IFIP/UNESCO's Informatics Curriculum Framework 2000 for Higher Education

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Authors' Preface to Reprint

University curriculum schemes for computing / informatics

International curriculum discussions

The ongoing work on the ACM/IEEE-CS Computing Curriculum 2001 and the publication of the Ironman and Steelman Reports have intensified the international debate on university curricula concepts and models. The context in which this debate is developing, is a broad view on what is called Computing (in the US) or Informatics (as we say in Europe and within the International Federation for Information Processing - IFIP). This was reflected at the 7th IFIP World Conference on Computers in Education WCCE2001 in Copenhagen, which provided several opportunities to share visions from different international perspectives. At the conference both the very actual ACM/IEEE-CS CC2001 and the earlier but still actual IFIP/UNESCO Informatics Curriculum Framework (ICF-2000) were presented and discussed.

Comparison of ICF-2000 and CC2001

These two curriculum efforts are different in characteristics and complementary to each other. A comprehensive comparison has been presented at the WCCE2001. Here we summarize the most important elements.

ICF-2000	*CC2001*
Is a framework for the design of curricula to be implemented in a specific context; offers a global specification; links to various well-reputed curriculum schemes (among which are the ACM/IEEE-CS model).	Offers curriculum guidelines allowing for model curricula with some variety in approach; specifies content on a detailed level; is self-contained with no specific reference to other curriculum schemes.
Holds a generic and 'inclusive' view on the field of informatics/computing, including all those areas such as computer science, computer engineering, information systems, and software engineering; follows a top-down approach; is fully available in the form of one overview report.	Holds different specific and 'exclusive' views on the field of informatics/computing, which yields separate reports on areas such as computer science, computer engineering, information systems, and software engineering; follows a bottom-up approach; Vol.II (CS) is available (Steelman version); the foundation Vol.I is not available, nor are the volumes for the other areas.
Is driven both by supply and demand, the latter being accounted for by starting from global work force requirements in terms of various categories of professionals and their required competencies.	Is mainly driven by supply, expressed by academic requirements in terms of topics, knowledge and skills; there is a demand drive also but this originates from universities and colleges in the US that want up-to-date practical curriculum guidance.
Incorporates cumulative graduate profiles: basic instrumental, basic conceptual, a minor, a major.	Has its focus on full and separate bachelor programmes in CS, CE, SE, and IS.
Refers to a variety of non-informatics subjects, however addressing none specifically in the body of knowledge.	Refers to a variety of non-computing subjects, however addressing exclusively mathematics in the body of knowledge.
Being commissioned by UNESCO, accounts explicitly for the international dimension; has been developed by a small group of IFIP-linked experts.	Expresses international ambition, but definitely has a strong US base in both the development team and its context; is the result of a large project involving many experts, mainly in the US.

International interaction desirable

CC2001 offers a high quality curriculum model, obtained through a thorough process involving many experts. However, the approach up to now is intrinsically fragmented and the resulting report on just computer science (being the first in a series) does not yet offer a broad, generic and 'inclusive' view on the whole field of computing or informatics. The pragmatics of this approach is easy to understand, but the separate, field specific reports form a barrier for widespread use of CC2001 throughout the world. One would prefer a more ambitious approach that leaves behind the traditional fragmentation and takes account of the maturity of the discipline today.

The other curriculum effort, IFIP/UNESCO's ICF-2000, does offer a broad and generic view, but is a curriculum framework rather than a set of precise curriculum guidelines. In other words, using ICF-2000 you still have to design your own curriculum, dependent on a number of institutional, cultural and societal factors.

It seems desirable that international interaction continues to the benefit of the international community in computing and informatics, including both developing and developed countries.

Presentation of IFIP/UNESCO's ICF-2000

With this international interaction in mind, we present the Informatics Curriculum Framework 2000 that IFIP developed for UNESCO. The paper describing ICF-2000 was published earlier in a somewhat more condensed form in the proceedings of the 16th IFIP World Computer Congress 2000 in Beijing. Its inclusion in this ACM publication is with the permission of IFIP. The full text of ICF-2000 is available at: <www.ifip.or.at/pdf/ICF2001.pdf>.

IFIP and its relations with ACM and IEEE-CS

IFIP is an international federation of national computing societies among which are ACM and IEEE-CS. IFIP's mission is to be the leading, truly international, apolitical organization that encourages and assists in the development, exploitation and application of information technology for the benefit of all people.

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Abstract

Informatics is a relatively new discipline, nowadays of key importance in all economic processes. Many professionals are needed with different informatics backgrounds. The Informatics Curriculum Framework 2000 (ICF-2000) has been designed to cope with a large diversity in demands for informatics education in a controlled way. It offers 8 different curriculum specifications that fit 8 professional role categories. It supports systematic and controlled educational policies in which educational informatics programmes can be developed in a cost-effective way, if need be from scratch. Learning materials can be developed in the local cultural tradition. ICF-2000 has many source links to model informatics curricula from leading professional informatics societies. Through this mechanism ICF-2000 can be easily kept up to date.

Background

In 1998 the International Federation for Information Processing (IFIP) has been requested by UNESCO to carry out a project under the title 'Modular training programme in informatics'. IFIP's Technical Committee 3 (on Education) has adopted the project. It is co-ordinated by the Chair of TC3 and has been executed by members of Working Group 3.2 (on Higher Education), complemented with input from other IFIP Technical Committees.

Rationale behind ICF-2000

IFIP/UNESCO ICF-2000 specifies a state-of-the-art informatics curriculum framework. IFIP TC3 strongly feels that only the state-of-the-art will do. This offers to institutions and countries where informatics education is still developing, the foundations from which to leapfrog to the front of developments. It is no use to fully repeat the development process with respect to informatics education that has already taken place elsewhere. This will only slow down developments and keep institutions and countries from closing the gap. Many opportunities arise from the field of informatics and its resulting technologies. This curriculum framework attempts to facilitate that fruitful use can be made of these opportunities.

ICF-2000 is offering an informatics curriculum framework, from which various curriculum implementations can be constructed in a straightforward way. These implementations depend on cultural, societal and institutional factors. Institutions and countries will be able to construct a modern curriculum from this framework in an implementation process in which specific needs, restrictions (for example with respect to resources) and possibilities are taken account of. Such a curriculum can also easily be extended with no consequence for the curriculum already in use: the ICF-2000 graduate profiles build upon each other.

ICF-2000 allows higher education publishers to produce learning materials in the cultural traditions of their country. Alternatively, popular high quality learning materials from developed countries may be used. This two-fold approach is supported by the many so-called source links in ICF-2000 to

other prominent and current informatics curricula from leading professional informatics societies.

The term 'curriculum' will be used in this document in the meaning of 'course of study'. The term 'curriculum framework' refers to a set of entities from which government authorities, industry, business and educational institutions may extract their own curriculum built from knowledge & skills units, in order to achieve a best fit implementation in their specific cultural, developmental and economical setting. We consider this a key asset of ICF-2000.

ICF-2000 is designed in such a way that it can be easily kept up to date. Whenever professional informatics bodies publish an updated curriculum these updates can be easily included in ICF-2000, which thus provides durable access to the state of the art in informatics education. The coverage of ICF-2000 can be judged by its mapping through specific source links on two current informatics classification systems that are both frequently updated.

Terminology

In this paper the term informatics is intended to be nothing more than an 'umbrella' label. Hence, 'informatics' or 'I' refers to a diverse, yet related family of domains, including 'computing', 'computer science', 'computer engineering', 'information systems', 'management information systems', 'computer information systems', 'software engineering', 'artificial intelligence' or 'AI', 'information technology' or 'IT', 'information and communication technology' or 'ICT', and so on.

Context and relevant trends

Paradox

In the last decade the field of informatics has shown an ongoing development, extension and linkage with other knowledge domains. In parallel we have witnessed a dramatic increase in demand for informatics and informatics-related university education from a broad and diverse population. Not only is the number of relatively distinct informatics educational programs growing, but there is also an increasing variety of educational programs in other disciplines that include informatics components in their core.

Thus, a paradox is arising. At the very same time that informatics education is emerging as an increasingly important part of core education for more and more students, we find a trend towards fragmentation within the informatics field itself. We also see informatics programmes appearing in other disciplines, where each discipline defines its own particular curricular needs and structures. This growing variety within informatics itself and in informatics programs in other disciplines creates a need for a common vision of the core concepts in informatics education.

Common vision

The development of a common vision was the focus of an August'97 international Working Conference organised by Working Group 3.2 of IFIP which brought together participants from around the world. The conference concentrated on higher education, including university education and higher professional education. Its editorial paper summarises the varying views on the informatics field and comments on the fragmented approach to its teaching. The paper advocates a more integral, generic and coherent approach, and it presents preliminary notions in a search for a shared identity for the informatics field [1].

In a recent issue of Computerworld [2] the necessity to have a common view of the field is underlined. It is the last part of an article that discusses the so-called 'discipline problem' in relation to the exploding enrolment of students in computer science studies in the USA.

> *Academia also appears to have a problem sorting out one discipline from the next. "One of the big issues is that the disciplinary boundaries are so fuzzy," says Barbara Simons, president of the Association of Computing Machinery in New York. Academia tends to break computer-related concerns into finer and finer particles, but students may have trouble understanding which major is which. At Berkeley, for example, computer-related studies encompass computer engineering, computer science, electrical engineering, applied math and basic sciences. Some of those areas are put under the umbrella of a College of Engineering, while areas such as IT management are often put under the rubric of Letters and Science.*
>
> *But while colleges and universities struggle with defining what a computer science major is and isn't, industry must deal with an incoming workforce of graduates that it perceives to be inadequately prepared to face its fast-changing needs. John Keast, vice president and CIO at PG&E Corp. in San Francisco, said schools need to do a better job of making their graduates attractive to employers. He added that he didn't care about academic definitions of degree programs. "CIOs are measured by how well they deliver systems that meet business requirements," Keast says. "For me, it's a question of finding a graduate that has successfully melded computer science principles with business focus." How does Keast think universities are doing in preparing graduates for this challenge? "Not very well," he says.*
>
> *Some observers within academia agreed with Keast. Jack Callon, director of new program development within the School of Engineering at the University of California, Santa Cruz (UCSC), says what's needed is a whole new way of thinking about computer-related curricula - one that more directly reflects the broader needs of the real world. "Look, there's technology everywhere in the business world - in research, product development, manufacturing, sales and marketing, design and implementation, and in the user community, too," Callon says. "A*

university should be able to offer various program choices to address each of these various dimensions," he says.

Some schools already are coming up with new programs that encompass both business and technical curricula. Take, for example, the growing number of colleges and universities that offer MBA degrees in technology. Callon, too, is starting a new class at UCSC that he calls "information systems management," which he contrasts to the business-school area of ITmanagement. "It's in the College of Engineering, but combines courses like economics, business and computer courses," Callon says. And he says internships are important, letting students learn to hold down a real job.

Notions and trends as pointed out in the above citation and elaborated at the IFIP Working Conference mentioned before, are very important for any new informatics curriculum efforts. Even stronger, they probably are essential in the context of countries and educational institutions that are in a situation of change and development. In such situation financial constraints are often severe while the economic need for practical professionals with a general understanding of informatics is very great. Only a state-of-the-art approach will allow leapfrogging to forward to better conditions. This is the reason why the IFIP/UNESCO project builds heavily on the state-of-the-art thoughts that have been developed at the '97 IFIP Working Conference and its follow-up activities.

Benefits from recent curriculum efforts

There are several precedents of co-operative activities by multiple constituencies to formulate shared curricular goals for (parts of) the informatics field. Among the more prominent of these are:

- *Computing Curricula'91* is a report produced as a joint effort by the Association for Computing Machinery (ACM) and the Computer Society of the Institute of Electrical and Electronics Engineers (IEEE-CS). It specifies common requirements in nine subject areas and relies on three working methodologies and a dozen recurring concepts. It is to be reviewed and revised by ACM and IEEE-CS, resulting in a new version for the year 2001.

- *Curriculum IS'97* was presented in 1997 as a joint effort by ACM, the Association of Information Technology Professionals (AITP) and the Association for Information Systems (AIS). This 'information systems' curriculum refers to a detailed IS body of knowledge, includes specific depth of knowledge metrics, and models courses in terms of small learning units.

- *Curriculum ISCC'99* has been developed by a task force from industry and academia with support from NSF and has been presented in draft version at the ACM/SIGCSE'98 conference. It provides an information systems-centric curriculum (ISCC) that is enterprise-oriented, based on a 'profile of the graduate' specified by industry, and that emphasises professional skills. A comprehensive draft report is being reviewed and used to seek endorsement by ACM, AIS and IEEE-CS.

- An education task force of the IEEE-CS/ACM Steering Committee is currently developing *curriculum recommendations for 'software engineering'* for the Establishment of Software Engineering as a Profession.

- *Curricula for Human-Computer Interaction* is a 1992 report by SIGCHI, ACM's special interest group on Computer-Human Interaction.

- *'A Modular Curriculum in Computer Science'* was produced by IFIP for UNESCO in a revised edition in 1994. It offers a curriculum framework for 'computer science' specifically meant to be applied in developing countries. In a way ICF-2000 can be seen as a successor of this UNESCO/IFIP'94 curriculum. ICF-2000, however, will have a much broader scope and evidently could benefit from the other curriculum efforts mentioned.

As mentioned before ICF-2000 attempts to link to these sources. The framework thus allows developing countries to benefit from the many efforts of informatics professionals in the world to produce state-of-the-art curricula.

How to use ICF-2000

The following steps lead to the construction of a state of the art higher education informatics curriculum with ICF-2000:

Step 1 Selection of curriculum specifications fitting the target category of professionals;

Step 2 Selection of graduate profiles from ICF-2000 fitting the educational environment;
Balancing the results of Step 1 with the results of Step 2;

Step 3 Producing unit descriptions using world-wide accepted informatics curricula that fit selected curriculum specifications;
Realisation of extracted curriculum units using widely available learning materials.

In the first step the educational need is identified on the basis of the need for informatics educated professionals in the local economy. These professionals fall into different categories and each category is linked to a specific ICF-2000 graduate profile. In the next step the educational possibilities are identified within the context of the particular circumstances of country and institution. Then the needs and possibilities are brought into balance. In the third extraction step curriculum unit descriptions are produced using the resources of worldwide-accepted informatics curricula. These descriptions may be produced in the own language

and in such a way that these fit the local cultural and educational setting. And finally the curriculum is realised using widely available learning materials linked with these worldwide-accepted curricula.

Extraction step 1
Selection of curriculum specifications fitting the target category of professionals

Higher education aims to educate the professionals of tomorrow. Their future professional role decides which informatics knowledge is needed. ICF-2000 distinguishes between three main categories of professionals, acting or interacting with informatics in a broad sense:

A I-users
Non-I-professionals using ready-made I-technology or I-applications in their work, for example non-informatics professionals using I-applications like text processors or I-technology like digital communication systems (many of the professionals in highly developed economies are I-users today);

B I-appliers:
Non-I-professionals applying I-knowledge and I-skills in areas different from informatics, for example non-informatics professionals in the economic field who use I-applications to model economic situations;

C I-workers:
I-professionals working in the field of informatics, for example the system engineer who, as informatics professional, develops I-applications or I-technology (note that the field of informatics is broad with diffuse boundaries with other disciplines).

It is important to note that I-appliers and I-workers generally will also be I-users, while I-workers may or may not be I-appliers too.

Further note that ICF-2000 deals with university and higher professional education. Lower level education programs are not considered.

ICF-2000 recognises eight subcategories within the three main categories of professionals and not more than four different graduate profiles to efficiently satisfy the educational needs of these professional (sub)categories. The size of the graduate profiles is 'measured' in terms of credit points: 1 credit point, equals one working day (= about 8 hours of study).

Category A actually has no subcategories, but its professionals will be referred to by the code A1, in order to have a uniform referring system. Categories B and C are divided over respectively four and three subcategories. We summarise their main characteristics below.

A I-users

Category of professionals	
	A1 INSTRUMENTAL I-USERS
Graduate profile	
	BIP Basic Instrumental I-Profile
Size of educational program	
	20 credit points (total)
	16 credit points (generic)
	4 credit points (specific)
Prerequisites	none

B I-appliers

Category of professionals	
	B1 CONCEPTUAL I-APPLIERS
Graduate profile	
	BCP Basic Conceptual I-Profile
Size of educational program	
	40 credit points (total)
	32 credit points (generic)
	8 credit points (specific)
Prerequisites	BP

B I-appliers (continued)

Categories of professionals	
	B2 INTERFACING I-APPLIERS
	B3 RESEARCHING I-APPLIERS
	B4 DIRECTING I-APPLIERS
Graduate profile	
	MIP MInor I-Profile
Size of educational program	
	80 credit points (total)
	64 credit points (generic)
	16 credit points (specific)
Prerequisites	BIP, BCP

C I-workers

Categories of professionals

C1 OPERATIONAL I-WORKERS
C2 ENGINEERING I-WORKERS
C3 RESEARCHING I-WORKERS

Graduate profile

MAP MAjor I-Profile

Size of educational program

160 credit points (total)
128 credit points (generic)
32 credit points (specific)

Prerequisites BIP, BCP, MIP

Curriculum specifications adapted to specific professional categories

Depending on their specific future professional role students have different educational needs. ICF-2000 meets these needs through 4 different graduate profiles:

- BIP, Basic Instrumental I-Profile;
- BCP, Basic Conceptual I-Profile;
- MIP, MInor I-Profile;
- MAP, MAjor I-Profile.

Because the graduate profiles build one upon the other an efficient curriculum structure results. However, professional categories B2, B3 and B4 have characteristics leading to differences within the identified graduate profile MIP. And professional categories C1, C2 and C3 have characteristics leading to differences within MAP. These differences concern:

- The coverage of a set of informatics themes;
- The orientation in terms of goals and competencies to be reached.

A curriculum specification is therefore needed that 'fingerprints' a graduate profile for the specific professional category with respect to:

- A set of twelve core curriculum themes taken from [1]

1. Representation of information;
2. Formalism in information processing;
3. Information modelling;
4. Algorithmics;
5. System design;
6. Software development;
7. Potentials and limitations of computing and related technologies;
8. Computer systems and architectures;
9. Computer-based communication;
10. Social and ethical implications;
11. Personal and interpersonal skills;
12. Broader perspectives and context (including links with other disciplines).

and:

- A set of four major possible orientations

AW AWareness (know or use):
Aiming at developing basic knowledge as well as skills that allow students to act basically literate with respect to informatics in general and to perform standard operations using computer technology or software packages;

AP APplication:
Aiming at developing a basic conceptual understanding of informatics and of some more advanced informatics skills which allow students to apply basic informatics to other disciplines or areas;

DM Design and Modelling:
Aiming at developing a general understanding and broad overview of informatics, especially with respect to the modelling and the design of informatics applications;

CA Conceptualisation and Abstraction:
Aiming at developing a thorough understanding of and well-developed skills in informatics as a broad discipline, the essence being to further develop the capability of students to abstract and to conceptualise.

An example of a curriculum specification is given in Table 1.

Extraction step 2
Selection of graduate profiles fitting the educational environment

ICF-2000 offers a considerable degree of freedom in the implementation of an actual curriculum in specific cultural and societal settings that are influenced by numerous implementation factors. Here we restrict ourselves to the most important factors in the educational environment. The context is that of higher education institutions where Major and Minor degrees in disciplines other than informatics are awarded.

Each of the four graduate profiles mentioned before demands specific resources in the educational institution. In this extraction step those profiles are identified that fit the local circumstances. From this starting point educational institutions may develop informatics curricula in a gradual and efficient way, both in terms of resources and personnel. This is facilitated by the fact that ICF-2000 graduate profiles build upon each other.

Two examples of the relationship between institutional characteristics and preferred options are given in Table 2.

Balancing results of Step 1 with the results of Step 2

Professionals are needed in the society in which educational institutions operate; the future professional role of students decides which informatics knowledge is needed. This educational need is identified by Extraction Step 1.

On the other hand important resource factors in the situation of an educational institution (or a country) will decide which

graduate profiles may be delivered within the local boundary conditions. This is the result of Extraction Step 2.

There may be a mismatch between what is needed (considering the needs of the local economy, Step 1) and what is possible (considering the situation of the educational institution, Step 2). One way or another such a mismatch must be resolved. Either new resources have to be allocated to the educational institution to meet the requirements of the graduate profiles to be offered or particular categories of professionals have to be educated elsewhere or brought in from elsewhere.

In a case where the resources of an institution are not sufficient to offer a particular profile, another – less demanding profile – may be offered. Once the situation has changed the educational offer can be easily extended to the more demanding profile. This can be done without consequences for the initial profile that is being offered already, as ICF-2000 graduate profiles build one upon the other.

Extraction step 3
Producing unit descriptions using world-wide accepted informatics curricula

After balancing the results of Extraction Steps 1 and 2 one or more curriculum specifications have been selected within one or more of the four graduate profiles.

Each graduate profile is described in terms of curriculum units (such as in Table 1). Each curriculum unit in turn is specified by referring to a number of important and current informatics curriculum sources, whereas the contents are classified through reference to:

CCS ACM Computing Classification System;

UCSI Unified Classification Scheme for Informatics (UCSI).

The first well-known system needs no further explanation, the second has been presented and utilised at the August'97 IFIP Working Group 3.2 conference, mentioned before (see the paper by Mulder and Hacquebard in [1]).

An example of a unit description is given in Table 3.

Making a concrete unit description

A concrete unit description is made from the ICF-2000 unit description using the references given. In the example in Table 3 the main reference is to the European Computer Driving Licence, Module 1. The actual units can be described in the own language and within the own cultural and educational tradition. However, when composing the concrete unit description the specific coverage of themes, the specific orientation and the specific learning approach have to be taken into account. Once the curriculum has been described according to local culture and educational setting, it can be realised in practice. Learning materials are essential in this. Many learning materials are now available in many languages. The current informatics curriculum sources referred to by IF-2000 have drawn on existing, widely available learning materials and resources, but also have led to the production of new learning materials and resources. Standard books have appeared and standard resources have been developed. For example, for the unit in Table 3, with the main reference to ECDL, many learning materials in various European languages have been developed and are widely available.

The Internet and the World Wide Web have much to offer in terms of freeware and shareware resources. If Internet connectivity is available at institutional level a possibility to reduce problems with obtaining suitable learning materials and resources may be found in collaboration with other institutes where these are available. Other possibilities could originate from collaboration with business and industry, or from international co-operation with sister institutions. Also governmental or non-governmental agencies for the support of developing countries may be able to help in getting the required learning materials.

Selected learning materials may be translated by local publishers into the own language or may be adapted to fit the local cultural and educational tradition.

Keeping ICF-2000 up to date

Developments in the field of informatics are very fast. The content of informatics education is changing continuously. This means that curricula and study materials have to be updated all the time. ICF-2000 is a framework that refers to major widely accepted and widely implemented informatics curricula and associated resources. Much effort is put into keeping these curricula up to date. For example, the ACM/IEEE-CS Computing Curriculum '91 is currently under revision. The revised curriculum is expected in 2001. To keep ICF-2000 up to date with this development the appendix in the full report on ICF-2000 describing ACM Curriculum '91 has to be updated to describe ACM/IEEE-CS Curriculum 2001. In ICF-2000 itself only the references to this appendix have to be updated. In this way ICF-2000 can be kept up to date with relatively little effort. Also new curricula, for example the IEEE-CS and ACM curriculum for software engineering, may be added. An updating mechanism is proposed in ICF-2000 to assure this process.

References

1 Mulder, F., van Weert, T.J. [eds] (1998) *Informatics in higher education: Views on informatics and noninformatics curricula,* Proceedings of the IFIP/WG3.2 Working Conference on 'Informatics (computer science) as a discipline and in other disciplines: what is in common?'. London, Chapman & Hall.

2 Fryer, B. (1998) 'The student population boom'. *Computerworld,* October 19, 1998; http://www.computerworld.com/home/print.nsf/idgnet.

Biography

Fred Mulder is on the Executive Board of the Open University of the Netherlands (since September 2000), and at the same institute he is a professor of informatics educa-

tion (since 1991). He has been associated with the Dutch Open University from its start in 1983, interrupted by an almost 2-year period until September 2000 when he was a senior ICT & Management education consultant at TSM Business School, the management institute of the Dutch universities of Twente, Groningen and Eindhoven. He has represented The Netherlands in the education committee TC3 of IFIP for almost a decade, until September 2000.

Tom J. van Weert is since September 1998 managing director of Cetis, the Expert Center for Innovation and Educational Technology of the Hogeschool van Utrecht, University of Professional Education and Applied Science, The Netherlands. Before that time he was director of the School of Informatics (Computer Science) of the Faculty of Mathematics and Informatics of the University of Nijmegen, The Netherlands. He has been active within several IFIP Working Groups and is currently chair of IFIP Working Group 3.2 on university education, until December 2001.

Notes

The full ICF-2000 document is posted on the IFIP website. The current location can be accessed from <http://www.ifip.or.at/>
by clicking on 'announcements' and then on 'projects'.
Direct access may be obtained at <http://www.ifip.or.at/pdf/ICF2001.pdf>.

Table 1 Curriculum specification of BIP

Graduate I-profile	**BIP**	**BASIC INSTRUMENTAL I-PROFILE**												
Categories of professionals	A1	Instrumental I-users												
		credit points (total)		credit points (generic)				credit points (discipline specific)						
Size of educational program	***BIP***	***20***		***16***				***4***						
Prerequisites	none													
Constituting units		***size***	***orien-***	***themes***										
code	***title***	***[cp]***	***tation***	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	***11***	***12***
[--- generic ---]															
BIP-01	Context for informatics applications [1]	3-5	AW		x		x		x		x	x	x	x	
x															
BIP-02	Hands-on with software packages [1]	3-5	AW	x		x	x			x	x			x	
BIP-03	Hands-on with software packages [2]	3-5	AW	x		x	x			x	x			x	
BIP-04	Hands-on with networking [1]	3-5	AW	x						x		x		x	
[--- discipline(X) specific --- X may be 1 ---]															
BIP/X-01	Operating software in area X [1]	4	AW							x				x	x
	Total size & theme 'fingerprint'	**20**	**AW**	**4**		**3**	**2**	**1**		**5**	**3**	**2**	**1**	**4**	**2**

1 credit point (cp) = 1 day of study

Table 2 Fitting the curriculum to the educational environment

The educational institution is small

Institutional characteristics	*Choose as option*
There is some, not very advanced, hardware and software Several staff members have pioneered in using computers No staff has graduated in informatics	Minor or Major in other discipline than informatics including: **BASIC INSTRUMENTAL I-PROFILE (BIP)** No Minor or Major programme in informatics
There is some, not very advanced, hardware and software Several staff members have a Minor in informatics	Minor or Major in other discipline than informatics including: **BASIC INSTRUMENTAL I-PROFILE (BIP)** **BASIC CONCEPTUAL I-PROFILE (BCP)** No Minor or Major programme in informatics

The educational institution is large; it has a further developed informatics department

Institutional characteristics	*Choose as option*
There is a good quantity of hardware and software of good quality There is an ICT-support centre Several staff members in the other departments have a Minor in informatics	Minor or Major in other discipline than informatics including: **BASIC INSTRUMENTAL I-PROFILE (BIP)** **BASIC CONCEPTUAL I-PROFILE (BCP)** No Minor or Major programme in informatics
There is a good quantity of hardware and software of good quality There is an ICT-support centre Most staff members in the informatics department have a Major in informatics; the other staff members in the department have a Minor in informatics	Additionally the informatics department offers both a Minor and a Major programme in informatics: **MINOR I-PROFILE (MIP)** **MAJOR I-PROFILE (MAP)**

Table 3 Example of a ICF-2000 unit description

BIP-01	**CONTEXT FOR INFORMATICS APPLICATIONS [1]**						**3-5 CP**
Targeted competencies	- the capability to basically recognise the context (business-wise, societal, individual, technical, managerial and historical) in which informatics applications are introduced and used - the attitude of being critically aware of the potentials of informatics applications						
Learning approaches	th ex						
Curriculum references							
CC91	Knowledge units	AL	AR	DB	HU	PL	SP1-3
IS97	Courses	1	3	4			
ISCC99	Courses	11/1.0	21	22	41	42	43
HCI92	Courses	CS1 CS2					
>>> *ECDL*	**Module 1**						
Classification							
CCS	B.0 C.0	D.0 E.0		H.0 I.0	J.0	K.1-2, 3.0-7.0	
UCSI	1 2	3		4.1-4			

Learning approaches

th Theoretical:
The approach is to transfer information and to interact on it.

ex Exercising:
The approach is to transfer information by letting students solve problems of various kinds (both abstract and concrete), generally with pencil and paper.

Main source reference: >>> *ECDL* **Module 1**