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Modelling the Integration of Project Management into building construction site management. An approach for Spanish site managers and general contractors.

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The need for tools to achieve a higher level of competitiveness and profitability has made management systems an important partner for construction companies. The environment in which building projects are carried out is dynamic, mainly characterized by complexity, uncertainty, interdependence, nonlinearity, ambiguity and speed. Dynamic means that the system changes its state, characteristics and behaviour over time. The construction process can be considered as one of the most complex activities of any industry. A Building Project, as a process, is a Complex Adaptive System. A system-model for managing building projects could conceptualize this complex reality, providing coordination and integration, flexibility and adaptability to multiple inherent functions, achieving a satisfactory solution, neither perfect nor optimal, because of the changing behaviour of this reality. Such a model would allow systematizing management processes for small and medium general contractors operating in the built environment. In this study, a conceptual framework for the development of such a system-model is established.

Keywords: Project Management; Building Construction Site Management; General Contractor (SME); Spanish Construction Site Manager; Complex Adaptive System.

Modelando la Integración de Gestión de Proyecto en Gestión de Obras de Edificación. Un Enfoque para Jefes de Obras y Constructoras.

La necesidad de contar con herramientas que permitan alcanzar un mayor nivel de competitividad y rentabilidad han convertido a los sistemas de gestión en un importante aliado para las empresas constructoras. El entorno en que se llevan a cabo las obras de edificación es dinámico, caracterizado principalmente por la complejidad, incertidumbre, interdependencia, no linealidad, ambigüedad y celeridad. Dinámico significa que el sistema cambia de estado, características y comportamiento con el paso del tiempo. El proceso de ejecución se puede considerar como una de las actividades más complejas de cualquier sector industrial. Una obra de edificación es un Sistema Complejo Adaptativo. Un modelo-sistema para la gestión de las obras de edificación podría conceptualizar dicha realidad compleja, aportando coordinación e integración, flexibilidad y adaptabilidad a las múltiples funciones inherentes, consiguiendo una solución satisfactoria, que no perfecta, debido al comportamiento cambiante de dicha realidad. Tal modelo permitiría sistematizar los procesos de gestión de una pequeña y mediana empresa constructora. En este estudio se establece un marco de referencia conceptual para el desarrollo de dicho modelo-sistema.

Palabras clave: *Gestión de Proyecto; Gestión de Obras de Edificación; Empresa Constructora (PYME); Jefe de Obra; Sistema Complejo Adaptativo*

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1. Introduction

General contractors (GCs), specializing in Building Construction, have expressed concern about implementing methods, techniques and tools of the discipline of Project Management (PM) for managing their Building Projects, as evidenced in previous interviews in this study. Currently, margins are so tight, and construction companies need management systems so as to ensure their survival. PM guidelines, such as UNE-ISO 21.500 (2013), PMBOK (2013) or ICB (2006), although imply recognition of a discipline that has been in place for over 40 years, are too general, too little concrete and difficult to implement directly to Building Projects by Construction Site Managers and GCs. Small and medium Spanish GCs operating in the built environment should address the management of their projects through Project Management Systems (PMS). A PMS is a set of policies, processes, techniques and tools that companies use to manage their projects (PMBOK, 2013). The aim of this study is to establish a conceptual framework providing a rationale for the further development of a system-model for managing Building Projects, integrating PM principles and practices using a systems approach. Such a system-model would be good for improving current Building Construction Site Management (Building CSM) practices. This contribution to knowledge could be considered a useful tool in the challenge of improving the traditional delivery method in Building Projects (Design-Bid-Build), so rooted in Spain, insofar as the challenging would be assumed from within the construction firm.

2. Objectives

This paper is the first of a set of scientific papers related to the needs to adequately model a management system for improving Building CSM practices in Spain, considering the potentials coming from the discipline of Project Management in the built environment.

The specific objectives for this paper have been:

1. To establish an appropriate philosophical stance so as to design the necessary research scheme to face the Building CSM modelling process.
2. Regarding the philosophical stance, to establish the research methodology to gather valuable information from literature and normative reviews and from participants´ opinions, perceptions and attitudes
3. To establish a theoretical positioning framework, which contains the underlying PM principles and practices in which the research is based on.
4. To rate empirically the current PM maturity in Spanish Site Managers' performance.
5. To present a competence-based framework and a process-based matrix for the Building CSM modelling.

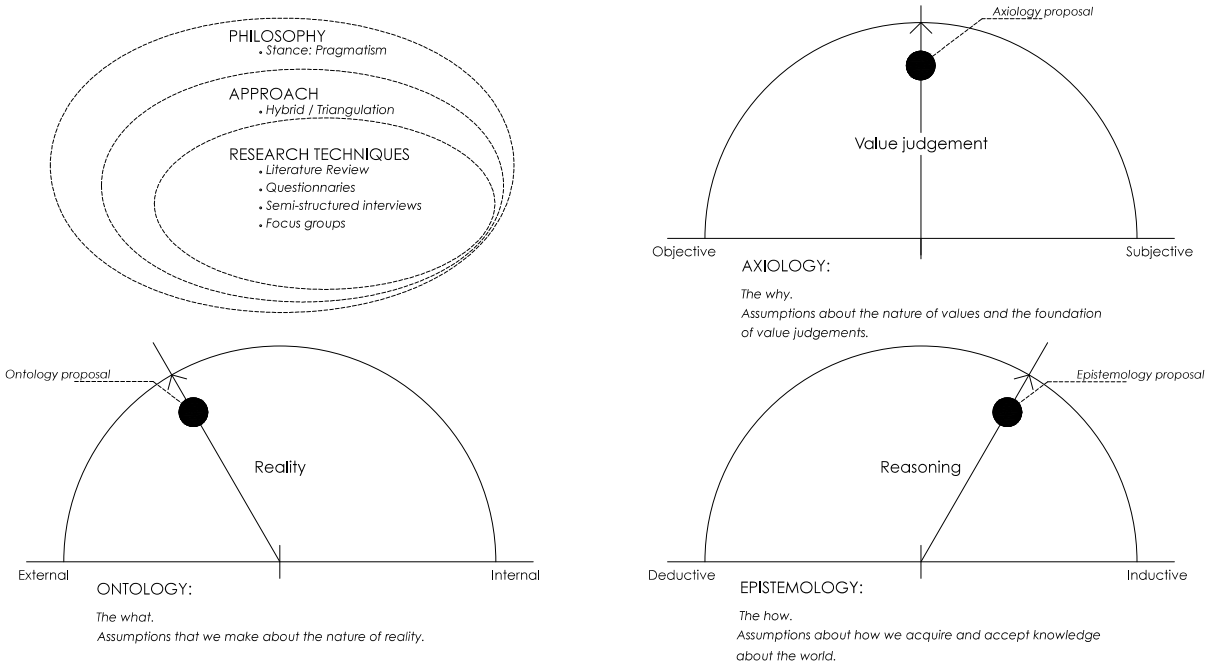
This paper shows the main results in relation with a bigger theoretical and empirical research in the topic of Construction Project Management that has been conducted in the department of Construction Science at the School of Architecture in the University of Navarre.

3. Philosophical stance and research methodology

The adopted philosophical stance for the development of such a model for Building CSM is illustrated in **Figure 1**. According to the mentioned challenge, the philosophical stance of Pragmatism seems to be best suited with a hybrid approach of deductive and inductive reasoning (Creswell, 2014), by using both quantitative and qualitative research techniques for data collection and analysis. The philosophy of Pragmatism provides for the adoption of hybrid methods because it allows that data collection is objective and, at the same time, that the analysis of the received contributions from the individuals involved in the research process is

subjective (Saunders et al., 2016). From a philosophical perspective, this research is slightly tending to objectivism (ontology), slightly tending to interpretivism (epistemology) and neutral in value judgements (axiology).

Figure 1: Philosophical stance

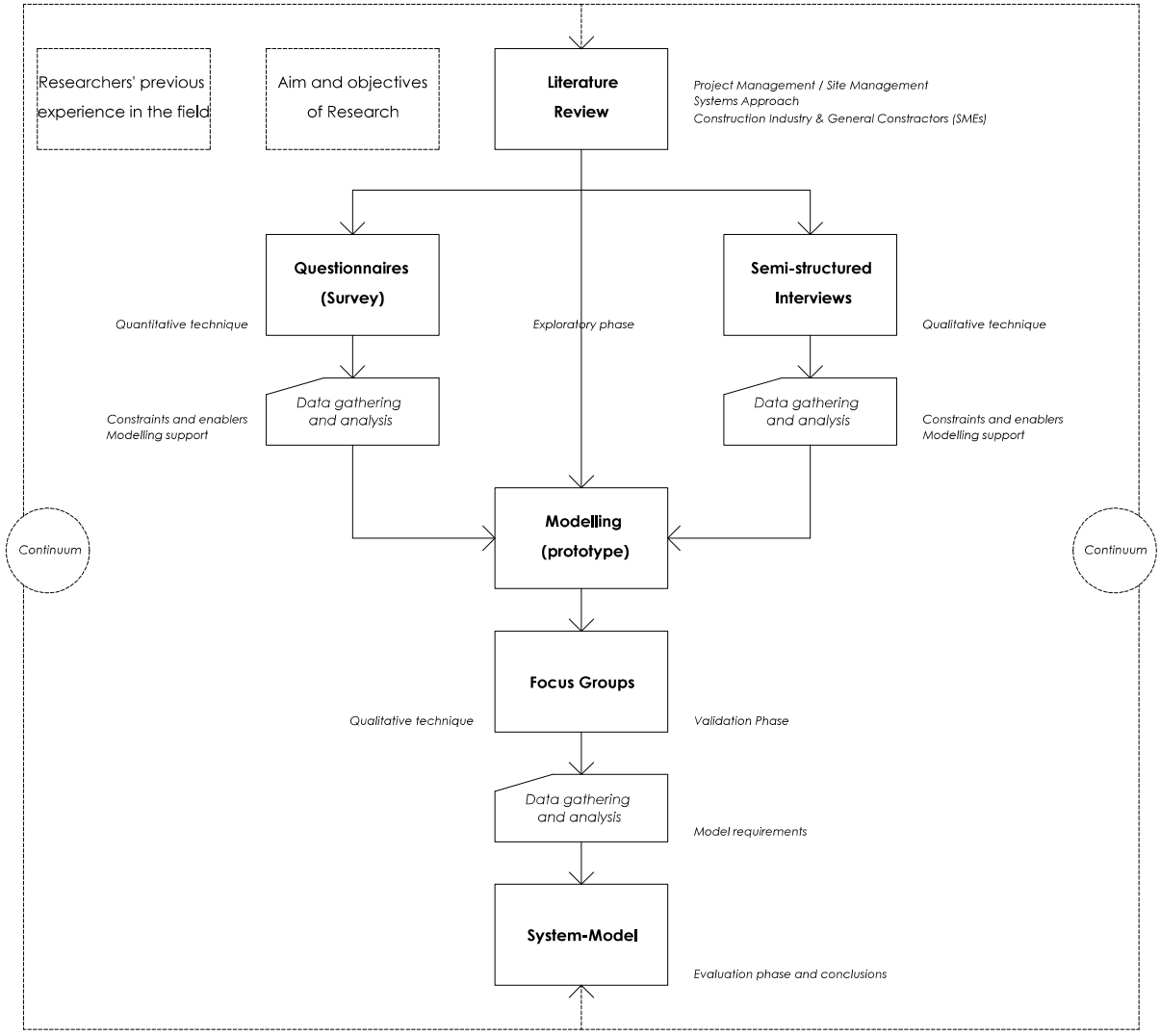


Research methodology is a system of explicit rules and procedures in which an investigation is based to assess knowledge (Frankfort-Nachmias&Nachmias, 1996). **Figure 2** illustrates the adopted research methodology. Triangulation process allows corroborating evidence from several perspectives or information sources (Creswell, 2014), and also allows relating literature review results with those from quantitative and qualitative empirical research techniques (Fellows and Liu, 2003). For achieving a satisfactory solution, a research methodology in four phases was adopted, based on data triangulation:

- **Phase 1,** called inception, consisted of non-structured interviews to construction practitioners, especially Spanish Construction Site Managers. The objective was to get support from practitioners in relation with the authors' personal conviction on the need for the formal integration of PM practices into Building CSM for Construction Site Managers hired by small and medium GCs. This need was also positively validated through empirical research.
- **Phase 2**, called literature and normative review, consisted of a comprehensive literature and normative review in three main areas: PM/CSM, Systems and Spanish Construction Industry and normative related to. The used review scheme is illustrated in **Figure 4.**
- **Phase 3**, called exploration, was based on empirical research using a questionnaire-survey with a representative sample of 450 professionals in the field of construction management as well as 10 interviews with open-ended questions for capturing opinions, perceptions and concerns from a representative group of professionals. The objective was to assess the current PM maturity in Spanish Construction Site Managers' performance and practices. The main empirical results are discussed in **Section 6.**

- **Phase 4,** called validation. The proposed process Model (**Fig. 10 & Fig.12**) was validated through the questionnaire-survey, and finally by a panel of experts (focus group) with extensive experience in Building CSM.

Figure 2: Research methodology



4. Theoretical positioning

The theoretical position for the development of such a system-model for Building CSM is illustrated in **Figure 3**, based on the purpose of linking PM, Systems Thinking and Building CSM. CSM is a complex reality (Bertelsen, 2003a; Bertelsen, 2003b), on the edge of chaos, whose dynamic attributes cause having to go to the Complexity Theory to perceive this reality as a complex phenomenon (mystery). Systems approach but forces a holistic analysis, implies to leave on the way many of the characteristics inherent to this complex reality. Heuristics, based on empirical knowledge and experience, brings flexibility to the modelling process, contrary to the restrictions of Systems Approach. Analysis should be critical and based on the effective combination of hard and soft systems thinking. The terms 'Hard' and 'Soft' are widely used in PM literature review. 'Hard' is vaguely associated to tangible goods and tasks, and 'Soft' is related to people and intangible goods (Crawford & Pollack, 2004). Pollack (2007) stated that the former is associated with a positivist epistemology, deductive reasoning and

quantitative techniques, while the latter is related to an interpretative epistemology, inductive reasoning and qualitative techniques.

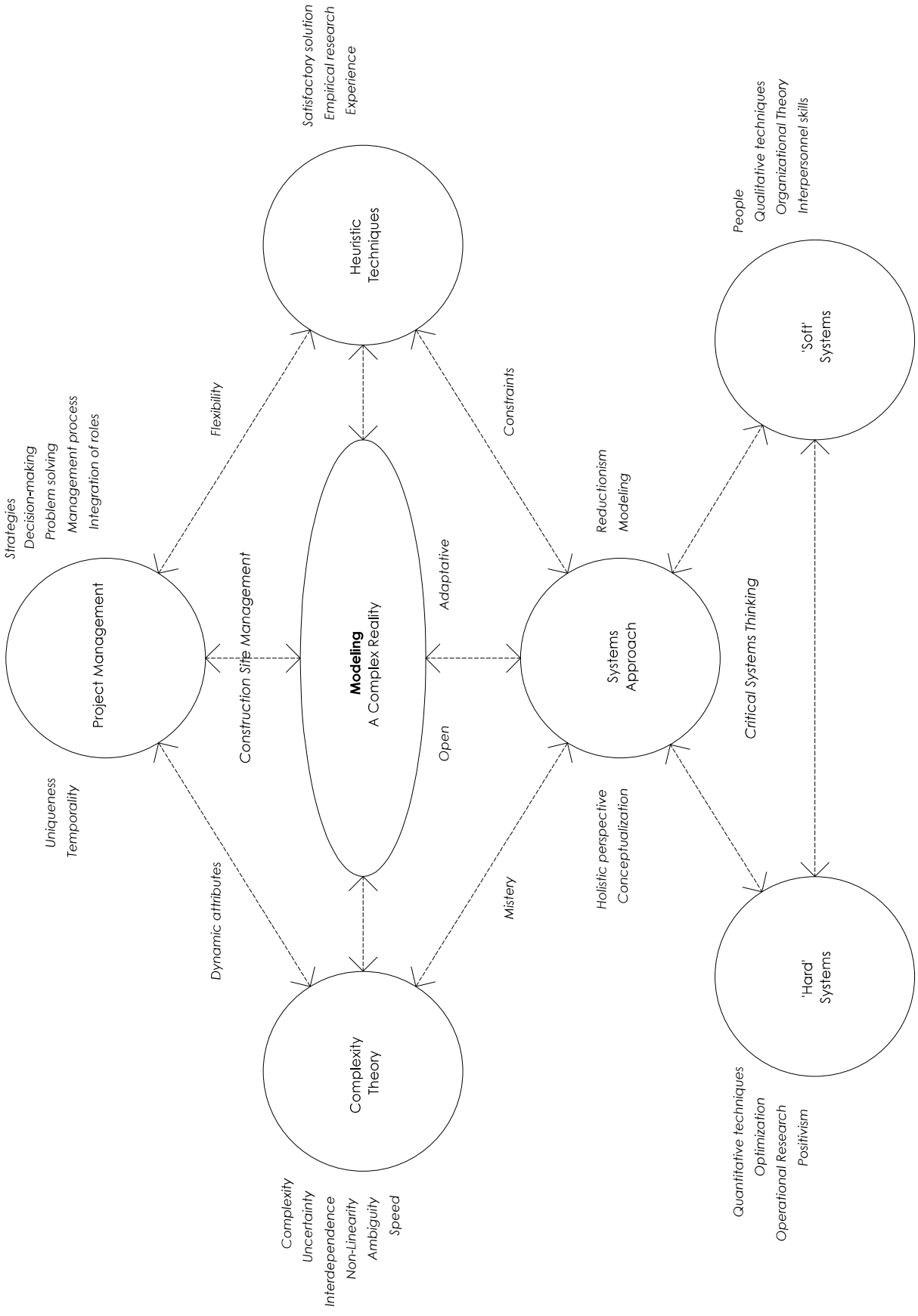
Keep in mind that the proposed challenge is to achieve just a satisfactory solution, neither perfect nor optimal. The process of Building Projects is characterized by its dynamic nature. Complexity, interdependence, nonlinearity, uncertainty, ambiguity and speed are inherent to this process (Baccarini, 1996; Bertelsen, 2004; Vidal & Marle, 2008). Many of these dynamic features are associated to complex systems features in Lucas (2000). Building Projects are organizational and technologically complex, and this fact is related to differentiation, which refers to the number of different elements, and interdependence or degree of interrelationship between these elements (Baccarini, 1996). Interdependence has to do with the intensity of interactions and behaviours within an organization, and helps to understand how the various departments and units within an organization depend on the performance of others (Thomson, 1967). These factors argue in coordinating the process locally rather than centrally. Non-linearity is due to the dynamic and ever-changing project environment (Bertelsen, 2004). Uncertainty is associated with lack of information and risks, and is the result of an increasingly customer-oriented market, in the effort to achieve client satisfaction for the service and product offered. Ambiguity is related to the multiple and contradictory interpretations, result of the relationships within a group of people, which is linked to confusion and lack of clarity (Thiry, 2002). Speed increases every mentioned dynamic attribute. Deadline is always a restriction, and thus time is a limited resource, so solving problems and making decisions associated to Building CSM always require a quick response. All these aspects suggest dynamic processes and procedures advocating flexibility, adaptability and integration of functions and tasks based on occurring situations in an ever-changing process.

Systems approach is an enabler for developing a system-model for Building CSM, while recognizing the interdependence and cause-effect relationship between system elements. Systems theory provides a framework for understanding the best way projects have to be carried out on their environments (Walker, 2002). System thinking is a process that allows us to understand how things influence one another from a broader perspective (Flanagan, 2014). The process of Building Projects can be analysed as an adaptive open system (Walker, 2002). Construction projects are complex in nature (Bertelsen, 2003a; Bertelsen, 2003b). Complexity theory is gaining prominence as it has considerable room to give a view of the systemic nature of managing complex projects (Note & Aiello, 2014). Complex Adaptive Systems (CAS) are characterized by a large number of entities with a high level of nonlinear interaction, and they have different characteristics and multiple systemic features, such as hierarchy, interconnection, control, communication, emergency and resilience. They learn and evolve by adapting to changes, and survive in this way by processing information and building schemes based on experience (Note & Aiello, 2014). Systems' thinking allows Construction Site Managers gain a holistic view of the project during the construction phase, contributing to a more effective Building CSM, by involving client's objectives to contractor's objectives as well as the requirements of codes, standards and directives. The process of managing Building Projects can be understood as a CAS.

5. Literature review

The literature and normative review was conducted based on the framework illustrated in **Figure 4**, focused on an exhaustive previous literature and normative analysis. A number of authors, since many years ago, mentioned that current theory of PM is obsolete because of scientific inability to understand what a project really is really (Koskela, 2002). Authors like Koskela (2000), Morris (1997), Starr (1966), and Turner (1993), great scientists in the field of PM, tried to characterize a project as a process in which people/experts are involved.

Figure 3: Theoretical positioning



These experts have to perform what has been requested, to formalize when actions must be carried out, to check total cost and actual cost, and so on.

In Spain, the professional profile of Project Manager is not identified as an official building agent (LOE, 1999), although, in practice, is associated with the person representing to clients/developers. However, this association of the term is not entirely correct, as a project manager, that is, the person using the discipline of PM to manage projects, is not unique for clients/developers. A construction company, for example, requires project managers to manage their projects. In the Anglo-Saxon world, Netscher (2014) stated that, for a person who represents the contractor in managing construction projects, different names are attributed depending on countries, and even differ depending on firms; project manager, construction manager, site manager and site agent.

Fewings (2013) stated that both main contractors and sub-contractors name project manager to the person assigned to manage their contracts, when the first ones only address the construction phase and, the second ones, just a piece of work. In Spain, fortunately, the term used is *Jefe de Obra* ('Boss of the Work', literally in English) (LOE, 1999) and, thus, no reason for confusion exists, being the person assuming PM within the organisation. PM is primarily characterized as a function for the integration (CMAA, 2010) of the many disciplines it covers, thus responding to the process (meta-process), product and people involved.

PM is an effective process using in many contexts (Fewings, 2013). Academics and experts discussed the concept of PM from different points of view, as a process of integration, coordination, decision making and problem solving (Fewings, 2013), as a process with a managerial approach (Meredith & Mantel, 2012), as a method based on oriented processes similarly to traditional methods as PMBOK (2013) or UNE-ISO 21500 (2013) (Kerzner, 2006), as a process with a people-oriented approach (Morris, 1997), or as a process with a strategic approach (Stacey, 2007). Koskela & Howell (2002) stated that the current definitions of PM are obsolete, and Morris et al. (2006) suggested that there is not still a proper definition. From the foregoing, the definition is, at least, incomplete. However, PM literature review revealed three crucial aspects of PM; thinking ahead, communication, and results assessment. In the construction phase of Building Projects, there are two key elements; decision and communication, which are mandatory for project tasks for successful performance (Koskela, 2002). All of these crucial key aspects are essential for CSM.

A project has two genetic features; uniqueness, while the result is unique, regardless of the presence of repetitive elements, and temporary, in that it has a finite duration (Cleland & King, 2007; Echeverria, 2011; Guerra et al., 2009; Lewis, 1995). A project is a temporary effort undertaken to create a product, service or result (PMI, 2015a). Construction projects are very complicated businesses because of their singular features with high levels of complexity, uncertainty and uniqueness (CIOB, 2014).

Within the scope of this study, A Building Project is defined as "A set of processes, consisting of coordinated and controlled activities with starting and ending dates, which require people and other resources (capital, information, services, materials, machinery and auxiliary equipment), gathered in a temporary organization so as to meet pre-determined goals and to create a unique result (Building/s)." A Building Project is a transformation process of an investment decision into an operationally effective physical reality. And that physical reality is what should ensure profitability for construction firm business.

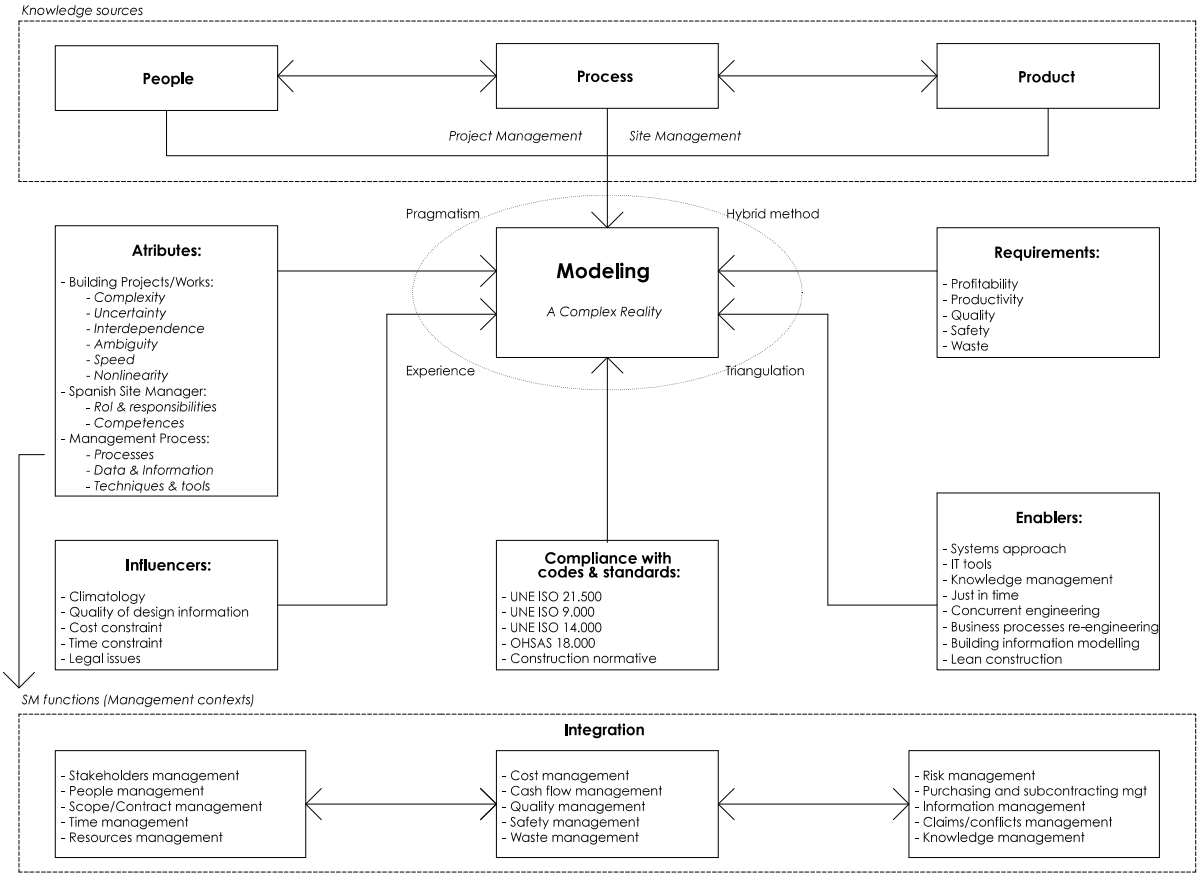
PM is the application of knowledge, skills, tools and techniques to project activities to meet product requirements (PMI, 2015b). Construction projects lend to PM because of their temporary and unique nature (Fewings, 2013). One of the most significant features of PM is that it allows "isolating" the management of a project out of the overall management of a company in order to separately manage the particular project investment and strengthening team synergy.

In this study, the term PM has a discipline approach, which integrates all necessary functions for managing the process for Building Projects. A strong relationship between the concepts of PM and Building CSM, project and building works, and project manager and Spanish Construction Site manager is suggested, perceiving PM as a multi-disciplinary management method applicable to Building Projects within GCs (SMEs).

In Spain, GCs are responsible for appointing one Construction Site Manager, becoming the person who assumes the technical representation in behalf of the contractor on site, and for assuring his/her appropriate training in terms of qualifications or experience in accordance with the characteristics and complexity of the project (LOE, 1999). Obviously, Construction Site Managers need project teams, which have to be managed with leadership and trust.

For managing the construction process of Building Projects, current Spanish Construction Site Managers require competencies in both construction technologies and PM, including technical, behavioural and contextual skills (Katz, 1955; ICB, 2006), and gaining a holistic perspective for integrating and coordinating multi-disciplinary and multi-departmental functions within and outside their enterprises. Many efforts for standardizing Construction Site Managers' functions and responsibilities have been made (CIOB, 2015). A modern Construction Site Manager should be a manager, exercising leadership and mature interpersonal skills. In Building CSM, leadership influences very significantly on profitability, since business results of a Building Project reflect the ability to lead teams of people in charge of its management (Minks & Johnston, 2011). Spanish Construction Site Managers, as project managers, have to assume responsibility, accountability and authority (Kerzner, 2006; Egbu, 1999). They are responsible for managing specific resources (capital, materials, equipment, facilities, information and personnel) as inputs in order to achieve the desired results (outputs) effectively and efficiently (Morris et al., 2006).

Figure 4: Literature and normative scheme



6. Empirical research

The empirical research has let determine the degree of maturity and knowledge in relation with the 16 management functions mentioned above (**Fig.4**) needed in the current performance carried out by Spanish Construction Site Managers, identifying the degree of formal or informal application of management processes, the degree of use and ignorance of the methods, techniques and tools proposed in the Model.

Figure 5 shows the degree of maturity of each of the 16 functions analysed through empirical research. Functions with a medium-high maturity are indicated by a blue marker; health and safety management, purchasing and subcontracting management, quality management, and information management. The functions with a medium degree of maturity correspond with the markers in orange colour; waste management, scope management, integration management, cost management, claims management, people management, time management, resources management, finance management, and knowledge management. And, finally, functions with a medium-low maturity degree are indicated by a red marker; risk management and stakeholder management.

In the literature review, 63 management processes were identified and grouped in relation to the management function with which they are related to. Respondents were asked to rate the frequency with which they are applied, formally or informally, in the management of their projects. The results indicate RAI (Relative Application Index) values between 0.61 (sometimes) and 0.55 (sometimes), being the mean value equal to 0.74 (often). Taking into account the results by groupings (management functions), the results show that the most frequently applied processes are those related to cost management (0.83), purchasing and subcontracting management (0.79), resources management (0.76), health and safety management (0.76), and time management (0.75) (**Fig.6**), and the less frequently applied processes are those related to finance management (0,69), and knowledge management (0,62).

In the literature review, 331 methods, techniques and management tools were identified, which were grouped in relation to the management function with which they are related to. Respondents were asked to rate the frequency with which they use them in the management of their projects. The results indicate RUI (Relative Use Index) values between 0.17 (never) and 0.96 (always), being the mean value equal to 0.65 (sometimes). Taking into account the results by groupings (management functions), the results show that the most frequently used methods, techniques and tools are those related to health and safety management (0.89), purchasing and subcontracting management (0.80), quality management (0.77), information and communication management (0.75) and scope management (0.69) (**Fig.7**), and the less frequently used methods, techniques and tool are those related to knowledge management (0.53), risk management (0,46), and stakeholders management (0,43).

Regarding the previous paragraph, the results indicate that the unknown methods, techniques and tools identified are between 0.00% and 39.71%, being the average value equal to 7.96%. Taking into account the results by groupings (management functions), the results show that the most unknown methods, techniques and tools are related to stakeholder management (20.89%), risk management (16.83%), finance management (14,00%), cost management (10.91%), resources management (10.33%), and time management (8.49%) (Fig.8).

One observation related to the results is the optimistic participants' perception about the use of PM processes in their management performance. In contrast, the lack of use of appropriate techniques and the high ignorance of some of them are evident in the contrasted results. Nevertheless, the overall situation analysis related to current PM maturity encourages insisting, convincing, fostering and suggesting that the possibility to formally integrate PM into Building CSM is possible nowadays.

Figure 5: Management functions Maturity (MD)

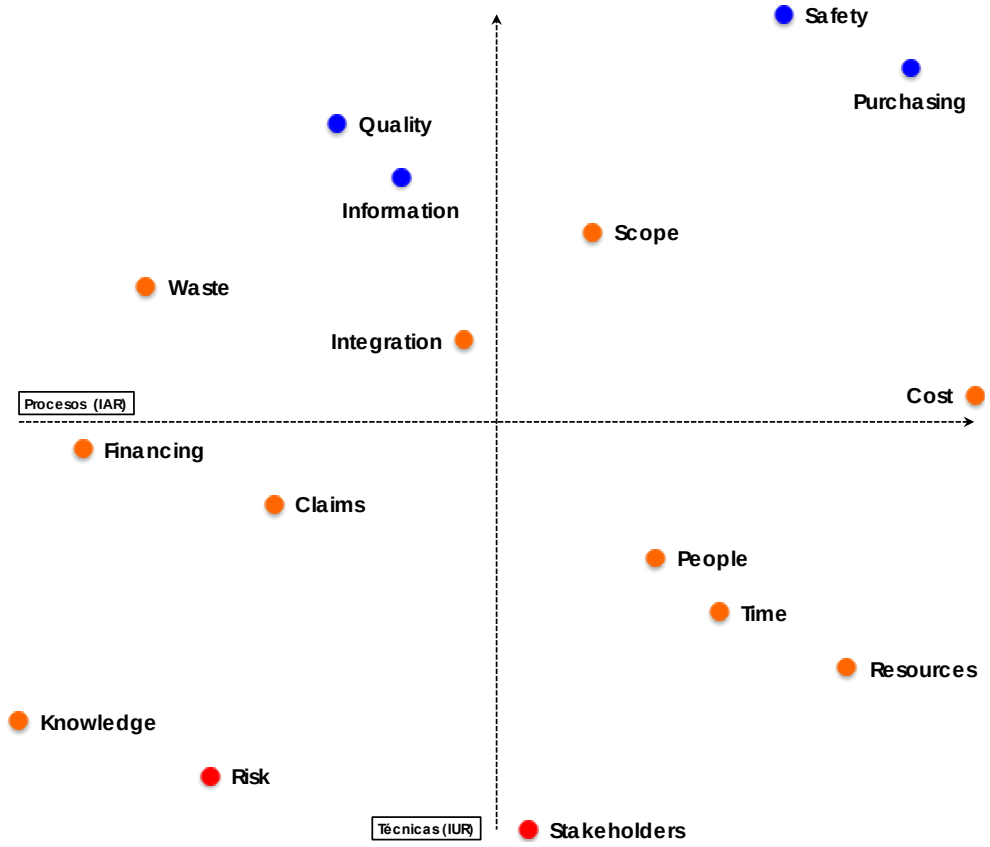


Figure 6: Processes Application (RAI)

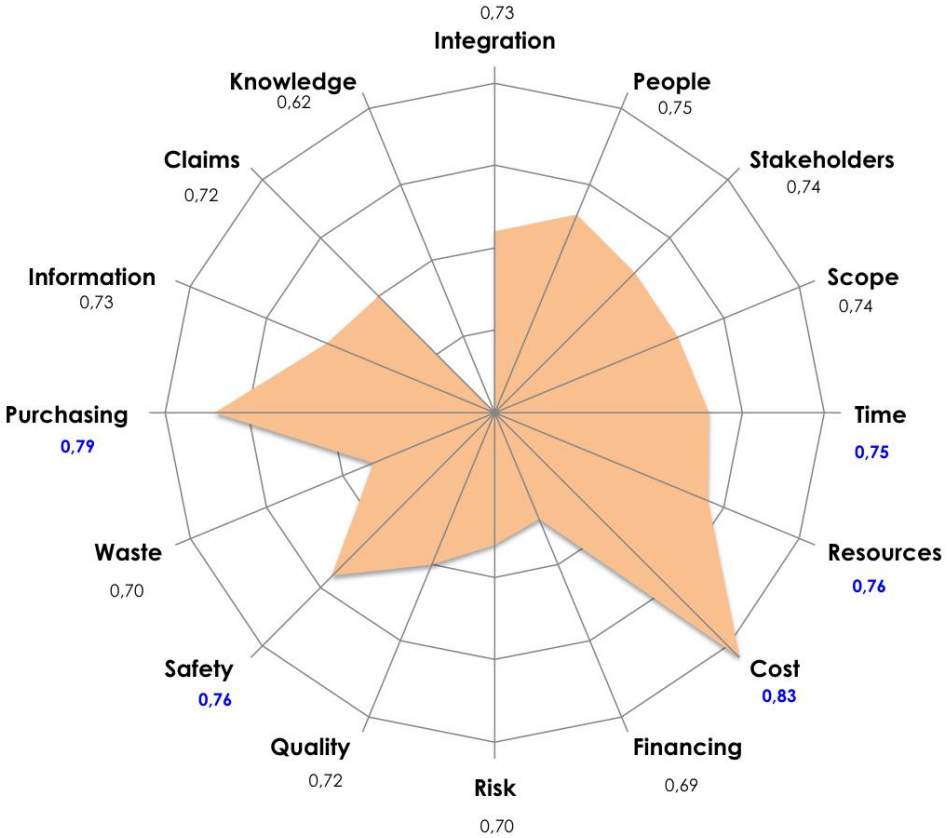


Figure 7: Techniques Use (RUI)

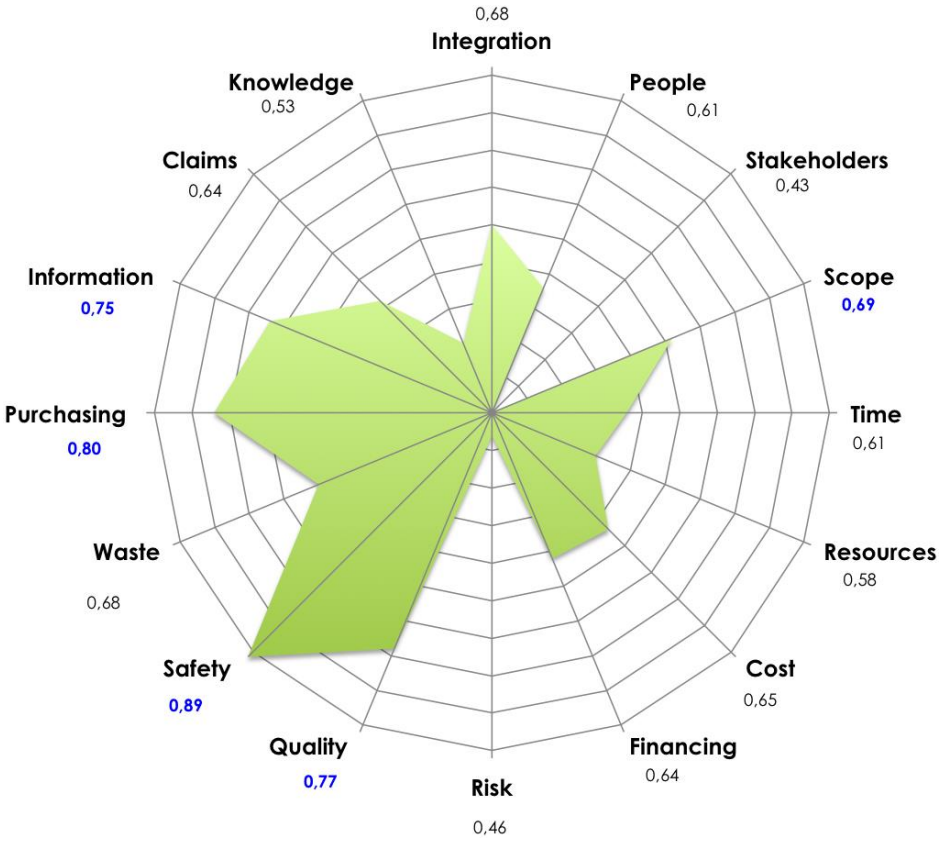
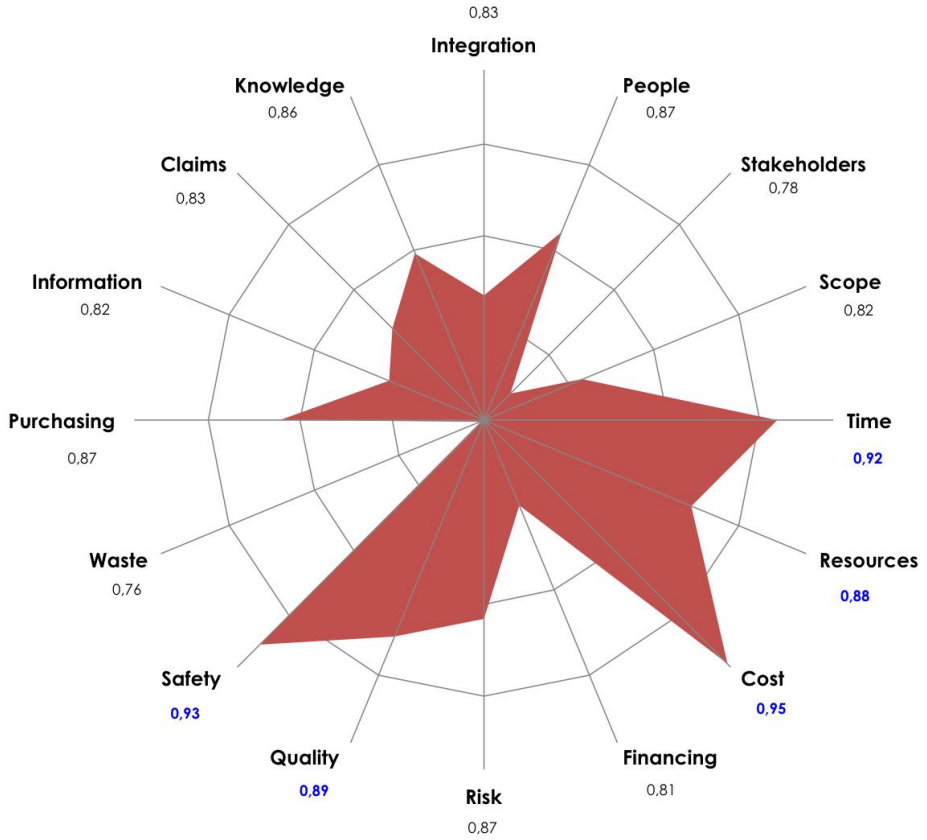


Figure 8: Techniques Ignorance (%)



7. Proposed Model

The main results of this study are two conceptual frameworks (**Fig.10 & 12**), which constitute the proposed Model, for supporting the development of a PMS and the required Building CSM knowledge and practices for GCs (SMEs) and their Construction Site Managers. The model is focused on Construction Site Managers and it intends to provide a holistic managerial approach where competences in all project complexity dimensions (technical, behavioural and contextual) impregnate the whole process on the job site.

The **first conceptual framework** (**Fig.10**) is related to project dimensions and the competence groups in relation with the current needs for Construction Site Managers for better performance in the management of Building Projects.

In the literature review, 47 competences for Spanish Construction Site Managers were identified and grouped into three categories; Interpersonal (behavioural), technological-constructive, and management (PM and General Management). Respondents were asked to rate the importance degree. The results indicate RII (Relative Importance Index) values between 0.78 (medium-high, important) and 0.94 (high, very important), being the average value equal to 0.87 (high, very important), which shows a positive agreement from respondents with all competences identified as essential in Building CSM nowadays.

As illustrated in **Figure 9**, the group of interpersonal competences (0.89) is the most highly valued by the participants, ranking first, followed by management skills (0.87), and Technological / constructive competences (0.85). The competence in first position is Knowledge in construction process - sequence of construction activities, corresponding to technological-constructive competences. In second position is the competence Ability to identify and solve problems and conflicts, corresponding to interpersonal competences; and in third position is the competence Ability to plan and schedule construction activities, corresponding to management competences.

The **second conceptual framework** (**Fig.12**) illustrates the processes needed for the effective management of Building Projects for Construction Site Managers.

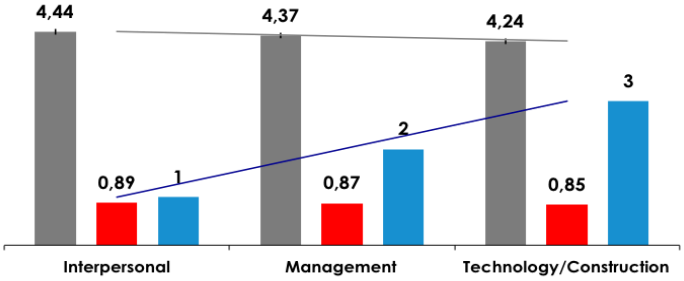
Figure 11 illustrates the model validation results. Respondents were asked to rate their degree of agreement with respect to the Model proposed in this research. The participation was 450 people; 415 participants have a 'constructor' profile and 35 have a 'non-constructor' profile. The overall valuation is 7.49 points (maximum 10), which represents the average value of a random sample whose size is equal to 450 people. The standard deviation is 1.38 points, resulting in a confidence interval at a confidence level of 95% equal to [7.37 - 7.62]. The mode and median of the data distribution are equal to 8 points.

Furthermore, five experts were asked to rate their agreement degree with respect to the Model proposed in this research. Agreement was also reached with respect to the results obtained in the survey-questionnaire and they also validated the proposed Model as a useful tool for the formal implementation of PM in Building CSM, and they also considered the Model as a good reference for the needed current competences for Construction Site Managers.

The results obtained are considered a good indicator for the Model validation, so it is considered satisfactory and a good reference for the future design of a PM System for Building CSM so as to improve the performance in the management function of Spanish Construction Site Managers.

All management functions are impregnated by methods, techniques and tools, quantitative or qualitative, which correspond to positivist or interpretative rationality. A global, holistic and integrative approach has been necessary, in which the pursuit of continuous improvement, professional excellence and client satisfaction are the benchmark of all management actions carried out by Construction Site Managers.

Figure 9: Const. Site Managers Competences: Importance (RII). Empirical results



Mean in grey; RII in red; Rank in blue.

Figure 10: Competences framework for Construction Site Managers

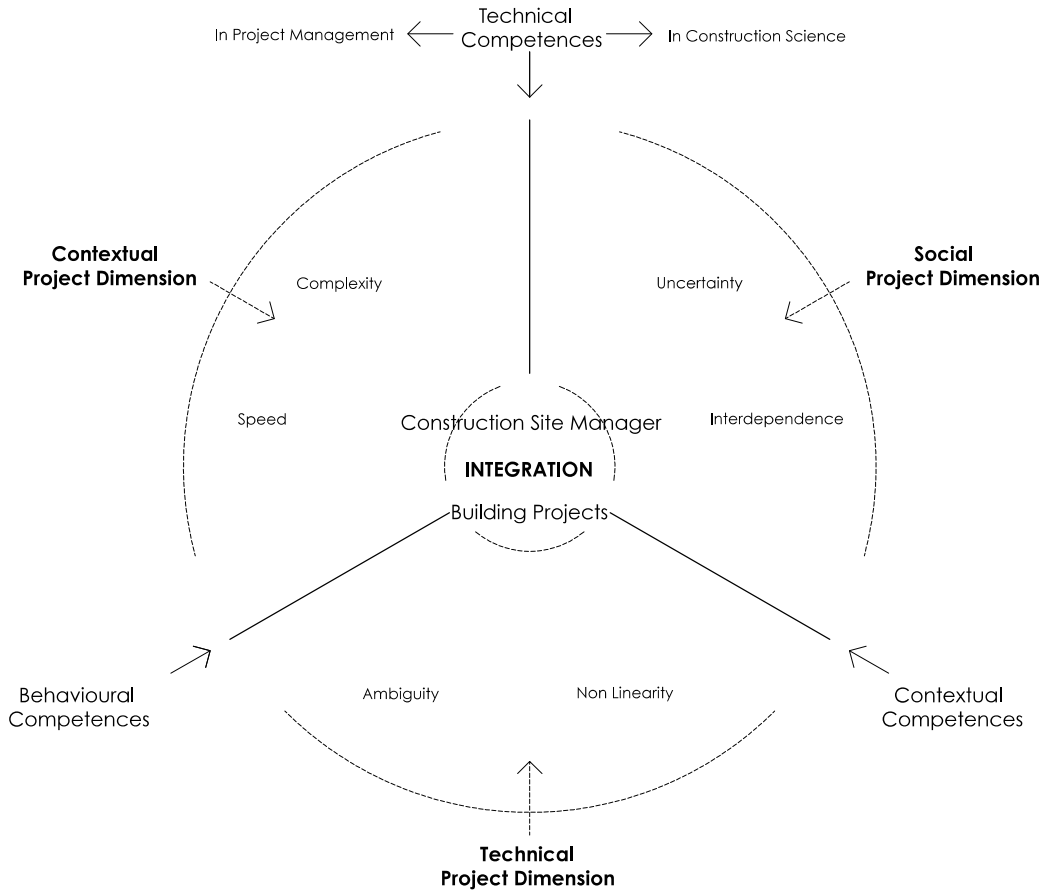
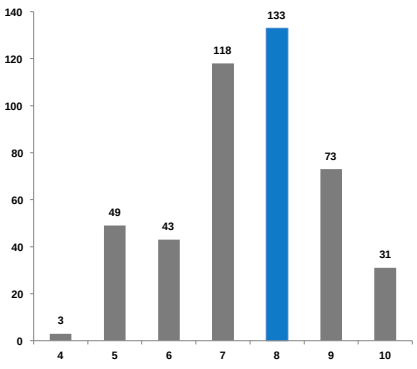


Figure 11: Model Validation: Empirical results



GENERAL		
Participantes:	450	
Puntuación:	Frecuencia:	Porcentaje:
0	0	
1	0	
2	0	
3	0	
4	3	0,67%
5	49	10,89%
6	43	9,56%
7	118	26,22%
8	133	29,56%
9	73	16,22%
10	31	6,89%
Media:	**7,49**	
Moda:	8	
Mediana:	8	
Desviación típica:	1,38	
Error típico:	6,53%	
Intervalo de confianza @ 95 %:	7,37	7,62

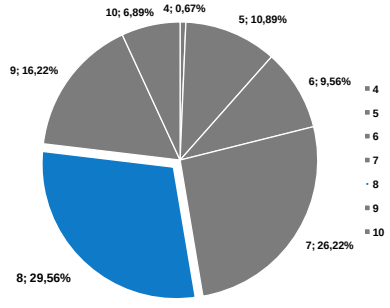


Figure 12: Process-based Matrix for Building CSM

Management Categories / Functions		Initiation (1)	Planning (2)	Implementation (3)	Control (4)	Closure (5)
1	INTEGRATION	1.1 (1)	1.2 (2)	1.3 (3)	1.4 (4) 1.5 (4)	1.6 (5)
2	People	2.1 (1) 2.2 (1)	2.3 (2)	2.4 (3)	2.5 (4)	2.6 (5)
3	Stakeholders	3.1 (1)		3.2 (3)		
4	Scope		4.1 (2) 4.2 (2) 4.3 (2)		4.4 (4) 4.5 (4)	
5	Time		5.1 (2) 5.2 (2) 5.3 (2) 5.4 (2) 5.5 (2)		5.6 (4) 5.7 (4)	
6	Resources		6.1 (2)		6.2 (4)	
7	Costs		7.1 (2) 7.2 (2)		7.3 (4)	
8	Financing		8.1 (2)		8.2 (4)	8.3 (5)
9	Risks		9.1 (2) 9.2 (2)	9.3 (3)	9.4 (4)	
10	Quality		10.1 (2)	10.2 (3)	10.3 (4)	
11	Safety		11.1 (2)	11.2 (3)	11.3 (4)	
12	Waste		12.1 (2)	12.2 (3)	12.3 (4)	
13	Purchasing		13.1 (2)	13.2 (3)	13.3 (4)	13.4 (5)
14	Information	14.1 (1)	14.2 (2)	14.3 (3)	14.4 (4)	
15	Claims		15.1 (2) 15.2 (2)		15.3 (4)	15.4 (5)
16	Knowledge		16.1 (2)	16.2 (3)	16.3 (4)	16.4 (5)

INTEGRACIÓN
1.1 (1) Charter
1.2 (2) SM plan
1.3 (3) Works management
1.4 (4) Works control
1.5 (4) Changes control
1.6 (5) Site Closure

People
2.1 (1) Site manager designation
2.2 (1) Site team assigning
2.3 (2) Site organisation
2.4 (3) Site team development
2.5 (4) Site team control
2.6 (5) Site team closure

Stakeholders
3.1 (1) Stakeholders identification
3.2 (3) Stakeholders management

Scope
4.1 (2) Scope analysis
4.2 (2) WBS creation
4.3 (2) Activities identification
4.4 (4) Scope validation
4.5 (4) Scope control

Time
5.1 (2) Activities sequencing
5.2 (2) Activities duration estimation
5.3 (2) Schedule development
5.4 (2) Weight activities identification
5.5 (2) Progress curves development
5.6 (4) Schedule control
5.7 (4) Progress monitoring

Resources
6.1 (2) Resources estimation
6.2 (4) Resources control

Costs
7.1 (2) Costs estimation
7.2 (2) Costs budget
7.3 (4) Costs control

Financing
8.1 (2) Income and expenses planning
8.2 (4) Financial control
8.3 (5) Financial closure

Risks
9.1 (2) Risks identification
9.2 (2) Risks assessment
9.3 (3) Risks treatment
9.4 (4) Risks control

Quality
10.1 (2) Quality planning
10.2 (3) Quality assurance
10.3 (4) Quality control

Safety
11.1 (2) Health and safety planning
11.2 (3) Health and safety assurance
11.3 (4) Health and safety control

Waste
12.1 (2) Waste planning
12.2 (3) Waste assurance
12.3 (4) Waste control

Purchasing
13.1 (2) Purchases planning
13.2 (3) Providers selection
13.3 (4) Contracts control
13.4 (5) Contracts closure

Information
14.1 (1) Filing drawer establishment
14.2 (2) Communications planning
14.3 (3) Information distribution
14.4 (4) Communications control

Claims
15.1 (2) Claims identification
15.2 (2) Claims quantification
15.3 (4) Claims prevention
15.4 (5) Claims resolution

Knowledge
16.1 (2) Lessons learned planning
16.2 (3) Lessons learned distribution
16.3 (4) Lessons learned utilisation
16.4 (5) Lessons learned gathering

The holistic approach aims to guide the construction of building projects towards adequate management, whose success will include not only the technical aspects on which traditional approaches are based, but also the interpersonal and contextual aspects that will make complexity management more possible.

8. Conclusions

Activity in the construction industry has a number of characteristics resulting in special features for management systems for GCs. These features refer to the construction activity itself, final product and construction process as well as special features in bidding and contracting processes and organizational structures of GCs. The previous no-structured interviews conducted with professionals made evident the need for a system-model as a reference to improve their performance in the management of their Building Projects.

Literature review shows that Building CSM is a complex reality, on the edge of chaos, whose dynamic attributes actually cause having to go to the Complexity Theory, which comes from Chaos Theory, to perceive this reality as a mystery. Systems approach, which is characterized by its holistic approach, helps the conceptualization of this phenomenon, by a modelling process, which allows achieving a satisfactory solution, neither perfect nor optimal. Building CSM can be considered a Complex Adaptive System.

The recent publication of UNE-ISO 21500 (2013) manifests the recognition of PM discipline, deeply rooted in Anglo-Saxon countries with a pathway of over 40 years. Nevertheless, like PMBOK (2013), these standards are too generic, due to their multi-industry conception, to be implemented directly to SM in building construction. In addition, specific codes for PM in construction, as CMAA (2010) and CIOB (2014), mainly with a client-oriented perspective, are also difficult to directly implement in GCs (SMEs).

A model-system for Building CSM could be materialized in a PMS for GCs (SMEs) and could be implemented in their building projects, like a new enterprise technology, with a focus on processes that might be integrated or coordinated to processes of other Enterprise Management Systems (Quality, Safety and Environment). The characteristic parameters of this proposed system-model are flexibility, adaptability and integration of processes and functions; a rigid model would not answer to such a complex phenomenon as Building CSM is. This system-model would impact in the performance of Building Projects, influencing in the critical success factors with which performance is assessed. Such a system-model would organize their processes using a PDCA cycle (plan, do, check and act), incorporating two more cycle dimensions, start and close, due to the finite duration of Building Projects, and organizing these processes by management functions (16 in total); Integration management, people (personnel) management, stakeholders management, scope management, cost management, time management, resources (materials and equipment) management, quality management, health & safety management, waste management, risk management, purchasing & subcontracting management, information & communication management, finance management, and claims management. This is a systems approach suggested by UNE-ISO 21500 (2013).

All mentioned above emphasizes the need for the current Spanish Construction Site Manager to require both competence in building construction and PM (technical, behavioural and contextual competences) in order to manage the complexity related to the dynamic context in which Building Projects are carried out. The main competence is related to interpersonal skills due to people management importance. Finally, Spanish Construction Site Managers needs PM education and training to improve their management performance.

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