# **TWENTE UNIVERSITY**

# GREENING CONSTRUCTION PROJECT MANAGERS' COMPETENCES AND PRACTICES FOR

# NEARLY-ZERO ENERGY BUILDING PROJECTS

Author

Pauline Massillon S2032899 Supervisor

Dr. Victoria Daskalova

Co-supervior

Dr. Yoram Krozer

# **TABLE OF CONTENTS**

Abstract			
List of	Tables, Figures & Abbreviations	4	
1. In	ntroduction	5	
2. Li	iterature Review		
2.1.	Competency-based approach		
2.2.	Typology of CPMs' competences: task competences & contextual competencies		
2.3.	Defining the concepts of competence, competency, & performance		
2.5.	Environmental management in the construction industry		
2.6.	Project management organizations: PMI, AIPM, APM & GPM	14	
2.7.	CPMs as change agent	17	
2.8.	Conclusion	18	
3. A	pproach & Methodology	20	
3.1.	Research approach	20	
3.2.	Liège as a case study	21	
3.3.	Research questions	22	
3.4.	Conceptual framework	22	
3.5.	Data collection & analysis	24	
3.6.	Interview sampling design	25	
3.7.	Interviews' procedures	26	
3.8.	Ethical considerations	27	
3.9.	Research limitations		
4. R	Results	28	
4.1.	NZEB Requirements	28	
4.Z.	NZEB opportunities for green CPMs	29	
4.3.	1 ne social competence domain		
	4.5.1. Project Stukenolaers management	دد 21	
	4.5.2. Corporate Social Responsibility		
	4.5.5. Theatth and sujety management		
ЛЛ	The economic competence domain		
1.1.	4 4 1 Project auality management		
	4.4.2 Project risk management		
	4.4.3. Project time management		
	4.4.4. Project cost management		
4.5.	The environmental competence domain	41	
	4.5.1. Energy management	41	
	4.5.2. Water management	42	
	4.5.3. Waste management	42	
	4.5.4. Project procurement management	43	
	4.5.5. Project logistics management	44	
<b>5. A</b>	nalysis	46	
5.1.	Validation of criteria & Interviews' results	46	
	5.1.1. The importance of green CPMs' organizational skills	46	
	5.1.2. Sustainable procurement management: green CPMs' scope for action	46	
	5.1.3. The importance of CPMs' awareness of sustainability	47	
5.2.	NZEB's or CPMs' shortcomings?	48	
5.3.	Conclusion	49	
6. Co	onclusion	51	
Refere	ences	53	
Annev	~es	56	
. minca			

# Abstract

As construction standards are increasingly getting stricter and greener, construction project managers (CPMs) are required to adapt their competences and managerial practices to meet the Nearly-Zero Energy Buildings (NZEBs) requirements. CPMs play an essential role in the realization of projects and have the potential to assume the role of change agent in the evolving construction industry. To contribute to their professional development, this thesis aims to identify the competency profile of green CPMs. Their competences are retrieved from competency frameworks of well-accepted project management organizations through a qualitative content analysis, and are in turn tested with construction experts through indepth interviews. Through a literature-based analysis and interviews, the results have shown that the competency profile of green CPMs encompasses broad knowledge and numerous managerial skills. This study can help establish a knowledge base for CPMs in order to be competitive and to proficiently execute NZEB projects.

# **List of Tables**

Table 1: Task Competences Table 2: Contextual Competencies

# **List of Figures**

Figure 1: Integrated Model of Competency and its Components Figure 2: Conceptual Model Figure 3: Core Task Competences of Project Managers Figure 4: NZEB Label Guide

# **List of Abbreviations**

AIPM	Australian Institute of Project Management
АРМ	Association for Project Management
BREEAM	Building Research Establishment Environmental Assessment Method
СРМ	Construction Project Manager
CSR	Corporate Social Responsibility
EPBD	Energy Performance of Buildings Directive
HR	Human Resources
HRM	Human Resources Management
IRR	Internal Rate of Return
IT	Information Technologies
NPV	Net Present Value
NZEB	Nearly Zero Energy Building
P5	P5 Standard for Sustainability in Project Management
PESTLE	Political Economic Social Technological Legal Environmental
РМВОК	Project Management Body of Knowledge
PMI	Project Management Institute
PRiSM	PRojects integrating Sustainable Methods
R&D	Research and Development
SDGs	Sustainable Development Goals
SPW	Service Public Wallonie

# 1. Introduction

With increasing awareness of environmental issues, there is a growing concern to mitigate the impacts of the construction sector. The European Union's (EU) shift towards sustainability requires its Members States to build new constructions with high-level energy performance. The Energy Performance of Buildings Directive (EPBD) stipulates that, by the end of 2020, all new built buildings must be Nearly-Zero Energy Buildings (NZEBs) (SPW, 2017). As a result to that, the practices and processes of the construction industry increasingly need to get greener. It is within such evolving industry that the concept of sustainability reaches the practice of project management. Projects are considered instruments of change in the achievement of sustainable processes and practices. Project managers are thus change agents having influence on the sustainability of the projects they carry out and on the organization they work for (Silvius & Schipper, 2014).

A recurring theme in the literature linking project management and sustainable development is the crucial role of the project manager towards achieving sustainability in projects (*ibid*; Turner, 2010; Tabassi et al., 2016). This emphasis derives from the correlation between project managers' performance and project outcomes (Müller & Turner, 2007). Although CPMs have no formal authority over a project, they are responsible for its complete execution (Udo & Koppensteiner, 2004). CPMs are in charge of developing a project "within the constraints of cost, schedule, quality, [environmental] and safety requirements" (Edum-Fotwe & McCaffer, 2000, p. 111). Nevertheless, both research and practice recognize the need to improve CPMs' performance in order to meet the additional EU requirements placed on the construction industry (Dainty et al., 2003). The implementation of NZEB as construction standard compels CPMs to evolve into green project managers, which implies the integration of sustainability into their competency profile and managerial practices. As CPMs are confronted with new responsibilities, their multifaceted role requires the development of new competences to ensure adequate professional development (Silvius & Schipper, 2014). Without the appropriate competences, CPMs are unable to utilize the sustainability potential of the projects they carry out. Nevertheless, the standards for project management competences fail to address the influence project managers have on the achievement of sustainability, both in organizations and projects (Silvius & Schipper, 2014). For applying sustainability principles to construction projects and organizations, it is essential that the standards for project managers' competences close the sustainability competence gap. In this context, the use of a competency framework is an effective instrument in the practice of Human Resources Management (HRM) because it contributes to a holistic understanding of the competence requirements of a profession (Ahadzie et al., 2008). Although many studies have investigated the competency profile of project managers in order to increase their performance, very few have done so in the context of sustainability and green construction.

With these points in mind, this thesis aims at resolving the existing competence gap by cross-referencing the competence frameworks of well-accepted project management organizations. With the exception of the Green Project Management organization, project management bodies do not include sustainability practices and environmental management in their guidebooks. As a result to that, CPMs lack guidance on how to evolve into green CPMs. This constitutes the sustainability competence gap that this thesis aims to close. To identify the competences that form the competency profile of green CPMs, this research crossreferences project management organizations' competency frameworks, which are in turn verified with a focus group, namely construction experts, through qualitative interviews. The objective of this thesis is to develop the competency profile of green CPMs from Liège. The key competences that project managers should possess are derived from competence frameworks of project management organizations through a qualitative content analysis. The competences identified are displayed in a comparative table and are in turn complemented with the PRojects integrating Sustainable Methods (PRiSM) advocated by the Green Project Management organization. This is done by way of addressing the central question of this research: what is competency profile of green construction project managers from Liège? Based on this analysis, the findings are validated through in-depth interviews before being applied as a case study to the CPMs of the province of Liège, Belgium. Through the case study, this research aims to contribute to the professional development of CPMs from Liège and thereby provide guidance on the incorporation of sustainability into their competency profile.

The thesis proceeds as follows. Chapter 2 discusses existing literature linked to the research topic in order to present it into a broader context. It follows with the definition of the terminologies used throughout this thesis. Next, chapter 3 introduces the qualitative methodology and approach of the conducted research. Chapter 4 presents the results of the content analysis and put them into a sustainability context. Chapter 5 presents the validation of findings through in-depth interviews as well as their application as a case study to the province of Liège, Belgium. Chapter 6 concludes and summarizes the research findings.

### 2. Literature Review

Many researchers have studied project management competence in order to identify the competency profile underlying 'superior' project managers' performance (Crawford, 2003, 2005; Dainty et al., 2003; Cheng et al., 2005; Dogbegah et al., 2011; Hwang & Ng, 2013). This subject has indeed received a lot of attention since previous studies demonstrated that project managers have significant influence over a project's success (Crawford, 2005). As a matter of fact, a company can maximize its likelihood to achieve project success by recruiting, training and retaining superior project managers. HR literature reveals that high performance companies acknowledge that their biggest assets are their employees. Cheng et al. (2005) found that most 'best practice' companies pinpoint the managerial competencies required for superior performance. This shows that the translation of job requirements into a competency-based framework helps to enhance communication of job expectations, performance and professional development (Crawford, 2005). Indeed, "competency frameworks can assist jobholders to contribute more effectively to their personal development by enabling understanding of effective performance requirements for a job role" (Cheng et al., 2005, p. 25). This thesis assumes that the inclusion of sustainability principles in the competency framework of project managers could, in turn, give CPMs the means to consider and enhance the sustainability aspects of projects. However, existing project managers' competency frameworks do not integrate sustainability (Silvius & Schipper, 2014). Standards for project managers' competences are available from world's leading professional project management organizations, which fail to address the role project managers play in promoting sustainability. While they are numerous environmental management and management organizations, this thesis puts emphasis on project management, and more precisely on construction project management. The integration of competency frameworks, other than the ones provided by project management organizations, could bring confusion because they go beyond the scope of this study, namely project managers' competences. As a result to that, the scope of the literature focuses on project management because it translates project managers' functional requirements into competences. In order to address project managers' competence shortcoming, this thesis aims to identify the competences that are necessary for CPMs to enhance the sustainability performance of projects. It does so by discussing CPMs' competency profile in a sustainability context, and such through a competency-based approach.

#### 2.1. Competency-based approach

The use of a competency-based approach is a widely accepted tool in the literature and practice of HRM because it revolves around the identification of competences that lead to high levels of performance (Dainty et al., 2004). A competency-based approach argues that a competency profile is only accurately identified when functional areas are complemented with personal characteristics. Ahadzie et al. (2008), Crawford (2003) and Dainty et al. (2004) agree that a competency profile cannot be restricted to the definition of functional areas because it fails to capture the complexity of any profession. Like the aforementioned authors, a competency-based approach adopts a typology of competences, where personal attributes support the functional areas of a profession. A competency-based approach allows a deeper understanding of the project manager's multifaceted role and the competences it entails because the complexity of the profession is reflected within the approach, and more precisely within the typology of competences (Ahadzie et al. 2008).

Although Crawford (2005) adopts a competency-based approach in her writings, she also argues there is no statistically significant evidence that support the existence of a relationship between competence standards and effective workplace performance. However, the approach is widely used both HR's theory and practice (Dainty et al., 2004; Udo & Koppensteiner 2004; Ahadzie's et al., 2008; Hwang & Ng, 2013). In contrast with Crawford's findings, Ahadzie et al. (2008, p. 642) have concluded, "the [competency-based] framework has empirical relevance for the housing sector and could thus be adopted for CPMs performance measures". Furthermore, they argue that a competency-based approach is the most appropriate method for stimulating the professional development of project managers simply because it allows the identification of competences leading to proficiency in managerial functions. Accordingly, this thesis adopts a competency-based approach because, so far, it appears as the most suitable available method to stimulate CPMs' professional change towards sustainable practices (Ahadzie et al., 2008).

#### 2.2. Typology of CPMs' competences: task competences & contextual competencies

In studying the performance of superior project managers, academics realized that a single dimension of competences, and more precisely functional areas, does not accurately capture their competency profile. That is because superior project managers distinguish themselves by going beyond their required functions (Crawford, 2005). Indeed, they are "conscious of how they manage, reflect on their actions, experiment, and in doing so, learn and develop themselves" (Dainty et al., 2004, p. 878). Accordingly, it is necessary to distinguish personal

attributes from the knowledge and skills required for a profession in order to gain a holistic understanding of a competency profile. In an attempt to conceptualize project managers' competences beyond the restrictive and commonly emphasized project administrative skills, various studies have adopted a typology of competences as advocated in Borman and Motowildo's well-accepted organizational psychology theory of job performance (Dainty et al., 2004; Cheng et al., 2005; Hwang & Ng, 2012; Ahadzie et al., 2008). Through their theory, they argue that the conception of job performance is multidimensional and requires a distinction between task and contextual competences (Motowidlo & Van Scotter, 1994). In doing so, they have significantly advanced the conceptual understanding of performance and competences. Indeed, the competency-based framework has become a well-accepted approach in HRM for developing a holistic and multidimensional understanding of a profession's competency profile (Ahadzie et al. 2008). Moreover, the use of a typology of competences is widespread in the practice of HRM because it has the potential to enhance professional development and stimulate professional change (Dogbegah et al., 2011). Therefore, a task and contextual typology of competences is also applied throughout this research with the aim of steering CPMs' professional change towards sustainable practices.

*Task competences* are job specific and refer to the technical and managerial functions that form CPM's profession, such as planning, communicating, supervising and controlling. In brief, *task* competences relate to a job description (Dainty et al., 2004). CPMs' *task* competences are thus specific to project management and the construction industry. Ahadzie et al. (2008) indicate that task competences vary from one person to another according to cognitive ability, job knowledge, task proficiency, and experience.

In contrast, *contextual competencies* are not formally part of the job but are "discretionary job-related acts [that informally] contribute to organizational effectiveness" (p. 633). Contextual competencies are personality-oriented and refer to personal attributes and soft skills such as commitment, determination, professionalism and work ethic. Contextual competencies support the organizational and social environment in which the technical functions operate. Due to their generic nature, they are not role-prescribed. Instead, contextual competencies are common to most professions and are not explicitly part of the formal responsibilities of a job (Dogbegah et al., 2011). They vary from one person to another according to job dedication and interpersonal facilitation. Contextual competencies are thus of generic nature, whereas task competences are peculiar to CPMs but could be adapted to other project-based sectors (Dainty et al., 2004).

A typology of competences also contributes to the understanding of CPMs' competency profile in the context of sustainability. The consideration of sustainability aspects in the management of construction projects requires CPMs to go beyond their task competences. Given that the traditional and current management approach of construction projects does not yet encompass the management of sustainability aspects, it is yet not part of CPMs' job responsibilities or task competences. To consider the sustainable performance of a project, even though it is not included in CPMs' job description, implies going beyond minimum professional requirements, and thus their task competences. This shows once more that a single dimension of competence does not capture the full extent of a competency profile. The consideration of sustainability in projects can only be appropriately achieved with contextual competencies. Indeed, the practice of green project management requires commitment, resourcefulness as well as leadership (GPM, 2013). For instance, green CPMs are expected to inspire colleagues to motivate them to adopt sustainable practices. To do so, they should show cooperation and mentoring skills. Moreover, the sustainability aspect of a construction project is one that must be considered at the inception, as well as throughout the whole duration of the project realization. This means that green CPMs should bear in mind sustainability during all phases and decisions, which can only be achieved through commitment and dedication (GPM, 2013). Therefore, the competency profile of green CPMs must depict a typology of competences; otherwise the profile would be flawed and incomplete. Scholars have found evidence that, like task competences, contextual competencies contribute to job performance. Patterns of behaviors, outside formal job requirements, strengthen performance and profitability. There is indeed recognition that contextual competencies improve the effectiveness of teamwork and organizations as a whole (Motowidlo & Van Scotter, 1994). Accordingly, this research adopts a task and contextual typology of competences in order to offer a comprehensive understanding of green CPMs' multifaceted competency profile.

#### 2.3. Defining the concepts of competence, competency, & performance

Adopting a competency-based approach requires a precise understanding of the concepts of competence and competency, especially that they are often used indiscriminately. Although their common use is rather similar, researchers have highlighted the conceptual distinction between the two terms. *Competence* is a work-related concept that refers to a person's ability to undertake an action. In brief, competence relates to functional areas, and more precisely, to a person's ability to comply with a series of task requirements (Dainty et al.,

2004). Hence this research refers to task competences to depict the functional requirements of green CPMs. In contrast, *competency* is a person-related concept that refers to innate characteristics. Competency relates to personal attributes and interpersonal skills such as integrity, motivation and good judgment (Ahadzie et al. 2008). According to Prahalad and Hamel (1994), competency is the ability to combine resources. Competency is distinguished by the fact that it is hardly imitable and that it constitutes a precious competitive advantage. Hence, competency is considered a key factor for the success of a company. Accordingly, Prahalad and Hamel (1994) argue that the identification of a competency profile facilitates collective learning across a company. The skills that form a competency profile should thus be considered as a unifying principle for an organization and should help it to exploit resources in the most efficient way, which goes hand in hand with a green project management approach. It is important to clearly understand the concepts of competence and competency because they reflect the task and contextual typology necessary to identify the competency profile of green CPMs.



Figure 1: Integrated Model of Competency and its Components

Given that the use of the term *performance* is deeply rooted in the practice of project management and HRM, it is important to define it as well. Traditionally, performance means the result of actions and refers to the efficiency a person, organization or system. Recently the term has also been associated with managerial attributes such as quality, productivity and profitability (Ahadzie et al., 2008). In this research, performance refers to CPMs' ability to apply their competences throughout management processes and the realization of projects. Accordingly, the competences of green CPMs support effective and sustainable project management performance. In this research, sustainable performance refers to the harmonization of the environmental, social and financial aspects in the realization of a construction project. Similarly, sustainability competences refer to the set of skills that contribute to enhancing the sustainable performance of construction projects.

#### 2.4. Defining project management & green project management

According to the Project Management Institute (PMI, 2017), world's leading professional project management body, "project management is the application of knowledge, skills, tools, and techniques to a broad range of activities in order to meet the requirements of a particular project." On the other hand, green project management aims to incorporate environmental aspects into every project management processes (Krasnoff, 2010). The green project management approach embraces current working practices and supplements them with a method that aligns international standards, organizational goals, and ethics (GPM, 2013). Andrea Krasnoff, who coined the concept of green project management, argues that the approach is still in its infancy (Krasnoff, 2010). He also explains that the objective of green project management is to take the environment into account throughout projects' lifecycle and managerial processes (Krasnoff, 2010). The approach is based on PRiSM, the sustainability based project delivery method to manage the balance between finite resources, corporate social responsibility (CSR), and delivering 'green' project outcomes (GPM, 2013). Accordingly, "the green project manager embodies the commitment to act as an agent of change by managing and directing efforts to maximize sustainability within the project life cycle, improving the construct and delivery of goods and services produced as a project deliverable" (p. 21).

To put CPMs' competences in the context of green project management requires CPMs to develop sustainability literacy to enhance the environmental performance of construction projects. Sustainability literacy refers to the ability to juggle environmental priorities while complying with construction norms and making profit (GPM, 2014). As discussed in the results chapter below, the practice of green project management goes beyond the management of environmental-related impacts. Thus, green project management cannot be restricted to environmental or sustainability-related knowledge, such as energy, water and waste management. These areas of knowledge require deep scientific knowledge, including but not limited to the physics of building, the functioning of energy and water systems, and chemistry for handling waste. On top of developing environmental-related and scientific knowledge, to embrace a green project management approach, CPMs must 'green' their current managerial practices (GPM, 2013). As a matter of fact, each area of knowledge

of construction project management, whether it is cost, stakeholder, cost or risk management, can be complemented with sustainable thinking, which refers to an ethically driven approach where innovative reasoning is combined with analytical and decision-making skills (GPM, 2013). Therefore, the practice of green project management can be understood as the application of sustainable thinking to CPMs' task competences. This research aims to green CPMs' current working practices in order to give them the means to enhance the sustainability performance of construction projects. To do so, this thesis cross-references the competency frameworks of four project management organizations with the aim of establishing an integrated competency profile of CPMs. This established profile is in turn discussed and tested with construction experts from Liège.

As stated in the literature, the consideration of sustainability in the realization of projects is too often seen as a burden that requires extra costs and efforts (Hwang & Ng, 2012). It appears that CPMs they are not aware of the opportunities and benefits the practice of green project management has the potential to bring to construction projects and companies. For the practice of green project management to thrive, such a state of mind has to be overcome through increased awareness, for instance.

#### 2.5. Environmental management in the construction industry

Increased awareness of environmental issues puts pressure on industries to improve their environmental standards. On the one hand, national and international legislation is becoming increasingly stringent. On the other hand, citizens are becoming increasingly intolerant to environmentally unsound practices. This is especially true in the construction industry where companies can no longer ignore the environmental aspect of projects. To monitor, control and mitigate the environmental-related impacts of construction projects, companies and CPMs use an environmental management framework (Griffith, 2000). Environmental management is a tool and framework for saving non-renewable resources and reducing environmental impacts. It is highly relevant to the construction industry and its largest end product, buildings, given that they have considerable impact on the environment. The mitigation of impacts through environmental management is an inherent part of green construction project management. When establishing an environmental management system, companies seek to identify the environmental outcomes desired, the Political Economic Social Technological Legal Environmental (PESTLE) obstacles for achieving those outcomes and the most feasible options to do so (Griffith, 2000). However, environmental management does not fit in the traditional iron triangle paradigm. As Griffith (2000) argues, the establishment of an environmental system requires a change in perspective, procedures, practices and thus competences. It can be assumed that it also requires an adaptation of competences.

#### 2.6. Project management organizations: PMI, AIPM, APM & GPM

The competency profile of green CPMs is derived from the competency frameworks of the following project management organizations: the PMI, the Australian Institute of Project Management (AIPM), the Association for Project Management (APM), and the Green Project Management. The PMI, the AIPM and the APM provide the competency profile of project managers, whereas the Green Project Management provides guidebooks for green project managers. These sources are essential to this thesis because they constitute the main secondary sources on which this research is based. Indeed, the task and contextual competences included in the comparative tables on pages 31 & 32 derive from these organizations' competency frameworks with the aim of establishing the competency profile of green CPMs. In the section below, the PMI, the AIPM and the APM organizations and their guidebooks are further described.

Globally and academically recognized as the leading project management body, the PMI is composed of dozens of chapters worldwide with nearly 3 million people subscribed to the PMI membership (PMI, 2018). Its guidebook, titled the Project Management Body of Knowledge (PMBOK guide), is the most widely used in the practice of project management. The 2017 edition is the main reference to understand the competence requirements in the field of project management. Through the PMBOK guide, the PMI provides the terminologies, best practices, guidelines, standards as well as a code of ethics for the project management industry (PMI, 2017). The PMBOK guide contains an entire chapter dedicated to the project manager's role, knowledge and skills that revolve around the nine core competences, namely: integration, scope, time, cost, quality, communications, risk, procurement and human resources, as seen in Figure 3 below (PMI, 2017). The PMBOK guide is a thorough book of knowledge, so influential that its structure is reflected in other project management organizations' guides. This thesis also draws upon its structure by reproducing its nine core task competences' framework (see Figure 3) to avoid repetition in the comparative tables. The generic task competences are grouped according to nine core competences around which the project manager's role, knowledge and skills revolve (PMI, 2017). The nine core task competences are essential for managing construction projects, regardless of their types. This also shows that the selected project management organizations share a common line of thought.



Figure 3: Core Task Competences of Project Managers Source: PMI (2017)

The AIPM is the largest Australian project management institute. The Professional Competency Standards for Project Management is "the first performance based competency standards for generic project management to be endorsed by a national government" (Crawford, 2005, p. 10). The AIPM's competence guidebook revolves around the nine core competences presented in the PMBOK. Within each competence unit, the guidebook defines the competence and its associated performance criteria. It follows by underpinning the knowledge and skills relating to a specific core competence (AIPM, 2010).

The third project management organization used in this thesis is the APM, the British *Chartered Body for the Project Profession.* The APM is the biggest project management body of Europe (APM, n.d. para 2). The APM Competence Framework sets out 27 competences that project professionals are required to quire for an effective practice of project management. Each competence is composed of a series of criteria covering knowledge and its application. The APM Competence Framework "aims to reflect both current good practice and the future needs of the profession, and provides a common benchmark for all individuals and organizations engaged in project activities" (APM, 2010). Its structure does not mirror the one of the PMI's guidebook but integrates it instead by blending it in. The core task competences are indeed comprised within the 27 competences of the APM framework.

Like this research, the APM Competence Framework establishes an extensive list of competences and suggests using this framework in accordance to specific needs and objectives. It is meant to help project managers to promote professional and organization development (APM, 2010).

These three project management organizations cover a different geographic market but target the same audience, namely project management professionals. Whereas the APM covers the British market, the AIPM covers the Australian one. The PMI is recognized as the umbrella and benchmark organization (Crawford, 2010). The inclusion of organizations that target a different geographic market but the same audience contributes to a holistic understanding of the research topic. The three organizations were chosen among hundreds of project management organizations because they are the most influential in the domain of project management (Ahadzie et al. 2008; Hwang & Ng, 2012; Silvius & Schipper, 2014). Although the PMI's, the AIPM's and the APM's competency guides do not address nor mention the importance of sustainability when managing projects, they are relevant to this study because they are the leading references in project management and competence standards. Their competence guidebooks emphasize the best practices for project management in order to contribute to managerial proficiency. They are thus included in this study in order to subsequently include sustainability in the practices they promote.

In contrast with the PMI AIPM and APM, the Green Project Management's standards stress the best practices for sustainable project management. These best practices include financial elements accommodating for sustainability-based decision, and social and environmental practices addressing positive and negative projects' impacts. Whereas the other leading organizations do not address the importance of sustainability for managing projects, the green project management is entirely dedicated to it. The Green Project Management organization advocates sustainable managerial practices two books of knowledge for green project managers. The standards derive from the 17 Sustainable Development Goals (SDGs) through a value-based approach and a series of ISO standards, including ISO 21500, ISO 14001, ISO 26000, ISO 50001, and ISO 9001 (GPM 2013; 2014). Although recently awarded for its innovative approach, the Green Project Management is not as renowned as the other organizations used in this research. It is nonetheless the only existing project management organization with a focus on sustainability. The approach embraces current managerial practices and supplements them with a sustainable emphasis. The inclusion of environmental standards through project management processes has lead to the emergence of the practice of green project management (Krasnoff, 2010). Therefore, the competency frameworks of the PMI, AIPM and APM are used to retrieve the competences that form the competency profile of CPMs, whereas the Green Project Management provides the sustainability context that CPMs need in order to evolve into green CPMs. This thesis argues that CPMs from Liège can benefit from this emerging discipline by including sustainability-related aspects in their competency profile.

There exist other environmental management institutes, such as the Institute of Environmental Management and Assessment and the Chartered Institute of Ecology and Environmental Management. However, these organizations and their competency frameworks have a weak emphasis on project management. Indeed, the task competences emphasize areas that do not relate to CPMs, such as species, habitat and livestock management. As a result to that, this research uses the competency frameworks of project management organizations because they are the most relevant and compatible with the research topic.

There is also the Building Research Establishment Environmental Assessment Method, better known as BREEAM, which is expert in the sustainable management of buildings. BREEAM is however very costly, whether it is the application of its standards or the procurement of its certificates and guidebooks, which are not available free of charge. Due to such constraints, the competency framework of BREEAM's sustainability champion could not be included in this research.

#### 2.7. CPMs as change agent

The realization of projects always instigates change. As CPMs are vital for carrying out projects, they are at the center of this change (Hwang & Ng, 2012). Indeed, CPMs have a frontline role in the realization of projects with numerous and diverse responsibilities to fulfill. Accordingly, project managers are change agents in the organization they work for and projects they realize. In order to undertake such role of change agent, CPMs must understand the impact change can have on the company they work for and employees. By acknowledging how the company can respond to the changes brought by projects, project managers are aware of the changes and the impacts they can induce in order to help orchestrate them. Similarly, green CPMs have the potential to act as change agents by managing and directing efforts to maximize the sustainability performance during a project development life cycle (Silvius & Schipper, 2014).

#### 2.8. Conclusion

There has been a growing emphasis, both within research and practice, that CPMs need to adapt their competences in order to accurately deal with the increasing prioritization of sustainability (Hwang & Ng, 2013). Up until now, the EPBD legislation only takes the energy performance of a construction project into account. As a result to that, CPMs concentrate on energy management and tend to disregard other environmental-related aspects such as logistics, procurement and CSR. Nevertheless, the implementation of NZEB as construction standard throughout Europe calls for CPMs to supplement their current professional practices with more sustainable ones. At the present time, the integration of sustainability principles into the management of construction projects could be further enhanced (SPW, 2017). The construction industry is evolving and within such changing environment, CPMs' competences and practices need to be adapted because CPMs find themselves confronted with new environmental responsibilities that require to complement existing competences with sustainable practices (Silvius & Schipper, 2014). The studies linking project management and sustainability all recognize that project managers are important change agents for the achievement of more sustainable processes and practices (Hwang & Ng, 2011; Silvius & Schipper, 2014). They argue that the project manager is an efficient vehicle for inducing change, not only to the construction sector, but also to other project-based industries. Its multifaceted and frontline role gives the project manager a great position to influence organizations' activities towards sustainability.

On the one hand, competence is unanimously seen as a key success factor for a company (Ahadzie et al. 2008). On the other hand, CPMs are vital to the realization of a project and its success (Hwang & Ng, 2013). In order to implement sustainability in the realization of NZEB projects, it is essential to identify and understand the knowledge and skills required for CPMs to achieve this. However, Silvius & Schipper (2014), argue that they lack guidance and directions to do so. Indeed, The literature review has revealed that the study of project managers' competences in a sustainability context is innovative and understudied. In addition to that, the review of the competency frameworks of leading project management organizations has revealed that their standards fail to address the sustainability agenda (Silvius & Schipper, 2014). These organizations, namely the PMI, APM and AIPM, provide competence standards and certifications that translate project management proficiency. Silvius & Schipper (2014) have studied the coverage of sustainability in the competence frameworks of project management organizations and have concluded that they fail to address the enabling role of projects in sustainability. They argue,

"we cannot rely on these standards for project management competencies for the development of project managers in their role in implementing sustainability in organizations" (p. 52). This does not mean that these organizations have to be disregarded, but simply that they cannot be used to induce sustainable thinking to project managers. As a result to that, the Green Project Management guides and related literature are used to complement the competency frameworks of the PMI, APM and AIPM with sustainable practices. This is feasible because the four selected project management organizations share a similar framework based on a competency-based approach. The Green Project Management embraces current working practices promoted by the PMI, APM and AIPM but does not accept them at face value. Rather, it highlights how to green current project management practices, such as quality, cost and stakeholder management, with the aim of enabling project managers to enhance the sustainability performance of the projects they carry out. The two guidebooks of the Green Project Management are the only available sources linking competences to sustainability and project management. They are essential to this research because they address the competences gap by complementing the project manager's competency profile advocated by the other project management organizations. The competences gap refers to the competences and scientific knowledge that CPMs have to develop, such as waste and environmental management. It also includes competences that must be complemented with a sustainable context, such as procurement and quality management.

The green project management literature and literature linking sustainability and project management agree on the need to develop technical knowledge for increasing the sustainable performance of projects. However, such literature does not consider the importance of the mindset and values for CPMs to undertake change. The literature assumes knowledge and competences can be extended without prerequisite. However, the interviewees repeatedly stated how important it is for CPMs to clearly understand why they should challenge business as usual mindset and practices before acquiring technical and scientific knowledge to do so. It is only through awareness, values, and commitment that CPMs' technical core can be embedded with sustainability practices.

## 3. Approach & Methodology

#### **3.1. Research approach**

This research aims to identify the competences that form the competency profile of green CPMs from Liège. This research is of qualitative nature because it attempts to develop an expanded view of the research topic by cross-referencing competency frameworks with the aim of subsequently testing the findings and interpreting them. This qualitative study takes the form of a theory testing research where the competency profile of green CPMs is tested as a case study to the province of Liège with construction experts. The objective is to provide guidance to CPMs on how to include sustainability in their practices and to identify eventual factor that could hinder it. In view of the implementation of the strict NZEB construction standard, CPMs are called to integrate sustainability principles into their competency profile. Construction experts recognize that CPMs lack knowledge and expertise to manage the sustainability performance of projects. This research attempts to contribute to the professional development of CPMs towards sustainability by giving them guidance on how to close this gap.

To do so, this research first identifies the task competences that project managers need to carry out their professional responsibilities. CPMs' task competences refer to their functional requirements such as stakeholders, risk and quality management, etc. Second, it identifies the contextual competencies, or to put it differently, the dispositions that can contribute to professional proficiency. Contextual competencies refer to the personal characteristics and attributes that CPMs add to those functional requirements, such as integrity, initiative, teamwork, etc. Emphasis is put on the task competences in order to promote sustainable practices of construction project management. It is by applying their functional competences that CPMs have the potential to enhance the sustainability performance of a project. CPMs must thus clearly understand the benefits of adopting a green project management approach to dedicate it their technical core. Contextual competencies also contribute to the environmental performance of projects, through dedication and commitment for instance. However, they cannot be put in a sustainability context because they refer to innate and personal attributes.

Both task and contextual competences are retrieved from project management organizations' competency frameworks through a qualitative content analysis. The qualitative content analysis aims at effectively retrieving the important aspects, namely competences, from the project management organizations' competency frameworks. The identified competences are in turn presented into comparative tables in order to give an overview of the findings of the content analysis (see results section). The two tables depict the competency profile of green CPMs. The point of this thesis is not to invent new project management processes but rather, to include green practices into existing competences. Project managers' competences include, among others, stakeholders, procurement, risk, quality, time, cost, and health and safety management. The competency profile of project managers is complemented with sustainability principles by cross-referencing the competency frameworks of the different project management organizations. It is subsequently corroborated with interview data collected with construction experts of Liège. The nature of this study is thus rather descriptive at first. The research follows with an analysis by testing the application and validity of the competency profile of green CPMs to the province of Liège. This research aims to further increase the reliability of the literaturebased analysis by testing the competency profile of green CPMs through the conduction of in-depth interviews with construction experts from Liège, Belgium.

#### 3.2. Liège as a case study

The province of Liège was chosen as case study for several reasons. Firstly, the energy performance of the housing stock in Liège is relatively low compared to other major Belgian cities (SPW, 2017). Moreover, the average energy performance of buildings in Belgium is already lower compared to the EU average (SPW, 2017). With the capital of the EU located in Brussels, Belgium should, as much as possible, act as a model for the compliance of EU requirements, including construction norms. In 2017, only one building out of fifteen met the future NZEB construction requirements, which come into force in 2019 for public buildings and 2021 for residential ones (SPW, 2017). If Belgium is to meet its environmental requirements, efforts have to be undertaken, especially in the construction sector because it is one of the top energy and material-consuming sector. As a matter of fact, the construction industry is also amongst the most polluting sector (SPW, 2017). On top of that, the population in Liège is increasing whereas the household size is decreasing due to population ageing and the rise in the number of single-parent families (Alliance Emploi-environnement, 2017). As a result to that, the Walloon housing park keeps on expanding and developing. However, one third of the housing park, including public buildings, is energy intensive. Given that CPMs hold significant influence on the projects they carry out and have the potential to be vehicle of change, complementing their competency profile with sustainability principles could lead to enhanced sustainability performance of projects. Ideally, the identified competency profile could also guide the Walloon Region to develop adequate practical trainings for CPMs to evolve into green project managers.

Next, Liège shares common characteristics with other medium-sized European cities and provinces, such as Aachen, Germany or the provinces of Namur and Hainaut, Belgium. These cities have similar population size, geographic characteristics. Alike many regions in Europe, the province of Liège is in expansion due to demographic increase and the advanced age of its housing stock. Therefore, the results of this research and case study offer possibilities to extrapolate the findings to other cities with similar characteristics and construction trends.

#### 3.3. Research questions

This research aims to answer the following question: *what is the competency profile of green construction project managers from Liège?* This central question is broken down and addressed through two sub-questions. First, what is the competency profile of green project managers according to the competency frameworks of project management organizations? Second, how does the identified competency profile fit for construction project managers of Liège? By addressing these sub-questions, enough knowledge will be gathered to conclude what are the competences that form the competency profile of green construction project managers from the province of Liège.

#### 3.4. Conceptual framework

The structure of this research follows the one of the conceptual model presented below, which comprises four sections (see Figure 2). Starting from the left, the first section reviews the literature in order to place the research topic in a broader academic context. Moreover, it has identified a sustainability gap in the competency frameworks of renowned project management organizations. As a result to that, this research aims to close this gap by completing available competency frameworks with sustainable practices promoted by the Green Project Management organization. In the second section, namely the results, CPMs' competences are identified before being listed into tables based on the findings of the first section. The tables reflect a competency-approach as well as the task-contextual typology of competences adopted throughout the thesis. The tables aim to offer a comparative overview of the project managers' competency frameworks promoted by the four different project management organizations, namely the PMI, the AIPM, the APM and the Green Project

Management. The tables do not depict a competence checklist for green CPMs. Instead, the elaboration of an extensive competences list gives CPMs the opportunity to focus on a specific set they should or wish to further develop. They allow placing greater emphasis on the competences that are repeatedly stated in the different competency frameworks, such as the core areas of knowledge (see Figure 3). The tables yield the competency profile of CPMs, which is subsequently complemented with a sustainability context advocated by the Green Project Management organization. In addition to that, the potential benefits of including sustainability principles in each competence are stated. The competences are grouped according to the three sustainability pillars, namely social, economic and environmental as promoted by the Green Project Management. It does so, because for project managers to evolve into green managers, they must complement their existing competency profile with sustainability principles. Grouping competences according to the sustainability pillars allows doing so without giving less emphasis to the competences that are not part of the environmental dimension.



Figure 2: Conceptual Model

For the validation of criteria, interviews have been conducted with construction experts from Liège to test the applicability of green CPMs' competency profile. The interviews have yielded the information necessary to understand how the competency profile of green CPMs, developed in the previous section, fits CPMs from the province of Liège, Belgium. They have revealed that CPMs from Liège clearly lack awareness and understanding of sustainable construction project management practices and their benefits, which makes it more difficult to them to evolve into green CPMs. By explaining the context in which CPMs of Liège have to work and evolve in, the interviewees have contributed to understanding how the identified competency profile applies to CPMs from Liège. More importantly, the interviews' respondents have emphasized the competences they consider as particularly relevant to CPMs from Liège. Moreover, they contribute to a further understanding of the interaction between the typology of competences. The interviews have contributed to highlighting the gap between what the literature reveals and the complex reality experienced by CPMs.

#### 3.5. Data collection & analysis

The problem analysis depends both on secondary and primary sources. Secondary sources, and more precisely the competency frameworks of the PMI, APM and AIPM, provide insight into the competences that project managers need to carry out a construction project. The same applies for the Green Project Management handbooks, which provide insight into the practices green project managers should apply. By cross-referencing the competences included in the competency frameworks of these different project management organizations, this research aims to establish the competency profile of green CPMs. Crossreferencing data sources involve using different sources of information in order to increase the validity of the study's findings. This research applies such method with the objective of identifying the common and different patterns among the competency frameworks in order to draw conclusions and formulate recommendations for CPMs to move toward green project management. Related literature that links project management and sustainability also contributes to this research. As the Green Project Management organization is the only available source that discusses the practice of green project management through a competency-based approach, this research further cross-verify its findings through primary data, and more precisely qualitative interviews with construction experts from Liège.

In this paragraph, the primary data that contributed to this research, namely the five interviewees are presented. Pierre Biemar is an architect, specialized in industrial buildings. He often works with the BREEAM certification system. David Humblet is an architect of residential buildings who attempts to include sustainable practices in his projects as much as he can, even though it mainly depends on the client's priorities. Mr. Biemar and Mr. Humblet work with CPMs during the realization of their construction projects. Bruno Busch is a construction engineer that works on a great range of projects, including civil engineering and residential projects. He works on a daily basis with CPMs. Nelson Moore is a CPM that works on tertiary buildings. He is not as familiar with the green project management approach and the NZEB requirements than the other interviewees. During the interview, he

explicitly stated that at the present time, he would not capable of managing NZEB projects. Lastly, Catherine Soreille is a green CPM. The organization she works for is specialized in the realization of green buildings and neighborhoods. She distinguishes herself from traditional CPMs by the sustainability principles she systematically adopts when managing construction projects. The maximization of the sustainable performance of projects is an inherent part of her functional requirements. For each decision she takes she has to bear in mind the sustainability performance of the project, measure the tradeoffs and benefits of all available options.

With the exception that the architects and the construction engineer were asked questions about CPMs' whereas CPMs were asked to evaluate themselves. According to their profession, the respondents had quite different answer patterns, which turned the interviews into fruitful conversations. Interview respondents were asked whether they are familiar with NZEB construction norms, if they would be able to realize construction projects that meet NZEB norms, the competences they could improve and to identify external factors necessary for the proper realization of NZEB projects. On top of that, the respondents were asked to validate the identified competences that constitute the competency profile of green CPM. All the respondents systematically pointed out the shortcomings of the NZEB legislation. In their view, the legislation sometimes acts as a break to CPMs' consideration of sustainability-related aspects of projects. One of the interviewee stated that he regrets NZEB is too commercial and only puts emphasis on specific energy aspects (P. Biemar, personal interview, June 4). Discussing the competency profile of green CPMs with construction experts has been helpful to highlight matters that are not raised in the literature.

#### 3.6. Interview sampling design

The sampling methodology used for selecting interview respondents refers to a purposive sampling, also called a strategic sample. Respondents were chosen on selected criteria, namely on the basis of their profession and experience. All the interviews' respondents have more than ten years of experience in their field of expertise. The construction experts also all work with CPMs. On top of that, all the selected respondents work with sustainable practices, either daily or sporadically. Their sustainability engagement is an essential driver that motivated their selection for their participation in the interviews. Out of seven interview respondents contacted, five agreed to meet and contribute to the research. The interviews' respondents include two architects, two CPMs and a construction engineer. The two people that did not wish to participate refused because they both argued not having

sufficient knowledge on the matter. These people are real estate agents, who are the sponsors or investors of construction projects. It would have been interesting to hear their opinion because as project shareholders, they probably would have added a different perspective than the stakeholders. Depending on shareholders' environmental, reputational or financial priorities, the results would have varied from a sample to another.

The idea of extending the scope of interviews' respondents farther than CPMs aims at strengthening the accuracy of results. As the architects collaborate with CPMs, benefiting from their expertise and opinion on the competences that green CPMs should posses offers a more global perspective than restricting interviews to CPMs. Indeed, doing so contributed to expanding the scope of CPMs' perceptions to their stakeholders' perceptions of their competences. Previous research studies of project managers' competences only take the project manager perceptions into account. However, only asking CPMs what are the competences that form their competency profile could have lead to results lacking objectivity. The inclusion of CPMs in the interviews is however essential since they are the heart of the study matter. The participation of other project stakeholders thus aims to increase the reliability and validity of the research.

#### 3.7. Interviews' procedures

Green CPMs' competency profile is tested through primary research, and more precisely through in-depth interviews. The interviews were face-to-face and pre-structured, implying that the questions had been defined beforehand and in the same way for all the respondents. Each interview approximately lasted an hour. As this research follows a qualitative approach, in-depth interviews appeared as the optimal method to yield insightful findings. The in-depth interviews provided more detailed and thorough information on the research topic than other data collection methods, such as survey. The interviews consisted of open questions allowing flexibility given that the conversation could be adjusted according to what was learned. After validating the competences of green CPMs, interview respondents were asked to pinpoint competences that they consider essential for the realization of NZEB projects. Given that the competency profile of project managers is composed numerous competences, highlighting the ones interviewees see as key, helps giving guidance and directions to CPMs.

#### 3.8. Ethical considerations

Regarding ethical considerations, before the start of the interview, respondents were handed a consent form that gave them the opportunity to remain anonymous. The consent form also assured them that the generated data would only be used in the context of this study. As the questions had been preliminary formulated, they were forwarded to the respondents prior to the interview in order to avoid any possible discomfort. In addition, respondents could refuse to answer questions as well as to withdraw from the interview at any time.

#### 3.9. Research limitations

A key limitation of this research is that it is based on the hypothesis that social and environmental responsibility is translatable in competences, expertise and interpersonal skills. In addition to that, the concepts of sustainability and competences both encompass a long-term vision which, at the present time, often collide with the quick-return mechanism of the market.

Another limitation of this study is the small interview sample size used. To generalize and extrapolate the conclusions drawn from this research, a larger size sample should be used. Nevertheless, as explained in the next sub-section below, this research has attempted to bridge this gap by including different representative of groups of people in order to further increase the reliability of findings. Another limitation of this research relates to the qualitative in-depth interviews, where the findings depend on the respondents' ability to accurately express their opinions and experiences.

### 4. Results

A construction project is systematically realized with the assistance of a CPM who must fulfill numerous roles including those of leader, facilitator, and coordinator (Udo & Koppensteiner, 2004). The PMI, world's leading project management organization by turnover and influence for both management scholars and professionals, suggests a metaphor for understanding project managers' role by comparing it to the one of an orchestra conductor. "The project manager and conductor are both responsible for what their teams produce – the project outcome or the orchestra concert, respectively" (PMI, 2017, p. 51). A construction project is composed of many members, each undertaking a different role such as design, manufacturing, and portfolio and resource management. Similar to the sections in the orchestra, they embody different business units within an organization that the project manager has to coordinate. Indeed, the project managers' role is to support the team with leadership and coordination through communications. The conductor does not play every instrument in the orchestra, likewise, the project manager is not expected to assume every role of the project, but should have managerial and technical knowledge supplemented by a holistic view of the project. In brief, "the project manager is the person assigned by the performing organization to lead the team that is responsible for achieving the project's objectives" (p. 52). CPMs have thus a significant role in the realization of the projects they conduct. Accordingly, project managers also possess significant influence on construction projects, as they are responsible for achieving projects' objectives (Crawford, 2000). The same goes for the application of sustainable principles throughout the realization of projects. CPMs have both a significant role and influence on it (Ahadzie et al., 2008).

#### 4.1. NZEB Requirements

To address the global environmental challenges we face, Belgium imposes requirements for a minimum energy performance of buildings. The EPBD regulation derives from a common European obligation that aims to ensure the construction of healthier and more energyefficient buildings. The NZEB regulation is the future construction standard for newly built buildings, which stipulates that by 2021, all new buildings must consume nearly zero energy. By 2020, Europe has committed to reduce its energy consumption by 20%. To realize that objective, the EU encourages construction stakeholders to already build in accordance with future NZEB requirements (SPW, 2017). The NZEB regulation takes into consideration the overall energy performance of a building, including its level of thermal insulation, its airtightness, its use of solar heat gains, its system performance of heating and domestic water system, its ventilation, and the use of renewable energy sources (SPW, 2017). These aspects represent the energy performance of a building that is reflected through the  $E_{spec}$  indicator, which in turn refers to a label (see Figure 4 below). The smaller its value, the greater is the performance of the building. The  $E_{spec}$  indicator refers to the primary energy consumption of a building, which is expressed in kWh/m<sup>2</sup>/year. The level of energy performance required in 2017 corresponds to label B, whereas NZEB must meet label A (SPW, 2017).



Figure 4: NZEB label guide Source: SPW, 2017

#### 4.2. NZEB opportunities for green CPMs

Although NZEB is a great leap forward for the inclusion of sustainability in the construction industry, the requirements strictly focus on the energy efficiency and consumption of a building and do not consider its environmental or sustainability performance. Whereas NZEB only takes into account the energy aspect of a project, green project management considers the whole environmental dimension, including water, waste and energy. Although the NZEB regulation presents shortcomings, it should not prevent CPMs from undertaking a green project management approach for the realization of construction projects. With growing environmental concern, there are increasing pressures on the construction industry, coming from both the public and private sector. If CPMs limit their efforts to the strict compliance of the EPBD, they will undoubtedly miss opportunities to develop and apply their sustainable competences. Indeed, the law is increasingly being complemented by more ambitious private initiatives. In other words, customers increasingly demand environmental friendly practices and products, either for personal conviction or for their image and reputation (P. Biemar, personal interview, June 4). Therefore, green CPMs can use their commitment to sustainability as a competitive advantage. Next, the evolution of the EPBD requirements shows commitment to mitigate the environmental effects of the construction sector. One can assume that the regulation will only get stricter over time. Indeed, there is a slow but steady trend towards greater inclusion of sustainability in buildings' construction. Mr. Humblet, supports this idea and confirms that NZEB requirements solely cover the energy dimension of a project. In his opinion, construction norms evolve very rapidly, to the point that it can be a challenge for construction stakeholders to keep up (D. Humblet, personal interview, June 4). Mr. Biemar and Mr. Humblet both argued that the next logical step for the legislation would be to gradually start regulating the environmental performance of projects (P. Biemar & D. Humblet, personal interview, June 4). Since project managers have the potential to be change agents, they are recommended to be ahead of the curve and start adopting a green management approach by incorporating sustainability in their functional practices.

The two following tables were derived from the competency frameworks of the following four project management organizations : the Association for Project Management (2015), the Australian Institute of Project Management (2010), the Project Management Institute (2017), and the Green Project Management (2013; 2014).

TASK COMPETENCES	APM	AIPM	PMI	GPM
SOCIAL				
Leadership	х	х	х	Х
Ethics & professionalism	Х		Х	х
Top management relations			Х	
Governance arrangements	Х	х	Х	Х
Health & safety management	Х	х	Х	Х
Claim management			Х	
Contract management	Х	х	Х	
Corporate social responsibility			Х	x
ECONOMIC				
Literacy & numeracy skills		х	Х	
Strategic & business management	х	х	Х	Х
Investment appraisal				
(e.g. IRR, NPV, ROI)	х		Х	Х
Financial statements	Х	х	Х	
Operating systems	Х	х	Х	
Project management software		х	Х	
Reviewing & reporting processes	Х	Х	Х	x
ENVIRONMENTAL				
Procurement	Х	х	Х	х
Logistics				Х
Energy management				Х
Water management				Х
Waste management				Х
Environmental legislative requirements	Х			Х
Environmental Impact Assessment				Х
Sustainability reporting processes				x

Table I: Task Competences

## Table II: Contextual Competencies

CONTEXTUAL COMPETENCIES	APM	AIPM	PMI	GPM
Leadership				
Create effective environment		Х	Х	Х
Decision-making	Х	Х	Х	
Negotiation skills	Х	х	х	
Coaching & mentoring skills	Х	х		
Team work	Х	х	х	Х
Initiative & independent action	Х		х	X
within prescribed limits				
Consensus building			х	Х
Verbal skills		Х	х	x
Professionalism				
Integrity, reliability			Х	
Trustworthy			Х	
Political awareness/ Agility & Tact			х	
Interpersonal skills		х	х	
Resourcefulness				
Solution-oriented		х	Х	Х
Common sense/ good judgment				
Analytical skills		Х	Х	Х
Self-management & evaluation		Х		X
Motivation & commitment				
Pro-active, positive attitude			х	Х
Lateral thinking		х	х	
Adaptability			х	Х
Openness	Х			
Relationship skills			Х	X
Life-long learner			Х	
Change-agent skills				

#### 4.3. The social competence domain

The social competence domain in green project management focuses on achieving projects in an ethical way while maintaining mutually beneficial relationships with employees and stakeholders. In the following section, the social competences of green CPMs are discussed and put in a sustainable context provided by the Green Project Management guidebooks and related literature.

#### 4.3.1. Project Stakeholders management

"Project stakeholders management includes the processes required to identify the people [...] that could impact or be impacted by the project, to analyze stakeholder expectations and their impact on the project, and to develop appropriate management strategies for effectively engaging stakeholders" (PMI, 2017, p. 503). According to the governance framework, stakeholders have different interests and influence on the project. The project governance is the temporary structure that defines project roles, responsibilities, boundaries and levels of authority that need to be communicated to all stakeholders. Since project governance varies from one construction project to another, it is essential for green CPMs to identify all projects' stakeholders and prioritize their involvement in terms of interest and influence on key decisions and activities (GPM, 2013). Green CPMs should cast the widest net possible when forming the stakeholders group (Bradley & Anantatmula, 2014). Similarly, the Green Project Management (2014) strongly advises project managers to identify environmental-related stakeholders, either internal or external, in order to ensure the consideration of sustainability aspects in projects. One might argue that doing so requires relationship skills from green CPMs as well as negotiation skills to encourage top management to include additional stakeholders in a project.

Reed (2008) argues that stakeholder participation has the potential to improve the quality of environmental decision-making processes. He states "stakeholder participation [...] can empower stakeholders through the co-generation of knowledge [...] and increase participants' capacity to use this knowledge" (Reed, 2008, p. 2420). More importantly, stakeholder participation must be implemented right from the outset. Early stakeholders integration assures that they understand and support the project's sustainable objectives (Bradley & Anantatmula, 2014). Furthermore, stakeholders' input in the early development stages can help shape the construction project (Reed, 2008). Early and effective stakeholder engagement can "translate into a more cohesive project team, more engaged and supportive

stakeholders and a more collaborative design and building phase" (Bradley & Anantatmula, 2014, p. 55).

One might imagine that the key to green project stakeholders management is for CPMs to be surrounded with people that fully understand sustainability principles in the domain of construction, as well as their tradeoffs and benefits. Nevertheless, so far, many stakeholders do not acknowledge the benefits a green project management approach can induce to construction projects and their company's business value (D. Humblet, personal interview, June 4). In that case, one could argue that green CPMs should make best use of their coaching and mentoring skills to build sustainability awareness among project stakeholders, starting with the project team. Another option to companies would be to provide training, bearing in mind that that might affect the project's timeline and costs (Maltzman & Shirley, 2010).

#### 4.3.2. Corporate Social Responsibility

If we think about it, the construction industry has a huge impact on society. The built environment influences the wellbeing of a myriad of people, including users and developers. Therefore, it is essential for construction companies to develop and maintain a strong sense of social responsibility in order to optimize projects' positive outcomes (Maltzman & Shirley, 2010). CSR is "a self-regulating mechanism whereby a business monitors and ensures its active compliance with the spirit of the law, ethical standards, and international norms" (GPM, 2014, p. 9). To put it differently, CSR is about companies' liability to operate in a way that models responsible behavior. CSR intends to assist companies in contributing to sustainable development (GPM, 2013).

CSR encompasses the external and internal operations of a company. According to Maltzman and Shirley (2010), green CPMs should give priority to internal CSR aspects in order to improve the firm's reputation, employees' satisfaction and construction operations. Top management usually handles CSR's external aspects. CSR is voluntary and should include social, environmental and ethical values in the company's business model and processes (Maltzman & Shirley, 2010). For instance, construction companies and green CPMs can maximize their CSR impacts by designating responsible products and processes, selecting responsible supply chains, minimizing waste and environmental damage, and protecting the health and safety of employees (GPM, 2013).

To achieve those efforts, green CPMs should encourage customers to consider the total cost of ownership, including operations and maintenance, and not simply the project's

initial cost (P. Biemar, personal interview, June 4). If customers were well informed in terms of energy and sustainability performance, they would better understand the benefits of enforcing sustainability in construction processes. As a result to that, Pierre Biemar invites CPMs to acquire the skills to take the leading role to inform and educate those that are still only look at the initial costs. CSR offers new opportunities to enhance business value through the improvement of social and environmental conditions. Green CPMs should exploit these opportunities in order limit projects' negative impacts and increase the positive ones that benefit society and the company itself.

#### 4.3.3. Health and safety management

As briefly touched upon, adhering to CSR principles implies a link with project health and safety management. Project health and safety management is an organization's procedures for health and safety management relating to the project, its team and environment (Maltzman & Shirley, 2010). The most important health and safety issue regarding construction workers is the quality of the working conditions. Their work is physical and involves long working hours. Green CPMs can minimize accident rates and work-related illnesses through the design of safe working practices, staff training, and the use of appropriate and protective equipment (GPM, 2013). More importantly, CPMs must identify and implement the related and fitting health and safety requirements. Pearce and Kleiner (2013) found that green constructions include innovations, which, under new conditions, might expose workers to risks. With new construction standards, updated practices have led to the use of innovations, which cause workers to use technologies and processes they are unfamiliar with (Pearce & Kleiner, 2013). Architect David Humblet confirmed that construction workers tend to struggle with new processes, especially for laying rock wool insulation panels and the installation of the mechanical double-flux ventilation system (personal interview, June 4). Accordingly, green CPMs must ensure that health and safety standards reflect the risks and issues involved. In addition to that, practical trainings could be developed to explain construction workers how they should deal with these new processes and technologies.

According to the Green Project Management (2014) organization, compliance to project health and safety standards contributes to sustainable project outcomes. It advocates that a secure, safe and healthy workplace leads to staff commitment and engagement, which in turn positively impacts productivity and performance (GPM, 2013). Accordingly, it argues that it reduces loss of time and costs resulting from workplace illnesses and injuries. On top

of that, by complying to project health and safety standards, a company avoids fines and penalties from breaches. In other words, compliance to safety standards has the potential to minimize risks and increase the workforce health.

One might deduce that green CPMs need a background in legal knowledge to assure compliance with such standards. This also suggests that CPMs have to communicate the company's expectations regarding safe and healthy work behaviors. More than communicating, CPMs are expected to inspire and empower other employees to adhere to project requirements.

#### 4.3.4. Leadership

"[T]he ability to establish vision and direction to influence and align others towards a common purpose, and to empower and inspire people to achieve project [objectives] is the very essence of managerial leadership (GPM, 2013, p. 143). On a regular basis, CPMs require leadership skills to lead the project team. Effective leadership is nowadays all the more important for CPMs to deal with the new technologies and construction standards (Tabassi et al., 2016). Tabassi et al. (2016) argue that through leadership, green CPMs have the potential to improve the productivity and sustainable performance of projects. They suggest that, with intelligence and willpower, green CPMs can empower their project team to develop their potential so as to achieve the project goals (Tabassi et al., 2016). Accordingly, green CPMs are expected to lead by example and to hold their organization and project team accountable to do the same.

According to the Green Project Management (2013) organization, green project managers differentiate themselves from other managers by the principles to which they adhere and by their ability to convey that into others. Tabassi et al. (2016) agree and argue that, through transformational leadership skill, green CPMs have the potential to inspire and empower employees to commit to sustainability during the realization of projects. Indeed, transformational leadership skill includes the ability to inspire followers to go beyond their self-interest (Tabassi et al., 2016). One can thus deduce that leadership skill is tightly linked to the change-agent skills that green CPMs are expected to possess to induce change. In addition to that, green CPMs to possess empowering and mentoring skills (Tabassi et al., 2016).

#### 4.4. The economic competence domain

The economic competence domain in green project management focuses on achieving projects in the most efficient, productive and profitable way. In the following section, the economic competences of green CPMs are discussed and put in a sustainable context provided by the Green Project Management guidebooks and related literature.

#### 4.4.1. Project quality management

"Project Quality Management includes the processes for incorporating the organization's quality policy regarding planning, managing, and controlling project and product quality requirements in order to meet stakeholders' objectives" (PMI, 2017, p. 271). Through a green project management lens, quality management is accountable for ensuring that all activities are correctly performed in order to avoid rework and wasted energy and resources (GPM, 2014). Project quality management begins with the development of a quality plan, which defines the standards and controls for quality assurance. The quality management plan also integrates stakeholders' expectations and requirements that the project deliverables need to meet. To green quality management skills, the Green Project Management suggests including environmental considerations in the quality management plan. By discussing and raising awareness among stakeholders, green CPMs can learn about their potential green areas of interests. If green CPMs understand the environmental expectations of their customers, they can consider those as project quality requirements and include them in the quality management plan. Accordingly, project quality assurance and quality control should also encompass activities to promote sustainability (GPM, 2014). Subsequently, green CPMs can use a quality control checklist to endorse quality deliverables.

The Green Project Management recommends deriving and seeking guidance for project quality standards from ISOs 14001, 26000, 9001 and 5001, which are respectively related to environmental management, CSR, quality management and energy management (GPM, 2013). Quality standards are adopted to develop a project quality baseline, which in turn is used as the basis for monitoring and reporting within the quality assurance and quality control processes. Nevertheless, green CPMs should not restrict green quality management to reaching quotas set by the quality standards. The extent of sustainability performance in a construction project is not a quota to be accomplished. Instead, ideally, sustainability should be part of the mindset of project manager and team. In such a way, they

can suggest sustainable improvements in projects' processes and in areas of the construction company without restricting themselves to numerical quotas (Maltzman & Shirley, 2010).

Sound project quality management has the potential to prevent quality failure, which subsequently limits resources waste, including time, cost and material. Green CPMs can thus save resources by implementing the right quality standards for each project deliverables through prior planning and a strong control method.

#### 4.4.2. Project risk management

"Project Risk Management includes the processes of conducting risk management planning, identification, analysis, response planning, response implementation, and monitoring risk on a project. The objectives of project risk management are to decrease the probability and/or impact of risks in order to optimize the chances of project success" (PMI, 2017, p. 395). In other words, risk refers to the factors that may cause a failure to reach the projects' objectives. Project risks thus derive from the project's objectives and goal. It is the project manager's responsibility to identify the causes and situations of risk, analyze the potential impact in order to optimally protect the project objectives at every level. Similarly, green CPMs' are responsible for managing green project risk. Nevertheless, to manage green project risk, there must an environmental-related project objective, which nowadays is not systematically the case. When applying green project management, CPMs should expand the discussion of risk to environmental considerations (Maltzman & Shirley, 2010).

One might think that green project risks strictly refer to the impacts a construction project has on the environment. Nevertheless, negative green project risks are much broader and include a lack of management commitment, or resistance to sustainability principles, lack of integrated environmental policy, and a lack of funding to include sustainability principles in the realization of projects (Maltzman & Shirley, 2010).

As detailed in figure 3, project risk management processes include risk planning, risk identification and risk monitoring and control. The same processes apply to green risk management. It is in the risk identification process that project risk management and sustainability converge. The risk identification process is a way of identifying, classifying and ranking the risks that could potentially affect the project realization, both positively and negatively (GPM, 2014). In identifying both positive and negative project risks, green CPMs can in turn respectively increase and decrease their likelihood of occurrence. During regular conditions, ISO 14000 can guide green project managers to identify the environmental issues

that can be affected by the project risks. In an emergency situation, green CPMs should follow an environmental contingency plan (GPM, 2014).

#### 4.4.3. Project time management

"Project Time Management includes the processes required to manage the timely completion of the project", including the project schedule, from creation to change control (PMI, 2017, p. 173). The realization of construction projects through a green project management perspective implies making time to manage the newly added sustainability aspects. While this might seem obvious, Hwang and al. (2013) have demonstrated that the realization of green construction projects requires more time than the realization of traditional ones. One can thus assume that the same applies for the realization of NZEB projects. When managing a project from a green management perspective, CPMs should thus include the activities in support of the environmental management in the project schedule (Hwang and al. 2013). Through lateral thinking and common sense, green CPMs have also the opportunity to examine the schedule and the use of resources to save cost and energy. For instance, green CPMs could attempt to convince top management to invest in track-andtrace technological devices. Such system is designed to track personal and material on site in real time allowing efficient use of resources. The track-and-trace device also records working hours of each operation and allows a clear analysis of returns (CSTC, n.d.). In average, small and medium-sized enterprises recover the investment after two or three years (CSTC, n.d.). Green CPMs can thus make best use of the available tools to enhance the productivity and sustainable performance of construction projects. Small efforts can play into green CPMs' hand for a more sustainable project. Green CPMs should ensure that the project is delivered through the right methods in the most efficiency ways to obtain the most effective results (GPM, 2014).

#### 4.4.4. Project cost management

"Project cost management includes the processes involved in planning, estimating, budgeting, financing, managing and controlling costs so that the project can be completed within the approved budget" (PMI, 2017, p. 231). To supplement project cost management with sustainable practices implies to the inclusion of environmental-related costs in the project expense planning. To maximize the value of a project and minimize its cost, green CPMs use investment appraisals tools on an ongoing basis. They should also focus on ensuring direct financial benefits because it creates resources for future projects (GPM, 2013). Accordingly, the realization of direct financial gains supports the organization's longterm sustainability. To calculate the net present value, the Green Project Management recommends green project managers to focus on the asset cradle-to-cradle cost benefit. Doing so allows a clear return of the original financial investment. On top of that, they should continuously evaluate the benefit cost ratio to ensure the cost effectiveness of the project (GPM, 2014). The link between sustainability and the economic competence domain might not appear obvious; nevertheless, put in a green context, the aforementioned competences have the potential to maximize positive returns and opportunities. Green CPMs should consider environmental management the same way they consider quality management. The same applies for its related cost. Like the cost of quality, the opportunities and savings outweigh the cost brought by sustainability measures (Bradley & Anantatmula, 2014). Truly committed green CPMs are expected to use their leadership and mentoring skills to continuously raise awareness among the project's stakeholders and team members (GPM, 2014).

#### 4.5. The environmental competence domain

The environmental competence domain in green project management focuses on achieving projects in a sustainable way through responsible ecological practices. As the interview respondents stated, the management of resources, including energy, water, and waste, and procurement management skills is an inherent aspect of construction project management. The same applies for soil management. However, it is not part of CPMs' responsibilities because it requires deep and complex scientific knowledge of soil conservation, amendment and decontamination (N. Moore, personal interview, June 12). In the following section, these environmental competences of green CPMs are discussed and put in a sustainable context provided by the Green Project Management guidebooks and related literature.

#### 4.5.1. Energy management

Sustainable energy management refers to the procedures undertaken to minimize energy consumption and pollution through effective use of energy (GPM, 2013, p. 24). Efficient energy management requires green CPMs to minimize the levels of embodied energy in materials, prioritize the use of renewable energy sources, and establish principles that seek energy efficiency as a priority. Energy management skills also require green CPMs to control the amount of pollution emitted throughout the project development lifecycle. To control the air quality impact, green CPMs should measure the carbon footprint of the project. Green CPMs should further include sustainability in the realization of projects by finding alternative energy in order to reduce the environmental impact of the project (Maltzman & Shirley, 2010). Accordingly, CPMs should consider opportunities to reallocate the clean energy produced in order to provide secondary energy sources. In any case, green CPMs must be clearly aware of the types and amount of energy that will be used throughout the realization of the construction project to minimize the energy consumption (GPM, 2013).

Efficient energy consumption has the potential to reduce energy costs and greenhouse gases emissions during the total lifecycle of a project, including its development. Energy management is therefore an essential aspect of NZEB construction on which green CPMs place great emphasis. Efficient energy management requires green CPMs to acquire scientific knowledge to clearly understand the risk-return tradeoffs and the technical feasibility of the different energy systems (C. Soreille, personal interview, June 3). Scientific knowledge is also required for quantifying and controlling energy consumption and pollution.

As advocated in the contextual competences table, green CPMs should be life-long learner. Accordingly, they must stay informed about the latest technological developments. In the domain of energy management, green CPMs are notably expected to follow the advancements of energy systems integration, which allows operations across interdependent domain such as energy, water and wastewater systems. Green CPMs can and should be innovative and critical. Traditional paradigms of energy systems are already being reevaluated. Green CPMs are expected to rapidly adapt to these advancements. Nevertheless, they must show good judgment and always select the most reliable, efficient and flexible energy system (C. Soreille, personal interview, June 3).

#### 4.5.2. Water management

Sustainable water management refers to the procedures that pertain to the impact on water quality, water consumption and water displacement. This ability includes managing the optimal use of water resources to minimize the impact on local bodies of water and ecosystems (GPM, 2013, p. 25). In order to preserve ecosystems and bodies of water, green CPMs should take into account the amount of water necessary for the project realization and its impact on the local water table (GPM, 2014). On top of decreasing environmental impact, efficient water consumption has the potential to reduce the project costs for water use and treatment (Maltzman & Shirley, 2010). Green CPMs could therefore think of innovative methods to reduce water consumption. A first and easy step would be to use cisterns to collect rainwater. In addition to that, they should ensure that water runoff is appropriately and sanitarily handled in order to minimize water related diseases (Maltzman & Shirley, 2010). In brief, green CPMs must attempt to increase water use efficiency and sustainable withdraws to decrease the project's environmental impact. Such as energy management, sustainable water management skills also require scientific knowledge for understanding water flows and quality (GPM, 2014).

#### 4.5.3. Waste management

Sustainable waste management refers to the procedures with regard to waste disposal, the handling of waste during the project development lifecycle, and the type and amount of waste created by the project's output. This ability includes the optimization of all available resources and responsible waste disposal (GPM, 2013, p. 26). To sustainably manage waste, green CPMs are expected to explore options for material reuse and recycling. When

considering the project life cost, green CPMs have to include the cost of disposal. Doing so can encourage project stakeholders to consider decreasing the use of unwanted resources. More importantly, green CPMs are expected provide opportunities for new revenue streams by identifying the unwanted resources that could be used as input for other projects or organizations. Green project managers must explore options for reusing, recycling and responsibly disposing component materials (C. Soreille, personal interview, June 3) The Green Project Management (2014) also suggests carrying out construction projects with material disposal in mind. One might imagine that doing so requires green CPMs to apply lateral thinking and initiative to reconsider traditional waste management processes. Sustainable waste management has the potential to minimize waste and optimize the use of available resources, which in turn will lead to environmental protection and illness prevention from contamination (Maltzman & Shirley, 2010).

#### 4.5.4. Project procurement management

"Project Procurement Management includes the processes necessary to purchase or acquire products and services needed from outside the project team" (PMI, 2017, p. 459). Greening project procurement management skills refer to the integration of environmental preferences in the purchase of products and services. Like each aspect of project management, CPMs must first plan the procurement approach according to the principles agreed with the project stakeholders. These principles cover the parameters that guide the selection of goods and services (PMI, 2017). For sustainability to be included in these principles, a sustainable procurement strategy for the project must be elaborated. Most of the time, the construction organization already follows procurement policies that projects must adhere to. In that case, the best approach is to complement the organizational procurement standards with an environmental plan. This shows that sustainable project procurement skills require commercial and legal competences from CPMs (Maltzman & Shirley, 2010).

To further improve the environmental performance of construction projects, green CPMs are recommended, when possible, to give preference to local procurement (GPM, 2013; Alliance Emploi-Environnement, 2017). Doing so reduces carbon emissions from transport and contributes to the local economy. Green CPMs should also make use of tools such as Environmental Management System (EMS) and ISO standards to support and facilitate green purchasing processes (GPM, 2013). On top of that, they should check eco labels' database on buildings products and services. The database contains material's

characteristics that can help CPMs to make sound decisions when it comes to project procurement (B. Busch, personal interview, June 11).

The lack of availability of green products might be a barrier to green procurement (Maltzman & Shirley, 2010). It is nevertheless important to create the demand of such products and services. Giving preference to environmental friendly products can, in turn, encourage suppliers to improve the environmental performance of their products and processes (GPM, 2014). As sustainability is becoming an integral part of doing business, the number of suppliers of greener products will increase. Accordingly, prices will become more competitive. Nonetheless, commitment to green project procurement may involve higher costs, but when considering the added value of CSR, the benefits might outweigh the additional cost. Indeed, according to the Green Project Management (2013) organization, sustainable procurement has the potential to lead to both short and long term cost benefits. On the short term, it contributes to resource waste reduction through improved efficiency. On the long term, green procurement can enhance an organization's reputation on the market and mitigate risk exposure. In brief, sustainable procurement has the potential to lead to cost benefits, environmental protection and increased shareholder value (Maltzman & Shirley, 2010).

#### 4.5.5. Project logistics management

To green project procurement practices implies taking into consideration the project logistics, which refers to the "policies and procedures on the transportation of goods or materials" (GPM, 2013, p. 23). The Green Project Management organization advises green CPMs to give preference to bulk purchasing to reduce the frequency of shipping and to favor local suppliers to minimize transportation. When possible, it suggests project managers to purchase materials which package is designed in a way that minimizes waste (GPM, 2013). One can assume that requires resourcefulness from green CPMs to make the supply chain more sustainable and efficient. A good start to green project management logistics is to create a network of suppliers within a close radius (Alliance Emploi-Environnement, 2017). However, one may wonder how to do so in an increasingly globalized world. The Green Project Management organization therefore recommends the reorganization of material procurement to increase the sustainable performance of projects. The Walloon Alliance Emploi-Environnement (2017) also advocates local sourcing and procurement. It argues that sourcing improvements benefits both the sustainable and economic performance of projects. It states that sustainable logistics can save up to 10% on transport cost (Alliance

Emploi-Environnement, 2017). Sustainable logistics has the potential to reduce transportation costs, lead times, and packaging waste (GPM, 2013).

# 5. Analysis

#### 5.1. Validation of criteria & Interviews' results

The interviewees all validated the task and contextual competences included in Tables I & II as part of the competency profile of green CPMs. Through in-depth interviews, they were asked to pinpoint fundamental competences for green CPMs to carry out NZEB projects. In turn, they were asked to identify factors necessary for the successful realization of such construction projects. As a result to that, the interviewees indicated competences that, in their opinion, are essential for managing NZEB projects and might need to be further developed. In addition, they pointed out obstacles raised by the EPBD to the good management of NZEB projects.

#### 5.1.1. The importance of green CPMs' organizational skills

On top of validating the identified competences of green CPMs, Mrs. Soreille, argued that construction norms have become so constraining that project managers have to be proficient in all the aspects they manage. Mrs. Soreille highlighted the importance that the project objectives are clearly laid out at the outset for the project team and stakeholders. In her opinion, the formulation and communication of clear project objectives including the ones related to sustainability is an inherent part of green CPMs' functional competences, which requires careful planning as well as analytical skills (C. Soreille, personal interview, June 3). She also emphasized the importance of communications skills to establish clarity on project's processes and objectives among all project stakeholders. She confirmed that early stakeholders involvement is embedded in NZEB project decision-making processes because it has the potential to lead to high quality and durable decisions (C. Soreille, personal interview, June 3; Reed, 2008).

#### 5.1.2. Sustainable procurement management: green CPMs' scope for action

When it comes to procurement management and more precisely to the selection of materials, Mrs. Soreille, stated that CPMs have quite some influence on the process of materials' selection. They can guide and advise the choice of specific materials, as long as they are in accordance with the project objectives. The same applies for the choice of energy supply systems, including alternative energy sources. CPMs have the responsibility to inform and guide their clients regarding their choices of energy supply and options for efficient use of energy. This is done through a technic-economic feasibility study that displays the return

on investment of the different available options (C. Soreille, personal interview, June 3). Measuring the tradeoffs and benefits of the different energy systems and material require highly developed analytical skills. One can assume that green CPMs also need to possess negotiation skills as well as scientific and technical knowledge to provide appropriate advice on sustainable material selection. In addition to that, Mrs. Soreille recommended green CPMs to make the best use of available tools, in particular databases designed for a selection of sustainable construction materials and energy systems. Mr. Busch strongly agreed and also advised green CPMs to take advantage of the Dutch classification tool, Nibe, to have a clear overview of the sustainable performance of construction materials (B. Busch, personal interview, June 11). With these tools, green CPMs can gather the necessary information to advise clients to make the right choices in terms of material selection. She also underlined that green CPMs need to be resourceful and innovative in order to juggle between the sustainability and financial aspects of a project (C. Soreille, personal interview, June 3).

#### 5.1.3. The importance of CPMs' awareness of sustainability

Mr. Humblet, for his part, stated the importance of commitment and awareness, which, in his opinion, project managers from Liège currently lack. He argued that, at the present time, CPMs and many construction stakeholders see the EPBD requirements as institutional constraints. As a result to that, CPMs often fail to properly address the sustainable aspects of construction projects, especially when they are not part of NZEB requirements. In his opinion, CPMs poorly understand the benefits of taking into account sustainability matters in projects, which, in turn, refrain them from adopting a green project management approach. In brief, Mr. Humblet argued that, mainly due to a lack of awareness, CPMs do not dedicate efforts to increasing the sustainable performance of projects (D. Humblet, personal interview, June 4). Mr. Busch agreed that CPMs too often fail to understand the benefits of environmental management (B. Busch, personal interview, June 11).

As a way to address this problem, Mr. Humblet advocates the need to raise awareness among project managers for them to evolve into change agents and support the shift towards green project management. Next, he raised the issue of the absence of practical trainings for project managers and other construction experts. As a matter of fact, all the interviewees, with the exception of Mr. Biemar, complained that there are no adequate trainings for the realization of NZEB and green projects. This makes it very difficult for CPMs to evolve into green CPMs. The interviewees agreed that the rapid evolution of the construction norms complemented by the absence of trainings constitutes a break to the application of sustainable practices in project management. This applies to all construction experts, including CPMs and workers.

Mr. Moore, CPM, confirmed that the limited available trainings are too theoretical and do not reflect the complexity of the NZEB requirements. The practical recommendations that the trainings provide are very abstract and generic. In addition to that, he regrets that the people that give the trainings do not work in the field and thus do not acknowledge the difficulties that typically arise on site. He argued that this has problematic implications because when workers face a problem linked to newly used material no construction expert knows how to respond in a competent way (N. Moore, personal interview, June 13).

One can conclude that, the Walloon region must act and design appropriate practical trainings for the construction experts of the province of Liège, including CPMs. Mr. Moore further explained that the trainings should not be restricted to the presentation of outstanding green construction projects realized with huge budgets. In contrast, he argued that the trainings would be much more fruitful if they were to expose CPMs to projects with defects commonly arise in the realization of green and NZEB projects. In brief, Mr. Moore mentioned that CPMs could highly benefit and learn from trainings if they would show feasible projects' examples and how to deal with common green construction project issues (N. Moore, personal interview, June 13).

#### 5.2. NZEB's or CPMs' shortcomings?

The energy requirements established by Q-ZEN are based on a performance calculation tool. Mr. Busch explained that the physical condition of a building should not be planned according to a calculation tool. He argued that the tool is meant to quantify the building performance and classify it in accordance. In other words, the performance calculation tool serves to verify that the building complies with the construction norms in place. However, according to Mr. Busch, the physical design of a building requires other tools than a performance calculation to plan the elements. It is thus essential for CPMs to be able to use these calculation tools, which are specific to Belgium. Mr. Busch regrets that CPMs too often, have to base the realization of projects on these tools rather than on the true physical condition of the building. That is mainly because construction norms. Accordingly, he recommends green CPMs to take the time to fully understand the performance calculation tool and the physics behind construction systems to use it at as leverage rather than a liability (B. Busch, personal interview, June 11).

#### 5.3. Conclusion

As seen in this research, the competences of green CPMs are rather extensive, especially when environmental management is added to their responsibilities. As a result to that, Mr. Biemar and Mr. Busch explained that the profession of CPM will be split in two. They argue that most CPMs deal with the environmental aspect in projects in a too generic way, mainly because they do not have clear understandings of the tradeoffs. Mrs. Soreille and Mr. Moore, CPMs themselves, have recognized they could further develop their technical competences, especially when it comes to the operating systems. They also admitted having difficulties keeping up with the rapid changes, including technological advances and institutional changes, namely the EPBD requirements that keep on evolving. Ongoing innovation adds complexity to the realization of projects and, in turn, to CPMs' responsibilities and competency profile. Mr. Biemar and Mr. Busch argue that a new profession will most probably emerge from the CPM, which they respectively named the energy project manager and the green manager. Mr. Busch's argument is based on the observation that CPMs increasingly seek the expertise of engineering consulting firm such as the Greisch Bureau where he currently works (B. Busch, personal interview, June 11). Project managers do not systematically consult engineering bureau due to a lack of competences but sometimes simply due to a lack of time. Indeed, Mr. Busch argued that some CPMs are capable of undertaking the task assigned but the regulations can be so constraining that it takes a lot of time to best accomplish the task while meeting the strict legislative requirements. Time, which is not financially compensated. Therefore, project managers and architects increasingly seek the guidance of engineering consulting firms to optimize the energy and environmental performance of construction projects (B. Busch, personal interview, June 11). For medium or large-scale construction projects, consulting with an engineering firm is feasible and most probably beneficial. But what about small scale projects, such as residential houses? Limited budget for the realization of small projects does not allow consulting with such firms (D. Humblet, personal interview, June 4). In such cases, CPMs have no other option than managing the project's aspects without the help of additional stakeholders than their project team. For his part, Mr. Humblet believes that CPMs will gradually develop the necessary competences and knowledge necessary to manage NZEB projects. In his opinion, with time and experience CPMs will increasingly take into account the aspects related to sustainability in construction projects and develop the necessary expertise to manage them. To accelerate such process, Mr. Humblet wishes he strongly

recommended the development of much more practical and insightful trainings for CPMs and architects (D. Humblet, personal interview, June 4).

### 6. Conclusion

The overarching aim of this thesis has been to identify the competency profile of green CPMs in order to instill sustainability in the competences and practices of CPMs from Liège, Belgium. To do so, knowledge and competences were derived from the competency frameworks of well-accepted project management organizations, namely the PMI, the AIPM, the APM and the Green Project Management. The competency profile of CPMs embodied in the competences tables has been supplemented with a sustainability context in the results section to yield the competency profile of green CPMs. In turn, it has been tested with five different construction experts from Liège and applied to the province as a case study. The competency profile of green CPMs encompasses broad knowledge and numerous managerial skills, including but not limited to: scientific, technical, and legal knowledge, and leadership, negotiation and analytical skills. By putting CPMs competences in a sustainability context provided by the Green Project Management organization and related literature, this thesis has attempted to close the competences gap of green CPMs in order to give them the ability to enhance the sustainability performance of the projects they carry out.

As sustainability is becoming more common in the domain of construction project management, it is expected that, with time and experience, CPMs will further understand how to best apply and adapt their practices and competences through a proactive green project management approach. At the present time, CPMs from Liège find that ongoing innovation, arising from institutional and technological change, adds complexity to the management of NZEB projects. As a result of that, CPMs have no clear understanding of the benefits NZEB projects can offer. Moreover, CPMs from Liège tend to see the consideration of sustainability in construction projects as constraining rather than enabling. And such constitutes a break for CPMs from Liège to evolve into green project managers. In addition to that, the interview respondents explained that CPMs' lack of awareness of sustainability matters refrain them from acting as change agents like they have the potential to be. CPMs must be aware of the range of potential benefits of enhancing the sustainability performance of projects in order to fully commit to a green project management approach. It is only through awareness and commitment that CPMs' contextual competencies can support their technical core to contribute to their professional development.

The competency profile developed could be used to develop practical trainings to overcome those obstacles. The identified competency profile of green CPMs from Liège could guide the Walloon Region to establish the practical trainings that CPMs need and that are currently unavailable. It would be fruitful to develop trainings for raising awareness and for further developing CPMs' competences related to the sustainability performance of projects. These competences include leadership, sustainable procurement, logistics, waste, energy, water and environmental management. Ongoing trainings or the development of a newsletter could also help CPMs to be at the forefront of material and technological innovations and regulations. Up until the establishment of practical trainings, green CPMs must be resourceful to deal with sustainability matters in the projects they manage. Green CPMs must be innovative while meeting the norms and taking into account the financial aspect. One must juggle between NZEB norms, sustainability and profitability.

For future studies, it would be interesting to match green CPMs' competences to specific project types or development life cycle phases. In doing so, CPMs could specifically pinpoint the competences they wish to improve or develop. New competences and knowledge not included in this research could be explored in order to nourish the existing competency profile of green CPMs.

# References

- Ahadzie, D., Proverbs, D. & Olomolaiye, P. (2008). Towards developing competency-based measures for construction project managers: should contextual behaviours be distinguished from task behaviours? *International Journal of Project Management 26*, 631-645.
- Alliance Emploi-Environnement (2017). *Construction Durable*. Plan Pluriannuel 2016-2019. Wallonie, Belgique.
- Association for Project Management (2015). *APM competence framework*. (2<sup>nd</sup> ed). High Wycombe, UK.
- Australian Institute of Project Management (2010). *Professional Competency standards for Project Management*. Part C – Certified Practicing Project Manager. Sydney, Australia.
- Bradley, L. & Anantatmula (2014). Greening Project Management Practices for Sustainable Construction. *Journal of Management in Engineering.*
- Centre scientifique et technique de la construction (CSTC) (n.d.). *Track-and-trace et enregistrement du temps*. Retrieved from <u>https://www.cstc.be/</u>
- Cheng, M., Dainty, A., & Moore, D. (2005). What makes a good project manager? *Human Resource Management Journal 15*, (1), 25-37.
- Crawford, L. (2000). Profiling the Competent Project Manager. Sydney, Australia.
- Crawford, L. (2005). Senior management perceptions of project management competence. International Journal of Project Management 23, 7-16.
- Dainty, A., Cheng, M., & Moore, D. (2004). A competency-based performance model for construction project managers. *Construction Management and Economics 22*, 877-886.
- Dogbegah, R., Owusu-Manu, D. & Omoteso K. (2011) A Principal Component Analysis of Project Management Competencies for the Ghanaian Construction Industry. Australasian *Journal of Construction Economics and Building, 11* (1), 26-40.
- Edum-Fotwe, F. T., & McCaffer, R. (2000). Developing project management competency: perspectives from the construction industry. *International Journal of Project Management 18*, 111-124.
- Green Project Management (2013). *PRiSM. The GPM Reference Guide to Sustainability in Project Management.* Detroit, USA: GPM Global.

- Green Project Management (2014). *The GPM P5 Standard for Sustainability in Project Management*. Detroit, USA.
- Griffith, A., (2000). Environmental Management in Construction. MacMillan Press, London.

Hamel, G. & Prahalad, C. K. (1994). Competing for the future. Harvard School Press, Boston.

- Hwang, B-G. & Ng, W. J. (2013). Project Management knowledge and skills for green construction: Overcoming challenges. *International Journal of Project Management* 31(2), 272-284.
- Hwang, B-G., Leong, L. P. & Huh, Y-K. (2013) Sustainable Green Construction management: Schedule Performance and Improvement. Technological and Economic Development of Economy 19(Supplement 1), S43-S57.
- Hwang, B-G., & Tan, J. S. (2012). Green Building Project Management: Obstacles and Solutions for Sustainable Development. *Sustainable Development. 20*, 335-349.
- International Project Management Association (2015). *Individual Competence Baseline for Project, Programme & Portfolio Management.* Zurich, Switzerland.
- Maltzman, R. & Shirley, D. (2010). Green Project Management. CRC Press, USA.
- Motowidlo, S., & Van Scotter, J. (1994). Evidence That Task Performance Should Be Distinguished From Contextual Performance. *Journal of Applied Psychology* 79(4), 475-480.
- Müller, R. & Turner, R. (2007). The Influence of Project Managers on Project Success Criteria and Project Success by Type of Project. *European Management Journal 25*(4), 298-309.
- Pearce, A. & Kleiner, B. (2013). The safety and Health of Construction Workers on 'Green' *Projects.* Virginia Tech, USA.
- Project Management Institute (2017). *A guide to the project management body of knowledge* (6<sup>th</sup> ed). Newton Square, USA.
- Service Public Wallonie (SPW) (2017). *Quasi zéro énergie. Guide pratique*. Namur, Belgique. Retrieved from <u>www.energie.wallonie.be</u>
- Silvius, G., & Schipper, R. (2014). Sustainability in Project Management Competencies: Analyzing the Competence Gap of Project Managers. *Journal of Human Resource and Sustainability Studies 2*, 40-58.

- Udo, N. & Koppensteiner, S. (2004). *What are the core competencies of a successful project manager?* Paper presented at PMI Global Congress 2004 – Prague, Czech Republic. Newton Square, USA: Project Management Institute.
- Tabassi, A., Roufechaei, K., Ramli, M., Abu Bakar, A., Ismail, R., & Pakir, H. (2016). Leadership competences of sustainable construction project managers. *Journal of Cleaner Production 124*, 339-349.

# Annexes

# TASK COMPETENCES

# SOCIAL

Leadership: the ability to establish vision and direction, to influence and align others towards a common purpose, and to empower and aspire people to achieve project success

Ethics & professionalism: the ability to promote the wider public good in all actions, and to act in a morally, legally and socially appropriate manner in dealings with stakeholders and members of project teams and the organization

Top management relations: the ability to build strong relationships with senior managers and executives

Governance arrangements: the ability to maintain governance structures that defines clear roles responsibilities and accountabilities of the project

Health & safety management: the ability to understand the conditions and factors that affect, or could potentially affect the health and safety of people on site, including employees, workers, contractors, and visitors. This ability includes knowledge and application of health and safety standards.

**Claim management:** the ability to identify faulty performance and claim rectification through the implementation of claims towards third parties and, in contrast, the ability to prevent third party claims.

Contract management: the ability to agree contracts for the provision of good and/or services, to monitor compliance and to manage variances

Corporate social responsibility: the ability to promote social and environmental good in managerial practices and processes

Communications

**Digital communication:** the ability to communicate digitally with stakeholders. It includes encoding information and transferring it to the recipients.

**Communications planning:** the ability to create and define the plan for communications management, including the creation of communications policies.

Information distribution: the ability to create, collect, store and distribute project information.

**Communication control:** the ability to monitor communications to identify gaps and breakdowns and to provide accurate responses to communications gaps and breakdowns.

### Stakeholders

Stakeholders planning: the ability to create a comprehensive list of identified stakeholders and to create a stakeholder organizational chart

Team development & management: The ability to develop & manage teams

Stakeholder management: the ability to Develop and execute responses and countermeasures to maintain appropriate level of stakeholder engagement throughout project life cycle

# ECONOMIC

Literacy & numeracy skills: the ability to produce and work with a range of procurement and contract documentation. This ability includes an understanding of numbers and calculations and writing skills

Strategic & business management: the ability to develop an understanding of the concepts and steps required for effectively managing projects. This ability includes knowledge of finance, marketing and operations

Investment appraisal: the ability to value efficiency savings in terms of benefits, costs and risks

Financial statements: the ability to plan and control the finances of project activities

**Operating systems:** the ability to use low-level software that supports computer's basic functions, such as scheduling and monitoring tasks

Project management software: the ability to use software tools

Reviewing & reporting processes: the ability to manage reviews and reports during and after the realization of the project following the typical processes, including goal setting, measurement, analysis and action.

Time

Activity planning: the ability to lead and manage the development of schedule management plan. This ability includes the development of guidance and direction on how the project schedule will be managed throughout the project

Activity definition: the ability to identify and document the specific actions to be performed to produce the project deliverables

Activity sequencing: the ability to identify and document the relationships and dependencies among project activities

Activity duration estimation: the ability to estimate the duration of each activity with estimated resources

Schedule monitoring: the ability to monitor the status of project activities to update project progress

Schedule control: the ability to manage the changes to the schedule baseline.

Cost

**Cost planning:** the ability to create and define the plan for cost management. This ability includes the development of guidance and direction on how the project costs will be managed throughout the project

**Cost estimating:** the ability to estimate the cost for completing the project. This ability includes knowledge of cost alternatives, trade-offs, and risks

Cost budgeting: the ability to develop and have approval of the project cost baseline

**Cost & expenditure control:** the ability to monitor the status of project activities to update project costs. This ability includes managing the changes to the cost baseline

Quality

Quality planning: the ability to create and define the plan for quality management. This ability includes the identification of quality standards and/or requirements, the development of a quality management plan, and the documentation on how the project will demonstrate quality compliance.

Quality assurance: the ability to audit quality requirements and results from quality control measurements. This ability includes audits of quality executed in accordance with the quality and management plan. **Environmental legislative requirements:** the ability to acknowledge and respect environmental legislations and requirements. It includes the ability to ensure that the risks associated with the environmental legislation are included in the project risk register.

Environmental Impact Assessment: the ability to use the EIA for assessing the environmental impacts of development projects.

Sustainability reporting processes: the ability to manage reviews and reports in the context of the sustainability performance of the project following the typical reporting processes, including goal setting, measurement, analysis and action. Sustainability reporting processes includes reporting on economic, environmental, and social impacts, and should provide a representation of the sustainability performance. This ability includes knowledge of IT software such as SAP, Oracle and GRI.

#### Procurement

**Procurement planning:** the ability to create and define the plan for procurement management. This ability includes the development of guidance and direction on how the project team will acquire goods and services. On top of that, project managers must identify opportunities for economies of scale, value for monies, time, and cost-efficient procurement approaches

Contractors selection: the ability to select sellers and to document procurement decisions

**Procurement control:** the ability to manage procurement relationships by ensuring that both the project and sellers meet their contractual obligations. This ability includes monitoring and evaluating the seller performance according to the contract and scope of work.

Procurement closeout: the ability to confirm contract deliverables have been successfully met and that the scope of work is complete.

# **CONTEXTUAL COMPETENCIES**

Leadership

Create effective environment: the ability to create and nurture a healthy work environment.

Motivate self & others: refers to the force that drives people to do things. It is a key competency for personal and professional development

Negotiation skills: the ability to find a compromise or an agreement while avoiding an argument

**Team work:** the ability to administer and coordinate a group of individuals to perform a task. This ability includes communication, objective setting and performance feedback

Initiative & independent action within prescribed limits: the ability to take prompt action that goes beyond job requirements to achieve objectives

**Consensus building:** the ability to make plans, solve problems, develop recommendations, or make decisions in a collaborative (or cooperative) way, rather than in isolated, competitive, or confrontational way.

Communication

Verbal skills: the ability to a confident, eloquent and engaging speaker

Business correspondence: the ability to exchange written information while maintaining professional relationships. It includes internal, external and personalized business correspondence.

**Report writing:** the ability to write for a clear purpose and to a specific audience. It includes the presentation, analysis and application of specific information and evidence to a particular issue.

Professionalism

Integrity, reliability: the quality of being honest and having strong moral principles

Trustworthy: the quality of being able to be relied on as truthful

Political awareness, Agility & Tact: the quality of being sensitive to public policy and government, it is a key component in empathy, which is part of Emotional Intelligence.

### Personal attributes

Resourcefulness: the ability to find quick and clever ways to overcome difficulties

Solution-oriented: the ability to take an active approach to solving problems

Common sense/good judgment: the ability to weigh the options accurately and to choose the best option

Analytical skills: the ability to visualize, articulate, conceptualize or solve both complex and uncomplicated problems by making decisions

Self-management & evaluation: the ability to setting goals and managing your time. A key skill in self-management is self-regulation

Motivation & commitment: the general willingness to do something

Pro-active, can-do attitude: is a personality characteristic that has implications for motivation and action. It is a belief in the rich potential of changes that can be made to improve oneself and one's environment. This includes various facets such as resourcefulness, responsibility, values, and vision

Lateral thinking: the ability to solve problems by an indirect and creative approach, typically through viewing the problem in a new an unusual light

Interpersonal relations management: the ability to effectively interact with superiors, subordinates and co-workers within the organization. This ability impacts the environment at the workplace and motivation of employees

Adaptability: the ability to adapt and respond positively to changing environments and circumstances. It includes planning ahead while having alternative options in case things go wrong

Openness: the ability to be transparent, cooperative and collaborative as opposed to a central authority and secrecy.

(PMI, 2017; GPM, 2013; 2014).