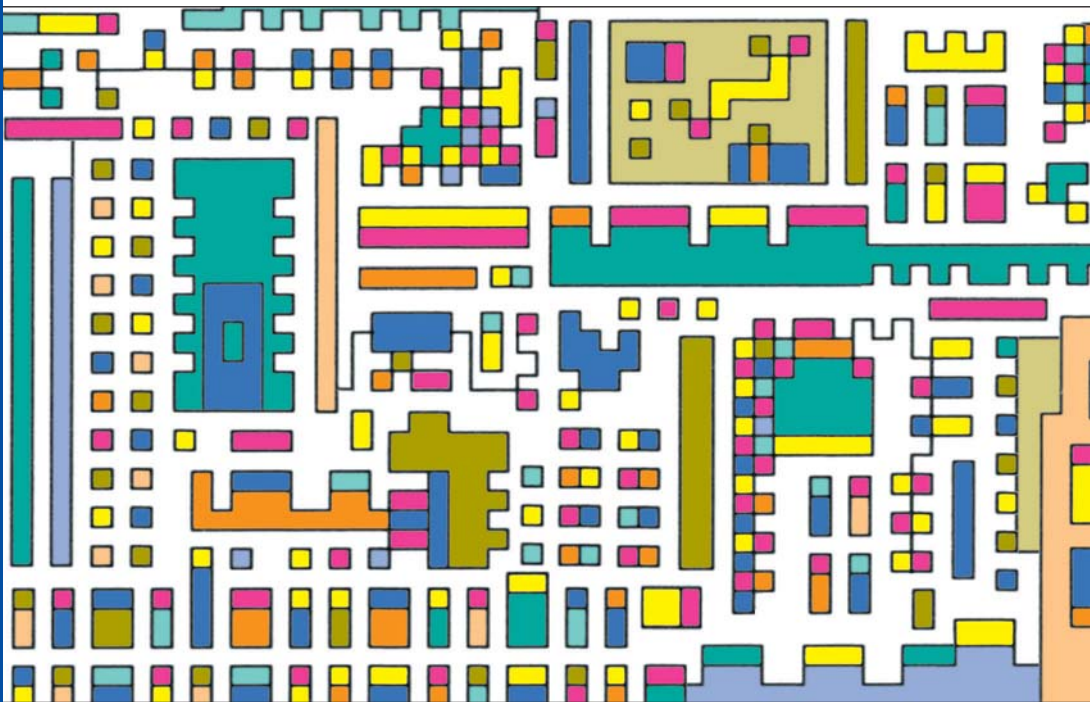RAFFAELE BRAMBILLA, MARINA CABRINI,
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THE ALL-ROUND IT PROFESSIONAL
Part C. Operate Knowledge Area: Operations and Support of Information Systems

AICA
Associazione Italiana
per l'Informatica ed
il Calcolo Automatico

EUCIP
European Certification of
Informatics Professionals
Core Component

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This publication is a **working translation** of the above text in the English language and do not pretend to do credit to the original Italian text. It has been prepared for the following purpose and target groups:
- Trainers and Lecturers: to allow them to prepare didactic material and courseware for the EUCIP Core training courses.
- Candidates for EUCIP Core certification: to be used as learning material to supplement EUCIP Core training.

Development:
The EUCIP Core Syllabus at [www.eucip.com] specifies the content of the EUCIP Core certification domain. This English language working translation can be used in conjunction with the EUCIP Core Syllabus as a basis to prepared further courseware in any language and in particular English language courseware.

Summary

**PART C
OPERATE KNOWLEDGE AREA: OPERATIONS
AND SUPPORT OF INFORMATION SYSTEMS**

Introduction

The Need for Common Competences and References

The spread of IT has brought a very wide public to face arguments (ranging from the concept of *bit* to the JPEG format) which were, up to not too many years ago, a prerogative of a few specialists.

The growing IT literacy that characterizes advanced societies does not mean however that specialized competences are not needed anymore. On the contrary, the demarcation line between "users" and "professionals" is thicker and thicker, and the differences between distinct professional specializations are such that a network administrator for a large company has very little in common with a Java programmer involved in the integration of information systems at some other company or with a pre-sale consultant working for a company that develops and commercializes CAD systems.

The risk that exists in this context is a great confusion, in which many individuals think they have good IT competences, but they are unable to communicate (due to language issues to begin with) with other groups of theoretically analogous people, who are also specialists in fields that may differ from the IT sector only for some marginal details.

The task of assessing IT competences turns out to be even more difficult (maybe) for those who are alien to the field. Suffice it to think of those who are called to promote learning initiatives in order to favour social development, or of human resource managers attempting to select candidate employees or to establish criteria for internal appraisal and stimulations of professional excellence.

It is therefore important to define a reference outline for helping one to identify some firm points of cross-sectional competences common to all IT professionals, that is those who do not simply use IT for their work, but are instead IT craftsmen themselves. All the technicians who work for companies of the IT industry as well as all

the staff dedicated to IT support at companies and organizations operating in other industries fall into this category.

The definition of such a reference outline for IT competences is the objective that has carried in 2000 to the formation of an international working group promoted by CEPIS (the Council of European Professional Informatics Societies). The outcome is the EUCIP (European Certification of Informatics Professionals) program, described in the last two sections of this introductory chapter.

Book Structure

The contents of this book correspond, also in the organization of arguments, to the Syllabus (included as an appendix) that defines the basic competence requirements necessary to get the EUCIP certification. Due to the vastness of the arguments which are dealt with, it has been chosen to subdivide the book in three volumes. Such a subdivision, in addition to corresponding to the EUCIP base level structure (which consists of three distinct examinations in the "Plan", "Build" and "Operate" areas), also reflects a logical distinction between discipline contexts.

This first volume deals with topics relating to the planning, to the use, and to the management of information systems and it therefore exposes a number of elementary concepts on information processing service "clients". An overview is thus given on organizations, on business process management, on project management, on legal and economic implications of IT investments, often from a "consulting" point of view, in the conviction that IT specialists must understand the real requirements and the context to which technology is intended.

The second volume deals with arguments related to the realization of information systems, with particular emphasis on software, meant as a development object.

Finally, the third and last volume of the series deals with problems related to operation and operating support of the information systems, emphasizing hardware components, operating systems, communication networks, and the delivery modalities of a support service oriented to a customer-supplier logic, which is already indicated as necessary in this first volume.

Acknowledgements

EUCIP Certification Structure
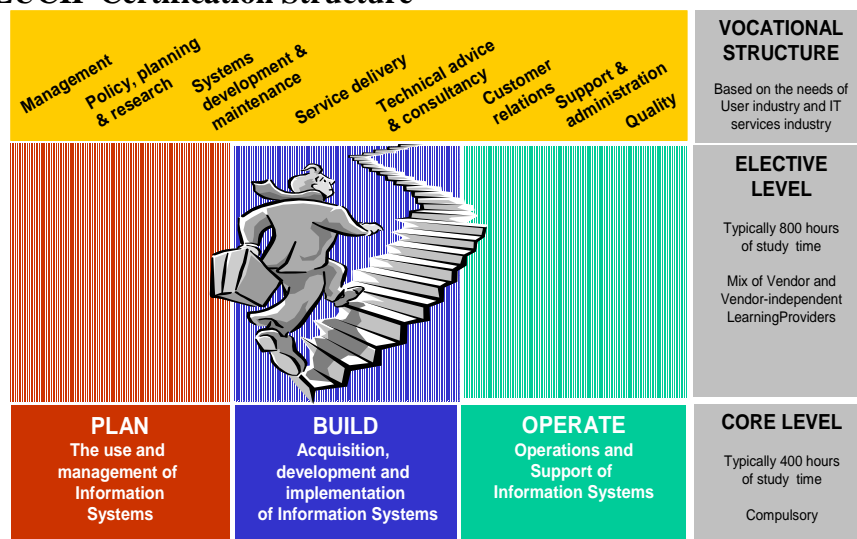
fig.I.1 –EUCIP conceptual structure

The EUCIP programme includes two certification levels, the second of which refers to a vocational structure.

- **Core level**: includes necessary competences, common to all of the paths, and covers the three fundamental processes: plan, build, and operate. A 60 minute exam corresponds to each of these three areas with multiple choice questions extracted from a question and test base (QTB). Preparation for the core level exam is estimated to require about 400 study hours, equally distributed among the three processes cited, for a university level student.
- **Elective level**: the elective level permits the choice of a specialised competence. The student has the power to arrange, with some level of freedom, elements of different areas of competence, including vendor modules as well as independent courses and modules. The overall path is expected to take about 800 hours of study, and the final exam for the certification is taken in the presence of an EUCIP examination board. The candidate provides the board with documentation that certifies the path studied and the realized projects prior to the exam. The combination of courses chosen by the student must correspond to one of the prescribed curricula (see the next point), thus guiding the candidate to a determined professional IT category.
- **Vocational structure**: the elective profiles, like, for example, Business Analyst, Information Systems Project Manager, Software Developer or Network Manager, correspond to typical profiles within businesses of the IT industry or other sectors. This structure of the EUCIP elective profiles aims to define the correspondence between the professional figures and the concrete requirements on various areas of knowledge and within the described elective level. The form is typically that of a study curriculum that describes how one can combine available modules to satisfy the requirements of the chosen position. For example, the profile of Network Administrator requires various education modules in the "Operate" area.

The Three Knowledge Areas
A. **Plan** – It refers to requirements analysis and the planning of the use of information technologies, and it is therefore strictly connected to the management processes and to the definition of the business needs in the ICT sphere put into the context of a strategic perspective. Important elements within this area are, for

example, the traditional notions of business organization, return of investments, financing, risk, etc.

B. **Build** – Includes the processes of specification, development and integration of IT systems. The central node of the area is represented by traditional aspects of development, implementation, and integration of IT systems.

C. **Operate** – This area regards the installation, supervision and maintenance of IT systems. It is characterized by arguments like network management, change management, service and delivery support, etc.

Part C
Operate Knowledge Area:
Operations and Support
of Information Systems

C.1. Computing Components and Architecture

C.1.1. Main Hardware

All modern computers are made up of a number of functional blocks, each responsible for a well-defined set of tasks. Computation is supervised by a control unit, together with an arithmetic-logic unit. Such units take on the responsibility of coordinating the entire set of operations which can be executed by the computer. Data is stored in central memory, which interfaces with the above mentioned units. To overcome the current capacity limitations of central memory, a number of mass storage devices may be used, which allow for the storing of huge quantities of data. These devices are not volatile, which means they preserve information when the computer is switched off.

Many Input/Output (I/O) devices exist to insert information into the computer, as well as to extract information from it. In the first generation of computers each computation block was made of a number of complicated circuits which occupied multiple circuit boards. Today they are part of the integrated circuits contained in a single chip. The control unit and the arithmetic-logic unit are usually implemented in a single integrated circuit called the CPU *(Central Processing Unit).* The same integration process is used for RAM *(Random Access Memory)* central memory modules. These are located on a single printed board hosting the integrated circuits containing the required memory modules. All the main circuits of a computer are integrated on a printed circuit board, called the *mother board* (or *main board*) that implements most of the computer's architecture, while hosting the connectors needed in order to interact with the other computer components.

fig.C1.01 – A PC mother board

Personal Computers (PC's) today have CPU's that are based on the CISC (*Complex Instruction Set Computers*) architecture, whereas, many servers have CPU's that are based on the RISC (*Reduced Instruction Set Computer*) architecture. In the latter case the trade off is instruction complexity for speed of execution. This choice was dictated by the fact that the development of compilers was generally unable to cope with CPU innovations. CPU power was thus wasted since it was impossible to exploit instructions not included in programs compiled with older compilers.

Central memory, which is volatile and thus loses data when the computer is switched off, is always coupled with a static memory, called **ROM** (*Read Only Memory*), containing the set of instructions needed to bootstrap the computer.

When the computer is switched on, the CPU executes the above mentioned instructions, to perform a first hardware verification phase called POST (*Power On Self Test*). Then, the same set of instructions loads the operating system stored on the hard disk into memory. In the case of Personal Computers, the program stored in ROM also contains the BIOS (*Basic Input Output System*). This is a set of

routines allowing the use of peripherals, for example, read/write operations from and to a disk, the read operations from a keyboard and image composition on the monitor's screen.

The BIOS operation is supported by a static CMOS (*Complementary Metal Oxide Semiconductor*) memory, powered by a small electric battery. The CMOS memory stores information about the type of hardware installed on the PC. Data contained in this memory may be viewed and modified by means of a specific program included in ROM. This program, generally called setup, can usually be launched during the first phase of system start-up by pressing the DEL key.

fig.C1.02 – A PC ROM containing the BIOS system

Almost all PCs host mass storage magnetic devices known as magnetic disks. Such devices accomplish the task of reliably storing not only data, but also all the programs and information useful for computer operation, including the operating system, the application programs and the user's data files.

Inside modern computers and especially inside PCs, we can find optical storage units which allow mainly read operations but sometimes also write operations, for example, the Compact Disk (CD), the Digital Versatile Disk (DVD).

Human interaction with a computer is made possible by terminals having a keyboard and a monitor. PCs are typically equipped with an internal video card which can be connected to an external monitor; similarly it is possible to directly connect a keyboard and a mouse to the PC.

The last but not least accessory for a computer is the network card, which lets the computer become part of a local network called a Local Area Network (LAN). For traditional computers, as well as for desktop PCs, this card has to be physically connected to a network

cable. For notebooks wireless cards are often used, which do not need any connecting cable, since they communicate with an access point through short range radio waves.

Connection to the network may also take place through a remote access, using either a common modem or a GPRS or a UMTS card.

fig.C1.03 – A PCMCIA wireless card inserted in a notebook

Magnetic and optical disks, together with keyboards, mice, terminals and communication cards all belong to the peripherals category. The term *peripheral* contrasts with the term *central*, as in *central memory* and *CPU*. Peripherals are all those devices which are loosely coupled with the CPU and which play a minor role in the data elaboration phase, while proving fundamental for data storage and exchange.

Peripherals may be further subdivided into input peripherals, output peripherals, input/output peripherals and storage peripherals. A keyboard is an input peripheral, useful to insert data into the computer. A monitor is an output peripheral, useful to show the output of a computation. A network card is an input/output peripheral, useful to both receive and send data between computers.

The main input peripheral is the keyboard, followed by the mouse. Besides these, we mention the *joystick,* usually associated with videogames, but also used for robotics applications. Also linked to games, we find the numerous steering wheels or *cloches*, which allow to use flight or car simulators. Some of the above peripherals, which are typical input devices, tend to become input/output

peripherals thanks to the adoption of feed-back systems that can simulate the effects of manoeuvring. This is achieved, for example, by producing either a reaction force or vibrations on the joystick or on the steering wheel.

Last among the input peripherals, but first for complexity, we mention *scanners*. These devices produce a digital representation of book pages and printed photographs. It is also easy today to connect a digital camera or a video camera to a PC, and then download the data recorded.

fig.C1.04 – Video converter, capable to translate analog input into a video digital format

PCs are today equipped with audio cards capable of capturing sounds from microphones and converting them into a digital format. Indeed, any device capable of producing electronic signals that can be connected to a computer is known as an input peripheral. Output peripherals are usually monitors, printers and speakers.

Video reproduction systems (also known as monitors) have evolved from the vacuum technology used in cathode ray tubes to the

solid state technology used for LCDs (*Liquid Crystal Display*). They are all used to realize a dynamic visual communication.

Monitors receive and reproduce a signal generated by a specific video card, which may be considered an inner (and thus less visible) part of the output peripheral. The first video cards could only produce character-based representations. Through the years video cards have evolved to cope with the graphical user interfaces used in modern computers and also including the graphic and animation demands of videogames.

Current video cards can generate images based on simple vectorial instructions, thus relieving both the CPU from the processing load and the bus from most of the data transfer load. To accomplish such a task, these cards are equipped with video memory, together with a Graphical Processing Unit (GPU), which is a dedicated micro processor.

Due to the ever-increasing number of applications with demanding graphical requirements, many cards are also equipped with a 3D accelerator, enabling them to create and reproduce three-dimensional objects derived from graphical instructions. Such instructions are coded in programming languages, such as OpenGL, which define the graphical commands to be used inside video cards in order to create graphical objects. Very often a reference to such languages appears on the packaging of the graphic cards.

Printers and plotters let us produce information generally printed on paper. Printers differ from one another and from plotters by the specific printing technique adopted. The first generation of printers made use of types on which the characters were impressed: depending on the technology employed, these were either drum printers, or chain printers, or daisy printers, or ball printers.

Drum printers are very fast. They consist of a drum rotating around a horizontal axis placed in front of the paper, but separated from the paper by an inked ribbon. Behind the paper there were as many hammers as printing columns. While the drum was turning the hammers were fired when the correct character was over the paper.
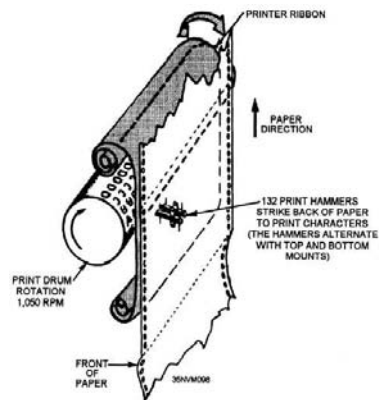
fig.C1.05 – Scheme of a drum printer

In Daisy wheel printers instead of a drum, printing was done by means of a wheel where type characters were displayed like the petals of a daisy flower. During printing the wheel rotated very fast and as each required character came into position in front of the paper it was hit with a hammer which forced the leaf with the character on it against an ink ribbon, which then struck the paper.

Ball printers brought the characters to the surface of a ball which was appropriately positioned and then pushed into the inked ribbon and the paper.

At the start of the personal computer era, needle printers came to the fore. With these printers, images are built with a matrix of needles controlled by solenoids.

More recently, we find bubble or ink jet printers *(Bubble Jet)*, that print by exploiting a matrix of small holes ("dots") ejecting microscopic ink drops. The ink drops are produced either through vibration of a piezoelectric crystal placed on top of the printing head, or through local warming of the ink by means of electrical signals.

In the 1980's Thermal transfer printers, using a head with heated elements, were used together with plastic ribbons to obtain high quality printing. They are nowadays used with thermo-sensitive papers especially for POS (*"Point Of Sale"*) terminals, which typically enable credit card based transactions.

Thermal technology is also the basis of sublimation printers and wax printers, both employed for professional quality colour printing.