

DEVELOPING LEARNING MANUALS FOR EUROPEAN CONSTRUCTION PROJECT MANAGERS

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Abstract

There is a need for supplementary learning and training in management applied to the construction industry, as many authors, professionals and organisations have already recognised. The assessment and up-keeping of management competencies are essential for the performance of individuals and organisations that work in the construction sector. Most of the universities syllabuses focus in traditional construction courses that do not deal with the most relevant features of management for engineers and architects in the construction industry; these graduate courses mainly cover an assortment of design-oriented issues, leaving no room for managerial topics. Thus, management is a crucial issue for professionals in the construction sector; currently, an engineer or an architect must have some knowledge of every managerial issue valuable in construction. Taking the complete life cycle of the infrastructure as a reference, a holistic attitude must be pursued. Therefore, a model for management and administration in construction is proposed in this paper. This model displays two dimensions: life cycle (per phase) and organisational level. The former is linked to time through the four well-known phases of the construction process: feasibility, design, construction and operation. The latter considers four organisational levels that can be found in the construction sector: life cycle, company, project (or team) and individual. In order to test the appropriateness and usefulness of the model, two applications are implemented. The first one is the analysis of the outputs of a European project which goal was to produce seven basic books for construction managers; this project was developed by several universities and professional associations of the European Union. The second one is the design of a new syllabus in civil engineering (M.Sc. degree) with a specialisation of 30 ECTS; right now, this proposal is being discussed in the School of Civil Engineering at the Universidad Politécnica de Valencia (Spain) to get it implemented in 2010 due to the new academic scenario according to the Bologna process. The model presented in this paper offers an innovative framework for orientation to organisations, professionals and academicians in order to improve the knowledge of management and administration in the construction industry.

Keywords - Construction, learning, life cycle, management, syllabus, training.

1 INTRODUCTION

Construction is one of the major drivers of any developed or developing economy, accounting around 10% of Gross Domestic Product [1]. Some authors see the construction sector as a process (construction process) instead of an industry [2] or as a life cycle (facility life cycle) [3]. Construction industry presents some distinctive characteristics [2]: companies execute projects ordered by the clients, demand fluctuates with economy and political cycles, regulatory and procurement policies also influence demand, and many organisations are involved through the life cycle. The tangible product is the built facility or infrastructure. This process or life cycle displays four traditional phases: feasibility, design, construction and operation; divestment could be also considered when needed. Through the paper, our line of reasoning is developed taking into considerations the four phases of this life-cycle.

Management and administration competencies for the whole life cycle are essential for the performance of organisations in the construction process [4-7]. The concern for management competencies led to the development of standards currently used for assessment and certification [8]. However, a previous research conducted through a European project in Lithuania, Poland, Portugal and Spain revealed that minor consideration was given to management and administration in university courses, despite the demand for continuous professional development in this area [9-13].

Most of the academic syllabuses are focused in traditional civil engineering or architectural courses that fail to cope with the most relevant needs in management and administration knowledge for professionals working in the construction industry. Moreover, courses in civil engineering and architectural (B.Sc.) degrees predominantly comprise a variety of design oriented topics, leaving little room for construction management subjects that are vital for successfully accomplishing construction projects [4,6,7,10, 13]. Nowadays, project managers in construction are faced by a lot of non-technical issues, performing many management and administrative activities [14-15]. Thus, contemporary construction professionals require additional knowledge management that goes beyond the aspects of traditional construction areas [4,6,13,16].

However, the usually packed university curricula do not let an easy solution for this problem. It could be done, depending on the circumstances, through a change of syllabus, making compulsory the required expertise, or by introducing appropriate topics in courses pertaining to the current syllabuses [17]. Beyond academic traditional curricula, continuing professional development is receiving increasing interest recently; construction professionals feel the need for expanding knowledge acquired at universities and are required to keep themselves up-to-date with new advances in the construction industry [18]. Both approaches are considered in the paper.

This paper presents a framework for management and administration in the construction industry. It takes into account two dimensions: time (through the life cycle) and organisational level. First, the results of a European project are presented and discussed within the framework of the proposed model; this project aimed to develop a library of seven manuals for professional construction managers. Later, the theoretical model is applied to the design of a new syllabus for a specialisation within a M.Sc. in Civil Engineering based on the Bologna framework [19].

2 MODEL

As previously discussed, management is a crucial issue for professionals in the construction sector. Most of the employers seek a well managed project, a growth in the productivity or an increasing of the quality of services offered. Initially new employees require knowledge in project management and, as they gained experience or occupy management positions, they require knowledge in business management (see Fig. 1). Currently, an engineer must have notions of every managerial issue worthwhile in construction.

Nevertheless, “management”, or its many times used synonym “administration”, is a very wide term. In 1916, Fayol [20] described the basic main functions of “management” or “administration”: planning, organisation, coordination (or direction) and control; his theories are still valid today [21]. Taking the whole life cycle of the infrastructure as a reference, a holistic approach is pursued. Therefore, a model for management and administration in construction is proposed in this paper (see Fig. 2).

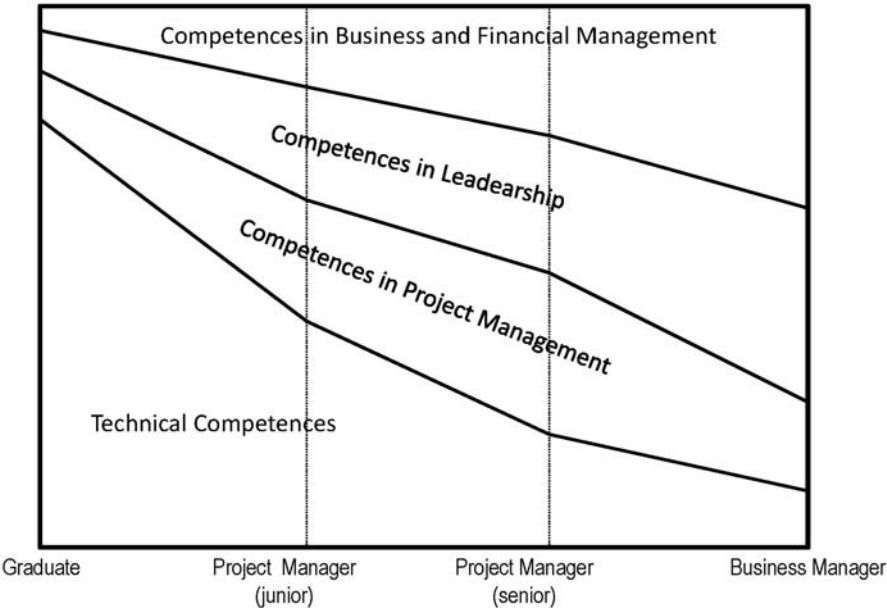


Figure 1. Maturity model in management competences (based on [22])

The Management and Administration Model in Construction (MAMC) displays two dimensions: phase of the life cycle and level of the organisation. The former is linked to time through the four typical phases of the facility life cycle: feasibility, design, construction and operation. The latter considers four levels of organisation that could be found in the construction industry (from less to more breakdown degree of disintegration): life cycle, company, project (or team) and individual.

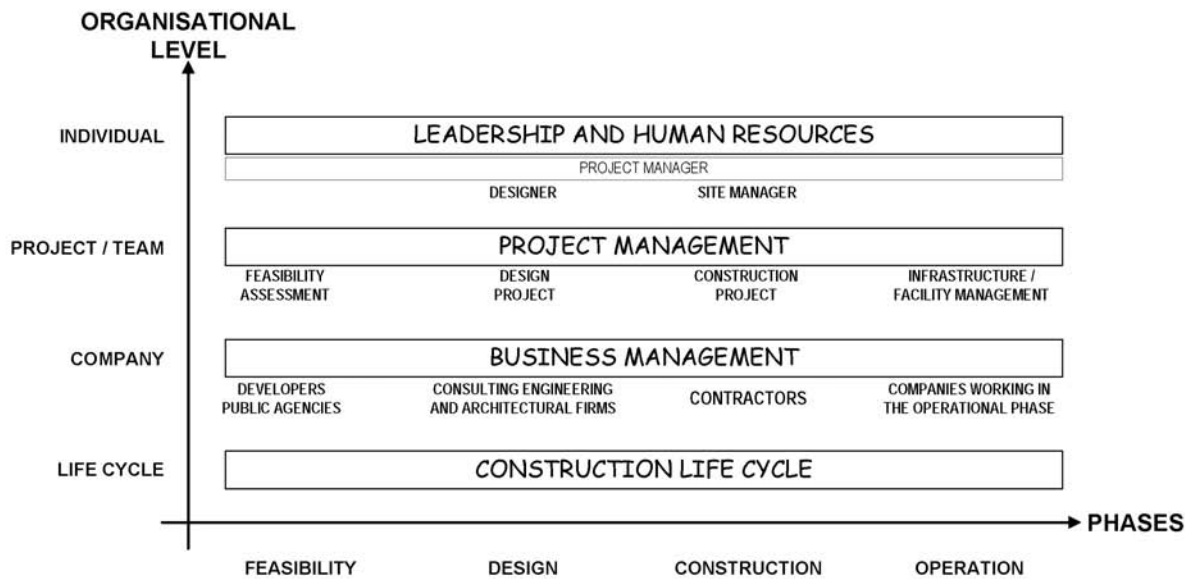


Figure 2. Management and Administration Model in Construction (MAMC)

At the individual level, leadership and human resources management are essential. This level can be fixed on the project manager as the main player; he/she can be particularised in the person of the designer (design phase) or the site manager (construction phase). Leadership does influence and motivate employees to carry out the tasks, being a combination of knowledge and skills. It includes issues such as negotiation processes, conflict management and team building. Resources management related to business management differs from the project management approach. These topics on resources management need a more advanced level: organisational design, productivity management, feedback techniques, re-engineering, diversity and incentives.

Project management is established at the project or team level. Companies in the construction industry work and manage by projects. Thus, construction professionals will join one or several projects team to develop their job. For that reason, it is essential to ensure expertise in issues related to project management. This can be divided into six main parts [23]: time management, cost management, resources management, quality management, environmental management and safety and health management. From the perspective of the life cycle, projects can be very varied: feasibility assessment (feasibility phase), design project (design phase), construction project (construction phase) and infrastructure or facility management (operation phase).

The company level focuses on business management. With the experience gained through the years, engineers may rise to intermediate positions as managers, in which managerial skills are needed that exceed the project management level. Business management in the construction industry embraces topics related to: operative and strategic planning, financial management, total quality management, control, marketing, etc. However, several types of firms appear through the process: public agencies and developers (feasibility phase), consulting engineering and architectural companies (feasibility and design phases), contractors and specialty subcontractors (construction phase) and maintenance contractors, service operators and concessionaires (operation phase). Consulting engineering and architectural firms, and contractors are the two most important, from the point of view of the number of technicians that are involved (mainly civil engineers, quantity surveyors and architects).

Finally, life cycle seeks a holistic view of the construction industry. This level displays the different linkages between phases and stages along the process. Furthermore, it explains the management of procurement from the position of the developer too. Approaches like lean project delivery (LPD) system or private finance initiatives (PFI) should also be considered.

This model intends to offer a framework for orientation to organisations, professionals and academicians in order to improve the knowledge of management and administration in the construction industry. In order to test its usefulness and completeness two application of the model are implemented. The first one is the analysis of the outputs of a European project whose goal was to produce several basic books for construction managers; this project was developed by several universities and professional organisations of the European Union thorough a period of 20 months. The second one is the design of a new syllabus in civil engineering (M.Sc. degree) with a specialisation of 30 ECTS; right now, this proposal is being discussed in the School of Civil Engineering at the Universidad Politécnica de Valencia (Spain), in order to get it implemented in 2010 due to the new academic scenario following the Bologna statement [19].

3 MANUALS

Knowledge required for management practice is much wider than that learned at universities [23]. A survey to 170 project managers from the UK construction sector showed that formal training and career experience play an important part in managerial competencies [15]. Professional competency in management is truly achieved by the blend of knowledge gained during training and abilities developed through experience. This is due to the quickly changing construction environment, the continuous pressures on the project management profession, and the lack of enough management courses in the present university curricula.

During 2007 and 2008, a project entitled “Common learning outcomes for European managers in construction”, financed by the European Union, was developed. The goal of the project was to produce a library of basic manuals for construction managers. The original purpose intended to cover the whole facility life cycle from feasibility to operation [13]. The project was based on the European Directive 89/48 on regulated professions in respect to scope of recognition, promotion and certification of qualifications by international associations and organisations. This is taking place in the framework of generalised change that is under way in many European countries in order to adapt themselves to the requirements of the European Space for Higher Education [19]. Thus, this set of manuals was an opportunity for the future professionals to attain and to strengthen their basic managerial knowledge in order to develop their careers in the construction sector. This managerial knowledge could form a basis for:

- Recognition and certification of managerial qualifications in European Countries for obtaining the title of EurMC (European Manager in Construction).
- Entering in post graduate education lectured in English, therefore allowing the increase of mobility among students going on scholarships through Erasmus-Socrates programmes.
- Training of construction staff through continuous professional development.

Aiming to develop a useful and applied set of books, several authors worked together. They foster their careers as professors in four different universities (Politechnika Warszawska, University of Salford, Universidade do Minho and Universidad Politécnica de Valencia) from four different countries (Poland, United Kingdom, Portugal and Spain), and they have a thoroughly experience in the construction industry. Each author developed (alone or jointly) the manuals and chapters in which they could add more value due to their professional and academic practice. Furthermore, the Chartered Institute of Building (CIOB) and the Association of European Building Surveyors and Construction Experts (AEEBC) also collaborated actively in the project [13].

The outputs of the project were seven books. The length of each book was about 50,000 words or 120 pages in A4 paper size. The manuals were entitled as follows:

- Project management.
- Human resources management in construction.
- Partnering in construction.
- Economy and financial management in construction.
- Real estate management.
- Business management in construction enterprises.

- Construction management.

The specific content of each manual is highlighted in Table 1. Each book is self contained and it can be read separately. However, reading the entire suite adds value, because the reader gets the whole picture of the construction process from a managerial point of view, allowing the establishment of links among the manuals and, hence, enhancing the comprehension.

Table 1. Contents of books.

<p>COMMON LEARNING OUTCOMES FOR EUROPEAN MANAGERS IN CONSTRUCTION</p>	<p>1 PROJECT MANAGEMENT 1.1 Introduction 1.2 Inception Stage 1.3 Feasibility Stage 1.4 Strategy Stage 1.5 Pre-construction Stage 1.6 Construction Stage 1.7 Commissioning and O & M Manuals 1.8 Engineering Services 1.9 Commissioning Stage 1.9 Completion Handover and Occupation Stage</p>	<p>2 HUMAN RESOURCES MANAGEMENT IN CONSTRUCTION 2.1 Introduction 2.2 Parties obligations 2.3 Corporate strategies & manpower planning 2.4 Organisational behaviour and culture 2.5 Human resource management 2.6 Leadership, motivation and morale 2.7 Industrial and employee relations</p>	<p>3. PARTNERING AND COLLABORATIVE STRATEGY IN CONSTRUCTION 3.1 Introduction 3.2 What is Partnering? 3.3 Why Choose Partnering 3.4 Selecting firms for partnering 3.5 Partnering in practice 3.6 Partnering skills 3.7 Partnering teams</p>
<p>4. BUSINESS MANAGEMENT IN CONSTRUCTION ENTERPRISES 4.1 Construction organisations 4.2 Risk management 4.3 Value management 4.4 Decision making in construction 4.5 Performance, productivity and benchmarking 4.6 Marketing applied to construction industry 4.7 Construction costs and budgets 4.8 Control of a construction contract 4.9 Control of operation of an enterprise</p>	<p>5. REAL ESTATE MANAGEMENT 5.1. Investment cycle 5.2. Real estate market 5.3. Real estate value 5.4. Management of the investment 5.5. Management of the company 5.6. Costs and profitability 5.7. Management plan 5.8. Example of implementation</p>	<p>6 ECONOMIC AND FINANCIAL MANAGEMENT IN CONSTRUCTION 6.1 Introduction 6.2 Investment project development cycle 6.3 Financing of investment projects 6.4 Methods of effectiveness assessment 6.5 Management of risk and uncertainty 6.6 Net present value and internal return rate 6.7 Analysis of scenarios and investments 6.8 Methods of determining cash flow 6.9 Value based risk management 6.10 Phase of operation</p>	<p>7 CONSTRUCTION MANAGEMENT 7.1 Introduction 7.2 Organising construction processes in construction companies 7.3 Documentation and record keeping 7.4 Machinery, equipment and productivity 7.5 Site setup and planning 7.6 Technology and quality management 7.7 Safety, health and environmental management 7.8 Supply chain 7.9 Resources management 7.10 Claims and change management 7.11 Progress payment 7.12 Project closeout</p>

A brief summary of each of the seven books is put forward [13]. The first book describes the business context of the construction process or facility life cycle including the key stages of the process and their inter-relationships. It covers every phase, from feasibility to operation. This first book is the basis of the other six, due to the fact that it serves as a reference, not only in vocabulary, but also because it deals with the complete construction process. Furthermore, it links the different topics among them, allowing for a better view of the facility life cycle.

The second book deals with the human resources management in the construction industry. It examines the roles, responsibilities, obligations and duties of the various stakeholders that take part in the construction activity. It considers not only the people, but also their performance at work and concludes with essential considerations for the manager. The text is equally applicable to consulting firms and contractors' personnel. Human resources management is a strategically important function of any business, as well as the construction industry. This book illustrates the scope and requirements of fine human resource management principles applied to construction.

The third manual explains strategic collaborative working in the construction industry. Last decade in the United Kingdom, several official reports stated that partnering should be used as the basis of establishing long term relationships, rather than just being project based. According to these reports, construction industry should aim for continuous improvement; the benefits of this progress should be shared on an openly fair basis so that all stakeholders have a genuine incentive and motivation to find better solutions. In order to meet these goals, these project teams have to include from the beginning design and construction skills working in fully integrated teams.

The fourth book illustrates economy principles and financial management applied to construction. They encompass the entire construction process, not only feasibility, but also design construction and operation. Construction managers are often afraid of making decisions due to lack of full knowledge in the field of economy and financial principles and their associated risks. Therefore, it is necessary to provide understanding of economy, recognize the methods of financing, and identify and manage risks while undertaking construction projects.

The fifth book deals with the housing market and property management. It comprises the economic environment where legalised land and residential buildings can be sold or purchased in accordance with free-market rules. Therefore, it focuses mainly in the feasibility phase.

The sixth book describes the business context of construction organisations approaches including application of appropriate organisational structures within the context of business operations; it also recognises the impact of construction companies on the business performance within the industry. In the construction sector, projects are managed using business organisations that are prepared to work systematically with this approach. Projects involve the normal production of the company, matching orders or contracts executed for clients. The management of projects (at the productive level) coexists with the management by projects (at the business level). This manual mainly focuses in companies that work in the construction phase.

Finally, the seventh book aims at the construction phase. The execution (or construction) of the project is its main subject. The contractor's point of view is chosen, even though the links with the owner are always taken into account. An envisioned outline of the management at the construction site is looked for, from the signing of the contract to the beginning of the operational phase.

The subjects of these books are also displayed in the MAMC model (see Fig. 3). Book 1 "Project management" covers, in fact, the whole construction process, making remarks in every of the four main phases of the cycle. The manual "Human resources management in construction" deals with the complete model; from the organisational level, it encompasses not only the individual, but also the project and the company, through the whole life cycle. The third book "Partnering and collaborative strategy in construction" takes also an integrated approach that embraces the entire model. The fourth manual "Business management in construction enterprises" explains management inside the firm in the construction industry. The fifth book "Real estate in construction" is fixed in the feasibility phase from the viewpoint of the developer. The sixth manual "Economic and financial management in construction" covers economic and financial issues from the standpoint of the project, the company and the life cycle. Finally, "Construction management" is focused in the construction phase of the process from the position of the construction site.

As previously commented, these books aimed to cover the whole construction process from the management point of view. As it can be seen in Fig. 3, two subjects are missing, from the position of the project: design and operation. Questions marks are posted in their correspondent place in the diagram. A post-reflection on the objectives really achieved by the project, allows reaching some conclusions. Even though the model was not highlighted during the procurement and development of the project, the team had intention to cover the whole picture. However, the tighten budget of the project did not allow to write additional books that would cover the entire model.

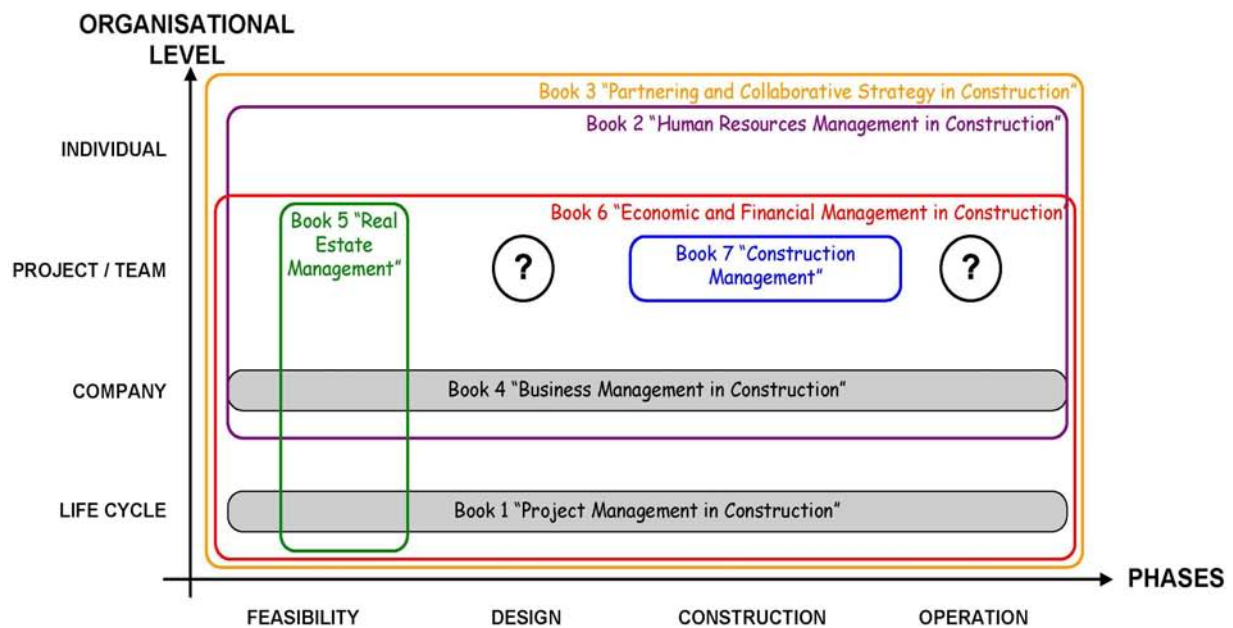


Figure 3. The manuals within the model.

4 SYLLABUS

The new academic scenario established by the Bologna process [19] forces the European governments, and therefore the European universities, to implement these measures. The School of Civil Engineering at the Universidad Politécnica de Valencia is developing a new syllabus in Civil Engineering, for Bachelor and for Master degrees based on the Bologna statement and further regulations dictated by the Spanish Ministry of Education. The graduate is a 4-year degree, whereas the post-graduate is 2-year. Within this degree, an intensification module of 30,0 ECTS in management is proposed by the School. In order to design this module, both degrees' background on management needs to be taken into consideration. The background, according to these new syllabuses (B.Sc. and M.Sc. in Civil Engineering), comprises four mandatory courses that are related to the model; three of them are displayed in grey in the model (see Fig. 4). These previous mandatory courses are:

- "Basic legislation, economy and administration" (4,5 ECTS – 1st year of B.Sc.): it gives a very general and basic approach to the economic and construction life cycle for freshman students; for this reason it is not included in the model.
- "Construction site management and quality assessment" (6,0 ECTS – 3rd year of B.Sc.): it provides an in-depth approach to the construction site, mainly from the point of view of the contractor.
- "Construction life cycle" (6,0 ECTS – 4th year of B.Sc.): it presents the whole life cycle of the infrastructure: stakeholders, organisations, procurement and contracts; it also offers some insights in the design phase of the project.
- "Business management: general approach" (4,5 ECTS – 1st year of M.Sc.): it introduces business management in general.

Taking as a basis this knowledge, the new specialisation in management is designed in order to fill in the gaps of knowledge in the model. The purpose is to cover, along with the background and the new specialisation, the whole model. This specialisation in management comprises 4 mandatory courses (21,0 ECTS) and 4 optional courses (18,0 ECTS); regarding the elective courses, only 9,0 out of 18,0 ECTS can be chosen. All these courses would be located in 2nd year of M.Sc. in Civil Engineering, either in the first or second quarter depending on the relationships among them and the integration with the other courses in the syllabus.

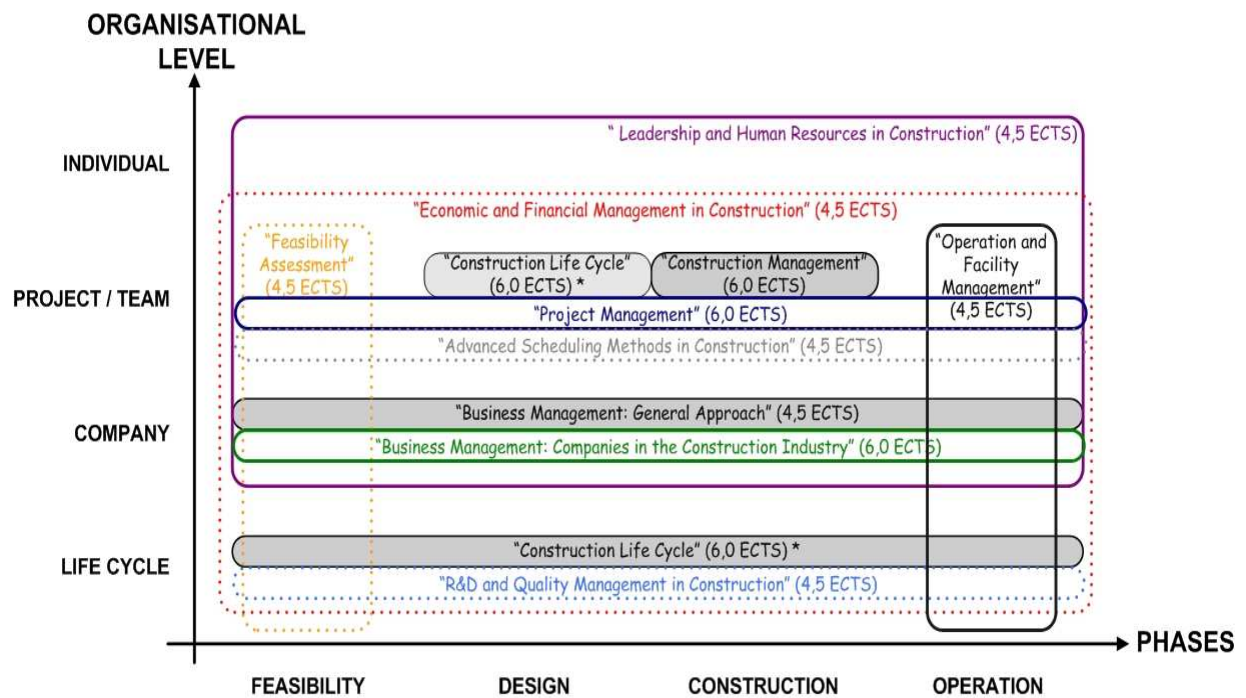


Figure 4. The new specialisation of the syllabus in M.Sc. in Civil Engineering within the model.

The compulsory courses, displayed in a continuous line in Fig. 4, are:

- "Business management: companies in the construction industry" (6,0 ECTS – 2nd year of M.Sc.)
- "Project management" (6,0 ECTS – 2nd year of M.Sc.)
- "Leadership and human resources in construction" (4,5 ECTS – 2nd year of M.Sc.)
- "Operation and facility management" (4,5 ECTS – 2nd year of M.Sc.)

The elective courses, displayed in a dashed line in Fig. 4, are:

- "R&D and quality management in construction" (4,5 ECTS – 2nd year of M.Sc.)
- "Advanced scheduling methods in construction" (4,5 ECTS – 2nd year of M.Sc.)
- "Economic and financial management in construction" (4,5 ECTS – 2nd year of M.Sc.)
- "Feasibility assessment in construction" (6,0 ECTS – 2nd year of M.Sc.)

The contents of these courses, using their main descriptors, are displayed in Table 2.

Table 2. Contents of courses

COURSE	TYPE	ECTS	DESCRIPTORS
BUSINESS MANAGEMENT: COMPANIES IN THE CONSTRUCTION INDUSTRY	Compulsory	6,0	(A) Production; Scheduling; Organisation; Strategic Planning; Operative Planning; Control; Marketing (B) Developers; Consulting Engineering and Architectural Companies; Contractors; Services Operators; Concessionaires Combine (A) for each (B)
PROJECT MANAGEMENT	Compulsory	6,0	Interaction Project/Company; Statement of Work; Breakdown Structures; Scheduling; Chart Diagrams; Network Diagrams; Critical Chain; Project Team; Responsibility Matrix; Allocation of Resources; Budgeting; Project Management Plan; Coordination; Project Start; Control; Earned Value Analysis; Project Finish; Multi-Project Management
LEADERSHIP AND HUMAN RESOURCES IN CONSTRUCTION	Compulsory	4,5	Personal and Professional Value; Project Team; Work Post; Communication; Reports; Public Presentations; Meetings; Empowerment; Leadership; Motivation; Behaviour; Legislation; Diversity; Recruitment, Labour Turnover ; Staff Performance; Training; Professional Career; Rewards; Discipline; Internationalisation
OPERATION AND FACILITY MANAGEMENT	Compulsory	4,5	Legislation; Procurement; Operation; Concession; Private Finance Initiative; Maintenance; Useful Life; Preventive Maintenance; Corrective Maintenance; Computer Tools; Parking Facilities; Roads; Railroads; Harbours; Airports; Water Facilities
ECONOMIC AND FINANCIAL MANAGEMENT IN CONSTRUCTION	Elective	4,5	Costs; Cash Flow; Financial Accountancy; Balance Sheet; Income Statement; Analytical Accountancy; Cost Centres; Decision Making; Planning; Control; Finances; Short Term; Banks; Investment Analysis; Information Systems; Information Technologies; E-Business
FEASIBILITY ASSESSMENT IN CONSTRUCTION	Elective	4,5	Types of Assessments; Decision Making; Risks; Multi-Criteria Analysis; Analytical Hierarchical Process (AHP); Financial Cost-Benefit Analysis; Financial Profitability; Economic Cost-Benefit Analysis; Economic Profitability; Life-Cycle Analysis
R&D AND QUALITY MANAGEMENT IN CONSTRUCTION	Elective	4,5	Basic Concepts; Quality Management Systems; ISO 9000 Standards; Total Quality Management; Deployment of Quality Function; Six Sigma; Environmental Management Systems; ISO 14000 Standards; Innovation vs. Research; R&D Policies; Standardisation; UNE 166000 Standards; R&D Projects; R&D Management Systems; Methodology for R&D Management; Technological Watch; Technological Transfer; Tools for R&D Management

5 CONCLUSIONS

The management discipline is crucial for the acquisition of professional competences by engineers and architects working in the construction industry. Most of the employers seek professionals with a sound background in management competences and leadership skills. Initially, they require knowledge in project management and, as employees gained experience or occupy managerial positions, they require knowledge in business management.

Taking the whole construction process as a reference, this paper proposes a holistic model for management and administration in construction. This model displays two dimensions: life cycle and organisational level. The former is linked to time through the four typical phases of the facility life cycle: feasibility, design, construction and operation. The latter considers four levels of organisation

that could be found in the construction industry (from less to more breakdown degree of disaggregation): life cycle, company, project (or team) and individual.

This model intends to offer a framework for orientation to organisations, professionals and academicians to improve the knowledge of management and administration in the construction industry. In order to test its usefulness and completeness two applications of the model are implemented. The first one is the analysis of the outputs of a European project whose goal was to produce several basic books for construction managers; this project was developed by several universities and professional organisations of the European Union. The second one is the design of a new syllabus in civil engineering (M.Sc. degree) with a specialisation of 30 ECTS; right now, this proposal is being discussed in the School of Civil Engineering at the Universidad Politécnica de Valencia (Spain), in order to get it implemented in 2010 due to the new academic scenario following the Bologna statement.

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