



# Bachelor of ICT

*domain description*

— HBØi

— HIGHER PROFESSIONAL EDUCATION  
ICT – BACHELOR PROGRAMMES

## Colophon

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Bachelor of ICT, domain description

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## Foreword

Reading messages on my Blackberry, quickly looking something up on Google, replying to e-mails, I regularly use ICT applications throughout the day. And I'm not the only one doing this. The CBS recently announced that over half of all internet users listened to the radio or watched TV online in 2008. And almost half of them read or downloaded newspapers or news pages. Internet activities have also become similarly integrated in computerised banking and electronic shopping.

New technologies are becoming increasingly useful on a large scale in many areas of society. It goes without saying that ICT has already become indispensable and you can no longer imagine the world economy without it. In the past decades it has developed into being a fully-grown sector of industry which is all around us and affects our daily existence and interpersonal interactions. ICT is everywhere. And ICT professionals are indispensable.

The developments within the ICT sector are in constant progress, and so is the world of ICT training. In 2004, to guarantee the quality of training, a profile description was drawn up for the first time to formulate Bachelor of ICT graduate skills. New training courses are presented, and hard and soft skills are inventoried in consultation with experts in the field. This is the revised version, which provides the training courses with a framework and standard for describing the knowledge and skills of Bachelor of ICT graduates. In short, this document tells you how to place a training within the broad domain of ICT, and what a Bachelor of ICT graduate has to know and be capable of.

The new description makes it possible to compare training courses with each other, so that the flow of students between training courses is supported, also worldwide. I see this description as an important document for the sector as a whole; for training courses setting their curricula, for students making well-founded study choices, and for employers gaining a clear picture of the professionals they are recruiting.

I congratulate the HBO-I on the new Bachelor of ICT description!

Doekle Terpstra  
*Chairman of HBO board*

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## 1. Introduction

Almost all facets of community, business, social and personal life rely on ICT. ICT is not just an important sector of economic activity of its own; it is also an indispensable engine for innovation in all knowledge-intensive domains in our society. The Netherlands has a great need for highly qualified, well-trained HBO (Higher Professional Education) ICT professionals.

The HBO-I foundation aims to keep the Bachelor of ICT description updated. This is a description which can serve as qualitative framework for the content and level of the HBO ICT education. This requires regular updating of the Bachelor of ICT description. We also see that the ICT domain is expanding and penetrating into more and more specialist areas: the demand for a new type of ICT professional is being created. And to meet with the requirements of new training courses, innovations and hypes, a more detailed description is necessary. We have therefore chosen a new line of approach in this document, for describing the Bachelor of ICT, compared to the 2004 description.

The HBO-I has been providing an up-to-date description of the ICT bachelor programmes since 1994. From 1994 to 2009 the current developments are outlined below. Next, the latest description of the Bachelor of ICT is explained in detail.

This description has been produced through intensive collaboration with the leading Dutch ICT companies represented in the HBO-I Counsel and the HBO-I Advisory Board. The members of the HBO-I approved the domain description of the Bachelor of ICT during the platform meeting on 10 June 2009. A broad representation of the ICT business community (named in Appendix 1) subsequently validated the description.

## 2. Developments

In the first editions of the Bachelor of ICT (1994, 1997, 2000), the ICT training courses were drawn up according to training guidelines. This way, training institutions, students and the professional field received a better insight into the contents and quality of the training courses.

But possibilities for students are changing. International and flexible learning processes were made possible by the Treaty of Bologna. The HBO-I foundation therefore engineered a revised profile (2004), which was characterised by five building blocks from the life cycle of information systems, describing the skills of a Bachelor of ICT. This descriptive method has been useful for HBO ICT training courses in the past. It has been adopted by other HBO domains and has more or less become a standard for describing training profiles.

The cycle of development and acceptance of new technologies is growing faster and faster. Society is demanding new knowledge areas, and know-how sometimes overlaps with one or more specific and existing training courses. It is often difficult to predict if these are short-lived developments or if they will have a lasting impact. These developments require a description; a dynamic one, applicable to the training domain and with enough details of ICT aspects and skill level.

Training courses / students must be able to position the programmes they offer / choose clearly within the whole ICT domain. The description from the 2004 version has therefore been extended in this revised edition. Extra dimensions have been added using architectural layers and skill levels. The knowledge domain can be displayed three-dimensionally. The contents of a

training course can be placed and identified in this '3-D space'. Not only does the whole design meet international quality frameworks, it is also a tool for conveniently arranging the programmes' quality, content and levels to be achieved. In this edition, the HBO-I foundation offers to the higher vocational training institutions and the professional field standards for describing ICT training courses, whereby particular attention is paid to the international context.

Training courses often want to base themselves on a Body of Knowledge (BoK) or compose a specific BoK which fits in with the chosen ICT domain. A BoK provides the professional group with knowledge, insights and ideas. It may cover various (scientific) disciplines (fields of study), but also consists of a professional group's established experiences. The BoK is a means for placing the training within the whole of ICT courses.

A BoK can be very useful for applying the tools provided by this Bachelor of ICT description for the mapping of ICT training courses.

The application of these tools can serve as a basis for training courses that do not have a BoK, so that a BoK can be developed, if desired. Descriptions of ICT training courses are positioned in relation to each other in the Bachelor of ICT three-dimensional model.

This document consists of a main text with seven chapters, followed by a second section which includes a large number of examples of characteristic professional situations for ICT professionals who are starting their careers. These examples can be seen as illustrations of elements from the description model and have the aim of visualising the relationship between the description model and professional practice. Finally, additional information is included in the Appendixes.

### 3. Aim and scope of the Bachelor of ICT description

With this description the HBO-I is aiming to provide ICT training courses with a framework and a standard for the description of contents, tasks and competencies. It is a tool for positioning a training in the ICT domain. The model offers users the possibility of explaining the training extensively and in detail, with a solid basis and room for innovations, specialisations and hypes. This makes it clear to students and to businesses what can be expected from a recent Bachelor of ICT graduate. This document offers the HBO ICT training courses support for the positioning, implementation, organisation and validation of their education.

Using the framework of this description, the training courses themselves should then come up with descriptions of the specific knowledge, skills and behaviour within a context, to arrive at training competencies.

The model enables training courses to take advantage of current developments using positioning and profiling within the ICT domain. When these developments give cause to do so, it is possible to design new educational courses and position them within the context of ICT training courses in higher professional education.

### 4. The model

The model gives a systematic description of the Bachelor of ICT domain. This gives training courses room to position themselves within the model. The five phases of the life cycle of information systems form the basis of the model. It must after all be possible for each Bachelor of ICT to be active in these phases.

In order to be able to position different training profiles in relation to each other, ICT architectural layers and the skill levels are also considered alongside the five life cycle phases. This creates a three-dimensional model: the choice of the ICT professional, the aspect of ICT this is related to and the level on which this occurs. The first dimension is the life cycle, as in the 2004 model. The second dimension consists of ICT architectural layers, which indicates which aspects of an ICT system are relevant. The third dimension is the level of skill.

An explanation of the three dimensions and the content of the model follows.

## 5. The three dimensions of the model

### 5.1 Life cycle phases

The life cycle phases of an information system formed the basis of the previous profile description. This appears to have been a useful classification for describing the Bachelor of ICT, which has been adopted by many training courses. Lots of other classifications are of course also possible; models such as the European e-Competence Framework or the framework from the ISO/IEC standard 12207 are also based on the life cycle. The various models distinguish themselves from each other by the level of detail, the interpretation of the life cycle space, the borders between different phases and the processes considered to be separate phases. Other classifications, which are not based on the life cycle, are of course also possible.

The model that the HBO-I used in the previous profile description has received great acceptance. ICT training courses frequently make use of it. It has therefore been decided to use this model as the starting point in this description. The description in this dimension is expressed as follows:

#### *Analyse*

Analysis of the relationships between processes, products and data flows within the context of the environment, and drawing up functional specifications.

#### *Advise*

Formulation of substantiated advice for the reorganisation of processes and / or data flows and for a new ICT system to be developed or purchased on the basis of an analysis and consultation with stakeholders. Aspects such as financing, time, organisation (change), feasibility and risks as well as possibilities for outsourcing are taken into account here.

#### *Design*

Design of an ICT system on the basis of specifications, in connection with an analysis and within the set frameworks for quality, testing, security, lead-time, budget, exploitation and management.

#### *Implement*

Build an ICT system on the basis of a functional and technical design and within the set frameworks for quality, testing, security, lead-time, budget, exploitation and management.

#### *Manage*

Design the utilisation and management of ICT systems, taking care of introduction, testing, integration and commissioning of a new (release of an) ICT system. Provision of services that are agreed (in a Service Level Agreement) within set frameworks for quality and financing. Together with the design and implementation, provide maintenance of ICT systems.

The order in which the phases are described here fits in with the traditional order of life cycle models. This does not mean that this domain description starts from development processes in which the named phases are run through in succession.



## 5.2 ICT architectural layers

The activities in the life cycle phases can relate to very different aspects of ICT systems. The specific activities with regard to content for this can be very different within each life cycle phase. The activities within the life cycle phase designs differ even when they relate to software, business processes or hardware interfacing. In order to make this project differentiation visible, the life cycle phases are represented on the aspect of a related ICT system. A design requirement is that the differences are recognised in the layers.

A different aspect of ICT systems can be found in so-called enterprise architecture models. Examples of this are the Zachman Framework, the DYA-model, the Integrated Architecture Framework (IAF) and The Open Group Architecture Framework (TOGAF).

The aim of these models is to provide mutual harmonisation between the interests and perspectives of stakeholders and subsystems in the development of ICT systems within organisations, as described in the meta-model of the ANSI/IEEE 1471-2000 standard. Classifications in aspects of ICT systems and stakeholders are therefore drawn up in the various architecture models.

The aim of the framework presented here is to describe the broad profile of the Bachelor of ICT. A framework must provide the possibility of giving a description for both the extension of the profile and a sufficient level of detail for learning activities. For aspects that require an extensive learning process, the content needs to be broken down into detailed levels. This has led to the following five ICT architectural layers: User Interaction, Business Processes, Software, Infrastructure and Hardware Interfacing

In combination with the life cycle phases distinguished above, the following matrix is then created. Here the two dimensions are arranged in the extensive profile of the Bachelor of ICT (figure 1).

	<i>analyse</i>	<i>advise</i>	<i>design</i>	<i>implement</i>	<i>manage</i>
<i>user interaction</i>					
<i>business processes</i>					
<i>software</i>					
<i>infrastructure</i>					
<i>hardware interfacing</i>					

figure 1

From the aim of describing education, professional duties which are connected with the implementation of these products are included in the matrix cells. The Bachelor of ICT is trained for these professional duties.

A short description follows for each of the ICT architectural layers. We explain which aspect of ICT systems the layers describe. We also look briefly at the relationship between the layers and at the connection between the ICT architectural layers and the life cycle phases. The ICT

architectural layers sometimes have some dependency and even overlap; they are also not completely independent of the life cycle phases.

#### *User interaction*

User interaction as an architectural layer relates to those aspects of ICT systems in which the interaction of and over the ICT system with the (end) user is central. Interaction of an ICT system with the user relates for example to the system's user interface, while interaction over an ICT system is relevant for example in user documentation and marketing. The emphasis can be on both form and content in this interaction. This row from the profile matrix relates to the development of the user interaction and not to the interaction with users. This occurs when an ICT system is being established and is of course an issue in each ICT architectural layer.

#### *Business processes*

The business processes architectural layer relates to aspects of ICT systems that support the operational management. This therefore concerns the functionality of the system as a whole (automated and non-automated components), seen from the context of the professional goals to be achieved.

#### *Software*

The professional duties in this layer are aimed at the development of (application) software. For clarification: in this architectural layer, management relates to management duties that are part of the software development (and adaptation). Management in the meaning of operation takes place in the infrastructure architectural layer.

#### *Infrastructure*

The infrastructure architectural layer contains the aspect of an ICT system that can function as a service. Alongside the traditional hardware infrastructure, the emphasis is also increasingly being placed on a software infrastructure. Professional duties in this layer relate to making and keeping both the hardware and the software infrastructure available. The development of the separate components of the infrastructure is not part of this architectural layer. The development of the hardware infrastructure belongs to the domain of the electrical technician. The development of the software infrastructure takes place within the software architectural layer.

#### *Hardware interfacing*

Hardware interfacing is the architectural layer where the Bachelor of ICT domain is most closely related to the electro technical domain. This concerns the professional duties that add an elementary software interface to hardware. Despite the necessary conceptual agreements, this layer has been explicitly distinguished from the software architectural layer. Each of these two layers has a large number of specific professional duties that demand an extensive learning process. The wish to be able to describe that with sufficient detail justifies the distinction between these two architectural layers.

Each of the five layers relates to different aspects of sometimes one and the same ICT system. The different layers are related. This connection is not one-dimensional however, as is apparent from the following.

The five architectural layers are presented in a certain order. The five architectural layers roughly describe the areas of knowledge between computer hardware on the bottom, and user(s) of ICT systems on top. Without going into too much detail here, each subsequent layer builds on top of the provisions

established in a previous layer. The order of the five layers is however subject to examination. The position of the infrastructure layers will possibly lead to various opinions. On the one hand the software development uses an infrastructure, on the other hand the software development often leads to the extension of an infrastructure. The order of the business processes and user interactions layers should also be evaluated. Even though the result of this evaluation can possibly lead to a better model, it is not essential.

The introduction of the ICT architectural layers affects the meaning of the life cycle phases. An example of this is described in the software architectural layer explanation. The introduction of the ICT architectural layers makes it possible to describe the contents of the life cycle phases in much more detail. The consequence of this is that it is necessary to actually reconsider what the relevant life cycle phase contains in each layer. By distinguishing business processes from software, it must for example be determined when the analysis relates to business processes and when it relates to software. This depth of content is the aim of the new model. At the same time the borders between architectural layers cannot always be clearly set, which results to (some) professional duties being found in different architectural layers in exceptional cases.

The limits of the model mark the borders of the Bachelor of ICT. The connection to the Bachelor of Engineering is at the bottom, and the Bachelor of ICT connects to various profiles of e.g. the Bachelor of Communication and Bachelor of Design at the top, or even to business of commerce related bachelor profiles such as the Bachelor of Business Administration. Based on the development of the field of study so far we can conclude that the Bachelor of ICT profile extends upwards across the architectural layers. There is also a diversification of the profile at the top.

The conclusion is that with the introduction of the ICT architectural layers to the life cycle phases, we are able to describe the scope of the Bachelor of ICT profile in detail. It is comparable with the way a sentence is created by combining a verb and a subject. By linking life cycle phases to architectural layers, a description of the content of the Bachelor of ICT profile is created in a similar way.

### ***5.3 Skill level and professional duties***

#### *Skill level*

The life cycle phase and architectural layer dimensions from the profile matrix in particular guarantee the Bachelor of ICT domain relevance: it stretches across the breadth of the Bachelor of ICT profile. The combination with the skill level dimension also further defines the depth of the profile and offers a guarantee for the HBO level.

The contents of the cells in the profile matrix give a specific indication of the requirements from the student. For successful implementation of the described professional duties, extensive knowledge and understanding of the field of study is required, which builds on from the level achieved in secondary education.

A description based on professional duties implies professional application as well as knowledge and insight.

Training courses and students can place different emphases within the broad Bachelor of ICT profile, providing different levels at which sub-areas can be managed. To make comparisons possible within this diversity, we distinguish three skill levels. These roughly correspond to the levels 1 to 3 from the

European e-Competence Framework. From this, another representation can be made for levels 3 to 6 from the European Qualifications Framework.

For the characterisation of the skill level, we link in with the level description in dimension 3 of the European e-Competence Framework (e-CF).

The e-CF states five levels of competence at the workplace and always integrates three facets in this competence:

- a. Autonomy: has a range from “carrying out instructions” to “making personal choices”.
- b. Behaviour: represents what is seen as the consequences of an attitude and has a range from “the capacity to apply” to “the capacity to penetrate”.
- c. Context: has a range from “structured - predictable” situations to “unpredictable – unstructured” situations.

The e-CF makes use of competence levels because it is primarily aimed at the ICT professional practice and the human resource management it contains. The EQF levels are related to learning results.

Our focus on a training course profile leads to a more subtle interpretation of the level indication in the e-CF model. Training courses educate and develop skills which serve as a platform for development during a future career. Within the training course, at the third skill level the highest complexity for all facets will therefore not always be achieved in a number of cases. For descriptions at the third skill level it is therefore possible in some cases that autonomy and behaviour, for example, have the highest complexity, when the context is predictable or the context and the behaviour have the highest complexity, still with a minimum of professional assistance.

### *Professional duties*

Professional duties are described in the cells of the profile matrix. This specifies knowledge, skill and attitude of the ICT professional beginning his career. A link with dimension 4 of the e-CF can be made here.

The description of the professional duties in the profile matrix is closely linked to the criteria from the Dublin descriptors or the Netherlands Qualification Framework for Higher Education (NQF-HO). The contents of the cells in the profile matrix (see tables on page 14 - 18) give a specific indication of the performance required from the student.

Each of the mentioned professional duties requires extensive knowledge and thorough understanding of the field of study, building on from the level achieved in secondary education. In many cases it concerns duties that link in with current developments in the field of study, the required knowledge for which can be found in professional reviews. Because the description is based on professional duties, not only knowledge and understanding are required, but also their professional application.

The professional duties from the advise life cycle component phase require at many places explicit competencies relating to accountability and argumentation. More implicitly, these competencies are also in order in the analyse and design life cycle phases for the majority of professional duties. Results from analysis and design always require justification.

Competencies relating to making judgements and communication are mainly required when performing professional duties in the analyse, advise, design and manage life cycle phases.

The completion of almost all professional duties requires lots of new knowledge and skills. It therefore concerns very innovative domains in the majority of cases. This, combined with the increasingly individual knowledge at higher skill levels, requires extensive learning skills from the Bachelor of ICT.

Visually, this leads to the 3-D-model given here. The various architectural layers are displayed on the following pages.

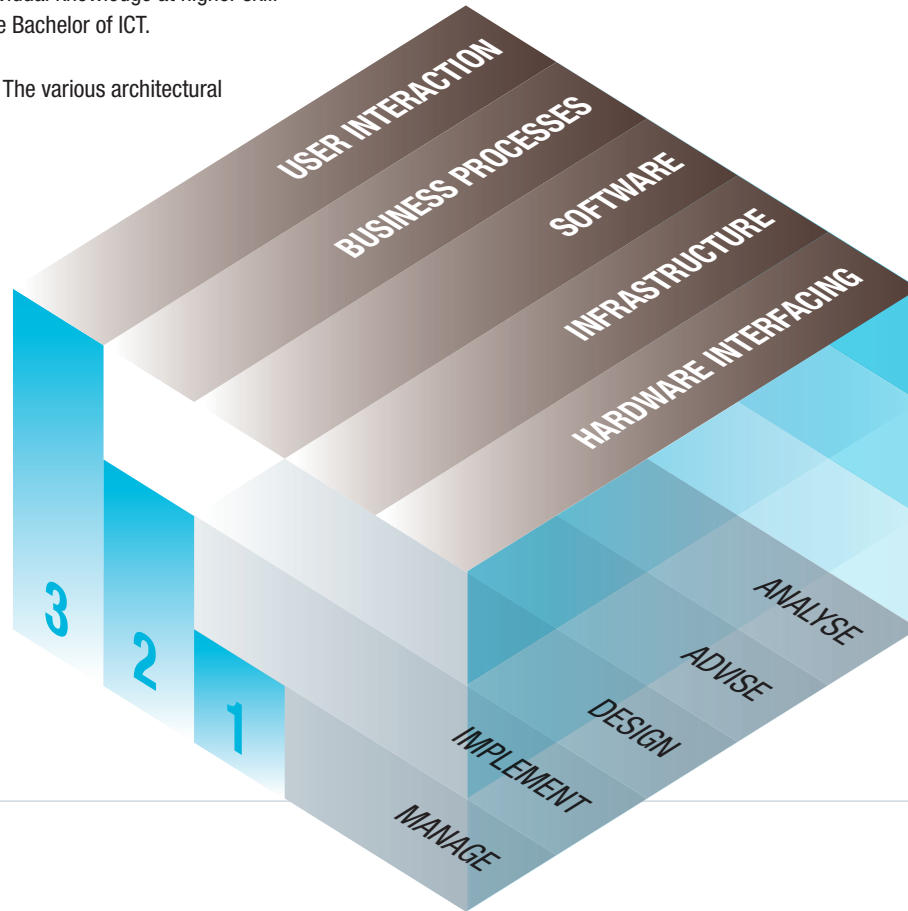


figure 2 – 3D-model of Bachelor of ICT

## USER INTERACTION

LEVEL 3

- |  |  |   |  |  |
|--|--|---|--|--|
| <ul style="list-style-type: none"> <li>– Investigate the corporate and cross-media marketing communication used by an organisation.</li> <li>– Perform market research with a view to new information services, product development, acquisition of new clients and orders.</li> <li>– Draw up an analysis report (problem, users, context, information requirement).</li> <li>– Carry out an information audit.</li> <li>– Draw up a documentary structure plan.</li> </ul> | <ul style="list-style-type: none"> <li>– Develop an integral communication strategy.</li> <li>– Inventory, analyse, define and harmonise objectives, starting points and preconditions for the knowledge infrastructure designed for the company policy.</li> <li>– Draw up a marketing communication plan.</li> </ul> | <ul style="list-style-type: none"> <li>– Draw up an integral and cross-media communication plan.</li> <li>– Develop creative campaign concepts.</li> <li>– Design a house style, associated styling and interaction design.</li> <li>– Draw up an implementation plan.</li> <li>– Draw up a media concept.</li> </ul> | <ul style="list-style-type: none"> <li>– Implement multimedia campaigns.</li> <li>– Set required competencies for end-users.</li> <li>– Supervise, coach and support end-users, (from knowledge and experience).</li> <li>– Carry out marketing research.</li> <li>– Work out a multimedia component (prototype).</li> </ul> | <ul style="list-style-type: none"> <li>– Carry out corporate design management.</li> <li>– Supervise and cooperate on the execution of agreed information services.</li> <li>– Promote the information services and ensure quality.</li> </ul> |
|--|--|---|--|--|

LEVEL 2

- |  |   |  |   |   |
|--|---|--|---|---|
| <ul style="list-style-type: none"> <li>– Chart the relationship between different media releases.</li> <li>– Record the change capacity of the organisation in relation to changes in the information provision.</li> <li>– Recognise and apply design aspects.</li> <li>– Draw up a target group analysis, define a message and draw up an end report.</li> </ul> | <ul style="list-style-type: none"> <li>– Advise in the choice of cross-media platforms.</li> <li>– Advise on the requirements, preconditions and conditions under which a supplier must provide their services.</li> <li>– Present a recommendation, take part in a promotion or present a product.</li> <li>– Draw up a navigation structure.</li> </ul> | <ul style="list-style-type: none"> <li>– Design cross-media communication campaigns.</li> <li>– Recognise and apply design aspects</li> <li>– Draw up a test plan.</li> <li>– Draw up a content plan.</li> <li>– Set and describe the structure (taxonomy, etc.).</li> </ul> | <ul style="list-style-type: none"> <li>– Build integral means of communication.</li> <li>– Provide information, instructions, and demonstrations with the aim of transferring built-up and available relevant knowledge to others, with a pre-defined learning objective.</li> <li>– Set up and perform usability tests.</li> </ul> | <ul style="list-style-type: none"> <li>– Organise content management systems.</li> <li>– Research separate systems and services (perspectives: business processes, technology, customer satisfaction) in order to be able to realise improvements and savings.</li> </ul> |
|--|---|--|---|---|

LEVEL 1

- |  |  |  |  |  |
|--|--|--|--|--|
| <ul style="list-style-type: none"> <li>– Carry out a design analysis at product, communication and environment level.</li> </ul> | <ul style="list-style-type: none"> <li>– Advise on the choice of media in relation to communication purposes and target groups.</li> </ul> | <ul style="list-style-type: none"> <li>– Design multimedia means of communication.</li> <li>– Draw up a story board.</li> <li>– Make Sketches for a user interface.</li> <li>– Design a user interface.</li> </ul> | <ul style="list-style-type: none"> <li>– Apply basic principles of design in constructing a one-dimensional means of communication.</li> </ul> | <ul style="list-style-type: none"> <li>– Collect, select and order internal and external information from order, resulting in a (digital) report tailored to clients.</li> </ul> |
|--|--|--|--|--|

ANALYSE

ADVISE

DESIGN

IMPLEMENT

MANAGE

## BUSINESS PROCESSES

LEVEL 3

- Study the consequences of a (strategic) change of course for business processes and their information provision.

- Advise on the harmonisation between business and ICT (alignment and governance).

- Design architecture of processes with associated management and information provision.

- Change operational management including the introduction of systems with interfaces.
- Supervise and execute change processes.

- Manage process architecture (principles, business rules and models).

LEVEL 2

- From the perspective of the information provision, analysis and description of:
  - business processes
  - organisation
  - data flows
  - process control (at tactical/operational level).
- Describe bottlenecks and cause-effect relationships.

- Advise on bottlenecks in the field of:
  - relation between processes
  - organisation (roles)
  - process structure
  - operational / tactical control
  - information provision in a chain.

- In relation to IT possibilities, design of:
  - business processes (whether in a chain or not)
  - process management of business processes
  - the functional
  - organisation structure.

- Realise introduction and acceptance of new procedures in relation to changed information provision and control.

- Organise process management and implement process changes.

LEVEL 1

- Make an inventory of the organisation and the data flows / information provision for a single business process and describe bottlenecks and cause-effect relationships.

- Advise with regard to bottlenecks, for a single process and within a simple context with a limited number of perspectives, in the field of:
  - organisation (structure)
  - process structure
  - information provision.

- Styling of:
  - a single business process
  - an organisation component
  - the information provision for a business process within a simple context with a limited number of perspectives.

- Describe and draw up work instructions, function and role descriptions and procedures for an adapted process.

- Maintain process documentation and make an inventory of the need for process changes.

ANALYSE

ADVISE

DESIGN

IMPLEMENT

MANAGE

## SOFTWARE

LEVEL 3

- |  |   |   |   |  |
|--|---|---|---|--|
| <ul style="list-style-type: none"> <li>– Carry out a requirement analysis for a complex software system in a context of various existing systems with different interested parties.</li> <li>– Draw up an acceptance test plan.</li> </ul> | <ul style="list-style-type: none"> <li>– Advise with regard to the choice of structural software architecture (such as n-tier, client server) and software frameworks (such as Spring, Struts, etc.) within a single software platform (such as .Net, JEE, etc.).</li> <li>– Draw up a recommendation for organising a software development process.</li> </ul> | <ul style="list-style-type: none"> <li>– Draw up a design for an information system using elementary software architectures.</li> </ul> | <ul style="list-style-type: none"> <li>– Build, test and make software available using a development environment, making use of existing software frameworks which link in with existing software.</li> </ul> | <ul style="list-style-type: none"> <li>– Organise and manage a team software development environment and carry out extensive configuration and change management.</li> </ul> |
|--|---|---|---|--|

LEVEL 2

- |  |   |  |   |   |
|--|---|--|---|---|
| <ul style="list-style-type: none"> <li>– Carry out a requirement analysis, taking account of the different interested parties, functional and non-functional requirements, and existing systems.</li> <li>– Draw up an extensive acceptance test.</li> </ul> | <ul style="list-style-type: none"> <li>– Advise with regard to adapting existing software.</li> </ul> | <ul style="list-style-type: none"> <li>– Using a design tool, draw up a complete design for an information system that consists of multiple subsystems and connects to existing software.</li> </ul> | <ul style="list-style-type: none"> <li>– Build, test and make an information system available, which consists of multiple subsystems. Also connect to existing software and make use of a development environment.</li> </ul> | <ul style="list-style-type: none"> <li>– Use and configure tooling to support software development in teams.</li> <li>– Manage and optimise personal software development process.</li> </ul> |
|--|---|--|---|---|

LEVEL 1

- |  |  |  |   |   |
|--|--|--|---|---|
| <ul style="list-style-type: none"> <li>– Carry out a requirement analysis for a simple information system, in accordance with a standard method.</li> <li>– Draw up a simple acceptance test.</li> </ul> | <ul style="list-style-type: none"> <li>– Advise with regard to the development, realisation, adaptation or purchasing of a simple information system.</li> </ul> | <ul style="list-style-type: none"> <li>– Draw up a design for a simple information system with a technical drawing.</li> </ul> | <ul style="list-style-type: none"> <li>– Build, test and make a simple information system available.</li> </ul> | <ul style="list-style-type: none"> <li>– Manage personal files and the configuration of these files in a software development environment.</li> </ul> |
|--|--|--|---|---|

ANALYSE

ADVISE

DESIGN

IMPLEMENT

MANAGE



## INFRASTRUCTURE

LEVEL 3

- |  |   |  |   |   |
|--|---|--|---|---|
| <ul style="list-style-type: none"> <li>– Analyse an existing, complex and large-scale or global study into the use of technology, methods and alternatives.</li> <li>– Carry out an advanced security analysis of network and applications.</li> </ul> | <ul style="list-style-type: none"> <li>– Advise on information security and on the organisation of an large company network.</li> <li>– Have ability to apply a broad argumentation for technology, business processes, costs/benefits, risks and legislation.</li> </ul> | <ul style="list-style-type: none"> <li>– Design a secure, multi-site, worldwide company network including possible security measures with specialist and state-of-the-art technology.</li> </ul> | <ul style="list-style-type: none"> <li>– Prepare, roll out and test a system of customised solutions (non-standard solutions).</li> </ul> | <ul style="list-style-type: none"> <li>– Optimise and control a management organisation, taking the client organisation into account: SLA management, and application management.</li> <li>– Evaluate the quality of the service and infrastructure and organise and / or optimise management processes.</li> <li>– Apply security information management.</li> </ul> |
|--|---|--|---|---|

LEVEL 2

- |   |   |   |  |  |
|---|---|---|--|--|
| <ul style="list-style-type: none"> <li>– For a medium-sized company network:             <ul style="list-style-type: none"> <li>- research requirements and wishes</li> <li>- assess standard technology and available alternatives</li> <li>- investigate security risks with applications</li> <li>- analyse the performance of applications in relation to a chosen OS.</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>– Advise on the layout and security of a company network with applications.</li> <li>– Carry out package selection for infrastructure and security related software and hardware.</li> <li>– Propose measures for the benefit of the information security of the network.</li> </ul> | <ul style="list-style-type: none"> <li>– Design a medium-sized company network, on the basis of the information systems in the organisation with standard technologies, taking security requirements into account.</li> <li>– Describe functional design, processes and procedures for maintenance and management.</li> </ul> | <ul style="list-style-type: none"> <li>– Build, configure, implement and describe a medium-sized company network.</li> <li>– Measure the capacity of the infrastructure and applications.</li> <li>– Implement security measures in a medium-sized company network.</li> </ul> | <ul style="list-style-type: none"> <li>– Manage infrastructure and applications.</li> <li>– Carry out secure management of services and applications remotely.</li> <li>– Evaluate the performance of applications and infrastructure.</li> <li>– Report on the performance of infrastructure and applications.</li> </ul> |
|---|---|---|--|--|

LEVEL 1

- |   |   |  |  |  |
|---|---|--|--|--|
| <ul style="list-style-type: none"> <li>– Analyse a simple network or stand-alone computer system on the basis of given client wishes and requirements.</li> <li>– Draw up specifications (OS, LAN, workplace, security).</li> </ul> | <ul style="list-style-type: none"> <li>– Advise on security and organisation of a workplace or simple network.</li> </ul> | <ul style="list-style-type: none"> <li>– Design and specify a simple network.</li> </ul> | <ul style="list-style-type: none"> <li>– Build, install and document a simple computer network.</li> </ul> | <ul style="list-style-type: none"> <li>– Carry out the operational management of infrastructure and services.</li> </ul> |
|---|---|--|--|--|

ANALYSE

ADVISE

DESIGN

IMPLEMENT

MANAGE

## HARDWARE INTERFACING

LEVEL 3

- Specify an embedded system, equipped with actuators and sensors, taking timing, resources and performance into account.

- Bring out an advice report for an embedded system, including HW/SW decomposition.

- Methodically design programmable hardware and complex programmable building blocks.

- Realise an embedded software system, including HW/SW co-design and device driver design.

- Organise a complete development and test platform for HW/SW co-design, including associated tooling.

LEVEL 2

- Analyse signals and regulation aspects of an embedded system environment and methodically specify an embedded system.
- Draw up an acceptance test plan.

- Advise with regard to the architecture to be chosen for an embedded / IA system, particularly the micro-controller, OS, memory distribution and peripheral equipment.

- Methodically design an embedded / IA system, including HW/SW decomposition and low-level interfaces, and design programmable building blocks, including drawing up the driver design.

- Activate a link or regulation between an embedded / IA system and hardware using a device driver and hardware-oriented programming.

- Set up a cross-platform development environment (both software and hardware related), including associated tooling.

LEVEL 1

- Describe architecture for an embedded system.
- Draw up functional specifications for an embedded system and an associated acceptance test.

- Determine an initial architecture based on a given system configuration and provide technical advice.

- Design a simple programmable system.

- Realise a simple embedded system equipped with actuators and sensors, including delivering the hardware and write and test the driver software.

- Organise a compiler environment for a micro processor and associated peripherals.

ANALYSE

ADVISE

DESIGN

IMPLEMENT

MANAGE

## 6. Application of the model

The model presented above broadly describes the Bachelor of ICT. No description has been given of a specific training course or a professional who has graduated from such a training course. That is a task for the various training courses, leaving room for the refining of training course profiles, seen from the perspective of the range of education programmes on offer and the demand from individual students and employers. In the following text we describe the possible roles that the presented model can then play in the development and accountability of curricula, education performance and recruitment, selection and personnel policy.

### 6.1 Development and responsibility of curricula

The development of a curriculum from the model implies the definition of the scope and the extent at which options can be made. In other words, defining what the training course profile will look like by direct or indirect referencing to the training competencies of the model.

We can display the positioning of a curriculum in this model as a table in which the life cycle phases are compared to the ICT architectural layers. In the cells in this table, the training courses can show which levels are required and which are optional for a training course profile or its phases. A curriculum is characterised by the contours in the profile matrix and the further specific details of the professional duties formulated in chapter 5. In figures 3 – 6, examples are shown of possible interpretations of the profile matrix for a number of training courses.

A more indirect relationship with the profile matrix is achieved by then relating the scope and the extent of choices defined in training course competencies to the profile matrix. It's possible to choose for a more or less strict relationship between the training course competencies and the profile matrix.

There are various different paths for defining training course competencies based on the profile matrix. The training courses can make various choices in the level of detail that they are aiming for and in formulating the style. The more the formulated training course competencies follow the structure of the model, the higher are its possible applications. The relationship can be simply visualised by using the classification of the profile matrix for defining and delimiting of the competencies. If a completely different, own classification is used for the definition of the competencies, then a separate description and reference are required.





























		<i>analyse</i>	<i>advise</i>	<i>design</i>	<i>implement</i>	<i>manage</i>
 level 3	<i>user interaction</i>					
 level 2	<i>business processes</i>					
 level 1	<i>software</i>					
	<i>infrastructure</i>					
	<i>hardware interfacing</i>					

figure 3 – example of profile matrix for Business Information Technology

Regardless of the way in which training courses use the model to characterise a training course profile, it will always be necessary to specify the contents of the model in more detail. This can also take on different forms. Required knowledge, skill and attitude aspects can be described further, for example, using performance indicators. On one hand for educational development, on the other hand for assessment and testing. This further specific description also offers the possibility of looking in more detail at aspects of the HBO qualification (NQF-HO) in relation to the content of the profile matrix. It is then possible to link the more detailed content to specific curriculum components.

After following the above-mentioned steps, the profile matrix will fulfil an important role in the accountability of a curriculum.

The profile matrix offers the possibility of displaying a training course profile in a very convenient and organised arrangement. The profile matrix is also a tool

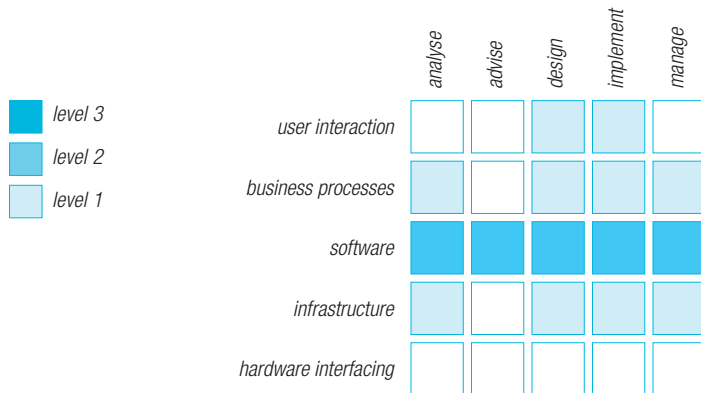


figure 4 – example of profile matrix for Information Technology

for showing how a training course profile is translated into specific curriculum component contents.

## 6.2 Education performance

In education performance, the profile matrix can play a role in training, student choices, and the assessment process. Hereafter follows a brief explanation of each these applications.

The education offers can vary from a standard programme to simply the definition of final terms in combination with education fully meeting the demands. In practice the reality mostly lies somewhere between these two extremes. We describe both options of the role in the profile matrix below. The practice, which mostly lies somewhere in the middle of these two education options, allows for using a part of each of these methods.

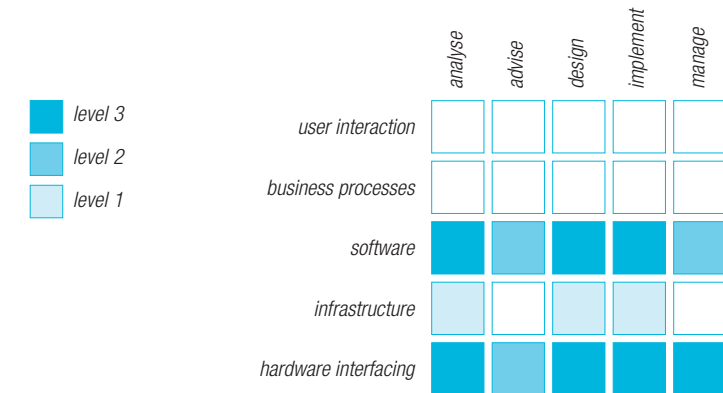


figure 5 – example of profile matrix for Computer Science

When offering a standard programme for a training course, a student can make a choice from the training courses offered. An explanation is needed about the objective and assessment criteria for a standard programme, as well as regarding the mutual relationship between programme components. By referring to cells in the profile matrix from components of the standard programme and performance indicators linked to them, the student can form her/his own opinion about the programme. An image of the mutual relationship is formed as various curriculum components refer to the same profile matrix.

With an education model based fully on demand, a student formulates learning requests within the context of the training course profile. The student then searches for the education that meets these requests. The profile matrix, with its specific effect on e.g. performance indicators will then play an important role in the requests formulated by the students.

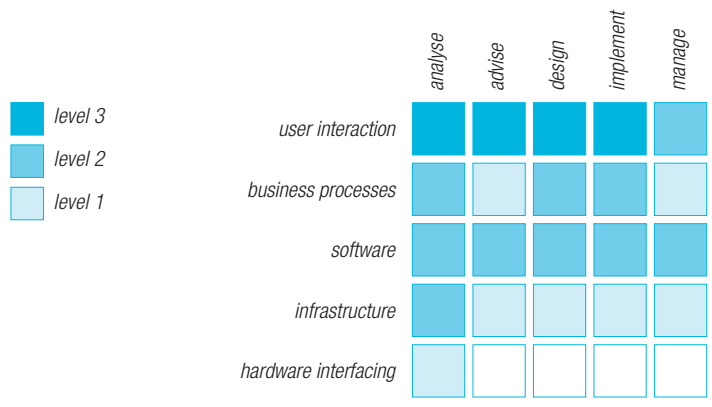


figure 6 – example of profile matrix for Communication & Multimedia Design

Once the learning demands have been formulated, a matching education must be found. If, in addition to fully customized education, a choice is possible from a range of existing training courses, then the profile matrix is a tool for finding the appropriate education. After all, for every available curriculum component a matching component can be found in the profile matrix. If a student also does the same with their learning demands, they will be able to determine which education fits in with their formulated learning demands. This process does not of course have to limit itself to an educational institution or even to training institutions in general. Also business courses and internships can use the model, so that they can be selected for a matching formulated learning demand.

This model can also be of service for the assessment, particularly for the evaluation of individual study paths and previously acquired skills. The assessment can take place using criteria that are related to the model. The relation with the profile matrix makes it possible to determine to what extent the profile meets a certain curriculum. If necessary this can be separate from an educational programme in which exact goals to be achieved and certain criteria are set beforehand in individual programme components. This can be done through unambiguous reference to cells in the profile matrix and further associated details such as e.g. performance indicators.

The student also has a role to play in determining objectives and criteria in another way, for example, in the case of area selection and work placement assignments. For the assessment, the student can indicate the corresponding components of the profile matrix. The performance indicators related to the profile matrix then also play a role in the assessment. Or a training course can also leave space for students to draw up their own performance indicators.

### ***6.3 Application from the professional field***

Input for drawing up the profile matrix, and in particular for the formulation of professional duties as part of it, is supplied from a professional critical review. The ultimate profile matrix can play a role in the recruitment and selection of new employees, as well as in professionalisation projects.

For recruitment and selection, a job vacancy profile can be created using the profile matrix. Potential candidates can use this basis to gain insight into the employer's wishes. In the selection process it is then possible to draw up candidates' profiles and compare them with the profile for the appropriate job vacancy. Explicit pretraining course requirements follow from the training course profiles that are represented on the profile matrix.

An example of an existing workforce on the profile matrix displays the quality and the skills of the workforce. Something similar is possible for the requirements that assignments and customers set for employees. The monitoring of the match between the training course domain and the job vacancy profile is a way of then directing the specific professionalisation.

## 7. Summary

The HBO-I foundation, in which the Dutch HBO ICT training courses cooperate, published a broadly accepted profile description for the Bachelor of ICT in 2004. This description has served as a basis for the curriculum for almost all ICT training courses in the Netherlands. In this description five globally described competency building blocks are supplemented with a large number of concrete illustrations. On the basis of this each training course has formulated its final terms or competencies and organised its curriculum in its own way.

The HBO (ICT) landscape has of course changed since the publication. Information and communication technology has gained an ever greater influence and meaning in society. Without ICT the economic engine in the Netherlands would have come to a standstill. In fact ICT applications have penetrated all aspects of public and private life. And its importance is increasing. More and more professionals with knowledge and skills in this field of study are needed in order to continue supporting this increasing influence of ICT.

Society is demanding new knowledge areas and know-how sometimes overlaps existing training courses. It is often difficult to predict if these are temporary developments or if they will have a lasting impact. These developments require a description. A dynamic one, applicable to the training domain and with enough details of ICT aspects and skill level.

In this new description of the Bachelor of ICT domain more attention is given to the description of the contents of HBO ICT training courses in comparison with the previous version. The new profile refines the description by describing the various life cycle phases (Analyse, Advise, Design, Implement, Manage) for five ICT architectural layers. A further refinement is the description on three levels, which fits in with developments at a European level. A relationship is made with the e-CF (European e-Competence Framework) and the EQF (European Qualification Framework for Lifelong Learning).

Professional duties are described briefly and concisely for the Bachelor of ICT for each life cycle phase, each architectural layer and each of the three levels. The full scope of the Bachelor of ICT profile is therefore outlined in three dimensions. Training courses can position themselves easily in the three-dimensional space thus created. The image of a curriculum in a three-dimensional area enables curriculum development to gain structure and flexibility. At the same time it is easy to determine the mutual position of various training courses. This way, students are supported in their choice of a training course and the transfer and flow between training courses is simplified.

The Bachelor of ICT description is illustrated using a large number of examples with characteristic professional situations (for ICT professionals starting their career).





# Illustrations of the Bachelor of ICT

## ... an easy-to-read analysis report...

### CONTEXT

#### *Profile of the organisation*

Automed is a multinational enterprise which focuses on the design, construction, sales and maintenance of medical systems.

#### *Specific profile*

Automed is a specialist in biometric equipment. These are machines that can measure physical functions: temperature, heart rate, blood pressure, electromagnetic brain activity, muscle activity, etc. The basic configuration of such machines, which vary in size from smaller than a centimetre to man-sized, is always the same. One or more sensors measure a physical function and send measurement data to a processor unit, which collects and processes data. The processor unit then controls an output device, which makes the data visible. Clients are naturally found mainly in the medical sector: hospitals, independently established specialists, doctors and sometimes also patients.

#### *Situation*

Automed recently began an internal project which has to provide answers to the following questions: Is the TINI (Tiny InterNet Interface: a printed circuit board (PCB) the size of a SIMM containing a processor on which a Java virtual machine runs, together with a real-time operating system and a TCP/IP stack) suitable for applications developed by Automed? Is Linux a reliable platform for Automed applications? And what type of applications is the TINI/Linux combination suitable for?

#### *Assignment*

Find out if the TINI/Linux combination is usable for a number of promising applications. If this is the case, describe how the combination can be deployed. All technical difficulties must be analysed to a level that enables the manage-

ment to decide for which applications it is safe to make the switch over. This should also include an overview of the expected costs and the return on investment.

#### *Professional product*

An easy- to-read analysis report with conclusions from the research, with substantiated advice.

### THE ICT PROFESSIONAL

#### *Background*

Chaidza did a work experience placement with Automed in Hilversum during her Computer Science studies. The project she is now working on is a continuation of her thesis subject for which she did preliminary research into the applicability of TINI for Automed applications. She discovered a number of promising applications and concluded by recommending that these applications should be researched further. The project must be completed within six months. Chaidza felt attracted by the technical environment at Automed. With this enterprise she can use her technical knowledge for the health of her fellow man. This is very motivating for her.

#### *Roles*

The Research & Development department manager is the project leader, and Chaidza is part of a small research team made up from HBO students and academics. In this project Chaidza does not have much contact with the 'real' Automed clients, because the applications that she is researching are working applications with satisfied clients. The clients are not interested in the internal working of these applications.

### Tasks and activities

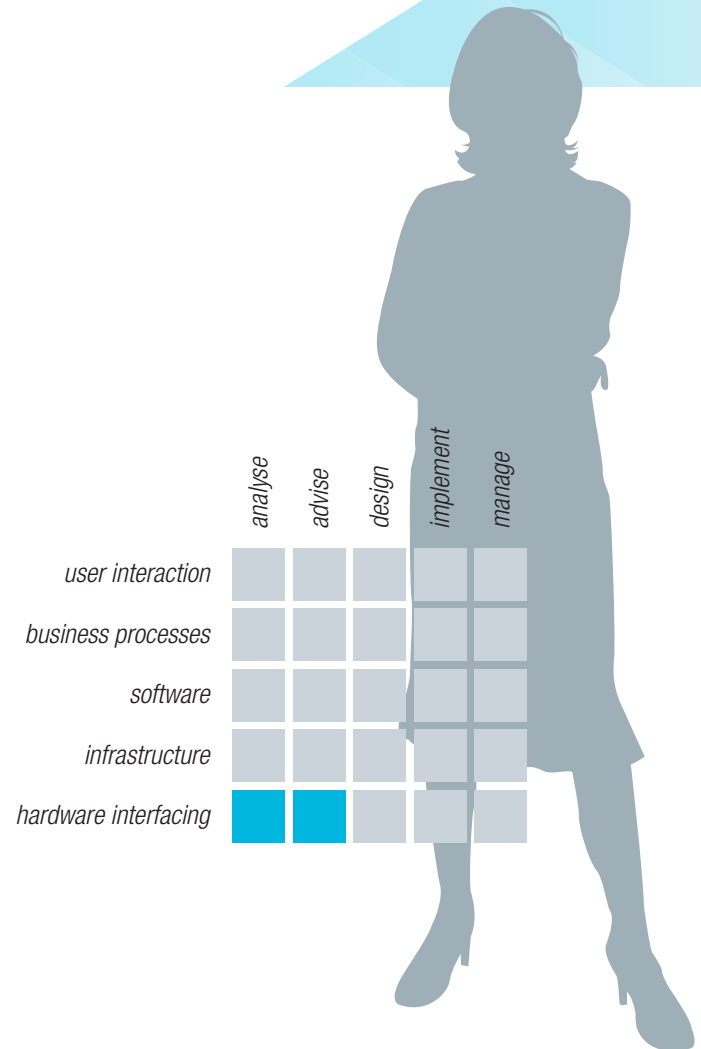
Chaidza has to push herself to the limit in this project. Her technical knowledge is given a thorough test. She already knows, also from her work experience placement, a lot about the TINI, but the combination with Linux is new for her. The variety of sensors that Automed works with regularly causes technical complications. Chaidza has worked with databases. This is useful here as the measurement data has to be stored in databases. The combination with portable machines that send data wirelessly to a database on the internet is completely new for her, however.

### Expertise

Chaidza is curious; she wants to know the exact details. She likes getting her teeth into difficult problems with her colleagues. She is open to other people's findings, but is persistent when she is certain she's right. Chaidza has good knowledge of operating systems and real-time processes. She can save and manage data with the help of a database. As Automed is a company that operates internationally, she works in a multi-national team. The official language used is English.

### Career perspectives

Chaidza came straight to the R&D department after her thesis project. Many of her colleagues first spent a couple of years working in the field, where implementation of hardware and software and maintenance and management questions make up the bulk of the work. For the moment she is not expecting any spectacular career moves.



## ... develop an information system...

### CONTEXT

#### *Profile of the organisation*

The headquarters of the NBVB football association looks after the interests of its affiliated associations.

#### *Specific profile*

The association headquarters is a small organisation. The internal and external communication is informal. The lines are short. The association takes care of the promotion of the sport (national and international), strives for optimal performance from members and associations, supports associations and members and organises competitions. The NBVB provides training for coaches and has a national training centre where talented young players can develop further under the guidance of an association coach.

#### *Situation*

The association headquarters provide the administration and national organisation and has ten employees. They work with account managers for the contact with and service provision for the various associations. They are the first point of contact for the associations. At the association headquarters, there is a (paper) archive of the various questions from members and associations, with appropriate answers / solutions to support the account managers. This archive doesn't function as well as it should. Looking things up takes too much time and information is often obsolete and not updated. The association's board recently decided to dramatically improve this information service.

#### *Assignment*

The NBVB commissioned the software consultancy agency Info-consult to come up with a prototype information system for the account managers. The possibility

of making the system via the internet accessible for the individual associations in the future is part of the task.

#### *Professional product*

Clear and unambiguous specifications of the information system to be developed for the benefit of the account managers. Also a working prototype based on these specifications.

### THE ICT PROFESSIONAL

#### *Background*

Karen started to work as a junior systems analyst at Info-consult straight after graduation. In her first projects her work consisted of translating analyses into programme designs under the supervision of experienced business analysts.

#### *Roles*

Info-consult composed a project team to perform this task. Karen has the role of junior systems analyst / designer in this project team. Eric, the senior systems analyst at Info-consult, is the project leader. The rest of the project team is made up from developers / programmers. During the assignment, the project team has close contact with the customer and various account managers.

#### *Tasks and activities*

Karen, together with Eric, had meetings with the account managers, studied the paper archive and visited various associations. Together with Eric she put together a survey to gain a better picture of the account management tasks and the desired service provision. This survey was sent to the account managers and the associations.

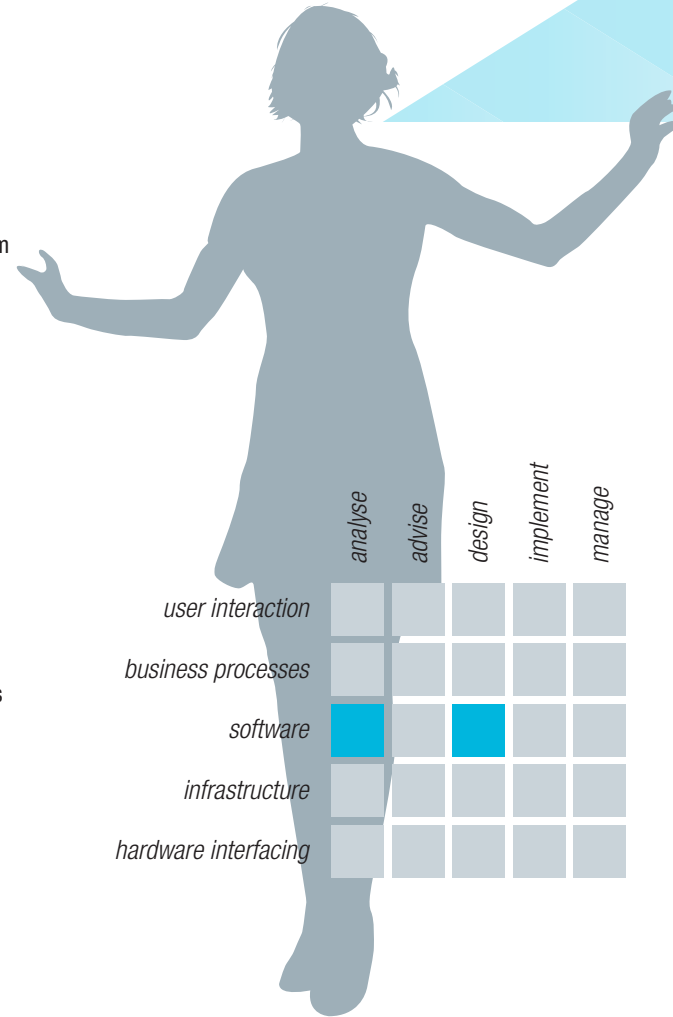
On the basis of this information, and in consultation with Eric, she set the specifications for the prototype with the help of UML. A conversion was made into a data model using ERD technology to design the data structure. This all took place in constant consultation with the other members of the project team and the account managers, whereby the developers / programmers always updated the prototype for the desired information system on the basis of the latest specifications. Karen and Eric demonstrate this prototype in regular progress meetings with the customer.

### Expertise

Karen can put together an analysis of the current and desired situation for a small information system on the basis of meetings and a survey. She is client-oriented and can, in cooperation with others, come to a design for the data structure that can be transferred to the developers of the system. This means that she can work with accessible methods and techniques for designing information systems. She has knowledge of various programming methods, including prototyping of database systems and web programming. Karen is good at listening to others and translating comments into adaptations in the design.

### Career perspectives

Karen can grow to the level of a senior information analyst.



## ... a functional design...

### CONTEXT

#### *Profile of the organisation*

Engineering firm Blue Chips concentrates on designing and building embedded systems.

#### *Specific profile*

Typical projects are designing and building software for a large photocopying machine factory or for a company that builds equipment for manufacturing chips. The software is always 'baked' in chips. This sets high requirements for the quality of the software. They have to be 100 percent fault-free, reliable and almost always extremely fast. Lots of chips are used in production streets which are set to be accurate to within a millisecond.

#### *Situation*

A robot arm must perform an extremely precise task in a production street for a new type of photocopying machine. The robot arm must be exceptionally precise, which is a new experience in this work. The software must be 100 percent reliable; a small deviation directly results in a big problem. The arm receives its information via sensors, the data is processed and the movements of the arm respond to this. Everything happens in real-time: the response time must remain limited to a maximum of 10 milliseconds.

#### *Assignment*

Make a functional design for the control 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 formulated clearly and unambiguously and approved by the customer.

### THE ICT PROFESSIONAL

#### *Background*

Peter has worked for Blue Chips as a junior engineer for one year. He has completed his training in Computer Science, where he acquired much technological know-how. He also learned to work in projects. Peter has spent the past year collaborating on a new project for a regular customer of Blue Chips, a photocopying machine manufacturer.

#### *Roles*

Peter is a project team member in this project.

#### *Tasks and activities*

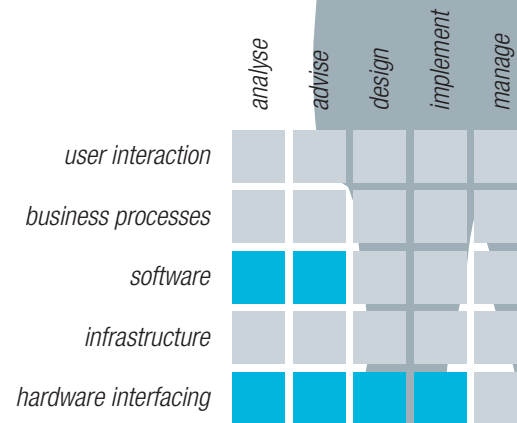
Peter's main contribution on this project consists of drawing up functional requirements for the software to be built. This gives him a complete insight into environment variables. He also has to look after the interests of Blue Chips. He is learning very fast the specific possibilities and difficulties of the used technique. He is making estimates of the financial consequences of his work. He is contributing to the offer and making a first draft for the project. He works together with colleagues, also from other specialist areas, and communicates with them and the customer.

### Expertise

Peter can communicate well with clients, customers and colleagues. He has good technological know-how and can quickly learn technical specifications for an order. He has a thorough command of design methods and programming languages which are suitable for creating real-time embedded software.

### Career perspectives

Peter hopes to complete this project successfully and then to start work with another client on a new project. He participates in all sorts of company activities with Blue Chips and is a member of an expert group which does research into new technologies that the company might use in the future. A lot of his research is seen as recreational, but if Peter has a real training question, his personal manager is always happy to listen. Peter also discusses his PDP and has his assessment and function meetings with him. Over the next six years, Peter would like to grow into being an expert in the field of system development, who can supervise and coach colleague developers on methodology, architecture and techniques. He thinks that he might have to change employer for this and is also looking for a master's course to attend alongside his work.



## ... instrumented software...

### CONTEXT

#### *Profile of the organisation*

Nedcon is one of the world's largest producers of semiconductors and is a world leader in the field of complete, affordable and easy-to-use systems-on-silicon.

#### *Specific profile*

The Nedcon Innovation Centre (NIC) develops architectures, reference designs, software platforms and applications. Solutions for consumer products are designed and implemented in cooperation with lead customers. The company employs around three hundred people who collaborate closely with other development centres in Europe, the United States and Asia.

#### *Situation*

A digital TV platform, which integrates the basic functionality with the programmable digital TV chips produced by NIC, is being developed within the company for the TV market. A high image quality is very important for lots of TV viewers, and Nedcon distinguishes itself in this from its competitors. The TV platform is constantly being expanded and improved. The scope of the platform is in the region of a million lines of C-code and is growing further.

The platform is divided into various subsystems for which a team supervised by a team leader and a subsystem architect are responsible. The subsystem that provides the improved picture quality after decoding has grown over the years and is difficult to maintain. The subsystem now contains around 150,000 lines of code. This leads to performance problems and uses too much memory. It is unclear what causes this problem.

#### *Assignment*

The assignment concerns the instrumentation of the software (expanding the software in such a way that measurements can be taken from it) and taking measurements to gain an insight into the problem. It should be possible to easily implement this instrumentation and measurement layout in other subsystems at a later date.

#### *Professional product*

Instrumented software and a report that describes the instrumentation and measurement structure for its later use in other subsystems. It is also expected that it will be possible to perform and analyse the measurements independently in close consultation with the subsystem architect.

### THE ICT PROFESSIONAL

#### *Background*

Rachel has worked for nearly two years at NIC since graduating as a Bachelor of ICT. She mainly works on setting up and maintaining the development environment for the image processing system. She recently switched from this situation to the development team for the image improvement subsystem. This is her first assignment.

#### *Roles*

Team leader Louis is Rachel's supervisor. He is responsible for the improvement of the subsystem together with system architect Ger. Rachel works together intensively with Ger and the four other team members. She also works together with Peter, who is responsible for the functional and performance testing of the platform.



### Tasks and activities

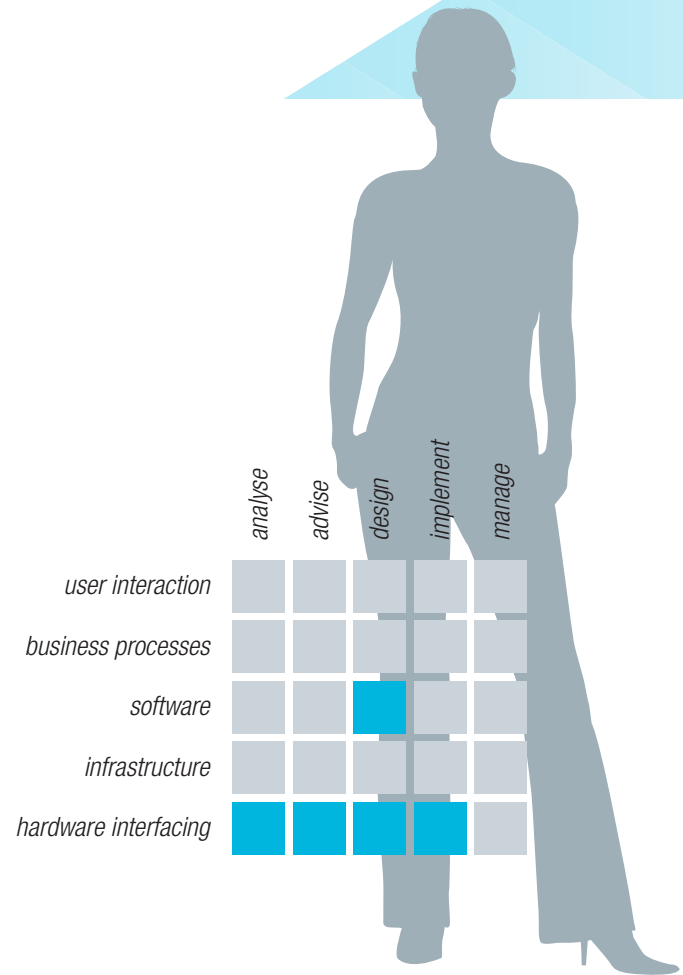
Rachel needs to examine further the multi-threading aspects and memory management. A tool belonging to the real-time core that provides insight into the multi-threading behaviour is an important resource for this. She makes a concept design and a measurement plan from the instrumentation in cooperation with the other team members, particularly Ger and Peter. She also looks for other environments within the company which have been confronted with this problem. After a review and improvements, Rachel implements and tests her design and carries out the agreed measurements independently. She uses this experience and the acquired knowledge as a basis for adding more new measurements. She discusses the results with Ger and Louis and makes a report with a description of the causes of the problems. She also makes suggestions for improvement.

### Expertise

Rachel knows about multi-threading applications and the aspects relevant for the performance, both software and hardware. She can analyse and penetrate complex code written in C and communicate effectively about it with the other members of the team. She can gain insight into performance aspects on the basis of measurements, and indicate where improvements are needed.

### Career perspectives

Rachel wants to work further on implementing new subsystem components as a member of the team. Ideally, she would eventually like to become a subsystem architect. In order to make this happen, she has agreed with her supervisor that she will draw up a training plan for the coming years, which will include both the necessary professional research as well as the required development.



## ... perfectly working programme components...

### CONTEXT

#### *Profile of the organisation*

Tunnelgroep BV is a conglomerate of a number of well-known important players on the infrastructure and construction market. It was set up to meet the large demand for expertise and building capacity for tunnel construction, especially from the central government.

#### *Specific profile*

In the next twenty years, the construction of dozens of tunnels is planned in large infrastructural projects, particularly for train and road transport. The safety requirements in tunnels have increased dramatically in recent years. Recent tunnel accidents, such as in the Mont Blanc tunnel, the Channel tunnel and in the Austrian Kaprun, have contributed to this. Tunnelgroep BV has created a separate department to design and test the tunnel safety systems.

#### *Situation*

In the past systems for lighting, signalling (signs, traffic lights, information boards), ventilation, fire fighting and other systems worked completely independently of each other. If these systems had been integrated, the consequences of the above accidents would have been less severe. The Security department has since developed a systematic design for an integrated tunnel security system. The components have been thoroughly tested. Each possible 'route' through the code is investigated, so that the behaviour of the component can be predicted even in extreme situations. Detailed documentation is available for the programme code. But every tunnel is different. A team is busy designing the security system for the new railway tunnel in Vriezenrecht. The starting point is that the system is fully automated, so that human errors are practically excluded in the event of a disaster.

#### *Assignment*

On the basis of the standard system design, develop the software for the specific situation of the tunnel in Vriezenrecht, from the placement of the sensors to the adjustment of the software.

#### *Professional product*

Perfectly working programme components, based on already existing components. Full documentation for the programme code.

### THE ICT PROFESSIONAL

#### *Background*

Bart focused on programming as much as possible during his HBO ICT education, especially in the projects he collaborated on. He feels very at home in this discipline.

#### *Roles*

The project manager of the Vriezenrecht tunnel project is the customer. He is ultimately responsible for the whole construction and delivery, and therefore also for the safety aspects. He has delegated this last responsibility to the safety officer in this project, who is the project leader for a team of programmers. Bart is part of this team.

#### *Tasks and activities*

Bart contributes to the specific design. He (re)designs object-oriented code components with clearly defined interface. All code is written in the house style, as agreed within the Tunnelgroep BV Security department. Bart knows exactly what data a component receives and what it has to produce. Extensive testing,

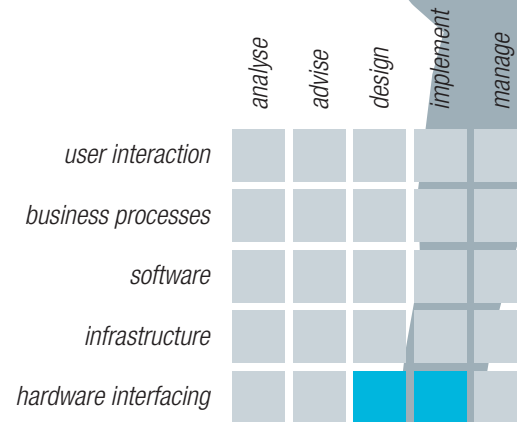
in accordance with the test plan that was set up beforehand, is part of the normal procedure. The system must react predictably and reliably in exceptional circumstances. Bart documents his work accurately. Another programmer would be able to take over his work effortlessly. He tests these components and implements them in the available tunnel simulation. All other components must be able to rely on the expected functioning of Bart's component. Reliability is the most important requirement in this project. Bart has intensive contact with his project co-programmers. He discusses with them about the encountered specifications and technical problems and he proposes solutions for the same. He consults his manuals and uses the internet as an important source of information.

### Expertise

Bart has good knowledge of issues surrounding programming and modelling techniques, especially with regard to UML and testing. He works very accurately. He knows how he has to prepare and execute test procedures.

### Career perspectives

Bart enjoys programming and is enthusiastic about his work. But eventually he would like to go a stage higher. His primary objective is to have ultimate responsibility for the system design.



## ... designing and constructing a sales site...

### CONTEXT

#### *Profile of the organisation*

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

#### *Specific profile*

Milanov adds new images to the database every month and checks them for quality, exclusivity and trend-sensitivity. Photographers and DTP experts work in the studio. The company is led by a director who takes care of acquisitions together with an account manager. One person maintains the stock archive, and there are two dispatchers and a part-time receptionist who work on the administration. Milanov can call on twenty freelance photographers who specialise in e.g. landscape, portrait or urban photography.

#### *Situation*

Milanov wants to introduce an e-commerce application to be able to provide the full range of photos to clientele via the internet. Milanov's target audience consists of designers, art directors and web designers. Because these buyers knowingly look for a certain product, it is not necessary to entice them. It is important to strengthen links with the client via the site, however. Quality, reliability and speed are important. The client wants to be able to make fast purchases and get the product in house quickly. The client has to use a login procedure to find an image that can be requested by price, colour or design, and must be able to order and download the photo. A link between the application and Milanov's existing CRM system is required.

Payment must be made securely via the internet, whereby Milanov makes a distinction between existing and new clients. Milanov wants to keep service and quality at the same level, even when the operational management is changed

by the internet. An implementation plan must show what the consequences are of introducing an e-commerce application. Milanov wants to be able to maintain 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 access to the Milanov's complete of products so that the client has a quick and targeted overview of the possibilities.

### THE ICT PROFESSIONAL

#### *Background*

Bob is starting his career as a young contractor. During his ICT studies he has shown a good understanding of building e-commerce applications which look good, perform well and are secure.

#### *Roles*

Bob is an all-rounder and fulfils the roles of analyst, adviser, designer, builder and implementer.

#### *Tasks and activities*

During the development process Bob pays lots of attention to the wishes of the user. He has learned lessons from a product which flopped in the past, as he worked too much according to his own decisions. This is why he now does a significant part of the development work on site, where the end-user is 'easily available'. Bob uses his knowledge of storing data in a database and accessing

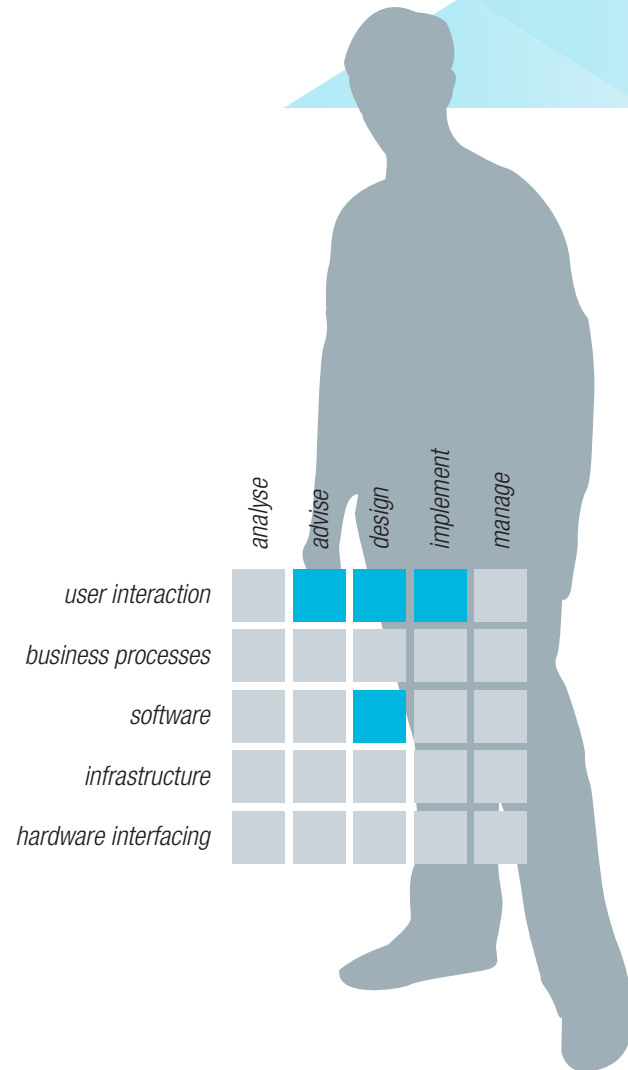
them on the internet. He makes choices from available technologies, such as PHP, JSP and ASP. He pays lots of attention to security and encrypting data. In this environment, where the customer sets the artistic bar high, he uses his creativity when designing the user interfaces. Bob gives sound advice with regard to the changes that are needed in the organisation for the sales process to be run over the internet. He advises Milanov on payment methods over the internet, the implications of copyrights for the photographic material and an approach for publishing copyrighted material on the internet. He communicates a lot with the customer.

### *Expertise*

Bob has good knowledge of database systems that are accessible via the internet. From the available technologies, he chooses the ones that are suitable for use in the application he is developing and for which he can apply these technologies. He has good knowledge of security and data encryption and availability aspects of applications. He can keep a record of changes that can result from introducing an e-commerce application in an organisation. Bob is aware of the legal aspects of storing third party data in a database and knows when he has to refer his clients to e.g. lawyers and trademark experts.

### *Career perspectives*

Bob wants to specialise in building e-commerce applications and focus in particular on art-related applications. He would like to use the experience he has gained at Milanov for this. He wants to expand his company, and ideally work together with a graphic designer and a more technique oriented ICT professional.



## ... a participant monitoring system...

### CONTEXT

#### *Profile of the organisation*

ROC Middenland was established from a merger of institutions for professional and adult education.

#### *Specific profile*

Each institution used its own participant monitoring system and this remained so after the merger.

#### *Situation*

The various participant monitoring systems are not compatible with each other. The provision of management information from the various systems is generally difficult and non-standardised for the ROC. The management college of the ROC finds it necessary that standardised information is available. None of the systems that are now in use can perform all functions of the six systems.

The ROC created a project group to select a new participant monitoring system on the market that is easy for the whole of the ROC to work with. It is expected that changes to the working methods are unavoidable for the various education authorities and that this will cause resistance.

Once the package has been selected, the ICT department will start a pilot project in which five departments of the ROC will be involved. The aim is to explain the possibilities of the best use of the system, any necessary changes, any training future that users might need and how the conversion to the new system can be performed in the most practical way.

#### *Assignment*

Select a new participant monitoring system on the market that the ROC can work with. Test the monitoring system using a pilot project in a number of ROC departments.

#### *Professional product*

A package that the ROC can use successfully as a participant monitoring system in the coming years.

### THE ICT PROFESSIONAL

#### *Background*

Ralph has been taken on as a junior ICT professional by the ROC for this project. He has just completed his HBO ICT training course.

#### *Roles*

Ralph is part of the project group that has to select the right package. The head of the ICT department is the project leader. Delegates from the education authorities are represented in the project group. The project group reports information to a steering committee that advises the management with regards to the ultimate choice.

#### *Tasks and activities*

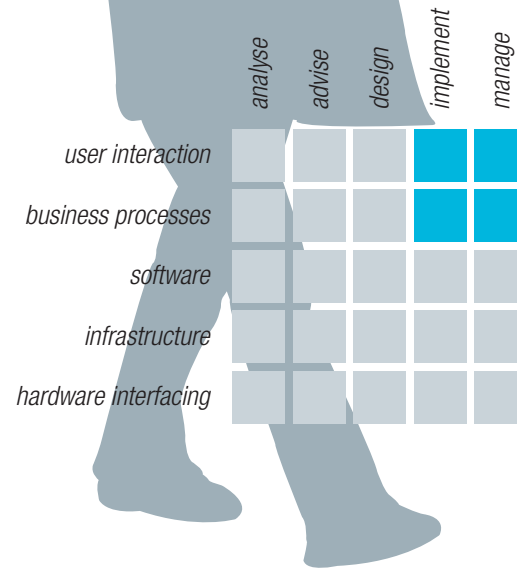
As part of the package selection procedure, Ralph researches various aspects relating to the introduction of a package, such as data conversion and changes in administrative processes. He looks at how the chosen package has to be configured, so that the organisation can have the desired export data, and processes the required time and manpower for this into the planning for the introduction process. He looks at what the introduction will mean for the end-users in the education authorities and tries to estimate how it will be accepted. His findings play a role in the selection of a package. He is then involved in executing the pilot project aimed at introducing the new package into the ROC organisation.

### Expertise

Ralph can operate well as part of a team and makes sure his voice is heard. He can communicate very well with users. He also has a good understanding of what happens in the administrative organisation and he is familiar with the pitfalls caused by changes in an organisation. He knows that he needs the cooperation of users to be able to start a new system successfully. He realises that processes depend on the provision of information and that this makes the organisation vulnerable. Ralph is good at reporting to the project team.

### Career perspectives

Ralph has the ambition of becoming an information manager in the future.



## ... an information system...

### CONTEXT

#### *Profile of the organisation*

The concrete manufacturer Concreet used to be part of a much larger concern of three factories that was forced – by the Office of Fair Trading – to split up into different parts.

#### *Specific profile*

The new organisation now has to stand on its own feet and regulate its own sales. The Sales department has its own system for processing orders. The company sells from its stock, but also has projects and primarily serves the Dutch market. The harmonisation between sales and production has been laborious for years. In the old concern this was absorbed by a considerable overcapacity. If one factory wasn't able to complete a project or supply an order, another factory was used. Now that the three factories have to serve the clients independently, this is no longer possible. The sector has been reorganised and overcapacity has disappeared. Clients are used to receiving their order on time. There are other suppliers who would be happy to provide the client with substitute products in this competitive market.

#### *Situation*

The new commercial director foresees problems and observes that there are lots of misunderstandings created by inadequate provision of information. The Sales department does not have the production capacity and the Production department has little view of the prioritisation of orders. A project to introduce an ERP system was therefore started shortly after they became independent. A quickscan showed that the introduction of ERP is favourable in this company situation.

The tolerance of the department managers supposes difficulties. They are hesitant when they have to let other people take a look behind the scenes. They were closely involved with the drawing up of the introductory plan. An ERP package and a supplier, XERP, have been selected.

#### *Assignment*

Automate the production administration and planning. Perform their implementation and aftercare.

#### *Professional product*

A working information system that satisfies the specifications as previously formulated. The support for the new working method, the service level to the clients and the implementation results in the factory are decisive for the success of the product.

### THE ICT PROFESSIONAL

#### *Background*

Philip graduated in ITC nearly a year ago and has gained experience as an application manager and programmer of customised extensions and interfaces. He has experience with the ERP package and realises from previous projects that implementations do not necessarily always run successfully. Sometimes the package is sold too easily.

#### *Roles*

Philip is employed by XERP as an ERP application expert. The functional analyst at XERP is ultimately responsible for introducing the package at Concreet. Philip is his right-hand man.



### Tasks and activities

XERP has been given the task of automating the production administration and planning together with the company's employees. One of Philip's colleagues has re-designed the processes. Philip is now going to make the package suitable for the designed processes by parameterising it. He is then going to train and coach the company's employees to use the package together with the aforementioned colleague. The Big Bang scenario has been chosen for the introduction. Converting the history to the new system is only taking place to a limited extent. The old systems have to continue running for a considerable amount of time.

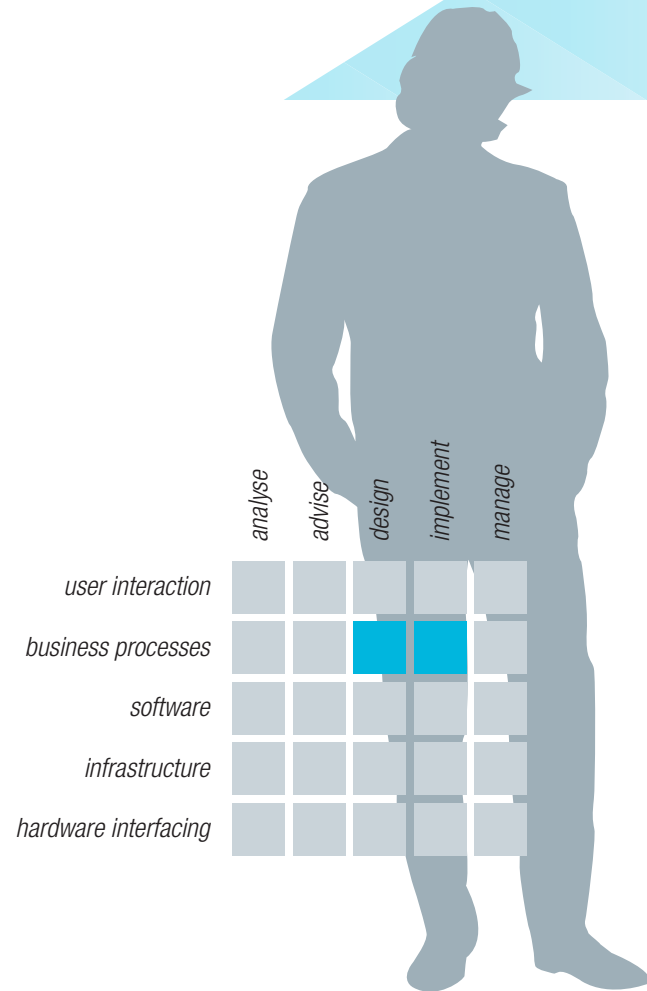
Philip keeps an eye on what possibilities there are for additional services and possible projects. He is carefully planning the timing and conditions together with the account manager. Philip is going to set up the package together with the employees at Concreet. His task is to convince and motivate, and implement the introduction of the package. The Concreet management has opted for very limited customisation. Philip is able to do this independently.

### Expertise

Philip has a service-oriented approach. He knows the problems that arise when introducing new working methods and is open to dealing with insecurities of the people involved. Philip is very result-oriented. He understands business processes and knows which ICT resources should be considered for the automation of these business processes. He knows the ERP package inside out. He can tailor the package to the wishes of the users and customers.

### Career perspectives

Philip has the ambition of becoming the head of the Projects department for the account managers within XERP. He is busy increasing his knowledge of project and programme management and is following training courses.



... an up-to-date database...

## CONTEXT

### *Profile of the organisation*

International News is a large, international press agency.

### *Specific profile*

The History department maintains an enormous database with all possible details of people who can be important for world news at any moment: biographical information, photos, scandals, functions, relationships, etc. The database contains text documents as well as images and audio material. The Information Requests department provides tailored information from this database.

### *Situation*

This multimedia database must be constantly 100 percent up-to-date. Every request for information undergoes careful analysis. The reply with tailored information comes from this database.

### *Assignment*

Keep the database up-to-date.

### *Professional product*

Adequate answers to information requests about politicians.

## THE ICT PROFESSIONAL

### *Background*

Judith has an HBO diploma in Information Services and Management. She has now spent two years working in the History department as an information specialist whose main knowledge area is in politics.

### *Roles*

Judith works independently in the Information Requests department. The head of the department supervises six specialist information analysts.

### *Tasks and activities*

Judith maintains the database with personal information about politicians and provides tailored information. Her most important activities are the collection, selection, filtering, classification, digitalisation and making available of information about prominent politicians. She analyses what domestic and foreign media report about politicians on a daily basis in the form of text, image and audio. She also uses online databases from large press agencies and other information suppliers. She adds anything that is important to 'her' part of the database in a structured way. She analyses information requests about politicians, selects the required information from the database and makes it available to the client in such a way that it can be used directly.

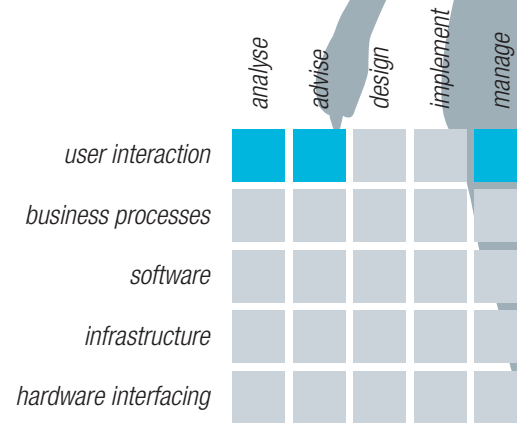
### *Expertise*

Judith knows how to find her way through both structured and unstructured information. She can arrange this information very well, distinguish between main and side issues, formulate it clearly and is an expert in looking up and finding information on the internet. She is very good at using modern ICT resources: standard packages, scripting tools, the internet, DBMS systems, etc.

She is very client-oriented and has a good general background. She has good knowledge of privacy legislation requirements and measures. She has a talent for knowing what can be important and has saved the information in such way that it is quickly accessible. Judith speaks English fluently.

### *Career perspectives*

Judith can grow into the role of team leader of a group of information specialists.



## ... a properly functioning website...

### CONTEXT

#### *Profile of the organisation*

Westerkruis Hogeschool is a small college in the Netherlands.

#### *Specific profile*

The organisation is undergoing a transformation from a traditional college into a broad knowledge centre. The website plays a crucial role in the communication with the knowledge centre.

#### *Situation*

The board of directors at Westerkruis thinks a good website is vital for the knowledge centre. Westerkruis has employed a content manager in a small team of four administrative employees who are responsible for the content of the site for several years. The first content manager changed his job for a position elsewhere that suited him better. The new content manager was given the task to modernise the website. The content manager has contact with users and must maintain a good relationship with them.

#### *Assignment*

Convert content, supplied by users, into effective content in the existing multimedia application to be modernised.

#### *Professional product*

A lasting, well-functioning website for the organisation.

### THE ICT PROFESSIONAL

#### *Background*

Daniel used to work a lot in the design and management of websites during his HBO ICT training course. He was involved with managing the institute's website in his training course. He has various skills: he earned study points and considerable amount of pocket money, and learned a lot in the field of content management. The institute considered him a dedicated perfectionist who apart from a student was also an end-user, which made him very aware of the wishes of end-users.

#### *Roles*

Daniel is the successor to the first content manager who was highly valued by everyone. Daniel supervises the team that is still used to the working methods of his predecessor. As a content manager he is responsible for maintaining the website and introducing new multimedia applications in the organisation. He is final and chief editor of the website. The content manager is charged with the aftercare of the introduced applications.

#### *Tasks and activities*

Daniel has the considerable task of adapting to the working method of his predecessor who was highly valued by everyone. He wants to change and modernise where necessary and set new procedures. He invests greatly in the relationships with all interested parties. He convinces them of his qualities thanks to his receptive attitude, critical view and thoroughly expert knowledge. Daniel regularly consults with the head of the Marketing & Communication and ICT faculties who, in collaboration with the board of directors, develop guidelines for the use of the Westerkruis website. He provides answers to questions about the best introduction of a multimedia application in the organisation, and

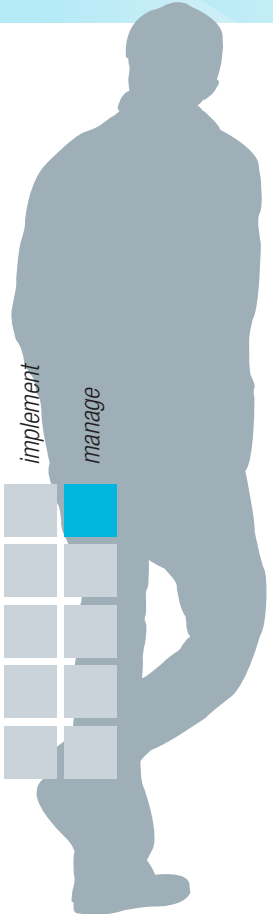
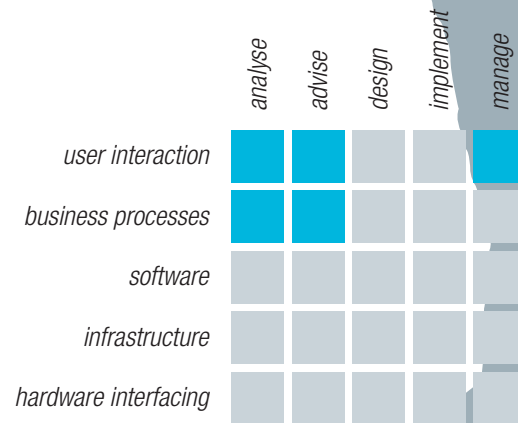
with regards to the organisation of the editorial staff and the management. On the technical side he ensures the content management systems and administration systems function as well as possible. This therefore relates to internet, intranet and extranet applications or programmes on CD-ROM or DVD. He determines where new content might be fit in the existing structure and assesses if adaptations are required. He makes suggestions for new functions or about adaptations to the management programme. He consults with users and makes recommendations about the multimedia possibilities of the applications in a field of study: communication, marketing, education and business information. He supports users in working with the application, both with regards to content and operation, and provides editorial advice and instructions. He analyses users' problems and formulates clear solutions for the users and the team. He advises users and the team, requested or not, about new solutions that are suitable for the further professionalisation of the website.

### Expertise

Daniel is able to take care of graphic, content and functional adaptations and updates for a web application. He oversees the production process of a multimedia application and can assess when it is necessary to use specialists. Daniel possesses management skills. He knows how to communicate with and listen to clients, and how to convert the wishes of the clients into applications. He has good editorial skills.

### Career perspectives

Daniel is in the right place at Westerkruis. There are no current growth perspectives. A job as policy adviser could be a possibility, but that's not where Daniel's ambition lies. That would take him too far away from the 'real work'. Daniel thinks that in some years, he might like to change from the relatively small Westerkruis to a comparable job in a larger organisation.



## ... managing a network...

### CONTEXT

#### *Profile of the organisation*

A large university medical centre has a wide range of specialist possibilities. The patients mainly come from the same region. For a number of specialities, patients come to the hospital from all over the Netherlands.

#### *Specific profile*

The hospital has now become largely automated. All departments within the hospital have started working with various information systems in recent years. For all operations ICT support has been introduced. After a reorganisation, a central (staff) ICT department was created, which covers the management of all applications. Around forty people work in this department in various functions.

#### *Situation*

A large successful project has recently been completed to the satisfaction of the users. A standard workplace was introduced for every employee in the hospital. They intend to improve internal cooperation and increase efficiency within the hospital. Expert users consider that the centralisation of the ICT function has led to impersonal ICT service provision. Where they used to call their application manager directly, they now have to contact a helpdesk with all ICT questions. They think that the processing of questions and faults takes too long. The heads of department complain about the service provision to the management. The head of the ICT department wants to start an ITIL process (ITIL is a much-used international collection of best practices in ICT service management) to be able to improve the management of the quality of the service provision to the departments.

#### *Assignment*

Manage a network, designed for the required level of ICT service provision.

#### *Professional product*

The professional product is a service provision level that fits in with the agreements that have been made in a service level agreement. It comprises management report on the realisation of this level with regard to availability and other network performances, and suggestions for improvements.

### THE ICT PROFESSIONAL

#### *Background*

Bart has been sent by an ICT service provider on a secondment agreement with the hospital for one year. He was originally drafted into the project, in which the new standard workplace was introduced, to set up the servers (file servers, database servers and application servers). He works closely together with a colleague who is taking care of the physical configuration of the network.

#### *Roles*

Bart has been responsible for the management of the network which primarily consists of Windows XP clients since the introduction of the new workplaces. He also provides supervision to five colleagues, who perform first line management activities.

#### *Tasks and activities*

Bart mapped out the requested service level in the previous project. This is now a starting point for him. As a co-designer of the infrastructure, Bart knows the

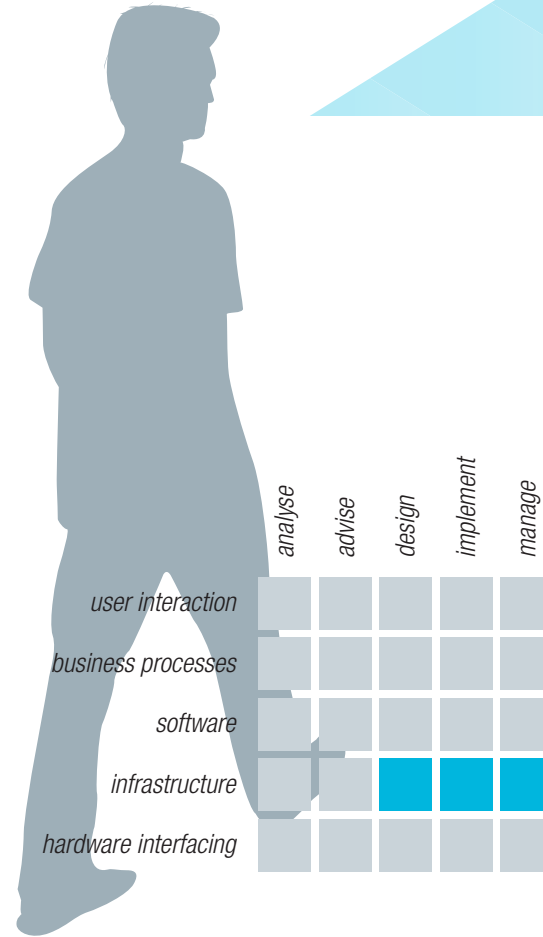
ins and outs of the new workplaces very well. In his current duties the emphasis is on preventive maintenance. Bart assesses the changing user requirements and has system changes performed by his colleagues in the ICT department. In consultation with end-users, he supervises the introduction of new applications. Bart is responsible for processing problems, complaints or faults and providing feedback to the helpdesk as well as possible, together with his co-workers. Bart reports to the head of the ICT department once per month.

### Expertise

Bart can make an inventory of the required service level for ICT service provision in an organisation. He is very well aware of accessible methods such as ITIL. He can set up a network and make the considerations necessary for determining to what extent the required service level can be achieved. Bart can provide guidance to a team of employees and divide up the work efficiently. He is good at dealing with users.

### Career perspectives

Bart has indicated that he would like a role in the introduction of a process-oriented working method. He expects that good results can be achieved quickly with the incident process. He suspects that the circle is not always complete and would like to work out, together with the other people involved, how this process can be improved.



## ... a configuration management system...

### CONTEXT

#### *Profile of the organisation*

ES is a large producer of embedded software for the car industry, which operates in a global market. An important activity for ES is the design and production of engine management systems.

#### *Specific profile*

Dozens of different types of engine management systems are designed for the international market, which belong to a more limited number of product families, in the design department for TVs. Embedded software has to be developed for all these systems. The developers use a large library of components. Each component is available in many very similar variants.

#### *Situation*

The introduction of new products on the market is always growing, partly because of the continuing international expansion of ES. The design department must develop reliable embedded software at an increasingly higher tempo. The management of all components and the documentation of the software has therefore become an essential part of the development process. It must be crystal clear at all times who is working on which version. The documentation of the software must also always be up-to-date and the developers must be able to revert back to previous (thoroughly tested) version. It must also be recorded which software is used in which system and how this software was produced. In order to cope with this complex management problem, the design department has developed its own configuration management system. The system consists primarily of a collection of clear rules and agreements and is supported by an application.

#### *Assignment*

Take care of the configuration management.

#### *Professional product*

A configuration management system that remains reliable in spite of a dramatically reduced embedded software development period.

### THE ICT PROFESSIONAL

#### *Background*

Phung studied Computer Science and concentrated on the design of embedded software in his graduation period. In his thesis subject he contributed to the development of the configuration management system in the ES design department.

#### *Roles*

Phung stayed on as a junior designer/developer in the design department of ES after his graduation. The use of the configuration management system is an integral part of the work for all employees in this department. Phung is a member of a small design team that develops products with short lead times.

#### *Tasks and activities*

Phung's team is working on designing embedded software for a product family to be developed for a well-known make of car. On the basis of the strictly formulated requirements Phung has contributed to a first version of a functional design that is applicable for the whole product family. The work is then distributed. Phung is now responsible for the configuration management of the whole product family. He works together very closely with all his team members for this.

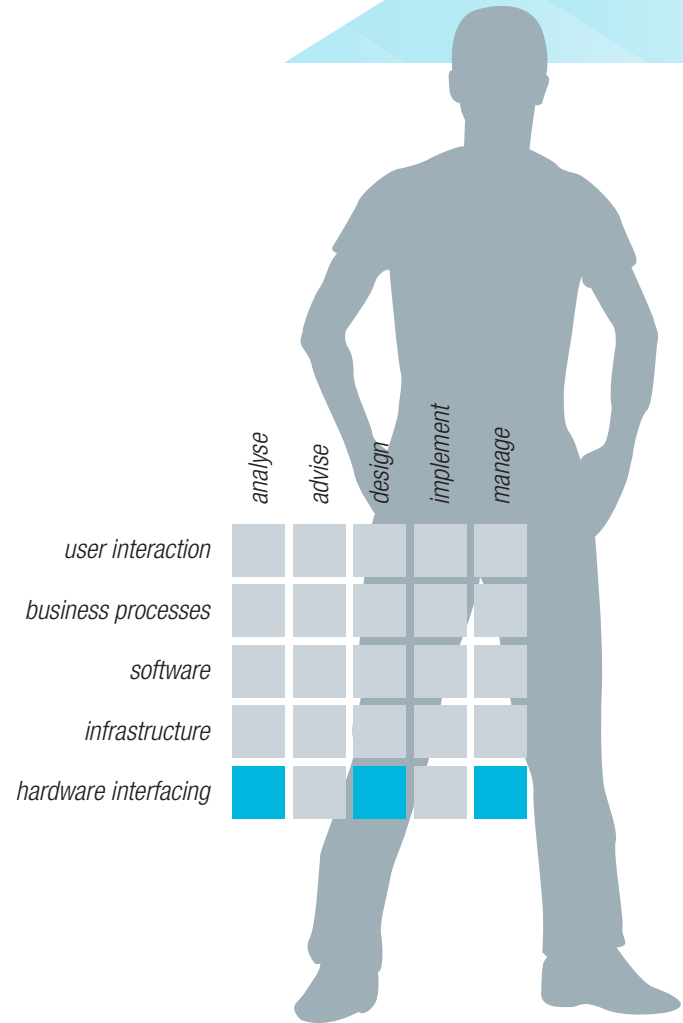


### *Expertise*

Phung has an excellent understanding of the design and development of embedded software. He has experience in using an integrated development environment and the role of components. Phung also has a good understanding of management aspects such as configuration management, version management and documentation management.

### *Career perspectives*

Phung wants to become a team leader of a development group at ES after a number of years.



## ... a properly working route planner...

### CONTEXT

#### *Profile of the organisation*

Software company Windesautomate is active in the field of Geographic Information Systems and Location Based Services. Windesautomate supplies customised and some standard applications.

#### *Specific profile*

Within Windesautomate the Application Development department is responsible for the (continued) development of map-based PDA and Tablet PC applications for inspection, inventorisation and obtaining data in the field.

#### *Situation*

There is a collaboration agreement with a new supplier of digital maps. This agreement offers new possibilities for the PDA and Tablet PC application in the field of route navigation functionality.

#### *Assignment*

Create a .NET application that uses the standard Duif maps to make route planning possible for transporters using PDAs and Tablet PCs.

#### *Professional product*

A properly functioning route planner that is suitable for PDAs and Tablet PCs.

### THE ICT PROFESSIONAL

#### *Background*

Mark has now been working at Windesautomate for six months. In the detailed Advanced Programming minor of his IT training course, he learned how to properly develop software methodically. A lot of attention was also paid to communication skills in the training course. Mark profited greatly here from contacts with clients, customers and suppliers.

#### *Roles*

Mark is working as a junior programmer on an assignment for a client in the field of mapping. This is first real job at Windesautomate.

#### *Tasks and activities*

Mark works in accordance with the Agile method, where the emphasis is on direct communication. As a developer he has a lot of contact with the customer. He regularly shows what he has done and discusses the next steps. Mark also consults with the supplier of the maps (Duif) to make sure he has the right data available.

If the data appears to be inconsistent, Mark has arranged updates for the map data. This has delayed delivery somewhat.

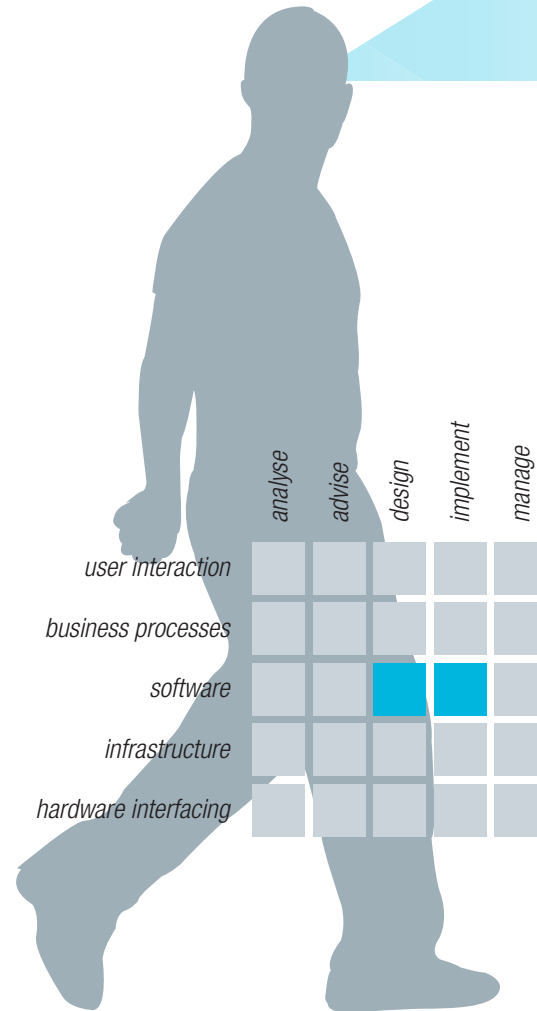
Mark has held regular peer reviews, together with his colleague Anton, about the specifications to be built and the final code that has been built. With a final presentation and demonstration at the customer's company, Mark has delivered and transferred the product.

### *Expertise*

Mark can plan and manage a project methodically, from design to implementation. He can communicate with customers, colleague and suppliers effectively. Thus, an end product is produced that the customer is happy with.

### *Career perspectives*

Mark can grow into the role of senior programmer. A senior programmer can build complex systems and direct building teams with regard to content.



## ... creating and introducing an application...

### CONTEXT

#### *Profile of the organisation*

Vliegbasis het Noorden is one of two Dutch F-16 bases. The air base has three operational squadrons: two F-16 squadrons and a Search And Rescue (SAR) helicopters squadron. Around 1,300 people are employed there (both professional servicemen and civilians).

#### *Specific profile*

A very important factor for the operational squadrons is the security and reliability of the equipment. Adequate information about the technical state of each F-16 is crucial. The state of maintenance and the upgrades are updated in the so-called 'Aircraft form'. This document is comparable with a logbook for a car, but it is more complex. Every time an F-16 pilot takes off, he has the Aircraft form with him. This means maintenance people at other air bases can see directly the state of maintenance and update the document after performing any work.

#### *Situation*

The Aircraft form for each F-16 must be updated with new, updated sheets a number of times per year. These so-called LuForm sheets each relate to a subsystem on the F-16, such as e.g. the jet engine and the weapons systems. The necessary information is retrieved from a central database at Lockheed Martin in the United States, and then transferred to the various LuForm sheets. This is a time consuming and error sensitive manual process. The responsible Configuration Management department would like to automate this. This raises a couple of questions: Is the underlying process with all relevant parties suitable for automation? How do you get support from the various relevant parties, such as management, engineers and supporting services?

#### *Assignment*

Create and introduce an application that makes the existing updating process for LuForm sheets more efficient, more reliable and more uniform.

#### *Professional product*

A LuForm generator that automatically retrieves the necessary data from the Lockheed Martin database and processes it correctly for the necessary LuForm sheets.

### THE ICT PROFESSIONAL

#### *Background*

Henry is doing this assignment in his third year work placement as a Business Information Technology student. It is his first work placement. His good communication skills, his no-nonsense attitude and his energy enabled him to quickly become accepted as a colleague.

#### *Roles*

Henry has various roles. Not only is he a builder of the required system, he is also an analyst, designer and adviser. An important aspect in this project is ensuring acceptance of the system in the organisation.

#### *Tasks and activities*

Henry first charts the existing process using process diagrams. He must quickly become familiar with the air force jargon and the many abbreviations for this. He records what the current difficulties are, divided by category (Human, Method, Tools, etc.). Henry then chose MS Access as the database technology for the new application to be developed in consultation with other relevant parties.

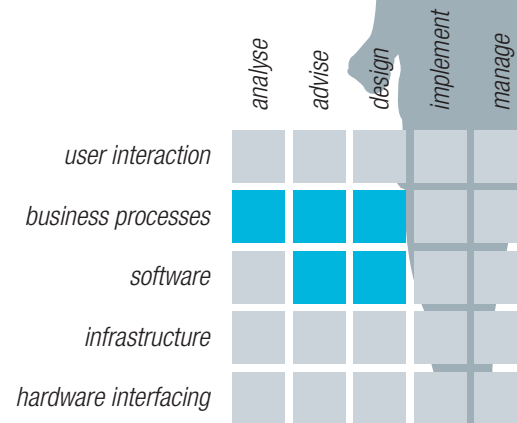
Throughout the whole process he maintains close contacts with the various parties involved.

### *Expertise*

Henry describes and analyses the environment and the process the application has to fit in, taking into account the various interest groups and applicable military aviation requirements. He consciously always involves colleagues from the Configuration Management department in the development process.

### *Career perspectives*

Henry has gained lots of confidence now this first work experience placement is as good as complete. He has both managerial and technical qualities. Henry would like to orientate himself in a broader sense. He is also attracted to enterprise so he is following the Enterprise minor at his college.



## CONTEXT

### *Profile of the organisation*

Thelas Netherlands has 2,000 employees and is the main provider of high-tech jobs in the Defence and Security sectors. Product innovation and quickly responding to the latest technological possibilities are the main interests.

Thelas Netherlands is part of the Thelas Group. The Thelas Group has 76,000 employees in over 50 countries and is one of Europe's largest electronics companies.

### *Specific profile*

The Business Line Above Water Systems develops hi-tech command & control systems for naval vessels. These integrate a wide range of sensors (radar, sonar, infrared) on the basis of a real-time distributed infrastructure. The Naval Application Delivery Centre department makes software for the combat management system TACTICOS.

### *Situation*

Extra functions are being added to the existing combat management system TACTICOS. One of these is Link16, a NATO standard for communication via tactical data links, so that ships can communicate and exchange data.

### *Assignment*

Integrate communication standard Link16 in the existing command & control system. This involves product development from Thelas Netherlands in collaboration with the German navy, who is acting as launching customer.

### *Professional product*

Combat management system TACTICOS with the functionality of Link16.

## THE ICT PROFESSIONAL

### *Background*

Roger completed his bachelor in Computer Science two and a half years ago. He finished his studies at Thelas Netherlands. His order was to use a PDA to monitor the climate management system in the radar towers. After graduating he stayed at Thelas and started his first job as a test engineer.

### *Roles*

Software and test engineers work in a multidisciplinary team for SA-Link16 within the Naval Application Delivery Centre department, on the development of software applications for the existing command & control system. Roger works as a test engineer within this team.

### *Tasks and activities*

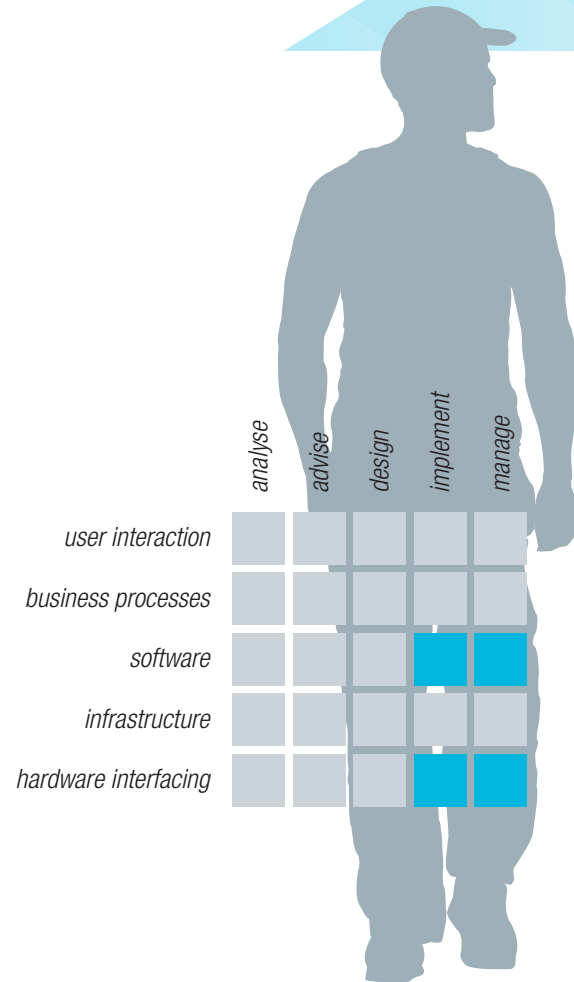
Roger is working on the test automation that will ultimately have to be introduced at all test levels. The test automation is used in the field of requirement based testing. The ultimate goal is to run all tests distributed over a number of machines every night. Roger has made the tooling for this. Every night a regression test is also run over the software build of the previous day. Roger looks at the test results in the mornings. If the results are not completely okay, he runs the tests again manually. Sometimes he then implements a solution for the problem. Next to his function as a tester, Roger is also administrator of the test area and the programme that is used for the version management of the source code (Clearcase). This programme is also used for parallel software development. If a new component is developed in the product, Roger creates a new project for this in Clearcase.

### Expertise

Roger gained a lot of knowledge of programming languages during his studies. This appears to be very useful for programming tools. He also learns a lot at work. He already has a lot of experience in the use of different test methods. His patience is an asset for the tests. Roger is open and communicative and enjoys explaining things. These appear to be good qualities for working as part of a team.

### Career perspectives

Roger can develop into being a system test engineer within Thelas Netherlands. A test engineer is responsible for the preparation and execution of the integration, verification and validation tests on the combat management system. This involves both the internal system tests and the integration and implementation tests on board.



## ... implementing a network security architecture...

### CONTEXT

#### *Profile of the organisation*

Rj-ICT is a specialist in the field of security, networking, storage and data communication. Certified engineers implement the systems within the clients' networks. After delivery, Rj-ICT provides maintenance and management: 24 hours a day, 7 days a week.

#### *Specific profile*

Technology only yields returns if sufficient knowledge is available to make optimal use of this technology. Rj-ICT has this vital knowledge. The technological components that Rj-ICT uses come from the world's best brands. This combination of having the right in-house knowledge and using the best technological components means that Rj-ICT is market leader, active for a wide range of users in various sectors. The key is: permanent and secure availability of critical data.

#### *Situation*

Total network security solutions are designed and implemented within the security division.

Even though every design is unique, firewalls, IPS systems, anti-spam, anti-virus and proxy servers are implemented on the perimeter of the network. Endpoint security software is installed on laptops and workstations. The aim is to keep the security level as high as possible, but to have as little impact as possible on the usability and manageability of the network.

#### *Assignment*

Implement the solution that has been designed for the client. The various partial solutions are installed and tested in the test laboratory, and then integrated in the client's network. Because different products usually have to be integrated,

various engineers work closely together to harmonise the functioning of the different products.

#### *Professional product*

A thoroughly implemented and tested network solution that is tested against the design, together with the client. The network solution provided is tested together with the client and taken into production under the supervision of Rj-ICT. Knowledge transfer to the client takes place during the implementation.

### THE ICT PROFESSIONAL

#### *Background*

Erwin graduated one year ago and has performed various installations for clients under the supervision of his new colleagues. He has been able to put his theoretical knowledge of TCP/IP, VPN, routers, switches, mail and web proxies, IPS systems into practice. He has followed manufacturer courses to gain specific knowledge of Cisco routers and Check Point firewalls. He has learned the fine details of the skill from his colleagues.

#### *Roles*

As a network security engineer, Erwin is part of the project team that takes care of the implementations with the client.

#### *Tasks and activities*

Erwin has the task of delivering various components for the complete project. This means Erwin is responsible for the implementation of the Check Point firewall. He will configure the set security policy together with the client, and report to the project manager. Colleague engineers take care of the implementation of any other components.

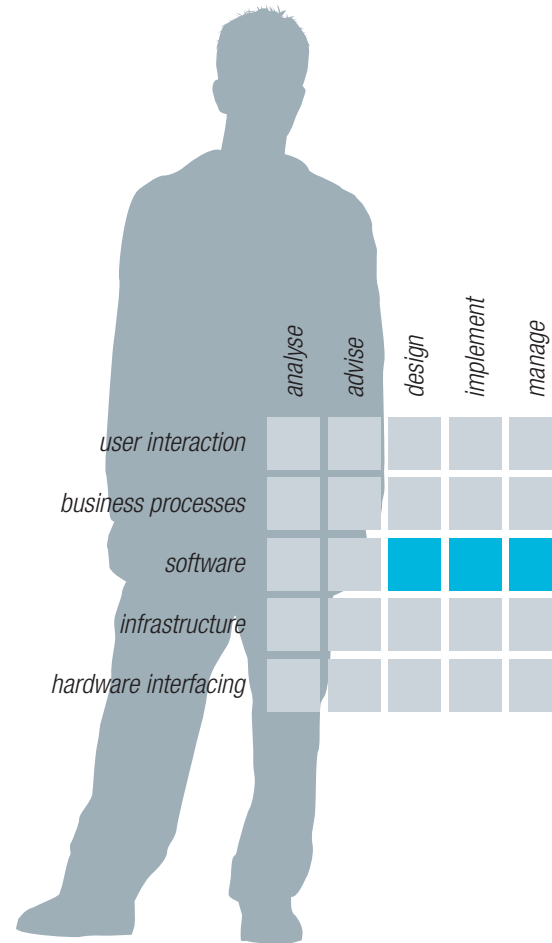


### Expertise

Erwin is very eager to learn and always busy expanding his technical knowledge and learning about the latest state of affairs. He does not only have specialist knowledge of his own products, but also has a conceptual knowledge of all other components within a network. This makes him very good at advising the client in making choices. Erwin has a feel for the wishes of the client, without losing sight of the objectives of the project he is working in. He is happy to combine his independence and clear way of communicating when working as part of a team.

### Career perspectives

Erwin has the ambition of becoming a senior security engineer. As well as expanding his specialist knowledge, it is also essential for him to gain work experience. Only by coming up against various problems in practice will he be able to become an “all-round” security specialist. In the role of senior security engineer, Erwin can advise on the design of the solution and provide leadership to his colleague engineers during the implementation.



## ... building a game for mobile platforms...

### CONTEXT

#### *Profile of the organisation*

STER is a strong SME, specialising in the development of cross-media campaigns. In recent years STER has set up a new department which is mainly involved in adver gaming within cross-media campaigns.

#### *Specific profile*

The company specialises in the development of viral campaigns and uses games for this. Because various platforms are used, user-friendly interfaces and intuitive game play are crucial. A small team is collaborating in the development of game concepts in a short space of time: from idea to execution.

#### *Situation*

STER is strong in image campaigns and works primarily for large national companies and multinationals. Many of the campaigns developed by STER are cross-media. STER also has branches in Tokyo and Chicago and so has lots of experience in dealing with cultural differences. This is highly valued by international clients.

#### *Assignment*

Build a game for Orange in the Netherlands, which runs on the various mobile platforms with gyroscope. This game is part of a media campaign and linked to other media campaigns.

#### *Professional product*

A game that runs on various mobile platforms which are available in the Netherlands and contain a gyroscope.

### THE ICT PROFESSIONAL

#### *Background*

Yosha enjoys working at STER because of the fast orders for a wide variety of clients. She particularly likes the global character of the campaigns. She can use her own (travelling) experience for this.

She is currently working on the smaller campaigns. She enjoys building games that are part of a multimedia strategy in a small team. She can use lots of various components for this.

#### *Roles*

Yosha works in a small team of three people. She can programme in both Flash and Java, just like her team members. Yosha also has design experience and she is particularly adept at conceiving various game formats. The team can also turn these concepts into reality. Each time she and her two team mates decide on the distribution of the tasks. Yosha also has close contact with the other departments working on the global concept, and with the technical department that takes care of the server management. She sometimes helps with the creation of games in other programming languages.

#### *Tasks and activities*

The Orange game that Yosha creates is being made on a platform that is new to her: mobile telephones with gyroscope. She only has little experience in this field. She is learning the required knowledge by doing research and discussing it with her colleagues. The team makes small tests to check the proper functioning of the technique and design. The acquired knowledge is well documented and shared with colleagues. The team is also creating a new concept for Orange, within the specifications of the general campaign. The campaign has to change

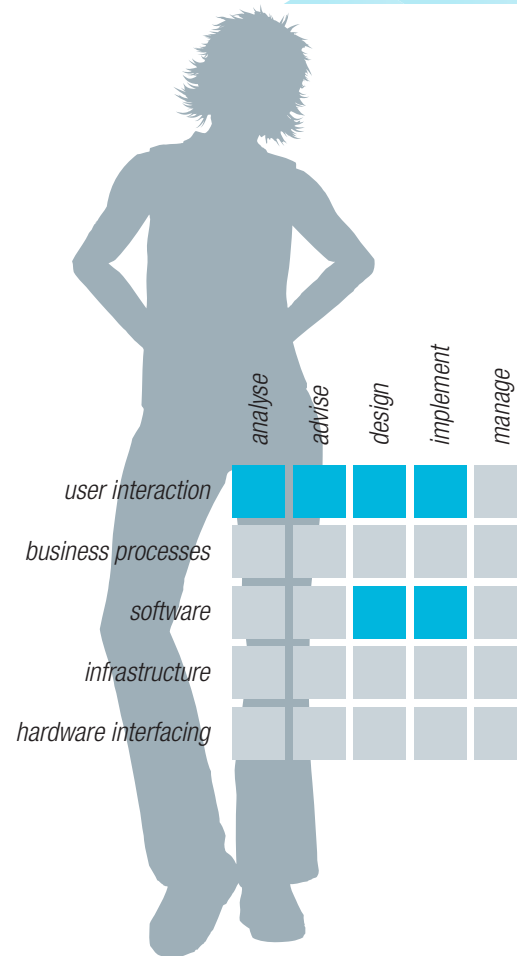
because of the specific characteristics of the game. Advergaming only has a limited lifetime and must continue to be enjoyable throughout the whole campaign.

### Expertise

Yosha can conceive and create new game concepts based on the specifications. She has good communication skills and is client oriented. She can realise an idea (together with her fellow team members) within the requested time and specifications.

### Career perspectives

Yosha would like to become part of the team that develops the international campaigns and so work for larger clients and global campaigns in the future.



## ... a fit-for-use system...

### CONTEXT

#### *Profile of the organisation*

The organisation Brug Water Weg (BWW) provides maintenance and construction of infrastructural works within the Netherlands.

#### *Specific profile*

The organisation considers the eventual outsourcing for every project. The wish of the politicians plays a big part in this. The organisation must therefore be able to fulfil a strong managerial role to be able to perform its tasks well.

#### *Situation*

One of the many information systems used by BWW is the GIS2000 application, a graphic information system. This system runs on Sun stations with a central Oracle database. The organisation wants to switch to a simpler software and hardware landscape.

#### *Assignment*

Migrate the GIS2000 to a Microsoft environment. Also ensure that the GIS information is available via smartphones to be able to better support the 'man on site'. This requires a different ICT infrastructure, a different software architecture and a number of small changes in the process. In this project there must be an equilibrium with regards to employees possessing the necessary know-how, managerial wishes, political preconditions and the technological (im) possibilities.

#### *Professional product*

a fit-for-use system.

### THE ICT PROFESSIONAL

#### *Background*

Kim has worked for BWW for a year and a half. Her education in Public ICT Management has provided her with insights into the working and decision-making in managerial organisations. This enables her to operate effectively within this organisation. Kim has already successfully carried out two smaller projects with BWW.

#### *Roles*

Kim is a project manager.

#### *Tasks and activities*

Kim prepares the project by holding interviews with interested parties. She regularly provides feedback and tests the project stages with domain specialists and fellow project workers. Using this method she provides clarity and transparency. When changes occur in the wishes and requirements, she tests their impact on the project.

Based on the outcome of this test, she advises her customer to include this change into the project, or to place it on the wishes list. Kim keeps a close eye on her environment. When there are developments on the managerial front, she evaluates their consequences for the project.

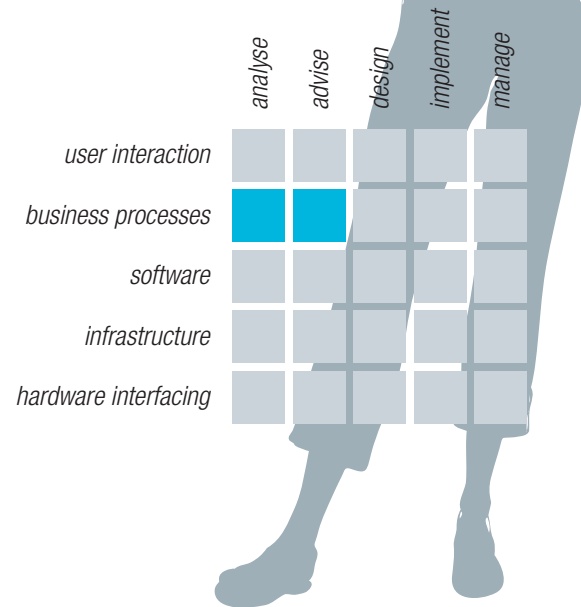
Kim functions as an intermediary / ambassador between the various interested parties.

### Expertise

Kim understands the internal relationships and the working of a managerial organisation. She is able to penetrate and process specific information in order to then be able to make the right decision for the preparation and execution of the project.

### Career perspectives

Kim can grow into functions such as senior project manager, programme manager, adviser and head of department.



## ... initiating an enterprise architecture...

### CONTEXT

#### *Profile of the organisation*

StieWo is a housing corporation with the social aim of providing accommodation. The organisation supplies suitable products and services sustaining a vital and liveable living environment. It therefore focuses primarily on people with few options. StieWo provides both rented and owner-occupied property for the target group.

#### *Specific profile*

StieWo strives for good provision of products and services to existing and future clients. The emphasis is shifting from quantity to quality within the housing market. New buildings will include more and more 'housing for life' homes, possibly in combination with care (with residential nucleus as a basic quality). A significant quantity of new buildings needs to be accessible for households with few options.

#### *Situation*

The organisation needs new applications, such as software to show video clips of accommodation on the website, or an ERP package, considering the current system is no longer adequate. The ambition of giving clients more choice has consequences for processes and systems. The current processes and systems are not designed with this ambition in mind. The ICT manager took part in a national congress of housing corporations. He was impressed by CORA, the Corporation Reference Architecture. He has advised the management on not only the regular updating of the information plan, but to also introduce 'working under architecture' in the organisation. For this a new function would be created in which a number of information management roles are invested.

#### *Assignment*

Initiate an enterprise architecture for the housing corporation, using CORA as a reference. The focus is on setting up the business architecture and the information architecture. Also make a recommendation for investing information management roles in the housing corporation and the introduction of working under architecture.

#### *Professional product*

An advice report about working under architecture whereby the information management roles in the organisation are fulfilled. The drawing up of business and information architectures should also be initiated.

### THE ICT PROFESSIONAL

#### *Background*

Bernard has worked for StieWo for a number of months. He was recruited as a junior information consultant to support the information consultant. Bernard knows the Amsterdam Information Management Model (AIM) and has become familiar with enterprise architecture and Business Process Management (BPM) during his graduation from his Information Management training course. He has applied working under architecture, based on the DYA model, in a practical placement during his studies. He has also analysed processes in a care institution and made proposals for improvement in the framework of a practical placement. This experience is useful as there will be radical changes in StieWo's primary processes.

### *Roles*

Bernard works together with the information consultant. Both fulfil the role of alignment manager and one of the eight roles from the AIM.

### *Tasks and activities*

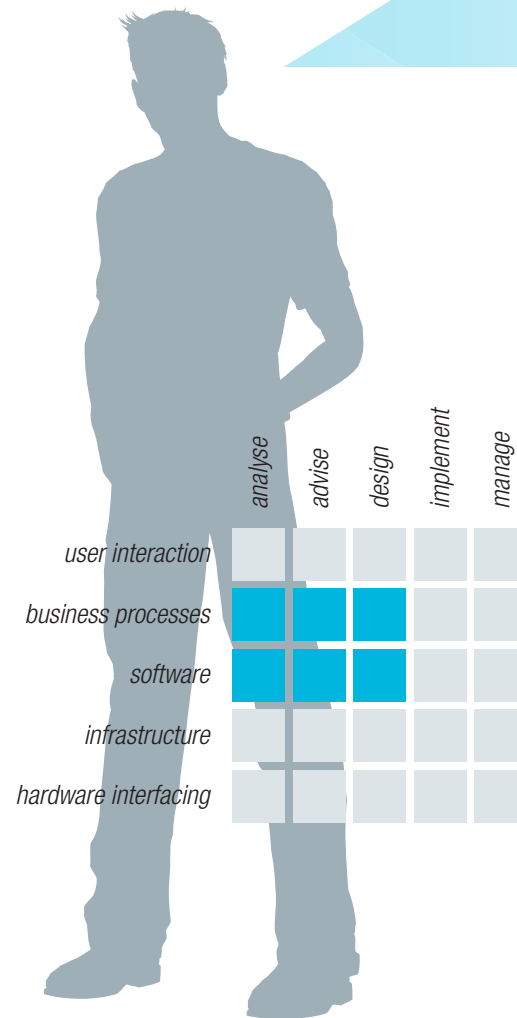
Bernard is working independently on parts of the business and information architecture, whereby he maps out the products, services and processes. He is drawing up starting points and principles together with the information consultant. When drawing up the information architecture, he takes good note of the relationship between the business architecture and application architecture. As well as the provision of information, the method of communication with the client is also central here. Bernard is writing an advice for working under architecture.

### *Expertise*

Bernard can apply various modelling techniques for drawing up parts of the enterprise architecture. He is able to perform a thorough business analysis and convert vision, goals and policy principles into the provision of information using modern ICT means. He can apply architecture principles and knows how to explain and make the management understand what contribution this makes to the organisation. He takes concrete decisions and communicates them clearly to all relevant parties. If necessary, he can adapt his point of view to agree with others. He is flexible in his work and knows how to manage changes.

### *Career perspectives*

Bernard can grow into the role of information manager or business analyst within his organisation. Working as an ERP consultant has also always appealed to him. He considers the implementation dynamics as a challenge.



## ... an educational game...

### CONTEXT

#### *Profile of the organisation*

ODOODEM is a company that specialises in the development of serious games. The company was founded in 2004 by people with very varied backgrounds: an ICT professional, a teacher and a social geographer. Many of ODOODEM's clients are non-profit organisations, such as hospitals and educational institutions.

#### *Specific profile*

It is typical of ODOODEM's clients that they can gather knowledge quickly with the help of experts in the field. ODOODEM then converts this knowledge into the design for an interaction model.

#### *Situation*

ODOODEM is making a teaching package on water consumption for the Friesland water authorities. Part of this teaching package is an educational game in which children have to make conscious decisions about their own possibilities for reducing water consumption. Within educational situations the technical possibilities for a game are limited, as computers are often outdated.

#### *Assignment*

Build an educational game for children aged between 10 and 12 years old with which they can become aware of their own possibilities for reducing water consumption. This game is part of the teaching material about water.

#### *Professional product*

A well-functioning educational game for children between 10 and 12 years old that contributes to raising awareness about water consumption.

### THE ICT PROFESSIONAL

#### *Background*

Helen studied Game Technology. As early as the first and second year she realised from her project assignments that she enjoyed managing projects. She has good knowledge of all the various components, but in particular she enjoys coordinating the cooperation between professional experts and the design team.

#### *Roles*

The water management game is the first time that Helen, as a junior project manager, has prepared all the stages independently. She will supervise the project together with her boss.

#### *Tasks and activities*

Helen starts with the target group analysis. Because the work is being done in a small team, she is also looking at the serious game solutions of competitors with the same target group. With this information she can first make an estimate of the time and costs needed for the project and the project design. She makes a team planning and finds out what external experts she also needs. This gives her a picture of the preconditions and possibilities for the creation of the game.

Helen also maps out all the risks, costs and benefits, and prepares all (legal) contracts for the relevant parties. In the implementation phase she keeps a close eye on matters to make sure everyone is working according to the plan. Helen reports to her boss.

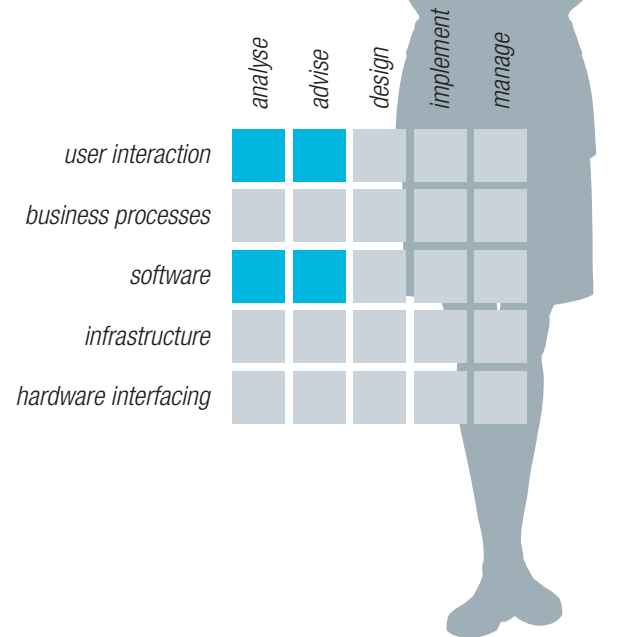


### Expertise

Helen knows the design process and can monitor progress well. She recognises the bottlenecks points in the process, knows how to signal them in good time and comes up with solutions. She has good social skills and so has good contact with all the relevant parties.

### Career perspectives

This assignment is giving Helen the possibility of supervising a project independently. Her boss has indicated that if things go well she can be involved in projects with greater independence more often in the future.



## ... developing testable parts of the engine...

### CONTEXT

#### *Profile of the organisation*

MULTGAM is a company that specialises in the development of triple-A MMOs (massive multi-player online game). MULTGAM has built up a global reputation in recent years. As well as triple-A titles, the company also makes other online games with different lead times and which are part of a different business unit.

#### *Specific profile*

Triple-A MMOs require a maintainable and expandable form of (technical) design and programming. The complexity of an MMO is very high because of the (dozens of) different systems that have to work together as a whole. An efficient structure is needed for this, and the tasks are very specialised and require a high level of expertise. The core team is complemented with various programmers so its composition keeps changing. Because of the complexity, keeping sight of the main aim is very important.

#### *Situation*

MULTGAM uses existing techniques, engines and libraries (middleware) where possible for the MMOs, and in which specific components have to be adapted to meet the special features of this game. A lot (around 60 percent) of the used engine is re-written to meet the specific requirements of a new game. It forms the basis of the game and all associated systems.

#### *Assignment*

Development parts of the engine for an MMO and make them testable in accordance with the test methods used within MULTGAM.

#### *Professional product*

An MMO for international release that can compete at world level. The game must also connect to back office and service systems and procedures, such as CRM, online support and business intelligence software, which has partly been developed by MULTGAM.

### THE ICT PROFESSIONAL

#### *Background*

John has worked at MULTGAM for one year. He also did a work placement here, which strongly motivated him to do his final year thesis in AI. C++ and the Standard Template Library also hold no secrets for him anymore. He has a unique chance to be involved from the beginning in creating a triple-A title. He can enjoy this with his colleagues who share his passion: games. Together with them he plays and analyses the new games that appear on the market, as much as his work allows him to.

#### *Roles*

In the technical project team the work is divided between network, network security, server administration, graphics, database, engine, GUI & Tools, game programming/AI, game programming/script, physics/animation and a GUI-scripiter. John has been added to the engine section as a junior.

#### *Tasks and activities*

John is creating the whole technical infrastructure of the MMO together with the other members of his team. They have made a planning together and stick

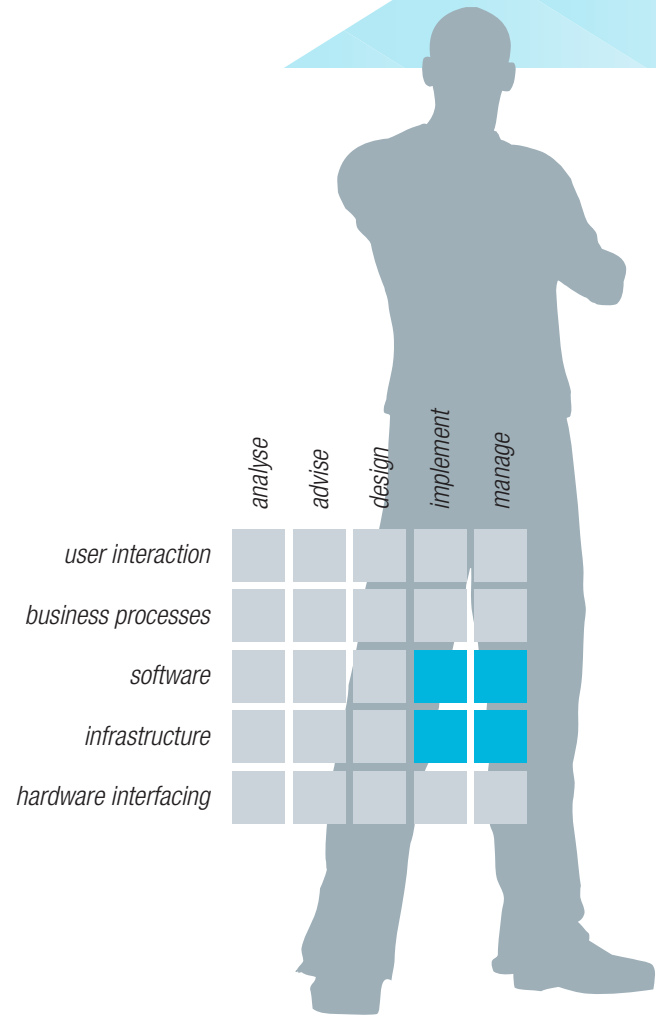
closely to the number of hours they need to create the components. Because of his junior position, he is not yet working on the mission critical systems, such as the server section or the payment component. As a junior John receives accurately written assignments from the technical team manager and develops the technical design for the engine components.

### Expertise

John's knowledge of C++ and AI are very useful in this role. He can convert required specifications into software. He is also a good team player, with good communication skills and able to work under pressure.

### Career perspectives

John is now a junior member of the team, but he can grow into being a senior team member and ultimately to technical designer, where he would have ultimate responsibility for the technical design of an MMO. In order to achieve this he must work on a considerable number of projects to gain experience. His senior colleagues have now often completed more than four projects and been in the business for up to ten years.



## ... an extension to the framework...

### CONTEXT

#### *Profile of the organisation*

Lumen is an organisation that focuses on increasing its clients' competitive advantage. It does this by developing new business models or applications that originate from innovation based on modern technology, such as the internet. In order to perform well in this knowledge-intensive market, Lumen is constantly striving for solutions where there is a healthy balance between its own research and development on one side, and its application on the other. The organisation is characterised by a human-oriented culture of professionalism, development and research. Lumen's range of products and services covers a broad spectrum from software engineering consultancy to ready-made solutions, in media and mobile markets, for example.

#### *Specific profile*

A number of clients are looking for new development methods, in particular to be able to shorten the time-to-market (the time taken to design and launch a product). Lumen is looking at ways in which it can help its clients do this.

#### *Situation*

A framework for code generation has been used by a client for a number of years. The framework has over one hundred users and is used to develop complex systems. A number of relevant standards are not yet supported by the framework. The client wants to connect with existing standards.

#### *Assignment*

Make an extension to the framework for a better support of Model Driven Engineering. An important aspect of this is the supporting of UML. UML profiles must be designed for this so it is possible to use a UML tool to model the software and then generate the right code on the basis of these profiles.

#### *Professional product*

A development tool that the client's developers can use to model and generate complex real-time systems. The development tool is delivered complete with design, training course and documentation.

### THE ICT PROFESSIONAL

#### *Background*

Alexander has been a software engineer for four years and employed by Lumen for one year.

#### *Roles*

Alexander is outsourced to clients for some of his time. He is also actively involved in research projects. Results from this are published and presented both internally and externally at conferences or in magazines.

### Tasks and activities

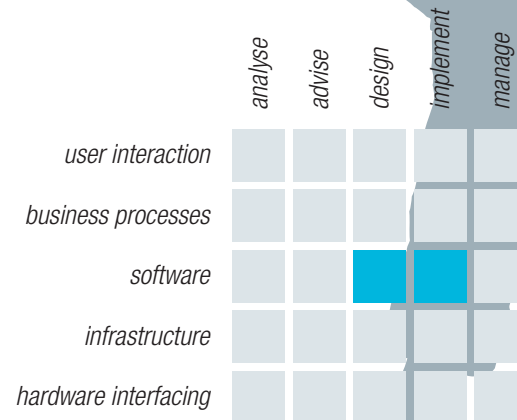
The range of duties is wide and varies from specifying the software to testing and providing support and training courses. Scrum is usually used as the development method. A good planning is important: a workable product must be delivered periodically. Alexander is in direct proximity of the user, so that questions can be resolved quickly.

### Expertise

Alexander is flexible and can settle into new projects, techniques and tools in a short space of time. This makes it possible to make a working product, using relatively new technology, within a year. He can communicate well with users and is able to point out risks and offer solutions.

### Career perspectives

Alexander wants to grow into the role of software architect in the future.



## ... management application...

### CONTEXT

#### *Profile of the organisation*

Nederbank is a large financial institution in the Netherlands with international branches. The bank is active in all facets of the banking industry.

#### *Specific profile*

The IT division is situated in various locations. The management of the infrastructure and the applications is fully centralised. For the business applications, a distinction is made between functional application management, technical application management and technical management. The design and programming of applications is fully outsourced.

#### *Situation*

Reports come into the service desk that an application is not functioning in accordance with the agreed service levels. These can be automatically generated reports, as well as reports from end-users. Incidents that can be resolved immediately are handled by the service desk employee. More complex reports and reports with a high impact are escalated to the functional application manager. The functional application manager tests and also accepts changes in the application or in the application environment.

#### *Assignment*

Manage an application in such a way that the agreed service level remains respected.

#### *Professional product*

A clearly defined service provision agreement and its good monitoring. The agreement contains management reports on the implementation relating to availability, performance, costs and quality of the relevant application.

### THE ICT PROFESSIONAL

#### *Background*

Luc has been working in the Application Management department for several months. It is his first job since graduating as an information engineer. His thesis looked at the implementation of ITIL in a new IT environment, the result of a merger between two companies.

#### *Roles*

As a functional application manager, Luc works together closely with technical application managers and technical managers. He also has a lot of contact with the functional manager within the business.

#### *Tasks and activities*

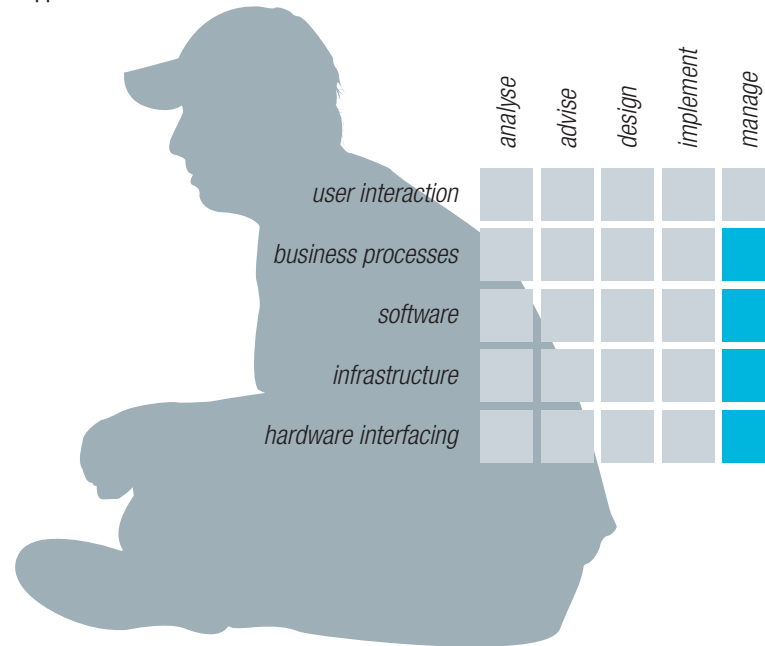
Luc collaborates with colleagues on providing solutions to faults in the application. He investigates why the fault is caused. If necessary he brings together the people who can contribute to provide a solution. He monitors the progress and escalates when a solution is taking too long to find or when there is not enough cooperation. In projects he provides the necessary input for the proper management of the application in the future, so that continuity is guaranteed according to the agreed service levels. Luc is the one who decides if a new version is applied. He also regularly provides management information on the compliance of the agreed service levels.

### *Expertise*

Luc has good knowledge of ITIL and with his good knowledge of the application, problem-solving abilities, result-oriented approach, communication skills and talent, he is able to bring the right people together.

### *Career perspectives*

Luc has the possibility of developing in various directions. Roles such as service delivery manager, project manager and service manager are some of the possibilities. He could also grow into a management role within application management.







# Appendixes

**APPENDIX 1****Consulted companies and organisations**

- Accenture Technology Solutions
- Alten PTS
- APG Investments
- Atos Origin
- Capgemini
- CIMSOLUTIONS B.V.
- Electrabel
- Expertisecentrum Arbeidsmarktcommunicatie Rijk
- Getronics PinkRocade
- ICT~Office
- Info Support BV
- KPN
- Logica
- Luminis
- Mediaan
- Movares Nederland
- NCIM Group
- Omnext bv
- Oracle
- Peak-IT B.V.
- Perfect for People
- Philips Corp. IT
- Procam Benelux BV
- Q-bit solutions BV
- Qi ict
- Quinity B.V.
- Raet bv
- SAP Nederland bv
- Scherrenberg-Makelaardij
- SNS Reaal
- Sogeti Nederland BV
- Sogyo
- Sysqa b.v.
- Stuurgroep Apeldoorn-IT
- Thales Nederland
- Transfer Solutions bv
- Vereniging VNO-NCW
- Virtual Affairs Nederland B.V.
- Yacht

## International developments

### *Introduction*

There is great interest worldwide for describing and charting the competencies of ICT professionals. This interest comes from various angles: governments, ICT trade and industry, higher education and employer and employee organisations. Internationally operating organisations with various interests and backgrounds run into differences in descriptions and competencies of ICT professionals. The differences concern the terminology, assumptions, business cultures and national legislation and cultures, amongst other things.

In ICT the international character of the labour market is an important aspect in the training of professionals, recruitment of personnel and planning of careers. Hence the great demand for transparency.

Since about 2005, various initiatives have evolved in Europe and worldwide with the objective to make descriptions of the ICT profession more transparent.

Parallel to this there are initiatives and developments to make higher education systems more compatible.

### *Europe*

In 1999, 29 European ministers signed the Bologna declaration with the aim of better harmonising national higher education systems. In 2001, when the Lisbon strategy was being drawn up, various aspects of ICT and the labour market, ICT and lifelong learning, and ICT and computer illiteracy were given attention from the European Commission. This developed very fast in a review of the Lisbon strategy in 2005.

Points of attention include:

- fragmentation of ICT frameworks (profiles)
- formal education versus professional training and certification
- image problem
- shortage of qualified ICT professionals.

A joint approach by three EU commissioners followed in 2007: Business and industry, education, training, culture and youth issues as well as the information society and the media.

They set the long-term e-Skills agenda. This agenda involves five action points at EU level. Of interest to the HBO-I foundation: long-term collaboration, appeal and lifelong e-skills.

### *Bologna process*

The Bologna process started in 1999 when 29 ministers of education came to an agreement to make links between national higher education systems. For 2010 a European Higher Education Area should be developed.

### *Dublin descriptors*

In 2001, under initiatives from the Netherlands and Flanders who collectively prepared accreditation frameworks, comparison was made of the existing descriptions for the end level of a bachelor and a master. The common aspects were then found and simply described in English in a meeting in Dublin, so that every participating quality assurance organisation could translate it into their own system.

The descriptors for the end level of the bachelor, master and doctor are included as reference points in the NVAO accreditation framework.

**QF-EHEA**

In order to ensure transparency and comparison of the systems and mobility of students and lecturers, the European ministers of education decided in 2005 to develop a Qualifications Framework for the European Higher Education Area (QF-EHEA).

According to his approach, higher education has a structure that contains three cycles: bachelor, master and doctor. A shortened cycle is also possible, the associate degree. In May 2005 the ministers responsible for higher education published the Bergen Communiqué. They recorded that the Dublin descriptors would function as QF-EHEA.

The QF-EHEA describes learning outcomes for the end of each cycle on the basis of the Dublin descriptors: knowledge and understanding, applying knowledge and understanding, making judgements, communication and learning skills. The value of the study components is expressed in the ECTS system of sixty study points per year.

The QF-EHEA provides the possibility in a meta-framework to correlate grades / titles from higher education in the Bologna member states with each other. For this it is necessary that the countries develop national frameworks (NQF-HE). For the Netherlands the Dutch Qualification Framework for Higher Education was drawn up by NVAO (NQF-NL) and declared to be compatible with the QF-EHEA in a European context.

**European Qualification Framework (EQF)**

The European Qualification Framework for Lifelong Learning (EQF) was established by the European Commission in February 2008. It is a meta framework for the translation, comparison and understanding of qualifications in professional training and higher education. The EQF describes eight levels in the form of learning outcomes with regard to what the student knows, understands and is able to do after completing a learning process. It is the

intention that in 2010 all member states will relate their national qualification systems to the EQF. For the Netherlands the NQF-HE has been available since December 2008. The Ministry of Education, Cultural Affairs and Science is responsible within the Netherlands for the national Qualification Framework for Higher Education. The NVAO is responsible for maintaining the NQF-NL and keeping it up-to-date.

**QF-EHEA and EQF**

The relationship between the QF-EHEA and EQF is important for higher education. The frameworks differ in methodology, but are mutually consistent and compatible. The levels 5 to 8 from the EQF can be directly linked to the descriptors in the QF-EHEA. The frameworks share the characteristics that they are both based on learning results; this is the link between both frameworks. The QF-EHEA components making judgements, communication and learning skills do not appear explicitly in the EQF. This is largely obviated in the EQF description of competencies.

**Profiles**

In 2001 a consortium of IT companies launched a description of profiles of ICT professionals, bundled together under the name Career Space. This description stemmed from dissatisfaction over the quality and quantity of starting ICT professionals entering the labour market. At the same time the consortium published curriculum guidelines for the benefit of higher education. It was also expected to make young ICT professionals enthusiastic about working in ICT via a website. Both documents were evaluated by the CEN/ISSS ICT Skills Workshop.

The outcomes of the evaluation were the occasion for a more detailed inventorisation of ICT profiles to be developed within Europe. The profile fragmentation for ICT professionals became then apparent. SFIA in the United Kingdom, AITTS

in Germany and CIGREF in France are examples of profile descriptions that differ in starting points, model and aim. This gave rise to the developments of the European e-Competence Framework (e-CF). This framework was published in September 2008.

In 2009 a study was started to make an inventory of curriculum guidelines in Europe. At the time of writing this document, no results are known yet.

#### *a. e-CF*

The European e-Competence Framework is comprised of four dimensions:

Dimension 1	Five e-skills areas, derived from the ICT business processes PLAN - BUILD - RUN - ENABLE - MANAGE
Dimension 2	A collection of 32 e-competencies that serve as a reference for the framework.
Dimension 3	Levels of skill for each e-competence. This specifies e-skill levels 1 to 5. These are related to the EQF levels 3 to 8.
Dimension 4	Knowledge and skills related to the e-competencies. These are optional example elements for the framework. The collection is not exhaustive.

The user guidelines provide a further explanation of the relationship with the EQF, amongst other things. The full e-CF and the user guidelines can be found on the e-CF website.

#### *b. e-CF, EQF and QF-EHEA*

Three frameworks are important for higher education. The e-CF was developed for trade and industry and human resources management. It relates to the functioning of an ICT professional in the workplace. The EQF and the QF-EHEA relate to learning results. Because learning results and qualifications affect the functioning in the workplace, a relationship between the skill levels in the three frameworks can be given.

Relationship between levels in the three frameworks:

e-CF	EQF	QF EHEA
e-5	8	Cycle 3 (Doctor)
e-4	7	Cycle 2 (Master)
e-3	6	Cycle 1 (Bachelor)
e-2	5	Cycle 1 (Associate degree)
	4	
e-1	3	

#### **Outside Europe**

A lot of attention is also paid to the profile of an ICT professional outside Europe. In the United States ACM and IEEE have been active in this field for a long time. The publications from ACM and IEEE provide worldwide support and reference for drawing up curriculums and profiles. Developments are ongoing in Japan and other parts of Asia. And Australia, New Zealand and South Africa are also active in this field. The international umbrella organisation of ICT professional associations, IFIP (International Federation for Information Processing) is also concerned with the profile of the ICT professional. It falls outside the scope of this publication to look at developments outside Europe in more detail. The websites of the named organisations provide further information.

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