EQF assigned occupational standard:

Software system engineer

(Field: Electro-technics, automatics, electronics, informatics/ IT)

EQF assigned curricula:

Master Program 4 semesters

"Parallel and Distributed Systems"

Provided by: ANC, RO	Last update: August 2011	Version: 1.0

The Occupational Standard that we propose as example for the implementation of EQF in Romania was elaborated in accordance with the Occupational Standard and Qualifications development and review Methodology – M2. The definition of Occupational Standard is in accordance with the European documents which refer to this concept. Occupational Standards are documents which are described in terms of units of competences and where there is mentioned the quality level associated to the activities outcomes of an occupation. The elaboration of the Occupational Standard represents one step forward in the implementation of NQF which is based on the principles of EQF. The Occupational Standard contains a certain number of units of competences which are covering all the important activities of an occupation. The Occupational Standard defines the necessary competences to respond successfully to the labour market requests. In TVET the unit of competence is defined as "a set of coherent and explicit learning outcomes". The persons that are involved in the elaboration of the Occupational Standard must look the "learning outcomes" as a declaration of what a student/ learner must know, understand or be capable of doing at the end of a training program corresponding to an unit of competence.

Every unit of competence within an Occupational Standard must include the following specific elements:

- The title;
- The elements of competence: a coherent set of results that can be measured;
- The criterion of achievement: the description of important elements which refer to the successful achievement of the activities. These elements refer to:
  - skills: *what a person must be capable of doing*;
  - knowledge: *what a person must know;*
  - attitudes: *what kind of behaviour a person must have.*
- The criterions of performance allow the objective assessment of an acquired competence;
- Range of variables: these are describing the contexts and the conditions in which are applied the criterions of achievement;
- Recommended techincs of assessment: the methods which are recommended to recognize if the requested learning outcomes have been achieved by a student/ learner;
- Level of responsibility: an unit can have one of the eight levels specified by the European Qualifications Framework. The level is determined by the degree of autonomy and responsibility that a competent person should have in relationship with the tasks of his/ her job;
- Credit numbers: credit numbers will be allotting to a unit of competence when the debates on this subject will be clarified on the European and national level.

In the following pages we give as *example an Occupational Standard* for the occupation of *Software system engineer* that will be followed by a *curriculum for a master program* named *"Parallel and Distributed Systems"* whom graduates can have a job in the field of Electro-technics, automatics, electronics, informatics/ IT.

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OCCUPATIONAL STANDARD

Occupation: Software system engineer
Field: Electro-technics, automatics, electronics, informatics/ IT
COR code: 213905
2006
Initiator : Center for Training in Informatics CPI – S.A.

* * *

The standard was drafted within the program PHARE 2003 Economic and Social Cohesion - Development of human resources

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The standard was validated by the specialists of the Sector Committee *Information Technology, Communications and Post Service* **on 08.08.2006.**

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COMPETENCE UNITS

Fields of competence	Item No.	Title of the unit
FUNDAMENTAL	1	Communication at work place
	2	Team work
	3	Professional development
GENERAL ON FIELD OF ACTIVITY	4	Applying the norms of security technique labor and prevention and fighting against fire
	5	Applying the quality procedures
	6	Organizing the activities
SPECIFIC TO THE OCCUPATION	7	Management of projects for IT&C solutions
	8	Ensuring the functionality of the IT&C solution implemented
	9	Monitoring the operation of the IT&C solution implemented
	10	Development of the implemented IT&C solution
	11	Training the staff for the use of the implemented IT&C technologies
	12	Coordinating the teams of specialists

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Description of the occupation

knows and has a permanent preocupation for **understanding** throughtly the activities performed in the organization (company, institution), the way they can be supported and developed by appropriate IT&C solutions[1]. The IT&C solutions specially designed or tailored will be based on the working requirements of the organization (company, institution), expected performances, under the conditions of some acceptable costs and in a determined period of time;

transposes/ participated in transposing the informational flows and processess from the organization (company, institution) in IT&C requirements and specifications; **understands** the strategies of the organization and **identifies the** IT&C available or adjustable solutions;

studies, knows, understands and analyzes the technological trends from IT&C industry; is an expert in computers, computer networks, communications; **works in team** with other experts for selecting, tailoring, designing, integrating the most convenient IT&C solutions.

designs, selects, tailors, configures, develops, tests, implements, integrates the IT&C solutions: gives the most convenient solutions to the employees and management of the organization (company, institution), depending on the specific of the performed activities and expected results; acts as a project manager for the implemented and future IT&C solutions.

applies IT&C technical standards in force and specific requirements of the organization (company, institution), as they are rising from the activities performed.

tailors the existing programs and equipment configurations (together with the application developers and hardware specialists), so that the new IT&C solutions or the ones changed and adapted to ensure the increase of performances of the organization (better products and services, higher working productivity, better working conditions, simplified works and operations etc.).

establishes solutions, procedures, techniques for the good operation and correct usage of computers, peripheral equipments and the communication ones.

establishes solutions for replication, duplication of the operating systems, aplications and data; establishes solutions for redundancy/ saving/ restoring data.

decides over the way in which the users (employees and management) have access and use the hardware and software resources available to them.

cooperates with all the functional compartments of the organization (company, institution) oferring assistance in using information technologies in the current activity; is up with the real hardware and software requirements and needs of each compartment and with the actual degree of covering and support .

informs the users (employees, management) about the new facilities, configurations, technologies, products launched and of which use could improve the quality of the products and/ or services making the object of the organization's activity (company, institution).

organizes sessions for training the users, according to the new technological solutions implemented, or which follow to be implemented.

identifies and distributes the activities of maintenance/ upgrade for software and hardware.

[1] IT&C, Information Technology and Communications, in Romanian, Tehnologia informației si Comunicațiilor

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Necessary knowledge to practice the occupation:

- operating systems, file systems, administration of systems, keyboard commands, files with commands, script files;
- hardware computers and sub-systems: structure and architecture of the computers, processors, disks, storage, input/ output adaptors for equipments, controllers, standard interfaces etc.;
- concepts and network architectures, operation of networks, types of networks, communication media;
- security of access to the network, security of the data accessible in the network;
- LAN networks, bridges, ruters, routing tables, concentrators, protocols, OSI levels, TCP/IP protocol, addressing and communication;
- WAN networks, switching of packets, X25., VPN etc.;
- theory and practice of the database systems, ways to keep and access large volumes of data, types of management;
- concepts and principles of the databases, processing transactions and transmission of the messages; Internet: Web servers, electronic mail servers, "firewall", other services;
- applications: "e-commerce", "e-business", "office", antivirus products, other applications; keeping security of the networks;
- platforms for applications: SAP, Lotus Notes/Domino, Microsoft SQL Server, Oracle etc. programming languages for computers (ADA, C, C++, C#, Java, Smalltalk, HTML, XML, SQL), principles for development of applications, design, encoding, testing, implementing programs, instruments for development of programs;
- graphical interfaces, principles of the man-machine interfaces;
- management of projects: requirements and strategies of team work, participating within the team, reaching the objectives, management of the team, managing conflicts;
- management of activities: planning, estimating, management, control, evaluating risk, reporting progress;
- quality assurance: compliance with the industrial standards as regard to the quality of the products and services;
- modeling the costs, efficiency of investments in IT&C solutions; trends of the development of the hardware and software technologies, etc.

Practical skills:

- analythical spirit: identifies absent information, analyzes logically a technical situation (problem) and solves it by new, innovating solutions;
- attention to details: obtaining a correct result even when is under pressure, verifies the accuracy (correctness) of the information before using them;
- passion for success of its own actions, disposed to excellence, responsibility, tailors the working time to the requirements of the activity;
- efficient communication: face to face, by phone, in writting, by presentations, uses new instruments of the communication technology; mobile phones, SMSs, MMSs, e-mail etc.;

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- oriented towards client: chooses what is best for the end user, for his confort and profit;
- takes decisions in a timely manner; flexibility, learns alone;
- initiative - doesn't expect to be told what he has to do;
- leader skills, risk management: considers and evaluates the possible consequences of the actions which will follow (of the lack of action) and performs so as to minimize the negative consequences;
- negotiation;
- persuasion - power of conviction; organizational spirit.

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UNIT 1 **Communication at work place**

Description

The unit refers to the necessary competence of efficient communication, in order to perform activities and the level of performance required by the job. The software system engineer initiates and participates in discussions in order to find and use the most convenient IT&C solutions.

Competence elements	Achievement criteria
1. Cooperates with all functional compartments of the organization	1.1. Cooperation for establishing the requirement of equipments, hardware and/ or software components is based on strategical and quality issues of the organization. 1.2. Cooperation for establishing the requirement of hardware equipment, operating systems, applications and software components is based on performing in good conditions the activity of the organization.
2. Informs the personnel over the technical news from the field	2.1. The IT&C solutions communicated to the personnel comply with the working requirements of the organization, specific of the performed activities, expected performances in well established conditions. 2.2. The personnel is periodically informed over the appearance of the technical news in the field. 2.3. Eventual changes/ adjustments of the current IT&C solution as also the implementation of new solutions are brought from time to the knowledge of the personnel. 2.4. The personnel is informed from time over the technical news which can improve own performances work and life style.

Range of variables

The communication can take different forms:

- oral
- presentation
- discussions (with one or more interlocutors)
- in writting - including by modern communication means (email, SMS, fixed or mobile phone, signaling systems of any type, warnings, alarms, etc.).

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Strategical and quality issues:

- development strategy of the organization
- increasing the quality of the products/ services
- increasing the productivity in work
- improving working conditions.

Performing under the best conditions the activity of the organization involves:

- good activity of all the compartments of the organization
- provisioning the current and perspective technological evolutions, both in the main activity field of the organization and in the field of IT&C technologies.

The personnel can be:

- employees
- management bodies

Interlocutors can be:

- network administrator
- programmers - application developers
- computer and network operators
- management personnel of the organization
- application users
- other employees using IT&C equipment
- etc.

The communication will be appropriate:

- to the problem in question
- working environment and
- experience of the interlocutor.

The expression is clear, concise, correct and will use the most adequate technical terms, in relation with the knowledge degree and educational level of the interlocutor.

Technical news from the field refers to:

- facilities
- configurations
- technologies
- released products

Conditions: time and costs

Guide for evaluation

Necessary knowledge refers to:

- learning and understanding the working terminology and technical terms used in technical speaking, in manuals, specialty documentations, user guides, as regard the activities and operations from the activity field of the organization and the ones used in the IT&C field.
- communication and information: the expression has to be clear, concise, correct and to use the most adequate technical terms.
- the dialogue with the interlocutor has to be opened, friendly and without ambiguities.

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In the evaluation will be followed:

- the capacity to synthetize and restore important events for the good operation of the hardware/ software components;
- correct, concise and efficient capacity of communication with different interlocutors;
- capacity to listen carefully and patience the dialogue partners and prevent eventual inconsistencies;
- demonstrating attitudes such as attention, firmness in taking decisions, prompt application of the hierarchically higher decisions;
- capacity to understand the activities developed in the organization and to identify the best IT&C solutions.

UNIT 2 **Team work**

Description

The unit refers to the necessary competence for team work, by which the software system engineer will participate as a member implementing and maintaining operational the components of the IT&C solution.

Competence elements	Achievement criteria
1. Identifies the roles specific to team Work	1.1. The roles are identified depending on the specific task achieved by the team. 1.2. The specific attributions of each member of the team are established by common agreement depending on the specific task indicated by the direct chief. 1.3. Proposals for improvement of the team activity are discussed and agreed jointly.
2. Makes the team work	2.1. Working conditions for the normal performance of the activity are ensured by participation of all member of the team. 2.2. The tasks of the team are solved by involving all members. 2.3. The team work is performed with compliance with the opinion rights of the the other members. 2.4. The team work is performed with complying with the inter-human established communication rules.

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	2.4. Implementing the activities of the team within the established terms is made by complying with the specific roles and individual responsibilities of the team members.

Range of variables

Activities/ tasks specific to the team:

- meetings for creating the team
- establishing the activities for each member of the team
- meetings to present the progress reached with the work, proposal of improvements etc.

The activity is performed in the informatics compartment, programming workshop or at the client, if the technical conditions allow this.

Members of the team: programmers, system engineer, beneficiaries etc.

The members of the extended wortk team can be: hyerarchical chief**,** colleagues from the team making the work, colleagues from other departments, suppliers, clients, consultants, marketing specialists etc.

Structure of the teams, number of members, main tasks of the teams will be disctinct depending on the main field of activity of the organization: bank institutions, financial service institutions, insurance companies, productions of cars and machines, long-term commodities, domestic goods and services, goods and people transportation, constructions and installations for constructions, trade etc.

Guide for evaluation

Necessary knowledge refers to:

- theory of the groups, management of the teams, management and prevention of conflicts, role of the members of a team, dynamics of the groups and teams.
- ways to establish objectives and evaluating their degree of accomplishment

In the evaluation will be followed:

- the capacity of analysis, synthesis, decision
- firmness in taking and applying decisions
- objectiveness, operativity
- capacity to integrate into practice the theoretical knowledge
- capacity to solve problems and conflicts
- capacitaty to negotiate and find alternatives.
- foreseeing spirit, evaluation and assuming of the risks, evaluating consequences of some actions (of the lack of action).
- qualities of leader and organized, the power to listen carefully the others, creating thinking, innovation.

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UNIT 3

Professional development

Description

The unit refers to the necessary competence of the software system engineer to self-evaluate permanently in order to improve his own professional performances; will have to deal with the technological evolution both in the IT&C field and in the one specific to the activities of the organization (company, firm, consortium, institution). The software system engineer is (and has to maintain himself) an expert in science of computers, computer networks and communication.

Competence elements	Achievement criteria
1. Identifies the neceesary of knowledge in accordance with the specific of the activities from the organization	1.1. The necessary of knowledge for perfecting is established by objective self-evaluation and on the observations coming from the work team. 1.2. The specialty materials are periodically referred or anytime is necessary in order to identify, structure and intensify the new information. 1.3. Identifying new sources of information and structuring the information to be achieved by periodical consulting or as any time is needed
2. Learns new knowledge	2.1. The knowledge is learned correctly following the participation in training courses and by individual study. 2.2. Self-training and professional training are performed periodically, after a well established plan. 2.3. Knowledge acquired following the participation in courses, seminars and by individual study are valued and applied correctly in the current activity, in the purpose of increasing the quality of the work

	2.4. Acquired knowledge, technicalogical evolutions are applied in interest of the users (employees and management). 2.5. The manuals. technical specifications, specialized documentations are used for optimizing the current IT&C solution for the design of future solutions.

Range of variables

Organization can be:

- firm
- institution
- company

The specialty documentary materials can be:

- specialty publications, studies, research works
- presentation and exploitation manuals, technical specifications
- user guides for some software products
- materials presented in exhibitions, fair, symposiums
- electronic documentation, Internet, discussion forum
- documents received/ made available/ consulted in stages of professional training/ specialization (to which participated), seminars, practice communities, professional organizations

Guide for evaluation

Necessary knowledge refers to: specialized publications, manuals, use of Internet, other information sources, knowing different learning styles, using specific training/ self-training programs.

In the evaluation will be followed:

- capacity of self-training and organization of its own work
- objectiveness in self-evaluating the level of knowledge
- capacity of analysis and synthesis of the information
- availability for acquirement of new knowledge
- preocupation for continuous training/ self-training
- consistency and inclination towards excellency in the field of interest
- power of work and concentration
- capacity to select useful information, to receive and share acquired knowledge
- capacity to reach and develop new knowledge.

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UNIT 4

Applying the norms of occupational security and prevention and fighting against fire

Description

The unit refers to the necessary competence for knowing and applying the norms of occupational security and prevention and fighting against fire.

Competence elements	Achievement criteria
1. Applies the norms of occupational protection	1.1. Legislation and norms of occupational protection are acquired and applied in accordance with the specific of the work place. 1.2. Correct acquiring of the procedures in force is ensured by the participation in periodical training of occupational protection. 1.3. The first aid measures are acquired correctly.
2. Applies the norms of prevention and fire fitghting.	2.1. Laws and norms of prevention and fire fighting are acquired and applied in accordance with the specific of the work place. 2.2. Correct acquiring of the procedures in force is ensured by the participation in the periodical training for prevention and fighting against fire 2.3. The fire fighting equipment and materials are correctly and rapidly identified according to the regulations.
3. Identifies danger.	3.1. The danger is identified and reported immediately to the person in charge for their removal. 3.2. The danger is recorded in the registry of events and are reported promptly to the persons in charge, according to the specific procedures.
4. Applies the emergency procedures.	4.1. The emergency and evacuation measures are applied in accordance with the specific of the work place. 4.2. The accidents are signaled by

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	contacting with promptness the persons in charge, according to the specific procedures. 4.3. First aid is granted fast and correctly in accordance with the type of accident occured. 4.4. The intervention equipment is used according to the PSI regulations, of the protection ones and occupational hygyene.

Range of variables

The activity is performed where there are IT&C equipments. The occupational protection norms and regulations for prevention and extinction of fire are applied anywhere there are components (equipments) of IT&C.

Warning systems: acoustic, lighting.

Equipment for fire fighting: hydrants, fire extinguishers, shovels, sand, picks, buckets etc.

Guide for evaluation

Necessary knowledge refers to:

- norms of occupational protection.
- norms for prevention and extinction of fire specific to the work place
- evacuation plan in case of major accidents or fire
- safety and protection systems for equipment
- warning systems, systems for placing the hydrants
- etc.

In the evaluation will be followed:

- correctness and promptness with which is acted in case of accident;
- application of the norms of occupational protection and prevention and fighting against fire within the routine activities; knowing the safety and protection systems of the equipment; knowing the warning systems, placement of the hydrants, etc;
- capacity of foresight, operativeness in taking decisions

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UNIT 5 **Applying the quality procedures**

Description

The unit refers to the necessary competence for applying, by the software system engineer, of the quality procedures, work instructions and also preventive and corrective measures regarding the fulfillment of own tasks.

Competence elements	Achievement criteria
1. Applies the quality procedures.	1.1. All the activities are performed by complying with the quality requirements included in the quality documents both for the IT&C field and for the activity field/ fields of the organization. 1.2. For achievement of the quality exigencies are used corrective and preventive actions.
2. Checks the results and remedies inconsistencies	2.1. The quality defficiencies are determined by comparison with the quality requirements. 2.2. The quality defficiencies determined are reported in a timely manner by persons capable to establish remedial measures.
2. Proposes updates/ changes of the quality norms	2.1. The proposed quality norms are +issued according to the applicable standards of the the organization. 2.2. The proposed quality norms are communicated to the team members, and also to the involved personnel.

Range of variables

Quality documents:

- work instructions
- work procedures
- specific standards
- etc.

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Preventive and corrective measures

- reparatory procedures
- team decisions
- management decisions
- allotment of resources in critical areas
- etc.

Guide for evaluation

Necessary knowledge refers to:

- work instructions, procedures, quality standards
- plans of quality assurance
- preventive or corrective actions. At the evaluation will be followed:
- the capacity to make decisions in accordance with the quality procedures in force, attention and stringency of looking defects
- knowing te quality standards applicable to the organization

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UNIT 6

Organizing the activities

Description

The unit refers to the necessary competence of the software system engineer to organize and plan specific activities of the team in charge with maintaining in operation and development of the current solution IT&C and necessary for the good operation of the IT&C solution from the organization.

Competence elements	Achievement criteria
1. Identifies the activities of the team	1.1. The activities are identified according to the informational flow and data processing requirements from the IT system. 1.2. The identified activities are placed in a graph with clear successions and parallelisms. 1.3. Human, technical and informational requirements of each activity are correctly identified.
2. Issues the project for allotment of material and human resources according to the current solution of IT&C	2.1. The material resources necessary for the system are specified in detail for the general functions and for the usage places of the applications. 2.2. The human resources necessary for the system are specified both numerically, and by point of view of the competences. 2.3. The material and human resources necessary to the IT system are correctly divided in time.
3. Plans the performance of the activities of the current IT&C solution	3.1. Activity of the member of the technical team in charge with maintaining in operation and developing the current IT&C solution is planned periodically and completely established content. 3.2. Tasks and responsibilities of each team member are precise, concrete, with achievement terms and objectives to the reached. 3.3. The activities are executed according to a

	wel established diagram.
4. Estanlishes the priorities between the monitoring / surveillance activities and the design ones.	4.1. The monitored operations are planned with strictness. 4.2. The logs of the monitored operations are consulted periodically for evaluating the IT&C events which took place. 4.3. The activities for design of new components for the IT&C solution are ordered according to the implementation schedule.

Range of variables

The activities organized:

- through analysis of the activities performed in the organization (firm, institution),
- transposition/ participation in the transposition of the processess from the organization (firm, institution) in IT&C requirements and specifications;
- studying, knowing, understanding and analyzing the technological trends in the IT&C industry;
- designing, selecting, tailoring, configuring, developing, testing, implementing, integrating the IT&C solutions;
- applying the technicla IT&C standards in force and specific requirements of the organization (firm, institution),
- adaptation of the existing programs and equipments (togther with the application developers and hardware specialists);
- establishing solutions, procedures, techniques for the good operation and correct usage of computers, peripheral equipments and the communication ones.
- establishing solutions for replication, duplication of operating systems, applications and data; establishes solutions for redundancy/ saving/ restoring data.
- establishing the way in which the users (employees and management) have access and use the hardware and software resources available to them.
- assistance in using the informational technologies in current activity;
- informing the users (employees, management) about the new facilities, configurations, technologies, products launched and of which use could improve the quality of nthe products and/ or services making the object of the organization's activity (company, institution).
- organizing the training sessions of the users,
- identifying and distributing the activities of maintenance/ upgrade for software and hardware;
- establishing solutions for replication, duplication of operating systems, applications and data;
- establishing solutions for redundancy/ saving/ restoring data;
- access of the users to resources
- traffic of information in the network
- working way of the services and applications
- etc.

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Guide for evaluation

Necessary knowledge refers to:

- instruments, techniques for organizing activities,
- instruments, techniques for monitoring and survrillance

In the evaluation will be followed:

- capacity of organization and planning
- stringency in fulfilling tasks
- compliance with the terms

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UNIT 7

Management of projects for IT&C solutions

Description

The unit refers to the necessary competence of the software system engineer to initiate, develop, implement and evaluate IT&C projects. The project corresponds - in large sense, generally - to a situation which must be solved without obstructing the normal activity of an organization, in order to speed the activity of the company.

The software system engineer assumes its role of a leader (manager) of project at least in case of finding and implementing the new IT&C solutions.

The system engineer issues a structured model of the costs forecasted for the project, technically well grounded, in order to allow the management team economical grounding and decision regarding the opportunity of the project

Competence elements	Achievement criteria
1. Identifies the solution to be solved	1.1. The solution to be solved is isolated and analyzed using specific means. 1.2. The launching of the project, as the case may be, for finding and implementing new IT&C solutions, is esytablished after detailed analysis of the causes and effects on long term of the perpetuation of the existence of the identified situation. 1.3. The solutions proposed are corresponding to the identified requirements.
2. Establishes the components of the project.	2.1. The general objectives of the project are established by complying with the general strategy of the organization. 2.2. The components of the project reflects the solutions to be implemented. 2.3. The project issued leads to solving the identified situation.
3. Checks the running of the project	3.1. Results expected are tangible, measurable and comply with the purpose and objectives 3.2. The activities performed by well established means and in times strictly controlled are necessary and suficient for reaching the general purpose and objectives. 3.3. Implementing/ running the project respects the preliminary potential assumptions and is within the established restrictions. 3.4. The checks and adjustments made are within the chart and correspond to the partial/ intermediary objectives. 3.5. Implementing/ running the project are within: the limits, restraints, planned resources.

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	3.6. The tasks of the participants in the project are concrete, strict, have well established terms and strict conditions for evaluation of the results.
4. Evaluates the results of the project	4.1. The intermediary and final results are evaluated in times planned with strictness. 4.2 The evaluation is made by using criteria which leave no place of interpretation and ambiguities. 4.3. The results are periodically and systematically analyzed for establishing the applicability/ usefulness/ uselessness of the procedure.
5. Modelates the structure of the costs	5.1 Structure of the costs involved by the project reflects the proposed hard-soft configuration, direct and indirect expenses. 5.2 the maintenance costs are provided in order to cover an optimum duration of exploitation. 5.3 Efficiency of the project is well sustained technically 5.4 The costs model is complete and flexibly structured in order to establish the financial efficiency of the project.

Range of variables

The projects to which will participate and assumes its role of leader are different depending on:

- the activity field of the organization
- actual degree of support by IT&C means
- actual restrictions and limitations of the organization
- predictable development of the general objectives of the organization
- physical (and moral) wear of the current machines, equipments and instruments
- general structure of the organization costs
- etc.

Direct and indirect expenses refers to:

- structure of the personnel involved
- expenses with locations used
- equipment configuration
- consumables
- etc.

Guide for evaluation

Necessary knowledge refers to:

- stages, evolution and completeness of the projects,
- main components of a project: identifying the project, issuing the project, budget and calendar of the project, available resources, checks, negotiations and decisions, organizing the project, monitoring, reporting, evaluation,
- fundamental notions regarding the budgets of the projects and structuring the costs
- modeling the costs,
- efficiency of the investments for IT&C solutions.

In the evaluation will be followed:

- the capacity to form and manage an IT&C project

- understansing the difficulties, restrictions and limitations
- clear vision over the problems which can be solved and over the means to be used
- compliance with the plannings and reaching the objectives
- organization, consistency, attention to details, fastness in taking decisions;
- strict compliance with the rules, capacity to find alternatives, tendency towards excellency, power of work and concentration.

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UNIT 8

Ensuring the functionality of the implemented IT&C solution

Description

The unit refers to the necessary competence of the software system engineer for:

- identifying and analyzing in depth the activities performed within the organization (firm, institution), by the way they can be supported and developed by appropriate IT&C[2] solutions.
- transposition/ participation in the transposition of the processess from the organization (firm, institution) in IT&C requirements and specifications;

  establish solutions, procedures, techniques to ensure operational status of equipment, systems, hardware and software subsystems, and all applications. proposal to staff and management of the organization (company, institution), the most suitable IT&C solutions based on specific activities and expected results; acts as "project manager" for the IT & C solutions implemented. application of IT&C technical standards in force and the specific requirements of the organization (company, institution), as they arise from the activities performed.

  adaptation of the existing programs and equipments (togther with the application developers and hardware specialists)m for increasing the performances of the organization

  establishing solutions, procedures, techniques for the good operation and correct usage of computers, peripheral equipments and the communication ones.

  establishing solutions for replication, duplication of operating systems, applications and data; establishes solutions for redundancy/ saving/ restoring data.

  taking decisions over the way in which the users (employees and management) have access and use the hardware and software resources available to them.

  identifying and distributing the activities of maintenance/ upgrade for software and hardware.

Competence elements	Achievement criteria
1. Identifies the existing IT&C systems/ subsystems	1.1. The existing IT&C systems/ subsystems are identified with stringency. 1.2. The identified systems/ subsystems have a good operation. 1.2. The identified systems/ subsystems are used according to the technical specifications of the producers.
2. Ensures the good operation of the IT&C systems/ subsystems	2.1. The rules, technical solutions, procedures established for installation, configuration, adaptation, rehabilitation of the hardware and software components of the IT&C systems/ subsystems and of the application are in compliance with the standards in force and with the technical specifications of the producers. 2.2. The rules, technical solutions, procedures

[2] IT&C, Information Technology and Communications, in Romanian, Tehnologia informației si Comunicațiilor

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	established and implemented for the for the installation. configuration, adaptation, rehabilitation software components of the hardware and of
	the IT&C systems/ subsystems and applications are carefully verified and corrected, so that their application always leads to obtaining correct and safe results. 2.3. The rules, technical solutions, procedures established and used for the replication/ duplication of the functions - hardware components, services applications - critical of the IT&C systems/ subsystems ensures the correct, safe and trouble free operation of the IT&C systems/ subsystems. 2.4. Appearance of errors non operation or wrong operation of some components are correctly identified. 2.5. The solutions targeting the removal of errors are stringently applied.
3. Ensures the correct and safe use of the IT&C systems/ subsystems by the personnel of the organization	3.1. Established and implemented rules ensures with controlled and safe access of the users to these resources - files, applications, equipment - needed for fulfilling tasks of the job according to the job description. 3.2. The data/ information are always correct, sure and obtained in time. 3.3. The strategies and procedures used for redundancy/ saving/ regenerating/ restoring the data ensures the recovery of data in case of predictable errors and incidents.

Range of variables

The IT&C solutions are different depending on:

- the types of computers
- types of operating systems
- management systems for collections of data
- type of applications used
- etc.

The technical solutions and procedures refer to:

- the installation of the hardware and software components of the IT&C systems/ subsystems and applications
- the configuration of the hardware and software components of the IT&C systems/ subsystems and of the applications of the hardware and software components of the IT&C systems/ subsystems and of the applications
- the adaptation of the hardware and software components of the systems/ subsystems and applications
- the rehabilitation of the hardware and software components of the systems/ subsystems and applications

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The rules, technical solutions and procedures established and used for replication/ duplication of the critical functions (hardware components, services, applications) of the systems/ subsystems are correlated with the IT&C solutions for:

- saving data
- restoring data
- replicating data
- redundancy of data
- regeneration of data

following the appearance of some incidents and operating errors.

The solutions used are different depending on:

- the operating systems
- applications and file systems used
- equipments used .

Guide for evaluation

Necessary knowledge refers to:

- computers and hardware sub-systems;
- computer networks and interconnection of networks;
- operating systems and software components, file systems, permissions, rights, privilleges and restrictions;
- network services and applications, concepts and network architecture, operation of the networks, security of the networks and of the data used in networks, resources distributed in the network and concurent access;
- files with commands, script files;
- automatic procedures for installation and configuration of the operating systems and applications;
- procedures and techniques for installation, maintenance, configuration of hardware ans software of the computers, computer networks, of the other peripheral and communication equipments;
- procedures of hardware and software configuration/ reconfiguration;
- risk management;
- clusters of computers/ replication/ duplication of hardware and/ or software components;
- configuration of services and application working freely in cluster mode;
- strategies for sacing/ restoring data and ways of implementation;
- technical solutions for duplication/ replication/ regeneration of data: RAID solutions, replication of the files;
- strategies for sacing/ restoring data and ways of implementation;
- operating systems, file systems, SGBD, databases, security rules.

In the evaluation will be followed:

- capacity of organization, analythical spirit, attention to details, availability to solve technical problems by offering alternatives, initiative;
- capacity to see risks, assuming risks;
- capacity to evaluate consequences of different actions, including consequences of the lack of action, foreseeing spirit, decision;
- capacity to take decisions rapidly, concentration, capacity to assume the role of a leader, objectiveness, stringency in applying rules and decisions, consistency, operativeness in selecting and reaching objectives

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UNIT 9

Monitoring the operation of the implemented IT&C solution

Description

The unit refers to the competence necessary for the software system engineer for follow the performances in exploitation of the equipments and software components. Long-term monitoring of the performances will be seen as an instrument for optimizing the operation of the systems, sub-systems and applications, as a mean to prevent and/ or detect from time operational errors.

Competence elements	Achievement criteria
1. Monitors the performances of the the IT&C systems/ subsystems and access of the users to resources	1.1. List of the reference/ control parameters and the benchmarks used for evaluation of the systems/ subsystems and applications are complying with the specifications of the producers and are within the standards. 1.2. Time moments, rules and procedures established for surveillance and collection of the values of the benchmarks - in order to evaluate the performances - does not affect the work of the users nor the safe operation of the systems/ subsystems / services/ applications. 1.3. The rules, procedures and criteria used for evaluating/ appreciating the performances are not leading to ambiguities and identifies from time the possibility of appearance of some operating errors. 1.4. The logs with the measured values of the reference / control parameters will be kept and analyzed periodically, in order to establish the additional corrections for preventing the appearance of operating errors.
2. Detects the defficiencies hard and soft in the IT&C solution implemented	2.1. For the significant events, errors, hard and soft defficiencies there are procedures/ successions of procedures well established executed by specialized members of the IT&C technical team. 2.2. The events, errors,defficiencies for which there are no standard procedures of correction/ adaptation/ reconfiguration are evaluated and are issued remedial measures.

Range of variables

Hardware features:

- type of computer
- architecture of the computer
- existence of a network
- type of the network
- etc.

Software features:

- operating system
- file system

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- SGDB
- Management system for collections of data
- etc.

The implemented IT&C solution: the assembly of the systems, hardware and software subsystems, services and applications, procedures, administration rules, control and use which form the informatic system of the organization.

List of the reference parameters for:
- evaluating the operating performance
- techniques and instruments used for collecting and measuring the values of the parameters
- periodicity of collecting these data
- appreciation criteria
- admittable values

will be established based on:
- hardware features
- software features
- number of users
- type of applications used
- expected performances
- etc.

The correction procedures and meand are depending on:
- the operating system
- architecture of the computer
- architecture and features of the computer network
- applications and services used
- hardware and software platforms operating
- etc.

Guide for evaluation

Necessary knowledge refers to:
- status parameters of the systems/ subsystems, services, applications and procedures for collection, maintenance, interpreration of the values of the parameters
- instruments, techniques for monitoring, supervising the operation of the hardware and software components
- instruments, techniques for monitoring (audit) the access of users to resources
- file systems and security rules
- resources distributed in the network and concurent access

In the evaluation will be followed:
- capacity of organization, analythical spirit, attention to details, availability to solve technical problems by offering alternatives, initiative;
- capacity to see risks, assuming risks;
- capacity to evaluate consequences of different actions, including consequences of the lack of action, foreseeing spirit, decision;
- capacity to take decisions rapidly, concentration, capacity to assume the role of a leader, objectiveness, stringency in applying rules and decisions, consistency, operativeness in selecting and reaching objectives.

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UNIT 10

Development of the implemented IT&C solution

Description

The unit refers to the necessary competence of the software system engineer for the design, adaptation, upgrading, encoding, integrating, testing, implementing the IT&C solutions specific to the organization.

Competence elements	Achievement criteria
1. Identifies the development requirements and opportunities of the solution implemented	1.1. The event logs are periodically analyzed in statistical and technical terms for evaluating the weak, critical points of the current IT&C solution and for checking the achievement of the objectives of the economic strategy of the organization. 1.2. The weak, critical points, limitations of the solution are removed by using the remedies established according to the technical specifications of the producers, equipments - hardware and software. 1.3. The correcting, upgrading, reconfiguring and optimizing procedures for performances are applied correctly an in time. 1.4. The resulted IT&C solution is within the operating strategy and development strategy of the organization.
2. Designs new IT&C solutions for the organization	2.1. The new IT&C solutions are designed starting from the weak/ critical points/ limitations detected, by the existing technological evolutions and the prefigurated ones 2.2. The new solutions and targeted on reaching the objectives of the strategy of development of the organization. 2.3. The new solutions are evaluated according to the cause-effect analysis, of the technical efficiency and investment return. 2.4. The accepted solutions are only the ones which are improving the target performances. 2.5. The new solutions are in accordance with the imposed constraints.
3. Implements the project of upgrading the IT&C solution	3.1. The operation of the new IT&C solutions is tested with stringency. 3.2. The tested components are strictly isolated in order to avoid disturbance of the current activities. 3.3. The tested components are integrated in the current activity of the organization by a plan strictly complied with, with minimizing the negative consequences of the change and without disturbing the current activities. 3.4. Encodes software components according

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	to the requirements of the hardware interfaces specific to the application.

Range of variables

implements the project for upgrading the IT&C solution: Tests, corrects, encodes, evaluated, integrates, implements the new IT&C solutions

Organization:
- firm
- company
- institution.

Procedures ensuring the operation of the systems:
- tailoring
- upgrading
- reconfiguration
- optimization
- etc.

Target Performances:
- productivity of the work
- working conditions
- economic - financial results
- etc.

Constraints:
- specific working requirements
- expected technical performances
- accepted costs
- imposed time interval
- etc.

Technical conditions refers to:
- installation features - operating voltage, size of the memory etc.
- operating features - working speed, response speed, size of the memory etc.
- features of maintenance and exploitation - periodicity of the tests, maintenance operations, replacement operations, user rights etc.

Guide for evaluation

Necessary knowledge refers to:
- operating systems, file systems, administration of systems, keyboard commands, files with commands, script files;
- hardware computers and sub-systems: structure and architecture of the computers, processors, disks, storage, input/ output adaptors for equipments, controllers, standard interfaces etc.;
- concepts and network architectures, operation of networks, types of networks, communication media;
- security of access to the network, security of the data accessible in the network;
- LAN networks, bridges, ruters, routing tables, concentrators, protocols, OSI levels, TCP/IP protocol, addressing and communication;

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- WAN networks, switching of packets, X25., VPN etc.;
- theory and practice of the database systems, ways to keep and access large volumes of data, types of management
- concepts and principles of the databases, processing transactions and transmission of the messages
- Internet: Web servers, electronic mail servers, “firewall”, other services;
- applications: “e-commerce”, “e-business”, “office”, antivirus products, other applications
- keeping security of the networks
- platforms for applications: SAP, Lotus Notes/Domino, Microsoft SQL Server, Oracle etc.
- programming languages for computers (ADA, C, C++, C#, Java, Smalltalk, HTML, XML, SQL), principles for development of applications, design, encoding, testing, implementing programs, instruments for development of programs
- graphical interfaces, principles of the man-machine interfaces
- management of projects: requirements and strategies of team work, participating within the team, reaching the objectives, management of the team, managing conflicts;
- management of activities: planning, estimating, management, control, evaluating risk, reporting progress;
- quality assurance: compliance with the industrial standards as regard to the quality of the products and services;
- modelling the costs, efficiency of the investments in IT&C solutions
- tendencies of the development of the hardware and software technologies.

In the evaluation will be followed:

- analythical spirit: identifies absent information, analyzes logically a technical situation (problem) and solves it by new, innovating solutions;
- capacity to observe details: obtaining a correct result even when is under pressure, verifies the accuracy (correctness) of the information before using them;
- passion for success of his own actions, oriented towards excellency;
- responsibility;
- efficient communication;
- capacity of orientation towards the client, for his conmfort and profit;
- capacity to take decisions in a timely manner;
- flexibility, capacity to learn alone;
- initiative - doesn't expect to be told what he has to do;
- capacity to evaluate possible consequences of the actions and minimazing the negative actions;
- capacity of negotiation;
- power of conviction;
- organizational spirit.

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UNIT 11

Training personnel for using the implemented IT&C technologies

Description

Thje unit refers to the necessary competence for the software system engineer to train the personnel in order to use correctly the IT&C equipment and technologies. The individual training of the employees will lead to the increase of individual and general competences, collective competences of the organization in general.

Competence elements	Achievement criteria
1. Establishes training requirements for the personnel involved in implementing and using the IT&C applications from the organization	1.1. The individual need for training/ self-training of the personnel is established as difference between the current knowledge and skills and the ones necessary for the good operation at the work place. 1.2. The individual need for training/ self-training of the employees complies with the IT&C technical solutions implemented or pending and is in accordance with the job description. 1.3. The objectives of training/ selftraining - individual thamtics of training / self-training - of the personnel complies with the job tasks, as they appear in the job description.
2. Organizes the activities connected to the training / self-training the personnel involved in implementing and using the IT&C applications from the organization	2.1. The individual plan for training/ self-training of each employee is tailored to the training requirements. 2.2. The individual plan for training/ self-training complies with the individual thematics and does not disturb the activities rendered in the organization. 2.3. The training plan is made for all the employees on a determined period required by the management body.
3. Checks the way by which the training of staff is performed	3.1. The training of the personnel is performed according to the planning. 3.2. The knowledges and skills of the personnel are tested and evaluated periodically.

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	3.3. The testing, periodical evaluation complies with the individual plan of training/ self-training and tasks - works - specified in the job description.

Range of variables

The objectives of training / self-training are established depending on:

- the used software equipment and components
- professional training and experience of the employees
- the activity specific of the organization
- job description
- etc.

Concrete items of the training plan:

- study thematics
- planning in time
- place of performance
- the person in charge (expert, trainer, instructor etc.)

Guide for evaluation

Necessary knowledge refers to:

- the ways to establish the needs of individual training: interview, questionary, significant practical activities, direct observation, etc.
- training techniques: theoretical presentations, practical demonstrations, simulations, etc.
- sessions of continuous training

In the evaluation will be followed:

- capacity of organization of a training environment or individual or group study environment;
- coordinating the team in charge.

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UNIT 12

Coordinating the teams of specialists

Description

The unit refers to the necessary competence to assume the role of a leader who implements and maintains in operation the components of the IT&C solution, or who designs new solutions.

Competence elements	Achievement criteria
1. Identifies the implementation stage of the IT&C solutions	1.1. The implementation stage of the IT&C solutions is identified exactly in the strategy of the organization. 1.2. the IT&C are subject to the approval of the management team, in respect to organization's strategy. 1.3. The approved IT&C solutions are implemented in the organization.
2. Coordinated the activity of design of the new IT&C solutions	2.1. Composition and size of the design team are established depending on the specific of the activities, of the problems with technical nature, Interdisciplinarity and expected results. 2.2. The general objectives, expected results and working conditions of the team are clearly expressed and acknowledged by all the members of the team 2.3. The attributions, degree of participation and results of each member are correctly established, evaluated and motivated. 2.4. The decisions taken are firm and transmitted to all the team members. 2.5. The potenatially destructive conflicts are carefully analyzed and correctly settled
3. Coordinates the teams of IT&C specialists	3.1. The tasks and rules established for the IT&C team are clear and in accordance with the job description. 3.2. Control of fulfilling the tasks is strict and is performed periodically and as needed. 3.3. The portfolio of the standards procedures and situation when they apply are periodically updated 3.4. The eventual deviations from the standard procedures in force are analyzed and settled with

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	responsibility and opportunity. 3.5. The environment maintained in the team is appropriate for work, of understanding and healp, of colleague-spirit and mutual respect.

Range of variables

Organization can be:
- firm
- institution
- company

The IT&C solutions refer to:
- the IT&C solutions being under operation in the organization
- the IT&C solutions designed to be implemented in the future.

The strategy of the organization refers to:
- the operating strategy
- development strategy.

Updating the portfolio of procedures involves:
- analysis
- correction
- tailoring
- modification.

The structure of the teams of specialists, number of membres, main tasks will be different depending on the specific of the activities.

Specific of the activities refer to the main field of activity of the organization:
- bank institutions
- financial service institutions
- insurance companies
- productions of machines and equipment
- productions of long-term commodities
- domestic goods and services
- transport of goods and people
- constructions and installations for constructions
- trade etc.

Guide for evaluation

Necessary knowledge refers to:
- - theory of the groups, management of the teams, management and prevention of conflicts, role of the members of a team, dynamics of the groups and teams.
- ways to establish objectives and evaluating their degree of accomplishment. In the evaluation will be followed:
- firmness in taking and applying decisions
- objectiveness, operativity

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- responsibility in coordinating the teams of specialists
- capacity to solve problems and conflicts
- capacitaty to negotiate and find alternatives.
- foreseeing spirit, evaluation and assuming of risks, evaluation of consequences of some actions
- of the lack of action
- qualities of leader and organized, the power to listen carefully the others, creating thinking, innovation.

Please find the example curriculum in the annex.

For further information on the project please consult:	For further information on the paper please contact:
www.project-predict.eu	anamaria.nisioiu@acpart.ro

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University "POLITEHNICA" of Bucharest

The Faculty of Automatic Control and Computers

Curriculum – Master Program 4 semesters
Master Name: "Parallel and Distributed Systems"

Cod	Type Discipline‡	Discipline	Sem	C	S	L	P	PC	Assessment (E/V/P)	Total no. of hours	Individual training hours
UPB.03.M1.O.05-01	C	Parallel Programming	I	2			2	6	E	156	100
UPB.03.M1.O.05-02	S	Computer and Network Security	I	2			2	6	E	156	100
UPB.03.M1.O.05-03	S	Operating Systems (practical)	I	2			2	6	E	156	100
UPB.03.M1.O.05-04	C	Scheduling Methods and Algorithms	I	2			2	6	E	156	100
UPB.03.M3.O.05-14	C	Scientific Research	I				1	6	V	156	142
		Total teaching activities: 15 hours	**I**	**8**	**0**	**0**	**9**	**30**		**780**	**542**
UPB.03.M2.O.05-05	C	Distributed Systems	II	2			2	6	E	156	100
UPB.03.M2.O.05-06	S	Cluster and Grid Computing	II	2		2		6	E	156	100
UPB.03.M2.O.05-07	C	Distributed Algorithms	II	2			2	6	V	156	100

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UPB.03.M2.O.05-08	S	Elective course	II	2			2	6	E	156	100
UPB.03.M3.O.05-14	C	Scientific Research	II				1	6	V	156	142
		Total teaching activities: 15 hours	**II**	**8**	**0**	**2**	**7**	**30**		**780**	**542**
UPB.03.M3.O.05-09	C	Advanced Topics in Distributed Systems	III	2			2	6	E	156	100
UPB.03.M3.O.05-10	C	Advanced Topics in Computer and Network Security	III	2			2	6	V	156	100
UPB.03.M3.O.05-11	S	Dependable Systems	III	2		1		6	E	156	114
UPB.03.M3.O.05-12	S	Elective course	III	2			2	6	E	156	100
UPB.03.M3.O.05-14	C	Scientific Research	III				1	6	V	156	142
		Total teaching activities: 16 hours	**III**	**8**	**0**	**1**	**7**	**30**		**780**	**556**
UPB.03.M3.O.05-13	S	Master Project PDCS	IV				12	12		312	144
UPB.03.M3.O.05-14	C	Intership, Scientific Research	IV				16	18		468	244
		Total: 28 hours	**IV**	**0**	**0**	**0**	**28**	**30**		**780**	**388**
		Total teaching activities: 74 hours		**24**	**0**	**5**	**45**	**120**		**90**	**90**

*****S = Synthesis, C = Advanced knowledg

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