme profiles HBO-I (2000) [17]

In the context of developments that have to lead to a limited number of nationally recognised Bachelor titles, the HBO-I stressed the importance of a broad Bachelor ICT programme in the full spectrum range of the ICT domain, to the Dutch Association of universities of professional education in 2002. The Dutch Association of Universities of Professional Education, in its advice to the Dutch universities of professional education on the Bachelor degrees, has indeed positioned the Bachelor of ICT[5] (Bachelor of Information and Communication Technology) as one of the Dutch Professional Bachelors [1]6.

In mid-2003, the Dutch Association of Universities of Professional Education initiated the process of moving from professional and educational qualifications to a framework for competency profiles for Bachelor programmes. The aim of the framework is two-fold:
- Indicating the joint competencies of students who graduate with a specific bachelor title
- Offering a starting point for programme validation when awarding a specific Bachelor title.

In September 2003 the HBO-I gave the working group 'Profile Bachelor of ICT' the following assignment: "determine the joint competencies of the Bachelor of ICT in conformance with the requirements of the Dutch Association of Universities of Professional Education, based on already existing material". The members of the HBO-I agreed to the description of the building blocks as the joint basis for the competencies of the Bachelor of ICT during a platform meeting held on June 9 2004. A wide representation of ICT companies validated this in September and October 2004. A list of companies whose representatives validated this profile document is included in Appendix 1.

## 3.2 Scope

The HBO-I uses a broad interpretation of the Bachelor of ICT title. The ICT domain is very broad, and this initial profile description is intended to allow universities of professional education enough room to design study programmes which provide training for this Bachelor title.

The building blocks for the competencies can easily be used for designing or redesigning educational programmes that award the title of Bachelor of ICT. Of course, it is up to the institutes to decide on the specific contents of a programme that comprises the described building blocks for the competencies. In all programmes represented in the HBO-I, students can more or less make personal choices regarding the curriculum of their intended programme profile. This can be done by choosing not only one of the known ICT programme streams in higher professional education mentioned below but also by making distinct choices in internships, project work, graduation streams or graduate projects. External employers are more and more becoming stakeholders in this process.

It is obvious that students must decide together with the stakeholders from which kind of environment and responsibilities they want to achieve a professional product. This choice indicates which knowledge, skills and attitude the students should possess in order to attain appropriate behaviour. It is this individual responsibility for personal development which distinguishes the Bachelor programme from the current system of programmes which teach a clearly defined set of knowledge, skills and attitude.

Within the profile of the bachelor of ICT, the current programmes will be recognised as professional profiles. These profiles are:
- **Business Information Technology**
  The Bachelor of ICT who applies his/her competencies mainly to optimise company processes with the help of ICT
- **Information Technology**
  The Bachelor of ICT who applies his/her competencies mainly in the field of design, construction and implementation of ICT systems
- **Computer Science**
  The Bachelor of ICT who applies his/her competencies mainly in the field of design , construction and implementation of ICT systems for product and production automation.

The HBO-I has explicitly declared to also be the voice of other programmes that award the Bachelor of ICT degree besides the programmes mentioned above. Well known examples of programmes that provide training for students to become Bachelors of ICT are:
- Communication and Multimedia Design (CMD)

The Bachelor of ICT who applies his/her competencies to the development of concepts, design and realisation of ICT systems for communication between people, organisations and companies
- Information Service and Management (IDM)

The Bachelor of ICT who applies his/her competencies to design and develop ICT systems which deliver custom-made integrated information in the form of data, text, image and sound for various user groups.

The HBO-I does not exclude the possibility that in the future, in addition to the existing profiles, different programme streams will arise at the crossroads or edge of existing streams. The competency building blocks will provide a generic profile description for all these and future streams.

[5] The notion of Bachelor is applied to both the title a HBO-graduate earns and the graduate him/herself.
[6] "the HBO-I platform has indicated that this degree applies to all profiles of the ICT programmes. A diploma supplement can describe the orientation more precisely."[1]

# 4. PROFILES AND COMPETENCIES

## 4.1 Competencies of the Bachelor of ICT

Starting point for the building blocks of the competencies of the Bachelor of ICT are the qualifications described in the HBO-I Educational and Professional Profile [13]. By "competency" the HBO-I means the cohesive entity of knowledge, skills and attitude that are required in order perform appropriately in a professional situation. Only if the different building blocks of those competencies come together in a relevant context, is this called a competency. Appropriate performance means professionals acting in a correct and expected way in a relevant context.

The HBO-I distinguishes:
- ten general building blocks that characterise any professional Bachelor, i.e., the ten core professional Bachelor qualifications and
- five specific building blocks that are characteristic of the Bachelor of ICT.

The contents of the building blocks will be different according to the professional profile for which the recent Bachelor of ICT graduate has been trained. The following example explains this. A Bachelor of ICT trained in a technically oriented programme or programme variant needs different knowledge, skills and attitude to show mastery of B3 'Design' building block than a Bachelor of ICT trained in a business-oriented programme variant. This example shows that the context in which a professional works determines the underlying knowledge, skills and attitude the professional needs to function satisfactorily. The fifteen building blocks have been chosen to ensure that the recent Bachelor of ICT graduate can function properly in any context they might end up working in.

It is not feasible to describe all possible or future professional contexts in which a recent Bachelor of ICT graduate might work. Therefore, the HBO-I has decided to give illustrations in different contexts which indicate the competencies a recent Bachelor of ICT Graduate should possess. The compact description of the building blocks implies an abstract level allowing professional institutions of higher education to build their own programmes that allow acquisition of the desired competencies.

When creating a Bachelor of ICT programme and developing the accompanying assessment, it is not enough to specify only the competencies. The educational translation of the profile of the Bachelor of ICT into a specific programme a university of professional education is creating is the responsibility of that university. The university decides the additional qualifications of its Bachelor of ICT in relation to the Bachelor of ICT described in this document.

## 4.2 Description method

The HBO-I does not name the competencies but leaves it to the institutes of higher education to name the competencies that are relevant for their competency-based educational profiles. The set of building blocks illustrates the most important qualities of the recent Bachelor of ICT graduate and provides a recognisable and transparent description of the Bachelor of ICT type of professional. There is no specification of detailed educational qualifications using a defined educational taxonomy. The HBO-I describes the context in which a recent Bachelor of ICT graduate can operate in a number of 'illustrations'. The illustrations are based on the role of the ICT professional in a professional situation and represent possible professional contexts in which a recent Bachelor of ICT graduate must be able to operate. Each building block of a competency is present in one or more illustrations. The illustrations show how broad the domain of the ICT professional is. In this way, the position of the ICT professional in society is described without pretending to be complete.

The set of illustrations is sufficient to provide:
- industry with a clear idea of the types of tasks which a Bachelor of ICT has been trained for;
- teaching staff with an idea of the competencies a future Bachelor of ICT should possess;
- education consultants and deans in secondary education and senior secondary vocational education with a clear idea of the characteristics of the profile of a Bachelor of ICT;
- undergraduate students of ICT with a goal when studying to achieve the Bachelor of ICT Degree.

## 4.3 Educational programmes

Each university of professional education is responsible for designing educational programmes which lead to the Bachelor of ICT degree. It is not up to the HBO-I but to the validation body (NVAO) to decide whether they have been successful. When designing educational programmes, an educational institution can make use of the building blocks of the competencies and the accompanying illustrations. The educational institution can design its educational programmes in such a way that each student can design a personal study plan that meets the requirements of the institution, based on the building blocks and illustrations. In any case, each Bachelor of ICT should prove he or she has the competencies comprising all ten general and five specific building blocks. During the discussion on the introduction of the Bachelor-Master structure, the percentages of the required workload for the acquisition of the relevant competencies were mentioned

The formulation of the starting points for the Bachelor of ICT programme is not the responsibility of the HBO-I. Upon graduation, all Bachelors of ICT will have proven that they have acquired the ten general building blocks for the general competencies for higher professional education at the required level. Furthermore, they have proven themselves able to apply each of the five specific building blocks for ICT competencies in a relevant context.

# 5. THE BACHELOR OF ICT

## 5.1 A Bachelor of ICT works everywhere

In principle, Bachelors of ICT can find employment in all sectors of industry. Throughout society there is a continuous need for the implementation of new ICT systems, the redesign of existing ICT systems and/or the maintenance of such systems.

The choice for the notion of ICT system is a pragmatic one. Depending on the context in which a Bachelor of ICT operates, ICT system stands for the ICT infrastructure, an embedded system, a software system, a knowledgebase system, a media system, a communication system, etc. These systems are characterised by the fact they are ICT driven in their functionality.

## 5.2 Competencies of the Bachelor of ICT

In order to decide on the competencies of the Bachelor of ICT, ten building blocks for the general competencies of higher professional education and five building blocks for the specific professional competencies are available (Table 3).

The building blocks for the general competencies for higher professional education for the Bachelor of ICT are based on the ten core qualifications for higher professional education which indicate the expected level of a starting professional with a Bachelor degree (Appendix 4). The core qualifications are formulated independently from any domain but should be applied and/or proven in the context of a professional domain. In this case, this is the broad professional domain of ICT. The building blocks for the specific competencies for the starting ICT professional at the Bachelor level are derived from the life cycle of information systems. Each Bachelor of ICT possesses the competencies which together comprise the fifteen building blocks. The context in which a bachelor of ICT operates determines the individual competency profile. Furthermore, the context determines at which level the recent Bachelor of ICT graduate should possess the specific professional competencies.

For example, Bachelors of ICT can design an ICT system on the basis of specifications and in accordance with an analysis (specific building block 3). In the context of a business application, Bachelors of ICT show that they are able to carry out their tasks in the organisation in which they work independently and that they are capable of taking their professionalism into their own hands (general building block 1). A number of other core qualifications are relevant in this specific competency, in this context. In this way, the Bachelors of ICT show that they possess a competency which comprises the Design building block on Bachelor level. Of course this also applies to Bachelors of ICT in a technical or other context.

A further description of levels has been intentionally left out because this might again lead to the description of the well known HBO-I educational profiles (2000) [13] in terms of qualifications. It is intended that users themselves ensure that the content of the individual competency profile of the Bachelor of ICT is satisfactory.

## 5.3 Illustrations

Chapter 8 describes a number of illustrations of professional situations. Each illustration emphasises one of the building blocks for specific professional competencies. It goes without saying that each ICT professional needs various specific competencies besides the general competencies for higher professional education simultaneously in each professional situation. Therefore, the other relevant building blocks are indicated in each illustration.

The illustrations subsequently describe:

- The organisation in which the Bachelor of ICT operates
- The assignment and the professional product to be delivered by the Bachelor of ICT
- Background, education and/or experience of the Bachelor of ICT
- The role the ICT professional fulfils in the professional situation described
- The tasks and activities to be carried out by the ICT professional
- The expertise he or she must have in order to be able to carry out the assignment satisfactorily
- The career perspective for the Bachelor of ICT
- The building blocks for the general and specific competencies to which the illustration refers

A complete profile for the current “small” ICT programmes, Business Information Technology, Information Technology, Computer Science, Communication & Multimedia Design and Information Service Management (Table 2) can be compiled using a sub-collection of illustrations.

For example, a complete competency profile for the “narrow” Business Information Technology Bachelor of ICT can be constructed with the illustrations 1.1, 2.2, 3.3, 4.5 and 5.4. Of course, the context described can be substituted by a comparable professional situation.

**Table 2: programmes and illustrations**

| | analysis | advice | design | imple-mentation | main-tenance |
|---|---|---|---|---|---|
| **Business Information Technology** | 1.1 | 2.2 | 3.3 | 4.5 | 5.4 |
| **Information Technology** | 1.4 | 2.5 | 3.1 | 4.2 | 5.3 |
| **Computer Science** | 1.3 | 2.4 | 3.2, 3.6 | 4.1 | 5.5 |
| **CMD** | 1.5 | 2.1 | 3.4 | 4.3 | 5.2 |
| **IDM** | 1.2 | 2.3 | 3.5 | 4.4 | 5.1 |

The future Bachelor of ICT can also build up a different competency profile, for example, by taking the illustrations 1.5, 2.2, 3.2, 4.4 and 5.3 (or comparable contexts) as a starting point. Such a profile can be justly called more broadly-based than the existing educational profiles. Practice will show what is feasible for each individual Bachelor of ICT. For each individual competency profile, the presence of each of the five building blocks for the specific professional competencies of analysis, advice, design, implementation and maintenance is essential in every context. Should one or more of these five building blocks be missing, a graduate cannot rightfully refer to himself as a Bachelor of ICT.

Table 3: building blocks for the competencies of the bachelor of ICT

## General building blocks for the competencies of the Bachelor of ICT (the core qualifications for Higher Professional Qualifications applied to the bachelor of ICT)

**A1 Broadly-based professionalism**
Operates independently and result driven in a multi-disciplinary team, also in an international environment. Directs the development of personal relevant professional competencies on the basis of feedback and self reflection and other factors. Is able to apply the latest scientific know-how and insights to different professional situations. Shows entrepreneurship and initiative and is not afraid of taking risks. Is equipped with cutting edge know-how closely tied to the latest academic know-how, insights, concepts and research results. Is result driven and immune to stress in critical professional situations.

**A2 Multidisciplinary integration**
Is equipped to address issues presented from the different disciplines of professional practice. Is able to integrate knowledge, insights, attitudes and skills of different domain specific disciplines from the professional perspective of the ICT specialist.

**A3 Scientific and non-scientific application**
Is able to apply the latest scientific know-how, insights, theories, concepts and research results to different professional situations in a predictable and reliable way. Is able to gather relevant information from a variety of sources.

**A4 Transfer and broad usability**
Is able to apply knowledge, insights and skills to different professional situations. Is able to transfer knowledge, insights and skills to ICT specialists and other professionals in an organisation.

**A5 Creativity and complexity of action**
Is able to analyse issues in professional practice which are not initially clearly defined at the start and to which standard procedures cannot be applied. Offers solutions, is creative, has an understanding of the potential “new” media from a user’s perspective.

**A6 Problem-oriented approach**
Is able to independently define a problem in situations of varying complexity in professional practice or when working as an ICT specialist. Analyses the set requirements and possibilities. Tackles domain related problems on the basis of relevant knowledge and theoretical knowledge in a structured manner. Develops and applies useful new and existing solutions strategically and is able to evaluate the effects.

**A7 Methodical and reflective reasoning and action**
Is able to plan research, development and maintenance in projects and is able to select and apply the right methods in a multidisciplinary environment. Sets realistic goals. Works out project plans. Is able to evaluate a project plan on its contents and financial and organisational aspects. Carries out project tasks according to the selected methods and techniques. Reflects on professional actions based on the gathering and analysis of relevant information.

**A8 Social and communicative skills**
Communicates effectively with different echelons in various ways. Works independently and works result driven in a multidisciplinary team. Is able to listen to the input of others and provide own input. Reflects on his or her own behaviour. Is able to deal with conflicts. Is able to read both Dutch and English technical and specialist literature. Is able to draw up a report in conformity with the guidelines.

**A9** **Basic qualification for management positions**
Shows leadership and is able to carry out simple management tasks. Is able to give clear instructions and to draw up a time planning. Checks a project's progress and is able to anticipate unforeseen circumstances. Consults effectively and efficiently with involved parties. Is able to divide and delegate work in a project.

**A10** **Sense of social responsibility**
Has the right professional attitude while taking relevant ethnic aspects into account. Has a great sense of responsibility, is quality and achievement driven and service minded..

## Specific building blocks for the competencies of the Bachelor of ICT

**B1** **Analysis**
Carries out an analysis of processes, products and information streams in their mutual relationship and environmental context. Sets functional specifications.

**B2** **Advice**
Formulates well-founded advice on the restructuring of processes and/or information streams and on ICT systems to be newly developed or bought, based on analysis and consultancy with the stakeholders. Considers financial and time aspects, the organisation including organisational change, feasibility and risks and the possibilities for outsourcing.

**B3** **Design**
Designs ICT systems based on architecture description and specifications, in conformance with analysis and within the boundaries set for quality, testing, security, running time, budget and use and maintenance.

**B4** **Implementation**
Builds and implements an ICT system on the basis of a functional and technical design specification and within the boundaries set for quality, testing, security, running time, budget and use and maintenance.

**B5** **Maintenance**
Models the use and maintenance of ICT systems. Sees to the introduction, testing, integration and rolling out of new or upgraded ICT systems. Gives service as agreed in a Service Level Agreement within the set boundaries for quality and finance. Sees to the maintenance of ICT systems in accordance with their design and construction.

# 6. INTERNATIONAL PERSPECTIVE

Profiles that draw the attention in Europe are APO, SFIA, ISM, EUCIP and Career Space. The computing Curricula of ACM/IEEE are important in the United States and profiles from Canada and Australia are also available. Table 4 gives a short description of these profiles. The profiles mentioned have very different backgrounds. ISM, SFIA and Career Space originate from industry. APO is the result of cooperation between education, government and industry. EUCIP comes from informatics associations (CEPIS: Council of European Informatics Societies). ACM and IEEE are major trade associations in the United States. The HBO-I building blocks for competencies come from education and have been validated by industry. The design and construction of the profiles differ strongly from one another. There is not just one profile that can be used as the European or global standard. There are initiatives from, for one, the European Commission to design frameworks to make it easier to compare profiles.

Table 4: Overview of some of the profile characteristics

| | Bachelor of ICT | APO | SFIA |
|---|---|---|---|
| **Literature reference** | | [14] | [7] |
| **Country** | The Netherlands | Germany | United Kingdom |
| **Name** | Bachelor of ICT | Arbeitsprozess- orientierten Weiterbildung | Skills framework for the information age |
| **Initiative** | HBO-I | Bundesminesterium, Fraunhofer Geselschaft, Bitkom, IG Metal, Ver.di, ZVEI | Industry trade associations, government professional bodies, practitioners and the academic world |
| **Motive** | Introduction Bachelor – Master system | Shortage of qualified personnel | Lack of commonly agreed classification of the jobs that exist in ICT or of the skills required to perform them |
| **Classification ICT job areas** | Process life cycle information system | Specialist profile system work process oriented | Work areas: categories, subcategories |
| **Classification domains** | | | |
| **Profiles of positions** | Illustrations | Advanced training profiles | |
| **Education** | Responsibility of Educational Institution | Admission requirements | |
| **Exams** | Responsibility of Educational Institution | Proof of qualification | |
| **Roles and tasks** | Illustrations | Responsibilities | For each subcategory |
| **Competencies** | Building blocks | Work process oriented competency development Areas of competency | Skills |
| **Indication of level** | Bachelor | Credit system and levels bachelor | Seven levels of responsibility |
| **Degree / title** | | | |

Two initiatives are important to the HBO-I.
•The European Skills framework
•The Overarching European Framework of Higher Education Qualifications (Appendix 5)

Both are still under development and the position of the Bachelor of ICT in them is as yet unknown. The Dublin Descriptors play a role in the development of the Overarching European Framework. Descriptors have been developed for the Bachelor, Master and Doctorate degrees. The general building blocks for the competencies of the HBO-I closely tie in with the ten general qualifications for higher professional education (Appendix 4) which in turn are quite similar to the Dublin Descriptors. Many descriptors start with a classification of the job areas, followed by positions and often roles and tasks and conclude with competencies. However, the term competency does not have only one definition. The same applies to the profiles that are based on the classification of a field. The HBO-I does not classify the IT domain but follows the process and life cycle of the development of ICT systems. Some profiles explicitly describe the level of employees, others do not. Within the EU there is general consensus to arrive at 5 levels, ranging from simple operative (1) to scientific and academic (5). Level 4 (Appendix 5.3) would befit the Bachelor of ICT.

| **ISM** | **CS** | **EUCIP** | **ACM/IEEE** |
|---|---|---|---|
| [6] | [2] | [3] | [8] |
| United Kingdom | Europe | Europe | USA |
| Industry structure Model | Career Space | European Certification of Informatics Professionals | Model Curricula for computing |
| British Computer Society | Consortium of major ICT companies | Council of European Informatics Societies (CEPIS) | ACM<br>Association for Computing<br>Institute of Electrical and Electronic Engineers |
| | Skills shortage | | Update 1991 curricula |
| Nine function groups | Four main areas | Process of delivering IT Service<br>Plan, build, operate | |
| | | | |
| | Broad job areas | To be developed for the elective level | Bodies of knowledge |
| Background Prior Knowledge and skills. Training requirements | | | Sample curricula<br>Illustrations of modules |
| Qualification | | Online Testing | |
| Three hundred IT roles | Role, lifestyle, task | | |
| Behavioural skills, Technical knowledge<br>Other knowledge and skills | Behavioural skills<br>Ethnical skills | | |
| Ten levels of responsibility | | Core level (compulsory) Elective level | Introductory courses<br>Intermediate courses |
| | | | US undergraduate |

# 7. CONCLUSION

The HBO-I presents a profile for the bachelor of ICT designed for the future. The starting point of a limited number of building blocks for competencies in changing contexts can be applied for many years to come, assuming that in the near future the building blocks will not change contrary to the contexts in which the Bachelor of ICT uses the competencies. Maintenance of this document is mainly done by updating the illustrations. The HBO-I expects illustrations to become outdated and replaced by new case descriptions in the coming years. The maintenance method and current document can be found on the website of the HBO-I: www.hbo-i.nl. For prospective students, students, teaching staff, industry as well as government, it is important to look at the relevant context in which a Bachelor of ICT operates. The vision of a broadly-based Bachelor programme with individual pathways closely ties in with the context approach and makes custom-made programmes possible. The profile of the Bachelor of ICT helps the reader clearly picture the competencies of the recent Bachelor of ICT graduate and helps institutes of higher education to design competency based curricula.

# 8: ILLUSTRATIONS OF THE BACHELOR OF ICT

# Illustrations of the Bachelor of ICT

## ANALYSIS

Conducts an analysis of processes, products and information streams with reference to their mutual relationships and situational context.
Defines functional specifications.

## ADVISE

## DESIGN

## IMPLEMENT

## MANAGE

## Context

- **SETTING** The Nescio insurance company insures specific properties of private individuals on the Dutch market and is located in a medium-sized town in the centre of the Netherlands.

- **DETAILED SETTING** The organisation is characterised by formal internal communication. The administrative handbook is not simply a little-used document, it is the basis for Nescio's business operations. Its employees' tasks are mostly specialised. Employees can only replace one another within a department on a limited scale and have little knowledge of what is done in other departments. The ICT department has a somewhat isolated position within the company, and its employees see ICT as a hindrance to company strategy.

- **SITUATION** The insurer uses a large 'old' legacy information system that runs on a mainframe. In a special meeting with the information manager, the company's management established that expenditure on development and maintenance are continuing to rise. Despite a firm decision not to allow end-user computing taken some years ago, a variety of systems and tools have been introduced into the company. The mainframe applications are not delivering the information required because they were not designed to deliver process information.

- **ASSIGNMENT** Nescio has commissioned Knowall Consultants to formulate an information plan.

- **PROFESSIONAL PRODUCT** A comprehensible overview of the bottlenecks in the current provision of information.

## The ICT professional

- **BACKGROUND** Edwin has been working for Knowall as a junior information specialist for almost a year. Knowall is Edwin's first employer since graduating with a Bachelor degree in ICT.

- **ROLES** Edwin is a member of the project team that has been asked to draw up the information model of Nescio. This is his third project and the second in which he is performing tasks independently. The information manager has been delegated by Nescio's management to commission the project.
  The project leader thinks it is logical to include Edwin in the discussions on the strategic options for the information plan. Edwin works with a colleague who has prior experience of the insurance sector and four years experience as an information analyst. This colleague and the project leader have worked together before.

- **TASKS AND ACTIVITIES** Edwin has prepared himself thoroughly by reading all the material supplied by his client and has formulated a research strategy. His project leader has presented Edwin's research strategy to the client who has approved the research. Edwin interviews users to ascertain and set down Nescio's organisation and most important working processes. He discusses the results with the users and the project team. He writes reports and gives presentations. Edwin detects bottlenecks and ineffiencies in business operations and the accompanying information provision. In addition, he pays special attention to the security of the information and relevant safeguards. He collects suggestions for improvement from users and uses these to develop ideas that are included in the project's reports and advice.

- **EXPERTISE** Edwin can apply various techniques for information modelling. He can translate the demands regarding the quality of the information service, the mutual dependencies, vulnerabilities, risks and the accompanying measures in concrete proposals. Edwin works in a customer-oriented manner. In meetings with the users, he uses ICT means to ascertain how information is provided and to exchange information with his team members. Edwin is able to prepare and conduct interviews from a user's point of view. He is respectful of the openness of the users and always discusses the results of the interviews with the interviewees.

- **CAREER PROSPECTS** Edwin wants to become a business analyst. Edwin's manager is mainly interested in his professional development during this project and wants to know if Edwin will be able to take the next step in his career after the project has ended .

## Building blocks A1, A2, A6, A7, A8, B1

## Context

- **SETTING** The Narwal Oil Company is a major multinational firm. Its Dutch head office is located in the Randstad (the urban conglomeration of the west Netherlands). The company maintains a number of information centres across the globe staffed by information managers and information specialists. The information centre of Narwal's main Dutch office is the KIM Department (Knowledge and Information Management).

- **DETAILED SETTING** These information centres characteristically process both structured and unstructured information. The task of the information centres is to deliver tailored information. They form Narwal's Centre for Business Intelligence and Marketing Intelligence.

- **SITUATION** These centres systematically collect, classify and disclose important external, and internal, information. Furthermore, the information systems to be developed must deliver the desired information, which must be available for the information centres. A project group is currently studying whether all Narwal information centres should be integrated.

- **ASSIGNMENT** A study into the feasibility of a worldwide integration of all Narwal information centres.

- **PROFESSIONAL PRODUCT** A thorough report on the existing services of the various information centres. An analysis of the similarities and differences and an overview of the demands and wishes for the future situation.

## The ICT professional

- **BACKGROUND** Irene has a Bachelor Degree in ICT. She works as a junior information specialist at the KIM department .

- **ROLES** Irene is a member of the project group and takes part in the analysis of the existing situation. The project group is led by an experienced information manager, who has wide knowledge in the field of processing both structured and unstructured information.

- **TASKS AND ACTIVITIES** Irene analyses how the different information centres operate, which products and services they offer, how they provide information, how they budget, the similarities and differences between the centres, and the demands and requests the different centres have on the subject of integration. Irene works in a team but carries out a number of tasks independently within this team. She does desk research, conducts interviews, discusses results with the parties involved, joins the discussions on improvements and reports on all this.

- **EXPERTISE** Irene is able to ascertain and set down work processes and the related information provision. She is able to analyse and describe the differences in the way of working of the different organisational units. Because of her knowledge in the field of both structured and unstructured information and in the field of business and marketing intelligence, she is an expert interlocutor for the employees of the various information centres. She can work independently and methodically and operates effortlessly in a team. Her manner of interviewing focuses on the information she wishes to gather and her interlocutors find her interviewing technique pleasant and professional. She is able to formulate and report clearly, both in writing and orally, and is also able to do this satisfactorily in English.

- **CAREER PROSPECTS** Irene could become a senior information specialist, information manager or business analyst.

## Building blocks A1, A2, A6, A8, B1

## Context

- **SETTING** Multimed is a multinational company that designs, builds, maintains and sells medical systems.
- **DETAILED SETTING** Automed is specialised in biometric equipment, machines that can measure body functions such as temperature, heart rhythm, blood pressure, electromagnetic brain activity, muscle activity, and so on. The basic configuration of these machines, that range in size from less than one centimetre to nearly two metres, is always the same. One or more sensors measure a body function and send the data measured to a processing unit, which collects and processes data. The processing unit subsequently controls an output device that displays the data. Customers are mainly found in the medical sector: hospitals, independent specialists, general practitioners and sometimes patients as well.
- **SITUATION** Automed recently started an internal project to answer the following questions: (a) is the TINI (Tiny Internet Interface: a printed circuit the size of memory chip with a processor running a Java virtual machine on it, together with a real time operating system and a TCP/IP stack) suitable for applications developed by Automed? (b) is Linux a reliable platform for Automed applications? (c) for what types of application is the TINI/Linux combination suitable?
- **ASSIGNMENT** Management wants to know if the TINI/Linux combination is usable for a number of promising applications and if so, how it could be implemented. All technical difficulties must have been sufficiently thoroughly analysed to allow management to decide which applications can be safely modified with the combination, and the expected costs and return on investment should also be calculated.
- **PROFESSIONAL PRODUCT** A well-written report containing the research results and well-founded recommendations.

## The ICT professional

- **BACKGROUND** During her computer science studies, Chaidza did a graduate internship at Automed. The project she is working on now is a continuation of her graduate assignment in which she did research into the suitability of TINI for Automed applications. During this assignment, she came up with a number of promising applications, and ended the assignment with the advice to continue exploring them. The project must be finished within six months. The technical environment and socially relevant market is appealing to Chaidza. The fact that Chaidza can use her technical knowledge for the benefit of her fellow human beings greatly motivates her.
- **ROLES** The head of the Research & Development department is project leader and Chaidza is part of a small research team of professional and academic researchers. In this project,
  Chaidza does not deal with the 'real' customers of Automed much, because the applications she is studying are working applications with satisfied customers. The internal workings of those applications is not interesting to those customers.
- **TASKS AND ACTIVITIES** Chaidza has to do her best in this project, which severely tests her theoretical knowledge. She already knows a lot about the TINI because of her internship, but its combination with Linux is new. The multiple sensors that Automed works with cause a lot of complications. Chaidza has worked with databases. This is really relevant here, because measured data must be stored in databases. The combination with portable machines which send data by radio to a database on the Internet is completely new, however.
- **EXPERTISE** Chaidza is keen on learning new things and wants to thoroughly understand how things function. She likes analysing difficult problems with colleagues. She is open to suggestions but maintains her own views if she knows she is right. Chaidza has knowledge of operating systems and real time processes. She can store and maintain data in databases. Because Automed is an internationally operating company, employees of different nationalities are part of her team. Communication takes place in English.
- **CAREER PROSPECTS** Through her graduate assignment, Chaidza immediately ended up in the Research & Development Department. Most of her colleagues first worked in the field, mostly installing, maintaining and controlling hardware and software. She does not expect any major changes in her career in the near future.

## Building blocks

A1, A2, A3, A4, A5, A6, A8, B1, B2

## Context

- **SETTING** The union office of the NVBV sports union represents its associated clubs.
- **DETAILED SETTING** The union office is a small organisation. The internal and external communication is informal and communication lines are short. The union promotes the sport (nationally and internationally) and encourages optimum performance of its members and clubs. It supports its clubs and members and organises competitions. The NBVB sees to the training of coaches and has a national training centre where talented sportspeople are trained by professional trainers.
- **SITUATION** The union office caters for the administration and the local organisation and employs a staff of ten. The union employs account managers for the communication with and service to the various clubs. They are the initial contacts for the clubs. A paper filing system, with the various questions and accompanying answers from members and clubs, was set up at the union office. This filing system is not functioning properly. Looking for information takes too long and the information is often not updated. The union association recently decided to radically improve the information service.
- **ASSIGNMENT** The NBVB has commissioned software consultants Info-consult to come up with a prototype of an information system for the account managers. There must be an option for the various clubs to access the system through the Internet in the future.
- **PROFESSIONAL PRODUCT** A clearly presented specification of the demands for the information system to be developed for the account managers. A working prototype based on those specifications.

## The ICT professional

- **AFTER GRADUATION** Karin started working for Info-consult as a junior system analyst. In her first projects, she worked using analyses to design programmes under the supervision of experienced business analysts.
- **ROLES** Info-consult has set up a project team to carry out the assignment. Karin's role in this project team is that of the junior system analyst/designer. Eric, Info-consult's senior system analyst, is the project leader and the rest of the project team consists of developers/programmers. During the execution of the project, the project team stays in close contact with the project initiator and various account managers.
- **TASKS AND ACTIVITIES** Karin, together with Eric, has meetings with the account managers, studies the paper filing system and visits various clubs. Together with Eric, she designs a questionnaire to quantify what account management does and the required service provision. This questionnaire has been sent to the account managers and the clubs.

  On the basis of this information and after consulting with Eric, she lays down the specifications for the prototype with the help of UML. A translation to a data model for the design of the information structure is made using the ERD technique. This is done in close consultation with the other members of the project team and the account managers, and developers/programmers continually adjust the prototype of the desired information system on the basis of the latest specifications. Karin and Eric demonstrate this prototype during regular progress meetings with the project initiator.
- **EXPERTISE** Karin knows how to design a questionnaire and analyse the current and desired situation for a small information system using information gained through interviews. She is customer oriented and, in cooperation with others, is able to design an information structure which can be handed over to the builders of the system. This means she can work with the current methods and techniques in the field of designing information systems. She has knowledge of various programming methods including prototyping database systems and web programming. Karin is a good listener who can use comments to modify designs.
- **CAREER PROSPECTS** Karin could become a senior system analyst.

## Building blocks A1, A2, A6, A8, A10, B1, B3

## Context

- **SETTING** Ffrisz!! sells millions of litres of soft drinks of different brands and is continually developing new products.
- **DETAILED SETTING** The shift in taste on the soft drink market – consumers preferring non-fizzy drinks and dairy products - was the incentive for Ffrisz!! to develop Brazzor. Brazzor wants to capitalize on the expected trend of 'back to the essence of coffee'. The name was deliberately picked: associating the world's biggest coffee producer Brazil with the popular Breexer .
- **SITUATION** Ffrisz!! wants Brazzor to be associated with the trendiest products. Ffrisz!! is looking for a creative marketing communication concept for Brazzor. This concept must increase the awareness of Brazzor amongst the target group. A pay-off, a logo and a 3D representation of the packaging, a so-called visual, will make the concept tangible. The campagne should promote the Brazzor name and image to as many people from the target group as possible. Ffrisz!! wants a multimedia campaign. The product must be interactive and entertain the user for five minutes at least. IDTHK, a young advertising agency, which makes an intensive use of ICT in its products, was approached to market the Ffrisz!! product. The agency uses multimedia presentation material in its campaigns such as interactive presentations at fairs, interactive websites and CD-ROMS.
- **ASSIGNMENT** Design and develop a creative marketing communication concept for Brazzor. Design a campaign to launch Brazzor. Fully develop one or more multimedia products.
- **PROFESSIONAL PRODUCT** A store check, target group analysis, campaign design, graphic design and a multimedia product.

## The ICT professional

- **BACKGROUND** Karel is a multimedia graduate. During his studies he specialised in marketing and ICT. He expected to find a job with a modern advertising agency and succeeded in this. Karel is a junior employee with ITHDK. The company offers him the opportunity to use his creativity and ambition to their full potential.
- **ROLES** He is a member of the team chosen to design the new Ffrisz!! advertising campaign.
- **TASKS AND ACTIVITIES** Karel is involved in all elements of the campaign but focuses mostly on multimedia marketing. He applies marketing and communications theories and strategies in preparation the design of a multimedia application. He analyses, creates a functional design and graphic design and text for the interactive multimedia product. He makes a 3D model for the visual.
- **EXPERTISE** Karel is able to oversee the development process of the design of a multimedia application, taking the purpose and market of the application into account. He is able to do this in a creative team. He demonstrates that he is growing in this role during the project.
- **CAREER PROSPECTS** Karel is a junior employee. In later projects at ITHDK, he could go on to become a team leader and, in the long run, art director.

## Building blocks

A1, A2, A4, A5, A6, A7, A8, B1, B3

# Illustrations of the Bachelor of ICT

## ANALYSIS

## ADVISE

Formulates well-founded advice on the restructuring of processes and/or information streams and on ICT systems to be developed or acquired based on analysis and in consultation with stakeholders. Considers financial, time and change management aspects, feasibility and risks and outsourcing options.

## DESIGN

## IMPLEMENT

## MANAGE

## Context

- **SETTING** Muiderdam is a medium-sized dormitory town.
- **DETAILED SETTING** National government required all local governments to provide 90% of municipality information online and to deliver 35% of their services through the Internet by the end of 2003. This was an incentive for municipalities to revise and update their websites, and the Muiderdam website has therefore been expanded and revised in recent years. It is now time to evaluate the changes.
- **SITUATION** The municipality has many unanswered questions. How is the website used, and what are its users' expectations? Are they satisfied with the website? Are more services required and if so, what are those requirements? Can the website be maintained easily now and in the future? How can it be best maintained and its continuity guaranteed? Is it supported within the municipality's departments, and is it possible to involve these in its further development? What are its development priorities? In answering these questions, the municipality has to take citizen response, government demands, widely accepted standards and the demands of its own ICT department into account. The municipality of Muiderdam has initiated two surveys to answer these questions: an external quantitive survey into how the website is used by the citizens of Muiderdam, and an internal survey into how the website is maintained and managed. This should result in recommendations on the design of the homepage and on the website's maintenance and management. Both surveys are designed to identify problems and formulate possible solutions. The recommendations in the advisory reports will be concerned with the policy to be followed and its consequences.
- **ASSIGNMENT** Conduct an external quantitive survey of the citizens of Muiderdam. Conduct an internal survey that shows how the website is maintained and managed.
- **PROFESSIONAL PRODUCT** Two advisory reports which provide a clear answer to the questions asked. A concrete and feasible proposal on updating the website and on how to structure the organisation.

## The ICT professional

- **BACKGROUND** Marianne has gained experience in these kinds of research and advisory projects during her Communication & Multimedia Design degree course. She is therefore used to preparing and conducting interviews with various stakeholders in similar projects.
- **ROLES** She has been posted to the municipality of Muiderdam to carry out the internal survey by an external consultancy firm. She is being advised and helped by one of the firm's senior advisors.
- **TASKS AND ACTIVITIES** Marianne focuses on the municipality's questions about the use and maintenance of the website. She prepares in-depth interviews and interviews people from different departments to produce a report containing an outline of the problems that occur in the maintenance and management of the website and possible solutions. Marianne builds up the required support for her report by discussing its results with the people she has interviewed. She quantifies the results from the interviews in a statistic package and presents the result clearly. She draws up proposals for the design, maintenance and management of the website and makes use of modelling and presentation techniques to convince the project initiator.
- **EXPERTISE** Marianne knows how to use different interview techniques. She is able to process the interview results with the appropriate means. She has fluent Dutch language skills. She is familiar with the latest developments in ICT on the development and maintenance of websites.
- **CAREER PROSPECTS** Marianne planned her career as soon as she started to work for the consultancy firm. She expects to go on to become a consultant in website development and maintenance in two years' time by carrying out assignments similar to the Muiderdam project. Outstanding performance might even allow her to become a senior consultant.

## Building blocks A1, A6, A7, A8, B2

## Context

- **SETTING** VWHW is a social security institution. It receives claims for different benefits, evaluates the claims in the light of current legislation and approves or denies them.
- **DETAILED SETTING** VWHW informs claimants about benefits approvals or denials. If claims are approved, VWHW pays them. VWHW's most important operation is processing benefit claims.
- **SITUATION** VWHW's management has noticed that the time needed for processing a claim is increasing. The reason for this is the growing complexity of legislation and expertise required for assessing claims. Claimants rightfully object to this. VWHW can only respond to enquiries about the status of a claim after an intensive and time-consuming investigation. The legal time span for assessing claims is regularly exceeded. Mistakes are made because of the workload . In the meantime, progress checks have been introduced putting a considerable demand on resources. To avoid claimants suffering because of delays, VWHW uses an expensive and time-consuming procedure of interim payment but wants to abolish this. They expect to greatly improve efficiency by shortening the total time it takes to process claims according to the normal procedure. During a conference on the growing independency of operational organisations, the project leader of an ICT service and organisation consultancy called Wflow presented a case very similar to that of VWHW. The managing director of VWHW attended the conference and approached the project leader to discuss VWHW's problems.
- **ASSIGNMENT** The managing director of VWHW has commissioned Wflow to carry out a quick scan of the expected benefits and drawbacks of implementing a workflow management system at VWHW and to particularly give a rough estimate of the costs involved.
- **PROFESSIONAL PRODUCT** An advisory report and a decision document including the results of the quick scan.

## The ICT professional

- **BACKGROUND** Karin has been working for Wflow for some months. She learned about workflow management during her degree course in business information technology.
- **ROLES** Karin is a junior advisor who works closely together with the project leader, thus learning the delicate skills of dealing with clients and presenting recommendations.
- **TASKS AND ACTIVITIES** Karin is expected to independently process the information about the information processing, the accompanying organisation – both structure and culture – and the infrastructure. Since the client has emphasised the importance of estimating the implementation costs, she makes a financial interpretation of both the benefits and drawbacks, building in large margins. When dealing with the benefits, cost cutting and possible increases in turnover are important. When dealing with the drawbacks, the necessary investment in change management and the necessary means are important. Karin reports to the project leader, who checks her results and adjusts them in consultation with her and then presents them to the client.
- **EXPERTISE** Karin knows how to analyse and design a process. From the analysis and designs, she is able to advise on alternatives to structuring processes, the importance of design variables and implementation strategies. Karin has great analytical and problem-solving abilities and the power to convince and motivate people to achieve results.
- **CAREER PROSPECTS** In the future Karin could become a senior advisor. She is still not sure whether she would like to set up her own company or become a manager in an ICT services company.

## Building blocks

A1, A2, A6, A8, B1, B2

## Context

- **SETTING** KnowledgeAdvice is a small company that provides advice and service to knowledge-intensive organisations.
- **DETAILED SETTING** Advice and solutions are provided to optimise the knowledge infrastructure of organisations.
- **SITUATION** In the VisionA organisation, who does what is still unclear. That is why some things are left undone or done twice. The management of VisionA feels that knowledge is not shared between employees often enough. They have not succeeded in capturing the knowledge necessary for innovation. The management of VisionA hopes to increase the innovative power of its organisation with the help of KnowledgeAdvice.
- **ASSIGNMENT** The management of VisionA has given KnowledgeAdvice an open assignment. Improvements in the field of the administrative organisation, information supply and human resource management have been suggested.
- **PROFESSIONAL PRODUCT** The professional product that KnowledgeAdvice delivers is recommendations on the improvements that VisionA can make in its knowledge infrastructure. The improvements must lead to more efficient working, sharing of knowledge in the organisation, and increased innovative power of the organisation. These recommendations must be feasible and custom made for VisionA.

## The ICT professional

- **BACKGROUND** KnowledgeAdvice was founded by Wiebe. After becoming an information analyst and information specialist, Wiebe specialised in knowledge management.
- **ROLES** Wiebe heads the company but is also an active worker. Wiebe and his employees are serious interlocutors for their clients.
- **TASKS AND ACTIVITIES** Wiebe selects his employees carefully. He sets great store by the continuous training of his team. When carrying out the VisionA assignment, they do an in-depth study of the client and his objectives, keenly analyse in which fields improvements in the knowledge infrastructure are possible, and consider the feasibility of these improvements. They advise on the deployment of ICT resources to implement the improvements proposed. Because Wiebe runs his own company, acquisition, marketing, setting up the administrative department; the welfare of his employees is an important additional task for him.
- **EXPERTISE** Wiebe already became acquainted with change management, human resource management, information management and knowledge management during his studies. He knows how to use ICT in order to reach a goal. He can analyse and describe an organisation. Social skills, listening, doing interviews, presenting, and reporting are important skills in his company.
- **CAREER PERSPECTIVE** Wiebe wants his company to excel in the service management it offers to clients. He wants to become a leading name by delivering quality advice and hopefully also implementation, by publishing in his field, and by providing seminars.

## Building blocks

A1, A2, A4, A6, A5, A7, A8, A9, A10, B1, B2

## Context

- **SETTING** Blue Chips Engineers specialises in the design and building of embedded systems.

- **DETAILED SETTING**
  A typical assignment has been designing and writing software for a large photocopier factory. Another assignment was for a company that builds machines for the manufacturing of chips. The software is always "baked" in the chips. That is why demands for quality software are high. The software must be one hundred percent error-free, reliable and nearly always extremely fast. A lot of chips are used in production lines that are accurate down to the millisecond.

- **SITUATION** A robot arm has to perform an extremely accurate task in a production line for a new type of photocopier. The robot arm has to be extremely accurate and this is a new factor. The software must be one hundred percent reliable as the slightest deviation will immediately cause great damage. The arm gets its information via sensors, the data is processed and the movements of the arm react to that. Everything takes place in real time, and the arm must respond to commands in no more than 10 ms.

- **ASSIGNMENT** Make a functional design for the operating software. In this situation, the collection of functional specifications must be exceptionally precise and absolutely complete.

- **PROFESSIONAL PRODUCT**
  The functional design. The specifications must be clearly formulated and approved by the client.

## The ICT professional

- **BACKGROUND** Peter has worked for Blue Chips as a junior engineer for a year. He studied computer science, and gained a lot of technical knowledge during his studies. He was also trained in project work. In the past year, he has participated in a new project for a regular customer of Blue Chips, a manufacturer of photocopiers.

- **ROLES** Peter participates in this project as a project team member.

- **TASKS AND ACTIVITIES** Peter's main contribution to this project is drawing up the functional requirements for the software to be written and he has complete insight into all environment variables. In addition, he has to represent Blue Chips. He quickly familiarises himself with the specific possibilities and difficulties of the technology used, both of which are mostly new to him. He makes an estimate of the financial consequences of his work. He works together with other team members in drawing up the proposal and makes a rough provisional planning for the project. He works in a multidisciplinary team, communicating with colleagues and the client.

- **EXPERTISE** Peter is able to communicate with clients, project initiators and colleagues. He has technical expertise and is able to quickly familiarise himself with the technical specifications of an assignment. He knows design methods and programming languages that are suitable for producing embedded software.

- **CAREER PERSPECTIVE** Peter hopes to finish this project successfully and then take on a new client in a new project. He takes part in all kinds of company activities and is a member of an expertise group studying new technologies which the company could use in the future. A great part of this research is done in his own time, but whenever Peter wants extra training, this is granted by his manager. Peter discusses his personal development plan with him and has his assessment interview and performance interview with him as well. Six years from now, Peter wants to be an expert on system development, coaching his fellow developers and giving them methodical, architectural, and technical guidance. He expects that he will possibly need to look for another employer and is also looking for a part-time master programme.

## Building blocks

A1, A2, A6, A7, A8, B1, B2,

## Context

- **SETTING** The information service department of a large municipality in the western of the Netherlands.
- **DETAILED SETTING** The Information Service Department is a municipality public service organisation responsible for the design and maintenance of a satisfactory information service for the different public services and for the residents of the town. These services mostly have their own, sometimes outdated, systems and mainly work independently. That is why the exchange of information is difficult.
- **SITUATION** If a service or resident needs specific information, the office concerned must be contacted. If information from another service is also needed, that service is also approached. Customer service is greatly hampered by the information being available from several sources. An additional problem is the fact that information is not updated throughout the organisation. This has led to awkward incidents in which services, such as the fire department and the police, were not rightly informed or not informed in time. After the municipality management's severe criticism on the situation, a consultancy agency was called in. This agency has reported on the current and desired situation in which the systems were linked to form an integrated system. The consultancy agency advised the use of XML.
- **ASSIGNMENT** The Information Service Department was commissioned to start a pilot called 'The Fire Department on the Way', in which the data of the public services are linked to the data of the fire department to ensure up-to-date traffic information for the fire department. Another goal of this pilot is to gain experience in and know-how of the linking of different systems and databases using XML and use this elsewhere in the organisation.
- **PROFESSIONAL PRODUCT** A fully operational link between the systems of the fire department and the public services based on XML. A report clearly describing and explaining the strengths and weaknesses of the application of XML in the integration of the municipality's systems.

## The ICT professional

- **BACKGROUND** From the moment he earned his bachelor degree in ICT six months ago, Jacco has worked as a system developer with the municipality.
- **ROLES** Jacco is a member of the project team together with Kirsten, an experienced system engineer with expertise in the field of integration of heterogeneous systems (but not in XML), and with Sander, a business analyst.
- **TASKS AND ACTIVITIES** Sander concentrates mainly on the business processes that need to be supported. Kirsten has general knowledge of the technical data of the different clients, servers, and networks. Jacco looks into the strengths and weaknesses of XML for the new project. This poses him a challenge, and he wants to showcase the XML possibilities in a pilot. In order to be fully knowledgeable, Jacco has done extra training, especially in XML. In the pilot, he not only regularly consults with his immediate colleagues and those of the information service department of the municipality but also with representatives of the fire department. When drawing up an advisory report, he takes other people's opinions into account as well as the quality aspects that relate to the information service and security.
- **EXPERTISE** Jacco is eager to learn and likes to try out new techniques and is creative in the way he conducts research into new options. He is able to focus on a problem, works methodically and is used to documenting his work. He is able to differentiate between main and side issues and discover the potential offered by new technologies. He is able to advise with the help of others on the potential of a certain technique for improving business processes. Jacco has knowledge of and experience in prototyping database systems.
- **CAREER PERSPECTIVE** Jacco can go on to become an ICT communication advisor, but he can also specialise as a system engineer.

## Building blocks

A1, A2, A3, A4, A5, A6, A8, B2

# Illustrations of the Bachelor of ICT

## ANALYSIS

## ADVISE

## DESIGN

Designs ICT systems based on architecture descriptions and specifications, in conformance with analysis and within the boundaries set for quality, testing, security, running time, budget, use and maintenance.

## IMPLEMENT

## MANAGE

## Context

- **SETTING** Sim-game is a company that markets simulation programs and computer games. It is a young company that has grown considerably since it was founded.
- **DETAILED SETTING** In the beginning, the company focused on making simulation programs mainly as training material for learners, but has lately started developing and producing computer games. Its organisation is open and informal and employs mainly young people with a variety of skills such as account managers, program managers, artists and ICT specialists work there.
- **SITUATION** Market research of the games market has shown the need for a game in which players find themselves in a virtual fairy tale world. Players can give their avatar (a different being) any look they want. In this world, they meet other avatars and other beings simulated by the game. Players can gain powers to modify their own avatar through working together and plotting. The game capitalises on the chat culture of the current generation of youngsters and their need for communication with others.
- **ASSIGNMENT** Draw up an implementable design based on the functional specifications of the analysis phase and in consultation with the graphic designers. The programmers can then build the game, and a team of artists can create the visual aspects. Use a RAD development methodology.
- **PROFESSIONAL PRODUCT** An implementable design for a new computer game.

## The ICT professional

- **BACKGROUND** Right after graduating in ICT, Dennis started to work at this company as a system designer and it was particularly its easy going and young atmosphere that appealed to him.
- **ROLES** Dennis is a member of a team of system designers, graphic designers and other specialists that was commissioned to come up with an implementable design based on the functional specifications from the analysis phase. A concrete game plan was worked out by an artist and psychologist in the analysis phase. Analysts have also drawn up a domain model in UML and the scenarios of the game have been inventoried.
- **TASKS AND ACTIVITIES** The user interface, the outer layer of the software, is designed together with the graphical designer. Dennis has an important task in this: modelling the games creatures, objects and spaces with the help of interaction diagrams and state diagrams. The graphic designers design a graphic representation through storyboards. Dennis must take existing software components into account when designing.
- **EXPERTISE** Dennis is able to work methodically and is skilled in the use of object-oriented models, and design and programming techniques. He quickly reads up on any topic and quickly knows his way around the libraries for software components of both Sim-game and the available libraries on the Internet. He has knowledge of and experience in designing graphical user interfaces. Being self disciplined and result driven, he works together with experts from different fields, including artists and programmers.
- **CAREER PERSPECTIVE** Dennis can go on to become a senior developer. He can specialise as a software engineer. Another option for him would be to move into the direction of management, to take on organisational and management tasks and thus develop into a program manager.

## Building blocks

A1, A2, A4, A5, A6, A7, A8, B3

## Context

- **SETTING** International Naval system Integration (INSI) is a company that specialises in the integration of complex and advanced radar and command and control systems on board naval vessels.

- **DETAILED SETTING** The System Integration & Testing department deals with the module, system, integration and acceptance tests of radar and command and control systems. The acceptance tests take place in both the factory (FAT, Factory Acceptance Test) and in the harbour (HAT, Harbour Acceptance Test) and on sea (SAT, Sea Acceptance Test). The acceptance tests take place in the presence of the customer.

- **SITUATION** Utor, a small country near Australia, has bought a frigate which was phased out by the Royal Navy. Utor wants to have the vessel fitted at a local wharf and have INSI see to the replacement of the radar and command and control systems, named TACTICOS. As a preparation for the Factory Acceptance Test (FAT, a formal acceptance test of the systems by the customer on INSI premises), extensive system testing takes place at the System Integration and Testing department.

  A test team, comprising a senior test engineer, some test engineers and an assistant test engineer, is responsible for the preparation of the FAT. Because the FAT date is fixed, accurate and fast execution of the preparatory tests is important.

- **ASSIGNMENT** Carry out the tests of the TACTICOS systems before the FAT date agreed with the customer.

- **PROFESSIONAL PRODUCT** Delivering the onus of proof of the correct working of the TACTICOS command and control system to ensure a smooth FAT.

## The ICT professional

- **BACKGROUND** A little under a year ago, Ingo graduated as a computer science Bachelor and since then has gained experience in testing of small modules of the TACTICOS system as a junior test engineer with INSI. This has prepared him for the next step towards becoming a fully qualified integrated systems test engineer.

- **ROLES** Ingo assists the test team of TACTICOS as an assistant test engineer. His colleagues have done a FAT and /or HAT a number of times. Carrying out various preparatory tests on the TACTICOS system, is a challenge to him.

- **TASKS AND ACTIVITIES** It is Ingo's task to carry out module, system and integration tests under supervision. For this, he uses test cases drawn up by his fellow test engineers to indicate the allocated module and system requirements for the desired functionality, performance and volume. He sees to the correct recording of the test results. These will be documented and used as the official onus of proof for the correct functioning of the system parts. He sees to the documentation of the discovered shortcomings to enable his colleagues to carry out the necessary troubleshooting. After testing, he sees to the configured storage of the tested system parts. In order to learn the trade, Ingo is occasionally allowed to make the test case design for small modules. He uses the input requirements as input and delivers the accompanying test case as output.

- **EXPERTISE** Ingo likes working with technical systems and has an adventurous disposition. He understands the relevant parts of the generic Test Engineering Process. He knows the different levels of testing, such as functional, module, system and integration testing. He knows the different sorts of tests such as functional, performance and volume tests. He has basic knowledge of the design of test cases and is able to apply this in black box testing. He knows how to organise his own work efficiently and is able to independently carry out problem analyses. He has a keen eye for quality and can work to deadline.

- **CAREER PERSPECTIVE** It is Ingo's ambition to become a test engineer and consequently participate in both HATs and SATs. Carrying out test and integration tasks on board a ship abroad, greatly appeals to him. Having the full responsibility over a SAT as a test engineer is his one of his final goals.

## Building blocks

A1, A2, A6, A7, A8, A10, B1, B3

## Context

- **SETTING** Idéfix is a small organisation which has made a customised application for the complete operational management of a specialised sector, the Mensendieck and César remedial therapists of the Netherlands.

- **DETAILED SETTING**
  The modular application comprises modules for each component of the operational management of a remedial therapist, from the appointments diary to the customer invoices and from statistical overviews to insurance claims. It started off with a customised application produced by the managing director of Idéfix during the work placement of her studies. This application was so successful that within a year, ten other remedial therapists asked her if they could use the application as well. This led to the founding of Idéfix which specialises in this market sector. Now, two years later, the application is run by more than 120 remedial therapists and is a real success story.

- **SITUATION** Each customer has a customised version of the application. Customer satisfaction is high but mistakes in use are easily made. Idéfix has to provide customer support daily on the workings of the software, deal with complaints about bugs in the programme and problems with the compatibility of printers or other software and answer queries about other modules. The questions are becoming more and more similar, but solutions have to be very often thought up from scratch and Idéfix wants to improve this situation. It needs an application which contains detailed information on all its customers.

- **ASSIGNMENT** Develop an application from which customer information can be retrieved easily including all relevant information on the version of their application. It should be possible to process all customer responses in this application. There must be a convenient search function to find all old question and answer combinations. An alternative might be to take a licence on an existing system, and to model this system for the specific target group.

- **PROFESSIONAL PRODUCT** An application which is a mix between a CRM application and a helpdesk application.

## The ICT professional

- **BACKGROUND** Marlies founded Idéfix after making a customised application during the work placement of her studies.

- **ROLES** Marlies is an independent entrepreneur and does almost everything herself.

- **TASKS AND ACTIVITIES** If necessary, Marlies modifies the software for her customers. She demonstrated the software to a group of potential buyers and representatives of health insurance companies a few times. She is now developing the application with which she hopes to improve her operational management. She models the database for all customer data, designs user screens and writes program code. She is a designer and end user at the same time. This makes the work easier but also more 'dangerous'. She deals with regular customers and potential new customers, answers the phone and deals with complaints. This diversity of work is appealing to her but causes her to work long hours. A 50-hour work week is not exceptional.

- **EXPERTISE** Marlies knows some modelling techniques for the building of a database application. She has chosen a combination of ER diagrams and a class diagram in UML. During her studies, she saw examples of badly modelled designs which were not well thought out and examples of badly documented products. Therefore, she is disciplined enough to model, design and document carefully even if she is her own customer. She knows different programming languages and the accompanying development environments.

- **CAREER PERSPECTIVE** Marlies hopes to expand her client base and to improve operational management. In the short term, she considers extending her business to reach more target groups in the paramedical sector. If Idéfix becomes somewhat bigger, Marlies will not have to do everything herself anymore and will be able to concentrate more on operational management and acquisition.

## Building blocks

A1, A6, A7, A8, B1, B3, B4, B5

## Context

- **SETTING** The Dutch organisation for development Bivon fights poverty strives to achieve sustainable development goals in developing countries in various ways.
- **DETAILED SETTING** Bivon also strives to raise the awareness of development issues in the Netherlands.
- **SITUATION** Publicity campaigns and education aimed at the world trade situation are important issues. Awareness of the limiting import regulations and other aspects of the current world trade situation, unfair in Bivon' eyes, is important. Bivon wants to have an interactive game developed which will affect Dutch consumers when buying and voting. The idea is that young people will gain insight into international trade relations by playing this game and will also be stimulated to help bring about changes for the better. The game must be informative and entertaining. It should generate ideas about how to overcome obstacles and expand the opportunities for people in developing countries without losing one's own.
- **ASSIGNMENT** Develop an interactive world trade game on CD-ROM which will provide young people with insight into current world trade relations and opportunities for improvement.
- **PROFESSIONAL PRODUCT** An interactive game which will provide insight into fair and unfair international world trade relations and the accompanying dilemmas (knowledge), involve young people in developing issues (attitude) and bring about a feeling of solidarity so young people will understand the consequences of their choices for people in third world countries (behaviour).

## The ICT professional

- **BACKGROUND** Tim recently graduated as a multimedia specialist. His studies were broad based and he specialised in game design. He is interested in not only making products but also in the impact such products might have. For a few months now he has worked for Wide Away, a profit-driven multimedia company that is also idealistic.
- **ROLES** Tim works on this assignment in a project team as a junior and is the youngest team member.
- **TASKS AND ACTIVITIES** Tim's first task is the analysis of the target group. He analyses the social environment and culture of seventeen-year olds in the Netherlands. He finds various subcultures in the target group and manages to find a common denominator which appeals to a major part of the young people in the target group. He continuously looks for opportunities to make this game appealing to the target group. His market research of the target group therefore results in game design proposals. From his analysis, he argues which game concept is most suitable. He is open to the different subcultures he analyses and discusses them with older colleagues. He studies fair and unfair international trade relations and the accompanying dilemmas in more detail. He does all this from the perspective of the assignment: the design of an interactive world trade game.
- **EXPERTISE** Tim knows how to set up a target group analysis taking social relations and social cultures and subcultures into account. He is able to put the results of a target group analysis in the perspective of the requirements of the multimedia product he has to develop. He is able to develop a game that appeals to the characteristics of the target group that can be created as a multimedia product. He has the necessary knowledge and experience in making interactive programs.
- **CAREER PERSPECTIVE** This assignment gives Tim the chance to pursue a career in game design.

## Building blocks

A1, A2, A4, A5, A6, A8, A10, B1, B2

## Context

- **SETTING** FinanceSystem is a software company that develops and markets software packages for the financial and logistics markets. These products are becoming serious competitors for established similar systems.
- **DETAILED SETTING** FinanceSystem's customers are large, small and medium-sized companies. The number of customers is increasing, putting considerable pressure on the customer service department. The company sets great store by high customer support standards.
- **SITUATION** FinanceSystem wants to strengthen its customer support by means of an online application. The company wants to catalogue the customers' questions and link them to answers. The idea is that customers can ask specific questions online and that the answers would be retrievable from a database. The company hopes to improve its customer service and have its helpdesk function more efficiently by using this system.
- **ASSIGNMENT** Design an online application
- **PROFESSIONAL PRODUCT** The functional design for an online application for the customer service. FinanceSystem's programmers will then build the system.

## The ICT professional

- **BACKGROUND** After her information service management studies at a Bachelor level, Ilona started work at FinanceSystem as a junior information specialist. Her assignment is to participate in the design process of this application.
- **ROLES** Ilona is a member of the team that designs the online application together with the customer service department.
- **TASKS AND ACTIVITIES** Ilona determines the requirements of the application together with the customer service department by analysing the information requirements. She chooses an approach to use the information customer service has collected and make the system function efficiently. She takes the quality aspects of the information service and the reliability into account. It is clear to Ilona that a thesaurus is essential because this will guide customers to the right answers. Customers will then be able to ask questions and find answers with the help of the thesaurus in a user-friendly way. Ilona designs the thesaurus.
- **EXPERTISE** Ilona knows how to work methodically and follow a plan. She is a good team player and is trained to find documentary information in a professional way. She knows how to design and build a thesaurus. She can build a prototype quickly to give customers insight into the functionality of the application to be developed. She also has an eye for interactivity and user-friendliness.
- **CAREER PERSPECTIVE** Ilona can go on to become a senior information analyst or business intelligence officer.

## Building blocks A1, A6, A8, B1, B3

## Context

- **SETTING** NedCon is one of the world's leading producers of semiconductors and is world leader in the field of complete, affordable and easy-to-use systems-on-silicon.

- **DETAILED SETTING** The NedCon Innovation Centre (NIC) develops architectures, reference designs, software and applications. Solutions to consumer products are designed and implemented together with lead customers. NedCon employs around 300 people and works extensively with other development centres in Europe, the US and Asia.

- **SITUATION**
  At NIC, a digital TV platform has been developed for the TV market which integrates the basic functionality of the programmable digital TV chips developed by the company. A high picture quality is essential to many viewers and NedCon distinguishes itself from its competitors here. The TV platform is continuously expanded and improved. The size of the TV platform has reached around a million lines of c-code and continues to grow. The platform is divided into various subsystems for which teams, supervised by team leaders and subsystem architects, are responsible. The subsystem for the improvement of the picture quality after decoding has grown throughout the years and is hard to maintain. The subsystem encompasses 150,000 lines of code. This results in performance problems and uses too much memory. It is not clear what the cause of this problem is.

- **ASSIGNMENT**
  The assignment involves instrumenting of the software (extending the software in such a way that measurements can be taken) and taking measurements in such a way that the results help to provide insight into the performance problem. The instrumentation and measurement set-up should be applicable in other subsystems later.

- **PROFESSIONAL PRODUCT**
  Instrumented software and a report describing the instrumentation and measurement set-up for later use in other subsystems. Furthermore, it is expected that measurements are taken independently and analysed in close consultation with the subsystem architect.

## The ICT professional

- **BACKGROUND** Since her graduation as a Bachelor of ICT two years ago, Hilde has worked at NIC in setting up and maintaining the development environment for the image processing system. From this, she recently moved to the development team for the subsystem for picture quality. This is her first assignment after getting settled into the company.

- **ROLES** Team leader Louis is project initiator for Hilda. Together with the system architect Ger, he is responsible for the improvement of the subsystem. Hilda will have to work closely with Ger and four other team members. Furthermore, she works together with Peter, who is responsible for the function and performance tests of the platform.

- **TASKS AND ACTIVITIES**
  Hilde has to study the multimedia threading aspects and the memory control more closely using a real time kernel tool, which provides insight into the multi-threading behaviour. She makes a conceptual design and measurement plan of the instrumentation with team members Ger and Peter. Within the company, she looks for other environments that faced these issues before. After review and improvement, Hilde implements and tests her design and carries out the measurements agreed upon independently, to which she adds new measurements on the basis of gained insight. She discusses the results with Ger and Louis, and she draws up a report describing the cause of the problems and containing suggestions for improvement.

- **EXPERTISE** Hilde has knowledge of multi-threading applications and is aware of the performance aspects of software and hardware. She is able to analyse and understand complex c-code and discuss this with the other members of the team effectively. On the basis of measurements, she can gain insight into performance aspects and indicate where improvements are needed.

- **CAREER PERSPECTIVE**
  As a team member, Hilde wants to work on implementing new parts of the subsystem. Ideally she wants to become subsystem architect in the short term. She has agreed with her manager that in order to achieve this, she will draw up a professional development scheme for the coming years for the necessary improvement and broadening of knowledge and skills.

## Building blocks

A1, A2, A5, A6, A7, A8, B1, B2, B3, B4

# Illustrations of the Bachelor of ICT

## ANALYSIS

## ADVISE

## DESIGN

## IMPLEMENT

Builds and implements ICT systems on the basis of a functional and technical design specification and within the boundaries set for quality, testing, security, running time, budget and use and maintenance.

## MANAGE

## Context

- **SETTING** Tunnelgroup B.V. is a conglomerate of a number of well-known major players on the market for infrastructure and construction. It was founded to meet the great demand for expertise and building capacity for tunnel construction, especially from the government.

- **DETAILED SETTING** For the coming twenty years, the construction of dozens of tunnels is planned in large infrastructural projects, notably for train and road traffic. The safety demands for tunnels have been increased in the last few years. Recent accidents in tunnels such as the Mont Blanc Tunnel, the Channel Tunnel and in Kaprun, Austria have contributed to this. Tunnelgroup B.V. has started a separate department which designs and tests safety systems.

- **SITUATION** In the past, systems for lighting, signalling (signs, traffic lights, information signs) ventilation and fire control operated completely separately. If these systems had been linked, the consequences of the accidents mentioned would have been less serious. In the meantime, Tunnelgroup B.V.'s Safety Department has developed a standard design methodology for an integrated safety system for tunnels. The components have been tested thoroughly. Every possible 'route' through the code has been examined, so that, especially in extreme situations, the behaviour of the components is predictable. Extensive documentation on the program code is available. However, every tunnel is different. A team is designing the safety system for a new train tunnel in Vriezendrecht. Starting point is that the system will be completely automated to exclude human failure if calamities occur.

- **ASSIGNMENT** Implement the software for the specific situation of the tunnel in Vriezendrecht, from placing sensors to fine tuning the software, based on the standard system design.

- **PROFESSIONAL PRODUCT**
Perfectly operating program components based on the already existing components. Complete documentation of the program code.

## The ICT professional

- **BACKGROUND** During his ICT studies at Bachelor level, Jeroen was programmer in the projects he participated in. This is what he feels he is good at.

- **ROLES** The project manager of the "Vriezendrecht' tunnel project is the project initiator. He has final responsibility for the entire construction and delivery and therefore also for the safety aspects. For the latter, the responsibility was delegated to the safety officer in this project, who is project leader of a team of programmers of which Jeroen is a member.

- **TASKS AND ACTIVITIES**
Jeroen contributes to the specific design. He designs object-oriented code components with a straightforwardly defined interface. All code has been written in the house style, which was agreed upon within the Safety Department of Tunnelgroup B.V. Jeroen knows exactly what data is received by a component and also knows exactly what data must be produced. Extensive testing according to a previously drawn up plan is run of the mill. The system should function predictably and reliably, especially in exceptional circumstances. He documents his work carefully. Another programmer should be able to take over his work effortlessly. He tests the components and implements them in the available tunnel simulation. All other components rely on Jeroen's component doing exactly what it is supposed to do. Reliability is of first importance in this project. Jeroen is in close contact with his fellow project programmers. He discusses the specifications, the technical problems he runs into and their solutions. He uses his technical handbook and the Internet as important sources.

- **EXPERTISE** Jeroen likes programming and is still challenged by his work. But in the end, he wants to move on in his career. His first goal is having the final responsibility for the system design.

## Building blocks

A1, A2, A3, A4, A6, A8, A10, B3, B4

## Context

- **SETTING** A big broadcasting organisation, 'Free Radio and TV Broadcasting' (FRTB), caters for various programmes for radio and TV broadcasts.
- **DETAILED SETTING** It is a public broadcasting organization, with a strong central board, a few hundred permanent employees and is supported by about a million members. The organisation is hierarchical. Besides the permanent workers, there are many employees with a temporary contract. New projects are often started on an ad hoc basis. There is a project work handbook but it is not really used here.
- **SITUATION** The New Media department was founded in order to retain the current market share. The department targets the research and introduction of new interactive products. Besides the head of the department, there are two programme managers, two graphical user interface designers and two programmers. The department is part of the Publicity department which is responsible for the relations with the members and the promotion of the department itself. This is done by publishing a weekly newsletter, organising activities for members, keeping the website up-to-date and by responding to comments and reactions of members.

  The New Media department initiates the development and supervises the implementation of new ICT products for the broadcasting company. Interactive Internet applications and interaction in TV programmes, e.g., via SMS text messaging, is intended to increase member involvement with the broadcasting company.
- **ASSIGNMENT** Producing an application which will enable interaction with the viewers via SMS text messaging during a certain discussion programme (the translator – disk programme).
- **PROFESSIONAL PRODUCT** FRTB will get a working and tested application enabling the required interaction in the TV programme.

## The ICT professional

- **BACKGROUND** Steven has worked for the broadcasting company for about half a year now. After graduating with a Bachelor degree in ICT, he first worked for a year at a company that develops Internet applications for various companies. This was a young, dynamic but rather chaotic company. Products had to be finished fast without thorough consultation with the clients. This resulted in necessary modifications afterwards and dissatisfied customers. Steven did not like this and when the opportunity came, he moved to FRTB.
- **ROLES** Steven works at the department to which the assignment was given. As a programme manager, he is in the project from the beginning and participates in setting up a methodical approach.
- **TASKS AND ACTIVITIES** Steven supervises and plans the project methodically. The programme requirements are rather vague in the beginning and an iterative development method is chosen. Part of the work is outsourced, especially the processing of large numbers of SMS text messages as a response to a broadcast. Steven makes clear agreements with the suppliers on the services to be delivered (Service Level Agreement). Steven makes agreements on the deliverables, the planning, progress control and quality with the developers and builders. He makes agreements on milestones, tasks and the workflow. He prepares a test with the other team members and carries it out in a real life situation. After delivery, Steven is present at live broadcasts to help solve possible problems together with others.
- **EXPERTISE** Steven knows how to methodically plan and control the process of the project, from design to implementation. He communicates effectively with designers and builders ensuring the timely delivery of programmes that meet the demands. He is customer-oriented and able to come up with plans and alter them under pressure. He is aware of dependencies and risks relating to information service.
- **CAREER PERSPECTIVE**
  Steven can develop into a senior project manager who independently manages ICT projects from design to implementation and acceptation.

## Building blocks

A1, A2, A6, A7, A8, A10, B3, B4

## Context

- **SETTING** Milanov is a medium-sized player in the photo stock business and supplies images to advertising agencies in the Netherlands, England, Belgium and Germany.

- **DETAILED SETTING** Milanov adds hundreds of new images to its library monthly and checks these for quality, exclusivity and trendiness. The studio employs photographers and DTP specialists. The company is run by a managing director who sees to the acquisition together with an account manager. One person updates the image library, the administrative tasks are carried out by two traffic workers and one part-time front desk worker. Milanov can rely for its images on twenty freelance photographers who are specialised in e.g., landscapes, portraits or urban photography.

- **SITUATION** Milanov is looking for an e-commerce application for an online image library for its regular customers. Milanov's target group includes designers, art directors and web designers. They do not need to be lured as they know what they are looking for. However it is important to strengthen the relations with the customers via the site. Quality, reliability and speed are important. The customer wants to make his purchase and have delivery of the product quickly. Through a login procedure, the customer should be able to search for an image by price, colour or topic and order then order and download the photo. A link between the application and the existing CRM system of Milanov is a must. Safe payment is to take place via the Internet, distinguishing between old and new customers. Milanov wants service and quality standards to remain unchanged even if the operational management changes because of the Internet. An implementation plan must show what the consequences of introducing an e-commerce application are. Milanov wants to maintain and update the site itself.

- **ASSIGNMENT** Design and build an e-commerce environment for Milanov and deliver a workable implementation plan for the new situation.

- **PROFESSIONAL PRODUCT** A website with an online image library enabling the customers to quickly and efficiently find the complete photo stock of Milanov.

## The ICT professional

- **BACKGROUND** Daan is a young, beginning entrepreneur who showed during his studies that he has a feeling for building attractive, safe and highly performing e-commerce applications.

- **ROLES** Daan is a jack-of-all-trades and fulfils the role of analyst, advisor, designer, builder and implementer.

- **TASKS AND ACTIVITIES** During the development process, Daan pays a lot of attention to the wishes of the customer, having become the wiser through a past experience of failing to deliver the right product because he followed his own course too much. That is why he does a major part of the development process on site to enable him to consult with the end user frequently. Daan uses his knowledge of data storage in and online use of databases. He makes a selection from the available techniques such as PHP, JSP, ASP. He pays a great deal of attention to the security and encryption of data. Having a customer who attaches great value to the artistic value of a product, he greatly draws on his creativity in the design of the interfaces. Daan gives thorough advice on the necessary organisational changes for online selling. He also advises Milanov on ways of payment over the Internet, the implications of copyright of photo material and on an approach to the publishing of copyrighted material on the Internet. He closely consults with the customer.

- **EXPERTISE** Daan has knowledge of database systems that can be used via the Internet. He has an overview of the available techniques, can make a well-founded choice for what is suitable for the application he is developing and knows how to use these techniques. He has knowledge of security and encryption of data and performance aspects of applications. He is able to map changes that may result from the introduction of an e-commerce application in an organisation. Daan is aware of the legal aspects of the storage of data of third parties in databases and timely refers his customers to legal advisors and experts on proprietary brands.

- **CAREER PERSPECTIVE** Daan wants to specialise in building e-commerce applications and focus on applications in the art sector. For this, he wants to use the experience he gained at Milanov. He wants to expand his company ideally with the addition of a graphic designer and a more technically oriented ICT specialist.

## Building blocks

A1, A4, A5, A6, A7, A8, B3,B4

## Context

- **SETTING** The Middenland College for Further Education resulted from the merger of six institutions for vocational and adult education.
- **DETAILED SETTING** Each institution uses its own student tracking system and has kept doing this after the merger.
- **SITUATION** The various student tracking systems are not compatible. Retrieving management information from the different systems of the college is difficult and not standardised. The board of the college has decided that standardised information must become available. None of the present systems is designed in such a way that it can carry out the functions of all six systems. The Middenland College of Further Education has decided to form a project group which will select a student tracking system for the entire college. They expect the different student support service points to object to this change in the work process.
  After the package has been selected, the ICT department will start a pilot involving five departments of the college. The aim is to gain insight into how to use the system best, which changes in the administrative organisation are necessary, which training courses future users should get and how to ensure the conversion process runs smoothly.
- **ASSIGNMENT** Selecting a new student tracking system for the entire college. Testing the system with a pilot in a number of departments.
- **PROFESSIONAL PRODUCT** A suitable student tracking system for the Middenland College of Further Education, which can be used successfully in the coming years.

## The ICT professional

- **BACKGROUND** Ralf has been hired by the College of Further Education as a junior ICT specialist. He has just graduated with a Bachelor degree in ICT.
- **ROLES** Ralf is a member of the project group that has to select a suitable software package. The head of the ICT department is the project leader. Other members of the project group are representatives of the student support services. The project group advises the information services steering group, which in turn advises the board of directors on the final choice.
- **TASKS AND ACTIVITIES** During the package selection, Ralf looks into the different aspects involving the introduction of a package such as conversion of data and changes in administrative processes. He studies the necessary configurations of the package so that the organisation will have the desired export data at its disposal, and he includes the necessary time and manpower in the planning of the introduction of the package. He considers the possible consequences for the end users of the student support services and their acceptance of the package. His findings will play a role in the selection of the package. Furthermore, he is involved in the pilot to introduce the new package in the college.
- **EXPERTISE** Ralf is an excellent team player who clearly expresses his views. He is skilled at communicating with the users. In addition, he has insight into administrative processes in an organisation and knows the stumbling blocks organisational change may bring. He realises he needs the users' support to implement the new system successfully. He realises that processes depend on information supply, and this makes the organisation vulnerable. He is able to report to the project team clearly.
- **CAREER PERSPECTIVE** It is Ralf's ambition to become an information manager in the future.

## Building blocks

A1, A2, A6, A8, A10, B4, B5

## Context

- **SETTING** Concrete B.V., a concrete production firm, was part of a much larger conglomerate of three factories that were forced to split up into different sections by the monopolies commission.

- **DETAILED SETTING** The new company has to function independently and take care of its own sales from now on. The selling department has its own system for the processing of orders. The company sells mostly from stock, partakes in projects and mainly operates on the Dutch market. For years, production has not kept up with sales. This was solved by a considerable over-capacity in the old conglomerate. If one factory could not do a project or deliver an order, another factory took over. This will no longer be possible in the new situation with three independent factories. Reorganisation has taken place throughout the sector making over-capacity a thing of the past. Customers are use to receiving their orders on time. In this competitive market, other players have appeared who are able to deliver substitute products to the customers.

- **SITUATION** The new commercial director foresees problems and finds a lot of misunderstanding because of an unsatisfactory information service. The sales department does not know the available production capacity and the production department has little insight into the priority of orders. That is why a project on the introduction of an ERP system was started right after the company became independent. A quick scan has shown the excellent potential for introducing ERP in this business situation. However, one of the risks is the departmental managers' acceptance of the system. They are not eager to invite outsiders into their departments. They have been closely involved in the making of the introduction plan and by now an ERP package and supplier, XERP, has been selected.

- **ASSIGNMENT** Automating the product administration and planning. Implementing the package and training personnel.

- **PROFESSIONAL PRODUCT** A fully operating information system that meets the set requirements. Success factors are acceptance of the new way of working, the customer service level and the factory production rates.

## The ICT professional

- **BACKGROUND** A little less than a year ago, Kees graduated with a Bachelor's degree in ICT, and he has gained experienced as an applications manager and as a programmer of customised extensions and interfaces. He has gained experience in the ERP package and therefore knows that implementations are not always successful. The package is sometimes sold too easily.

- **ROLES** Kees works as an ERP application expert for XERP. At Concrete B.V., the final responsibility of the package lies with the functional analyst of XERP. Kees is his assistant.

- **TASKS AND ACTIVITIES** XERT was assigned to automate the product administration and planning together with the employees of the company. The processes have been redesigned by Kees's colleague. Kees will adapt the package to the designed processes through parameterisation. Then he will train and coach the company's employees in the use of the package together with the colleague mentioned before. The Big Bang scenario was chosen for the introduction of the system. Only limited conversion from the old to the new system will take place. The old systems have to keep on running for a considerable time. Kees keeps his eye open to possible further services and projects. Timing and conditions are fine tuned with the account manager. Kees will implement the package together with the employees from Concrete B.V. It is his task to convince the employees, promote the package and carry out the implementation of the package. Concrete B.V.'s management has chosen for a limited customisation. Kees is able to implement this independently.

- **EXPERTISE** Kees is service oriented. He recognises sensitive issues in the introduction of new methods and sensitively deals with the insecurity of the people involved. Kees is extremely result driven. He has insight into company processes and knows which ICT means to use to automate them. He knows the ins and outs of the ERP package. He is able to customise the package to the needs of the users and customers.

- **CAREER PERSPECTIVE** It is Kees's ambition to become head of the project department of the accounts manager within XERP. He is studying project and programme management more deeply and follows courses.

## Building blocks

A1, A6, A8, B3, B4

# Illustrations of the Bachelor of ICT

## ANALYSIS

## ADVISE

## DESIGN

## IMPLEMENT

## MANAGE

Models the exploitation and maintenance of ICT systems. Sees to the introduction, testing, integration and rolling out of new releases of ICT systems. Gives service as agreed (in a Service Level Agreement) within the boundaries set for quality and finance. Sees to the maintenance of ICT systems in conformance with their design and structure.

## Context

- **SETTING** International News is a large international press agency.
- **DETAILED SETTING** The History Department maintains an enormous database with all sorts of data on people who might be world news one day. Biographical data, photos, scandals, positions, relations, etc. The database contains both picture and audio material. The Enquiry Department delivers customized information from this database.
- **SITUATION** The multimedia databank must be continuously one hundred percent up to date. Every request for information is analysed carefully. The databank delivers the customized reply.
- **ASSIGNMENT** Keep the database up to date.
- **PROFESSIONAL PRODUCT** Satisfactory replies to enquiries about politicians.

## The ICT professional

- **BACKGROUND** Judith has a Bachelor degree in Information and Service Management. She has worked at the History Department as an information specialist specialising in politics for two years.
- **ROLES** Judith works at the Enquiry Department independently. The head of the department supervises six specialised information specialists.
- **TASKS AND ACTIVITIES** She maintains the database with personal data of politicians and delivers customised information from it. Her activities are mainly collecting, selecting, filtering, classifying and digitalising information on politically important people and making this information available.
  She daily analyses what the media, at home and abroad, report on politicians in the form of text, image and sound. Furthermore, she uses the online databases of large press agencies and other information suppliers. She adds all relevant information to 'her' part of the database methodically. She analyses enquiries about politicians, selects the desired information from the database and makes this available in such a way that the customer can use the information immediately.
- **EXPERTISE** Judith knows her way around structured as well as unstructured information, is able to categorise clearly, can distinguish between main and side issues, formulate clearly and is an expert in finding information on the Internet. She effortlessly works with modern ICT means: standard packages, scripting tools, the Internet, DBMS and so on. She is very customer oriented and has had an all-round education. She is familiar with privacy legislation. She instinctively knows what is important and has the information stored in such a way that it is easily accessible. Judith's English language skills are satisfactory.
- **CAREER PERSPECTIVE** Judith can go on to become the team leader of a group of information specialists.

## Building blocks A4, A5, A6, B5

## Context

- **SETTING** The Westerkruis University of Professional Education is a small university.
- **DETAILED SETTING** The organisation is currently being transformed from a traditional university to a broad expertise centre. The website plays a crucial role in the communication with the expertise centre.
- **SITUATION** Westerkruis's board of directors wants the website to function as the core of the expertise centre. They have employed a content manager and four administrative staff for the upkeep of the website for a few years now. The first content manager, however, left and the new one has been commissioned to modernise the website. One of his tasks is to maintain a good relationship with the users.
- **ASSIGNMENT** Transform content delivered by the users into effective content in the existing, but modernised, multimedia application.
- **PROFESSIONAL PRODUCT** A well functioning website for the organisation.

## The ICT professional

- **BACKGROUND** Aziz spent a lot of time on the design and maintenance of websites when he studied for his Bachelor degree in ICT. During his studies, he played a part in the maintenance of his institute's website. This worked both ways: he earned credits and learned a lot in the field of content management. He was a dedicated perfectionist and being a student himself, understood the wishes of the end- users.
- **ROLES** Aziz is the successor of the first highly valued content manager. He heads a team of people that are still used to the ways of the previous head. As a content manager, he is responsible for the maintenance of the website and the introduction of new multi-media applications in the organization. He is the main and end editor of the website and in charge of the maintenance of the new applications.
- **TASKS AND ACTIVITIES** Aziz faces the difficult task of changing his predecessor's way of working. He wants to bring about the necessary changes, to modernize and lay everything down in procedures. He puts a lot of time and effort into improving the relationships with everyone involved. He manages to convince them of his qualities by listening carefully and demonstrating his analytical skills and profound expertise. He regularly consults the heads of the Marketing & Communication and ICT departments, who develop policies for the use of Westerkruis's website. He answers questions on the best implementation of multi-media applications, on the organisation of the editorial office and on website maintenance. The technical part of his job entails ensuring that the content management system or management systems (Internet) and intranet and extranet applications or programs on CD-ROM or DVD function properly. He decides where to place new content in the existing structure and decides on the necessity of new functions or modifications in the management program. He consults with users and advises on multimedia possibilities of the application in a field of expertise: communication, marketing, education and business information. He supports users in their use of the applications, both on the content and use and gives editorial advice and instructions. He analyses users' problems and formulates answers that are clear to staff as well as the team. He advises users and team on customized solutions for further professionalisation.
- **EXPERTISE** Aziz is able to carry out simple graphical, contextual and functional modifications and major changes of web applications. He oversees the production process of a multimedia application and knows when to call in expert help. Aziz has leadership capabilities. He knows how to communicate with customers, how to listen and how to translate customers' wishes into applications. He has editorial skills.
- **CAREER PERSPECTIVE** Aziz has found his niche at Westerkruis. There no chances for career growth in the short term. Aziz could become a policy advisor but that is not where his heart lies. He will then be too far way from the 'real work'. In the future, a similar job in a larger organisation might be interesting for him.

## Building blocks A1, A4, A5, A6, A7, A8, A9, B5

## Context

- **SETTING** Amor Libris Publishers is a medium-sized publisher of popular scientific books and magazines as well as textbooks for secondary and higher education.
- **DETAILED SETTING** The management and its supporting staff and Central Automation Centre are located at the main office. There are two branch offices in the Netherlands and Belgium. For the greater part these branch offices work independently, and have their own publishing and sales departments.
- **SITUATION** Every branch office is responsible for operations, maintenance and management of the local software, data and infrastructure. The branch offices work according to the agreed standards and meet the quality demands set by the Central Automation Centre. Crucial data on sales, buying, full and partial editions, contracts, etc., are centrally managed and stored as well. The central automation centre employs a staff of twenty, most of them in Operations and Management and four in Research and Development. Complaints on operations, especially on the performance of information systems, regularly reach the automation centre.
- **ASSIGNMENT** Improve the performance of the information systems.
- **PROFESSIONAL PRODUCT** An action plan for the improvement of the performance of the information systems.

## The ICT professional

- **BACKGROUND** Marion has worked at Operations and Management at the Central Automation Centre for about a year now. This is her first job after earning her Bachelor degree in ICT. She did her graduate assignment, research into the linking of information systems, at a branch office of Amor Libris.
- **ROLES** Marion works on the improvement of the performance of the existing systems, working closely with the database administrator, the head of automation and the applications manager.
- **TASKS AND ACTIVITIES** Marion and her colleagues work on the analyses of different kinds of transactions. Response times differ strongly and are sometimes unacceptably high. She carries out stress tests on the system using software tools. She includes all aspects that might affect the performance of the system. She compares the practical aspects with the theory. She works on a plan of approach containing well-founded proposals for structural improvement together with the database administrator.
- **EXPERTISE** Marion has general expertise in database management systems (including recovery, security and performance) and specific expertise in DBMSs. She works methodically, independently and result-orientedly with ICT specialists and users.
- **CAREER PERSPECTIVE** Marion could grow to become a database administrator responsible for the implementation, maintenance and operations of large data files crucial for the success of an organisation. She could obtain a management position in a department for functional management or specialize in data warehousing or Internet links.

## Building blocks

A1, A2, A6, A8, A10, B2, B5

## Context

- **SETTING** A large academic medical centre that provides hospital and specialist services to locals and patients from all over the Netherlands.
- **DETAILED SETTING** The hospital has been automated for the greater part. All departments have started using various information systems. All functions are supported by the ICT Department. After a reorganisation, the new ICT Department, employing some forty staff in various positions, provides IT services and support of all applications.
- **SITUATION** Recently, a project providing all hospital staff with individual work spaces was carried out successfully. Possible ways of improving efficiency and internal cooperation within the hospital are being explored. The remote centralized ICT service and support is not considered a success by experienced users. While they used to just pick up the phone to consult with their applications manager, they now have to contact the helpdesk on all ICT related issues. They feel that enquiries and malfunctions are dealt with too slowly. Departmental heads complain about the quality of the service and support to management. The head of the ICT department wants to start using ITIL (ITIL is a collection of best practices in ICT service management, widely used internationally) to enhance the quality of service management to the departments.
- **ASSIGNMENT** Manage a network for the desired level of ICT service management.
- **PROFESSIONAL PRODUCT** The professional product is a level of service management. It entails management reports on the realization of this level, relating to availability and performance of the network, and proposals for improvement.

## The ICT professional

- **BACKGROUND** For a year now, Jeroen has been posted at the hospital from an ICT services organisation. Originally his task was to install the servers (file servers, database servers and application servers) to pave the way for the introduction of individual workstations. He closely works together with a colleague who did the physical configuration of the network.
- **ROLES** Jeroen has been responsible for the management of the network that mainly comprises Windows XP clients since the introduction of the individual workstations. He supervises five colleagues who provide first level management.
- **TASKS AND ACTIVITIES** In the previous project he inventoried the desired service level and uses this as the basis for his current activities. As a co-designer of the infrastructure, Jeroen knows the ins and outs of the new workstations. His current tasks mainly concern preventive maintenance. Jeroen assesses the changing user demands and has system changes carried out by his colleagues from the ICT Department. He supports the introduction of new applications in consultation with the end users. Jeroen is responsible for the satisfactory handling of problems, complaints and malfunctions. Together with his colleagues, he sees to it that problems are dealt with satisfactorily and he reports to the helpdesk. Once a month, he reports to the head of the ICT department.
- **EXPERTISE** Jeroen is able to inventory the desired service level of ICT service management in an organisation. He is up to date on commonly used methods such as ITIL. He is able to build a network and decide on the degree to which the desired service level will be achieved. Jeroen has management capabilities and knows how to supervise a team and work efficiently. He is good at dealing with users.
- **CAREER PERSPECTIVE** Jeroen has indicated that he wants to play a part in the introduction of a process-oriented approach. For instance, he expects a quick result in the incident process. He thinks that process cycles are not always completed and would like to inventory this with the parties involved.

## Building blocks A1, A2, A6, A8, A9, A10, B5

## Context

- **SETTING** ES, a large producer of embedded software for the car industry, operates on the world market. ES 's main activity is the design and production of motor management systems.
- **DETAILED SETTING** Annually, a few dozen types of motor management systems are designed, as part of a limited number of product families, at the TV design department. Embedded software needs to be developed for all these systems. The developers use a large component library. Each component is available in many closely similar variants.
- **SITUATION** One of the reasons that new products enter the market more and more quickly is the continuous international expansion of ES. The design department needs to design reliable embedded software at a continuously increasing speed. That is why the management of all components and the documentation of software has become an increasingly essential part of the whole development process. It must be clear who works on which version at all times. Documentation of software must be kept up to date and developers must have earlier, well-tested versions at their disposal. Furthermore, it must be clear in the end which software was used in which system and how the software was developed. The design department developed its own configuration management system to manage this complex management issue. The system includes a collection of clear rules and agreements and is supported by an application.
- **ASSIGNMENT** Providing configuration management.
- **PROFESSIONAL PRODUCT** A configuration management system, guaranteeing reliable embedded software developed in strongly decreasing time scales.

## The ICT professional

- **BACKGROUND** Phung studied computer science and specialised in the design of embedded software in his studies. During his graduation assignment, he contributed to the development of the configuration management system at ES's design department.
- **ROLES** After graduation, Phung stayed with ES's design department as a junior designer/developer. Use of the configuration management system is an integral part of people's work. Phung is a member of a small development team that develops products within short times scales.
- **TASKS AND ACTIVITIES** Phung's team has been assigned to design embedded software for a product family that is to be newly developed for a well-known car brand. Using strictly defined requirements, Phung has contributed to a first version of a functional design which holds for the whole product family. The work was then allocated and Phung is now responsible for the configuration management of the whole product family. He closely works with all team members.
- **EXPERTISE** Phung has an expert eye for the design and development of embedded software. He is experienced in the use of an integrated development environment and the role of components. Besides, Phung understands management aspects such as configuration management, version management and documentation management.
- **CAREER PERSPECTIVE** It is Phung's goal to become the team leader of a development group at ES

## Building blocks

A1, A3, A6, A7, B1, B3, B5

# Appendices

## APPENDIX 1

List of consulted companies and organisations

## APPENDIX 2

Bachelor and Master levels

## APPENDIX 3

Position Paper HBO-I

## APPENDIX 4

Generic qualifications Professional Bachelor

## APPENDIX 5

International

## APPENDIX 6

References

# LIST OF CONSULTED COMPANIES AND ORGANISATIONS

ABP-CIS
Academisch Ziekenhuis Groningen
Accenture Technology Solutions
Ahold
Atos KPMG Consulting
Atos Origin
BioMérieux bv
Building IT solutions
Capgemini
Chess-iT
Corus Information Services
Defensie Telematica Organisatie
EDS International BV
Ericsson Telecommunication B.V.
Essent kabel.com
Gemeenschappelijk Centrum ICT van de IND
Genootschap van Informatiebeveiligers
HVL
IBM Software Group
ICTRO
Info Support
ING Group
Innovity B.V.
IT-eye
Licom
LogicaCMG Nederland B.V.
Lost boys
Mediaan/abs bv
Mitopics
Movares Europe BV
Nedap N.V.
Nederland ~ICT
Océ Technologies BV
Ordina Holding B.V.
Philips Centre for Industrial Technology Industrial Vision
Philips Medical Systems
Philips Research
Philips Semiconductors
Philips TASS
PinkRoccade
Landelijk Platform IO (Integraal Ontwerpen)
Platform informatiebeveiliging
Procam Benelux B.V.
Qurius ETX
SARA Reken- en Netwerkdiensten
SCIA
Shell International Exploration & Production BV
Siemens
Sogeti Nederland BV, Divisie Distributed Software Engineering
Syntens
Thales Naval Nederland BV
TNO Telecom
TU/e Faculteit Wiskunde en Informatica
Universiteit Utrecht, Instituut voor Informatica en Informatiekunde
Vanderlande Industries Nederland B.V.
Verdonck Holding
Vertis

Table 5: Formal criteria bachelor and master levels for professional and academic higher education

## Professional Bachelor programme

**Entry requirements:**
HAVO, VWO, MBO or Colloquium Doctum

**Award level**
The professional bachelor has competences at the level of a starting professional in a specific profession or related spectrum of professions.

**Most important source / orientation:**
Primary sources of knowledge are the existing knowledge reservoir and the professional practice. Knowledge streams are kept fully up to date.

## University Bachelor programme

**Entry requirements:**
VWO, HBO or Colloquium Doctum

**Award Level:**
The university bachelor can gain entry to at least one master programme or decide to enter the labour market and possibly continue part-time education at the same time. The university bachelor has general competences but, contrary to a professional bachelor, is not trained for a specific profession or related spectrum of professions.

**Most important source / orientation:**
Primary sources of knowledge are the academic discipline, the (international) scientific practice and requirements in a future professional field. First experience is gained with renewal and development of new knowledge.

## Professional Master Programme

**Entry requirements:**
Bachelor degree and possibly selection

**Award Level:**
The professional master strives to increase his/her expert knowledge or domain specific knowledge and skills at the level of an independent and/or managing professional in a specific profession or related spectrum of professions, and/ or strives to broaden his/her tasks in a more multi-disciplinary environment.

**Most important source / orientation:**
Deepening and broadening of the bachelor programme gained through close interaction with the professional practice and through research into the available relevant knowledge reservoir.

## University Master Programme

**Entry requirements:**
Bachelor degree and possible selection

**Award Level:**
The university master has the quality to to carry out independent research and/or has the skills to solve multi- and interdisciplinary issues in a professional practice. Furthermore, a university master is directed towards earning a PhD.

**Most important source / orientation:**
Primary source of knowledge is the academic dicipline, the international scientific practice and domain specific knowledge and skills in a future professional field.

Information and Communication Technology has become an indispensable part of our society. Without ict the economic motor of The Netherlands would come to a complete standstill. Every facet of society and our personal lives is and will be intertwined with ict. More and more professionals with knowledge and skills in the field will be needed to support the increasing impact of ict. This explains why interest in ICT education has grown strongly. Since 1980, universities of professional education have offered broadly based programmes in ICT. By now, more than twenty-thousand students are enrolled in ICT programmes, ranging from Communication and Multimedia Design to Computer Science. Many more study and use ict during their training.

All higher professional programmes in Information Technology, Computer Science and Business Information Technology in The Netherlands are represented in the HBO-I foundation. This foundation strives to contribute to the positioning and image building of ict programmes in The Netherlands, towards potential students (at entry level) and towards the professional field (award level). The HBO-I foundation endeavours to advance the quality of ICT education and stimulate an increase in the number of students enrolled in ict programmes, as it is convinced of the importance of ict in all facets of society. Having enough professionals with the right qualifications in the broad domain of ict, will be essential to the development of the Netherlands as a knowledge country.

The HBO-I foundation acts as the platform for ict programmes and in this role meets universities of higher education, the HBO-raad (The Dutch Association of Universities of Professional Education), industry, companies and other interested parties at home and abroad. Exchanging knowledge between programme managers and lecturers is of major importance. The foundation's endeavours have resulted in a national tie-up of professional and educational profiles and public relations and marketing towards potential students. Furthermore, the foundation represents all ict programmes in national consultative bodies.

The HBO-I foundation fully supports the HBO-raad's advice to award a Bachelor degree to its graduates. The HBO-I- foundation believes that the separate positioning of the ict programmes – independent from Engineering and Economics – is justified and desirable. The foundations aims to represent the full domain of ict. This means that it also wants to be the 'spokesperson' for all related programmes. The foundation is convinced of the future possibilities of broadly based ict programmes because of the increasing importance of ict in all facets of society. The foundation greatly encourages these broadly based programmes because these can attract more students to ict programmes and thus retain more talented students for the sector

The Validation Body for Higher Education has formulated the following ten qualifications [10]:

**1. Broadly-based professionalism**

Displaying cutting edge know-how closely tied to the latest academic know-how, insights, concepts and research results and tied to (international) developments in the professional pracitce as described in the professional profile leading to qualification for:
- independently carrying out the task of a starting professional
- operating in a working environment
- further professionalisation of one's personal relevant professional competences and/or profession

**2. Multidisciplinary integration**

Integration of knowledge, insights, attitudes and skills of different domain specific disciplines from the professional perspective of the ICT specialist.

**3. (Scientific) application**

Application of available relevant scientific insights, theories, concepts en research results to issues that graduates are confronted with in their professional practice.

**4. Transfer and broad usability**

Application of knowledge, insights and skills to different professional situations.

**5. Creativity and complexity of action**

Ability to analyse issues in the professional practice which are not clearly defined at the start and to which standard procedures cannot be applied.

**6. Problem oriented approach**

Ability to independently define a problem in a (complex) situation in professional practice, based on relevant knowledge and (theoretical) insights; ability to develop and apply useful (new) solution strategies and to evaluate the effects.

**7. Methodical and reflective reasoning and action**

Setting realistic goals, planning and/or carrying out a methodical approach of tasks; reflecting on (professional) actions based on the gathering and analysis of relevant information.

**8. Social communicative skills**

Communicating and working with others in a multicultural, international and/or multidisciplinary environment and meeting the demands set when participating in a working environment.

**9. Basic qualification for management positions**

Showing leadership and carrying out simple management tasks.

**10. Sense of social responsibility**

Understanding and involvement are developed relating to ethical, normative and social issues in coherence with the application of knowledge and the future professional practice.

Since 1999, inititatives have been taken in Europe to gain a better insight into the qualificatons, validation and recognition of educational programmes. To this end, a tie-up of acknowledgement and recognition is needed.

Examples of recent initiatives and developments are:
- supporting the development of frameworks for descriptions of e.g. qualifications or skills
- bachelor-master descriptors, such as the Dublin decriptors
- the diploma supplement
- European description of levels
- Validation of programmes

**5.1 Frameworks**

Publications of the European Commission show there is a lot of interest in making the information on knowledge, skills, qualifications and validation more accessible. This is the result of the mobility of workers and the relations on the labour market[12].

Examples of frameworks that stand out:

- Europass Framework for the transparency of Qualifications and Competences. ''Framework, adopted by the Commission on 17 December 2003 is significant here, as well as being the first concrete output of the Copenhagen process. Europass will be a co-ordinated portfolio of documents linked to the European CV."
- European Skills Framework
- Overarching European Framework of Higher Education Qualifications. "'Within such frameworks, degrees should have different defined outcomes. First and second cycle degrees should have different orientations and various profiles in order to accommodate a diversity of individual, academic and labour market needs. First cycle degrees should give access, in the sense of the Lisbon Recognition Convention, to second cycle programmes. Second cycle programmes should give access to doctoral studies." [11]

**5.2 Dublin descriptors**

The first proposals for the JQI (Joint Quality Initiative) Dublin descriptors for bachelors and masters date from March 2002 ( www.jointquality.org).

In the Berlin Communiqué [11] the Dublin descriptors have been described as follows:

" Bachelor's degrees are awarded to students who:
- have demonstrated knowledge and understanding in a field of study that builds upon and supersedes their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study;
- can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study;
- have the ability to gather and interpret relevant data (usually within their field of study) to inform judgements that include reflection on relevant social, scientific or ethical issues;
- can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences;
- have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy.

1. The word 'professional' is used in the descriptors in its broadest sense, relating to those attributes relevant to undertaking work or a vocation and involves the application of some aspects of advanced learning. It is not used with regards to those specific requirements relating to regulated professions. The latter may be identified with the profile / specification.
2. The word 'competence' is used in the descriptors in its broadest sense, allowing for gradation of abilities or skills. It is not used in the narrower sense identified solely on the basis of a 'yes/no' assessment."

**5.3 levels**

Since 2002 decriptions of levels [18] have originated from the Council of Europe and the European Parliament.

Five levels for ''professional qualification"

- level 1, ''attestation of competence"
- level 2, "certificate"
- level 3, "diploma certifying successful completion of a short training course, corresponds to training at post secondary level and of a duration of at least one year and less than three years"
- level 4, "diploma certifying successful completion of an intermediate training course, corresponds to a course of training at higher or university level and of a duration of at least three years and less than four years"
- level 5,"diploma certifying successful completion of a higher training course"

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