

## Master of Science

### Service Engineering and Management

#### Master description

The master program "**Service Engineering and Management**" responds to the present worldwide demand of service innovation. The scale and complexity of globally dispersed *service systems* is growing rapidly and the importance of using resources efficiently, effectively and in a sustainable manner is rising, as service activities become an ever greater part of value creation in modern economies. Proportionally, we are paying more for experience, advice, information, assurances, use of infrastructures and leasing, and less on growing, building and owning physical goods.

#### Professional competencies

The main objective of the 2-year interdisciplinary "**Service Engineering and Management**" master program, derived from this analysis of the demand for multi-facet service innovation, is to provide the following basic components in the education of service professionals, clearly requested by the economy of the 21<sup>st</sup> century:

- *New technologies* (i.e. the ability to design, understand and evaluate innovative technologies and processes)
- *New interaction modes or services* (i.e. understand user and consumer needs and be able to meet requirements and quality expectations)
- *New business models* (i.e. leadership and management capacity to meet stakeholder interests and the demand for organization flexibility, effectiveness and accountability)

Thus, general competencies of SEM graduates derive from study and approaches to **integrate resources of service systems**:

- (1) **Business and organizations as a resource** (operations management, marketing, industrial marketing, human resource management, communication management, strategy, innovation, financial engineering, value engineering)
- (2) **Technology** as a resource (systems design, engineering, software metrics, software development, product and software architecture, design)
- (3) **People** as a resource (psychology, economics, sociology, behavioural sciences, arts, design, innovation, intellectual property)
- (4) **Information** as a resource (ICT, simulations)

#### Specific competencies

Specific competencies derive from the general ones above defined. The new Master program in **Service Engineering and Management** (SEM) is still a program to educate

professional engineers, i.e. graduates will be prepared to *conceive, design, implement and operate* (CDIO) *complex value-added engineering systems*. SEM has a strong emphasis on:

1. Understanding the innovative technologies now required for service provision.
2. Understanding the functional and the experience requirements of people using services.
3. Management of the service CDIO lifecycle process and understand its value.

Specific competencies are provided by three complementary hands-on training modules: ICT (**Information and Communication Technologies**), PSO (**Psychology and Sociology**), and OMM (**Operations, Management and Marketing**); as an integrative force, the specific scope and related competencies include contributions from that map into the four fundamental resource categories (1) – (4) as represented in Table 1.

Table 1 - Specific competencies for SEM Master Project

ICT – Information & Communication Technologies	PSA – Psychology, Sociology and Arts	OMM – Operations, Management & Marketing
Mobile technologies	Sociology of Organizations	Service marketing
Information system	Cognitive Psychology	Service Operations and Management
Human-Computer Interaction	Communication	Financial management
Internet technologies	Information science and management Design	Management of Innovation
Multimedia technologies		Service design and development

Presenting an integrated theory of service activities and service systems, as well as practitioner driven tools, methods and data sets will provide the specific competencies. Some of these tools are used to model government agencies and public sectors, and businesses. Other presented tools and methods were developed for modelling industries as a system of business components with associated key performance indicators (KPIs). Finally, specific competencies come from the development of service-oriented architectures (SOA) for describing information technology "services" that support work and business practices.

The employment options for SEM Master graduates are:

- Service management
- Business ecosystem analysis and modelling
- CDIO of complex value-added engineering systems
- Internal and external consulting for enterprise management
- Strategic business development for enterprise structures, supply chains and services
- Enterprise modelling and integration

## Programme Structure

Code	Course	Sem.	C	S	L	P	ECTS	Evaluation (E,V,P,A/R)
UPB.03.M1.O.17-01	Mathematical Modelling of Economic Processes	I	2		1		4	E
UPB.03.M1.O.17-02	Data Mining and Data Warehousing	I	2		1		4	E
UPB.03.M1.O.17-03	Architecture of Service Oriented Information Systems	I	2			2	4	E
UPB.03.M1.O.17-04	Marketing and Financial Performance of Business	I	2		1		4	V
UPB.03.M1.O.17-05	Network and Systems Security	I	2			1	4	E
	Total didactic activities: <b>16 hours</b>		<b>10</b>		<b>3</b>	<b>3</b>	<b>20</b>	
UPB.03.M4.O.17-17	R&D Activities: <b>12 hours</b>	I	<b>12</b>				<b>10</b>	P
	Total	I	<b>28</b>				<b>30</b>	
UPB.03.M1.O.17-06	Business Process Modelling	II	2		2		4	E
UPB.03.M2.O.17-07	Supply Chain Management and Logistics	II	2			2	4	E
UPB.03.M2.O.17-08	Communication Management and Cognitive Psychology	II	2	1			4	V
UPB.03.M2.O.17-09	Foundations of Service Science	II	2		1		4	E
UPB.03.M2.O.17-10	Accounting and Financial Management for Services	II	1		1		4	E
	Total didactic activities: <b>16 hours</b>		<b>9</b>	<b>1</b>	<b>4</b>	<b>2</b>	<b>20</b>	
UPB.03.M4.O.17-17	R&D Activities: <b>12 hours</b>	II	<b>12</b>				<b>10</b>	P
	Total	II	<b>28</b>				<b>30</b>	
UPB.03.M3.O.17-11	Enterprise Integration and Management Architectures	III	2		1		4	E
UPB.03.M3.O.17-12	Business Service Integration and Management	III	2			1	4	E
UPB.03.M3.A.17-13 Elective Course	Knowledge Engineering and Services Ecosystem	III	2		1		4	V
	Knowledge Representation and Reasoning							
UPB.03.M3.O.17-14	Service Operations and Customer Relationship Management	III	2			2	4	E
UPB.03.M3.O.17-15	Intellectual Property and Entrepreneurship	III	2		1		4	V
	Total didactic activities: <b>16 hours</b>		<b>10</b>		<b>3</b>	<b>3</b>	<b>20</b>	
UPB.03.M4.O.17-17	R&D Activities: <b>12 hours</b>	III	<b>12</b>				<b>10</b>	P
	Total	III	<b>28</b>				<b>30</b>	
	Total didactic activities: <b>0 hours</b>	IV						
UPB.03.M4.O.17-16	Development and defending the master thesis: <b>14 hours</b>	IV	<b>14</b>				<b>14</b>	P/NP
UPB.03.M4.O.17-17	R&D Activities: <b>14 hours</b>	IV	<b>14</b>				<b>16</b>	P
	Total	IV	<b>28</b>				<b>30</b>	

**Evaluation:** E-exam; V-verification during the semester; P-project; P/NP – verification during the semester with qualifier passed / not passed

## Courses description

### **01. Mathematical modelling of economic processes**

The MMEP lectures propose a self-contained introduction in some of the mathematical areas with economic applications. The presentation concerns deterministic static and dynamic constrained optimization models. Firstly, linear and nonlinear programming problems are introduced through remarkable economic examples, with focus on the significance of some basic theoretical concepts such as strong and weak duality and the Lagrange multipliers as shadow prices. Then some important models of economic competition are treated within the game theory: zero-sum games, and bimatrix games. Other important modelling paradigms discussed in the first part of the lectures are the network models. The transportation problem is revisited and discussed as a pattern also for allocation problems. Finally, in the second part of the course, dedicated to dynamic economic models, the discussion focuses firstly on the off-line case, represented by the principle of optimality and its application to the shortest path problem, and secondly on the state-structured case, where the on-line optimal control is build based on the Bellman equation, with applications in optimal management of savings and spending.

### **02. Data mining and data warehousing**

This course presents technologies, methods and algorithms for Knowledge Discovery in Databases (KDD, also known as Data Mining). The course presents various classes of problems and their specific algorithms: Data Pre-processing, Association Rules and Sequential Patterns, Supervised Learning, Unsupervised Learning, Partially Supervised Learning, Information Integration, Web Usage Mining.

The last part of the course contains an introduction in Data Warehousing and also describes some techniques for Dimensional Modelling and its use in storing data.

Application hours target the understanding, presenting and testing some data mining algorithms, evaluation of their results for different datasets and different parameter values but also some case studies in Data warehousing.

### **03. Architecture of service oriented information systems**

The course explains the concept of the different architectural views (e.g. function view, organization view, data view, output view) and the relationships between those individual

views. There will be explained the principles for process orientation. Students will understand and interpret the models and methods for developing information systems architectures. They will be taught how to use those models and methods to define overall information systems architecture. The practical applications of this course offers to students the possibility to describe the principles of information systems; use in the correct way the standards for encoding numbers and letters; describe the conceptual basis of communications standards: TCP/IP, UDP; create and manage XML documents; writing simple SQL statements and XQuery code for database; create a web service based on SOAP/REST standards; writing a simple client application extension for internet standards; understand architecture for distributed applications.

#### **04. Marketing and financial performance of business**

The course offers students detailed knowledge about the methodology and framework of financial analysis requested in business management and marketing processes. Its aims are to explain, transfer and appropriate basic concepts, terms and tools used in financial analysis and planning, economic marketing, capital investment rules and business ethics. Also, the course is intended to build and develop adequate communication skills in service marketing, as well as to develop a modern managerial way of thinking. The course gives the student fundamental knowledge and the implicit necessary tools aimed at recognizing, analysing and projecting the optimal deployment of the marketing, management and business administration processes. Starting with the general presentation of the concept of management and marketing, of its functions and principles, the course activities are aimed at explaining, understanding and correctly assimilating the concepts and the utilized terminology in the management and the marketing of various structures present in the economic environment. The course gives to students the basic knowledge regarding the managerial theory and practice, helping them to develop and adopt a managerial mind set and to assimilate the main analysis levers of the management activities.

#### **05. Network and systems security**

The course discusses topics regarding the security of standalone systems but also security of systems integrated in networks: security models, security in organizations, cryptography, public key infrastructure, physical infrastructure, infrastructure security, authentication and access, wired and wireless networks security, intrusion detection systems, security practices and attacks, messaging, web components, secure software

development, disaster recovery, risk management, change management, privilege management, privacy, forensics, legal issues.

The discipline offer also hands on training on: Linux security, vulnerabilities and exploits, brute force and dictionary based attacks, software bombs, firewall configuration, ip address and port scanning, vulnerability scanners, Metasploit, security auditing, penetration testing.

## **06. Business process modelling**

This lecture presents a perspective on the role of architecture, requirements engineering and tool integration at the business level of an organization. Business modelling creates an abstraction of a complex business and establishes a common understanding that can be communicated to the business's stakeholders (e.g. owners, management, employees, and customers). Objectives: to provide students with basic knowledge on using models to understand the actual business and its goals, processes, resources, and rules; to provide students with basic knowledge on using models to understand how the business functions facilitates improvements to the business, and helps to identify new business opportunities; to help students understand how to use the business models to identify the correct requirements for the software that supports the business; to present guidelines on how to produce a business model and what it should contain; to present business patterns on how different aspects of a business can be modelled; to help students understand how the information and knowledge in a business model can be used to identify the proper requirements on software systems that support the business.

## **07. Supply chain management and logistics**

“Supply Chain Management” is a program of study concerned with the efficient and timely flow of materials, products, and information within and among organizations. A supply chain is a network of organizations that cooperate in order to optimize the flow of materials between the original supplier and the end user (client), resulting in a rapid and cost efficient flow of materials. Supply chain management encompasses the planning and management of all activities involved in sourcing and procurement, storing, conversion and all logistics management activities. It also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, SCM integrates supply and demand management within and across companies. It includes all of the logistics management activities noted above, as well as manufacturing operations, and it drives coordination of processes and

activities with and across marketing, sales, product design, finance and information technology.

## **08. Communication management and cognitive psychology**

Communication and Cognition Management are presented as new and even emergent fields developed in the system of managerial sciences. Cognition-grounded, communication-mediated and services-supported technical and managerial innovation is addressed in order to prepare our students for some specific activities in the e-Society, the foreseeable environment for an e-Management. Communication as action and interaction, as a process and as a function, is studied by the dedicated definitions, theories and models. Various communication types are characterized and described as psychological, social and cultural processes. Some features of inter-personalization in virtual groups and communities constituted on the web are revealed. More than a chapter is dedicated to the study of effective communication, its conditions and factors. Effectiveness types, degrees, measurement criteria and techniques are studied. Primary, secondary and high-level information processing activities, operations and products are studied. Thinking as an information processing activity: psychological characteristics. Conceptualizing processes and conceptual models used in various fields of culture. New types of thinking generated and used in knowledge work and research communities. Knowledge Intensive Services (KIS) and their importance in various team activities are depicted. Cognitive competence and communication performance are studied, as well as personal, organizational and social cognitive competencies as instruments for information systems and services management. Communication skills needed in team working and innovative team building are built. Levels and models of technical creativity are presented and how to manage the cognitive and communicating processes during an innovation cycle is learned. Economic characteristics, purposes and risks of invention management in various stages of technological evolution are described, and the life cycle dynamics of a technical innovation is presented. Managerial skills, styles and personalities are also studied, and the role of motivation management is emphasized, together with the advantages of a managerial culture building by promoting a cognitions, communication and culture-based management.

## **09. Foundations of service science**

The course covers basic aspects of Service Science including service and service systems, value co-creation, Service-Dominant Logic, service modelling and innovation. It investigates the nature of services, the need for interdisciplinary approaches to services innovation, and the technology and tools needed to provide services innovation.

Objectives: to help students understand the motivation behind the study of Service Science; to help students understand what theories are emerging in the area of Service Science and how to apply them to specific kinds of services; to help students understand how enterprises (public, private) are changing organizationally through innovative uses of technology and the implications of these changes; to help students understand how social computing technologies are providing innovations in services, specifically providing greater opportunities for co-production; to help students approach some techniques for service modelling, including hands-on experience with modelling tool(s); to help students understand the general notion of service-oriented computing and how its techniques can be used to architect services.

## **10. Accounting and financial management for services**

This course focuses on: understanding the company's financial statements accounting information (balance sheet, income statement, cash flow statement) and the tools of "window dressing" (creative accounting); understanding accounting information from the perspective of IAS (IFRS3, IAS 16, IAS 36, IAS 38); understanding of financial statements analysis; understanding of ratio analysis; understanding the risk –return trade-off and the impact on company's value; understanding of cash budget and working capital management; understanding of company's financial planning.

The applications are used to apply theoretical knowledge delivered by the course on study cases that reflect the practical issues the student might face in Accounting and Financial Management. This course offer to the student: understanding of accounting information delivered by financial statement; understanding of the relevance of accounting information for stakeholders; ability to perform the financial planning of the company; ability to identify the products, services that increase the company's profitability.

## **11. Enterprise integration and management architectures**

The course introduces Enterprise Resource Planning (ERP) systems attempting to integrate several data sources and processes of an organization into a unified system.

The course discuss the following topics (each topic being introduced and concluded by a case study): enterprise systems for management, systems integration, enterprise systems architectures, development life cycle, implementation strategies, software and vendor selection, operational and post-implementation, program and project management,

organizational change and business process reengineering, ethics and security management, supply chain management, customer relationship management.

The discipline offers hands-on training on strategic Enterprise Management using specific modules of the OpenERP software platform, the exercises are based on the main modules of the application: introduction exercises, case study: company details, database and users setup, purchases, sales, pricelists, human resources management, accounting, project management, stock management, production management, document management system.

## **12. Business service integration and management**

The course presents specific knowledge necessary for integrating business services and then managing and maintaining systems based on them. We discuss the technical background of service integration and its modelling with a standard language, with focus on the way business processes can be mapped to services. Regarding business service management, we study project management specificities for service orientation and the involved life cycle, risk management, and tools. We also consider challenges of existing service systems for maintenance, evolution, modernization and migration towards Service Oriented Architecture and Cloud Computing Environments. For the practical work you will elaborate a portfolio of projects / proposals dedicated to the development of service-oriented systems.

### **13. a. Knowledge engineering and services ecosystem**

Knowledge has become one of the most important factors of production in business terms, because the cost of obtaining knowledge and the value of having knowledge have increased. Knowledge is treated explicitly, may be used as a means to obtain social and economic benefits, and, furthermore, knowledge may be used to produce more knowledge. The basic objectives of the course aim at informing students on the activities to acquire knowledge from various sources, to understand it properly, to transform it into a form suitable for applying various knowledge representation formalisms, to encode it in the knowledge base using appropriate representation techniques, languages and tools to verify and validate it and to maintain it over time. This discipline includes the following topics: a comprehensive definition of the knowledge engineering, higher level view of knowledge engineering techniques and modelling, how conceptual modelling relates to knowledge engineering techniques, ontological engineering, knowledge management, and sharing knowledge networks and services ecosystems issues.

### **13. b. Knowledge representation and reasoning**

The course presents advanced methods and techniques for knowledge representation and automatic reasoning in artificial intelligence systems, including knowledge representation in the Semantic Web. Modern methods and techniques are introduced to allow the development of programs by representing domain knowledge and taking the optimal decisions for successfully solving complex problems. Moreover, the course is presenting how different methods and techniques for intelligent information processing can be applied in various domains and contexts, as well as integrating them with traditional methods for problem solving. The major themes presented at this course are: Knowledge representation in a model; Representing structured knowledge; Description logics and ontologies; Constraint-based representation and associated languages; Systems for maintaining data consistency; Bayesian networks; Propagation of trust; Plan representation and advanced techniques for automatic planning; Multi-paradigm representations and reasoning; Real life applications and usage of knowledge representation and automatic reasoning techniques. The applications aim at "demystifying" artificial intelligence techniques and offering the required knowledge for applying the models, techniques and algorithms presented at the course for solving real life problems.

### **14. Service operations and customer relationship management**

The operations are what the organization does and not what it should do. In other words, they represent the way in which the strategy is being implemented in practice. There are some well-defined approaches regarding operations in manufacturing and delivering products. Yet, in the services case things are not so clear due to the lack of visibility in the operations' flows compared to those in manufacturing. In this way, operations are becoming drivers for organization's strategy and the current extremely dynamic context of IT&C situates the operations among the most important factors on which organizations are competing. The present course aims a systemic approach on service operations which should make use of the previous engineering knowledge. Thereby the organization is seen as a transformation process which interacts with the external environment, and determining some performance measures, their measurement and achieving the desire level, cannot be decoupled from customer relations. This is way the second part of the course is dealing with customer relationship management.

## **15. Intellectual property and entrepreneurship**

Intellectual Property surveys the principal tenets of intellectual property, including trademarks, copyrights, patents, and trade secrets. The course also explores practical aspects of this area of law, such as client counselling and litigation strategy, and theoretical questions of public policy and the interplay of country and EU laws affecting intellectual property. This course aims at preparing students to analyse a wide variety of intellectual property issues at a general level. Dealing with more narrow topics, such as copyright litigation or patent prosecution, may require additional, specialized study. This class should also help to polish student's legal reasoning skills and introduce students to some of the practical and ethical concerns of a working attorney. Another major objective of the course is to study entrepreneurship with emphasis on personal characteristics, innovation, risk taking, and decision making as related to using land, labour, and capital for attaining organizational objectives, as well as to methods and techniques to identify market opportunities for a potential new venture.

## **16. Development and defending the master thesis**

The hours for this discipline will be used for the realization and presentation of the Master thesis: this module includes both individual R&D student activities for thesis development, and special preparation and follow up activities performed by the students with their mentor. The mentors are professors from the SEM teaching staff; they can collaborate with firm engineers when the Master thesis is developed within a collaborative framework between the University and the Enterprise. General objectives are: set up of the student's Master thesis, through individual research and development, team collaboration and mentorship; knowledge transfer for scientific and technical development of projects; identifying, describing and deployment of project management processes and services, of R&D service management for solution development, and of tests and experimentations management in applied research; approach a problem in a sectorial service, and solve it using IT service and SOA method; perform all steps in carrying out a technical project: problem definition, requirement analysis, documenting, method and tools selection, conceptual solution development, system architecting, implementation, debugging and testing, simulation / experiments, solution documenting.

## 17. Research

General objectives are: create research competencies and design skills in the main development lines of IT-based services; stimulate the innovative attitude of students when facing technical challenges, both from theoretical and practical perspective; involve the students in real activities complementary to research: demos, proof of concepts, technological transfer. This research module aims at defining and assisting the realization of a number of research subjects, which are usually linked to the research projects in which the didactic staff of SEM is currently involved, to collaborative R&D projects between the university and companies or research centres. Students are mainly asked to solve real technical problems for which implementing solutions are necessary. The research subjects will be selected from: research subjects proposed to students in the 4<sup>th</sup> semester for working out their Master theses; R&D subjects proposed by industry, i.e. by companies with which the University collaborates; research subjects identified in existing R&D national grants or European scientific projects in which the teaching staff is involved. The research subjects related to this Master module will be connected to the main research lines and objectives of the faculty's doctoral school, in the Service Science domain.