Green Project Management in the Construction Sector in Greece

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Abstract: *Green Project Management is directly related to the practices of technical companies for the construction of technical projects based on a sustainable design with the central objective of minimizing or eliminating negative environmental impacts, saving resources and minimizing the use of non-renewable energy sources. This work is aims at investigating the current situation regarding the application of green administration and management of technical projects and highlighting the importance of this application in terms of limiting environmental pollution by the Technical Companies of the construction sector in Greece. The research was conducted by distributing a questionnaire to a random sample of 60 employees - engineers of Greek technical companies in the construction sector, with experience in the management of Technical Projects. The results of the research showed significant deficiencies in the application of green management practices of technical projects in Greece and in the improper use of raw materials and green products as well as serious deficiencies in the financing of construction companies.*

Keywords: green management, engineering projects, construction sector

INTRODUCTION: Contemporary Environmental Issues

Overexploitation of Natural Resources

Globally, natural resources are becoming scarcer every year as more people pursue consumption and demand a higher standard of living (Le Billon, 2013). As countries seek more resources to exploit operationally, there are dire impacts on planetary resources of all kinds: water resources, fossil fuels, trees, natural resources (includes soils, rocks, forests (vegetation), water (ocean, lakes, streams, seas and rivers), fossil fuels, animals (fish, wildlife and pets), minerals, sunlight and air).

Natural resources are categorized into renewable and non-renewable:

Renewable Natural Resources: Renewable resources are those that are consistently available regardless of their use. They can be adequately recovered or replaced after use. Examples include vegetation, water, air and living things. Renewable raw materials that come from living things (animals, plants), are called biological renewable resources, while those that come from non-living

things, such as the sun, water and wind, are called inorganic renewable resources (Nellemann & Corcoran, 2010).

Non-renewable natural resources: Non-renewable resources are those that cannot simply be replaced or recovered once used or destroyed, such as fossil fuels and minerals. Minerals are classified as non-renewable because, although they form naturally through the rock cycle, their formation periods last thousands of years. Some animals, mostly endangered species, are similarly considered non-renewable because they are on the brink of extinction (Dobbs et al., 2016). Non-renewable materials derived from living things such as fossil fuels are known as non-organic non-renewable resources, while those derived from non-living things such as rocks and soil are referred to as inorganic non-renewable resources (McNicoll, 2014).

Climate Change

Rising temperatures are causing the oceans to heat up and lead to changes in weather patterns and rainfall that threaten both urban and rural populations. The Australian Academy of Science defines climate change as the long-term change in the weather that causes various events, such as melting polar ice, rising sea levels and increasing the intensity of natural disaster (Australian Academy of Science, 2018). It is argued that climate change has a negative impact on human life; however, its impact could be significantly reduced by implementing three strategies, including supporting green transportation, building a green city, and implementing organic agriculture.

Environmental Pollution

Environmental pollution can be broadly classified into natural pollution and human-made pollution. In natural pollution, the environment is often polluted by natural phenomena, such as earthquakes, floods, droughts, cyclones, etc., while human pollution includes human activities. Environmental pollution can also be further classified into categories such as air pollution, water pollution, land pollution, food pollution, noise pollution and radioactivity.

World Population Growth

According to many researchers, the increase of the world population from 7 to 8.8 to 10 billion by the middle of the century is inevitable (Bongaarts, 2016; Zahid et al., 2016). This increase is due to high fertility in sub-Saharan Africa, whose population is projected to more than double in the next 40 years, and a modest 23% increase in the vast population of Asia.

THE CONCEPT OF GREEN PROJECT MANAGEMENT

Despite signs of significant growth, green development is not without challenges and barriers, the most common of which is the cost premium associated with going green. Although research varies on the increased cost of sustainable buildings, with studies yielding a green premium of 0-10% over comparable conventional projects, a survey of construction industry professionals by McGraw-Hill Construction (2006) indicates that the perception of higher costs is the most frequently cited barrier to sustainable development. Therefore, sustainable strategies must also make economic sense for green projects to be sustainable.

The growing demand for green construction, combined with the increased perception of risks associated with going green, means that project managers will be responsible for managing tighter budgets with tighter margins for green projects. Based on these trends it is argued that delivering a cost-effective green building project requires adjustments to conventional project management methodology. The aim is to present the most important adaptations in project management practices necessary to implement a green construction project within acceptable budget parameters, considering the risk analysis of the costs of green facilities.

Sustainability and Project Management

The term "sustainability" began with the beginning of human civilization. The concept of sustainable development considered as the overall umbrella related to human sustainability on planet Earth is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (United Nations General Assembly, 1987).

Sustainability is based on three main concepts. The first is thinking about the future and intergenerational responsibility, the second is thinking about the ecosystem and looking at the planet's ability to absorb waste and sustain life. The third is social justice, meaning the integration of human rights, stakeholder voices, dignity, equality and basic services. Consequently, it is possible for sustainability to be based on three pillars of environmental sustainability, economic sustainability and social sustainability.

Project Management in Achieving Sustainability

Businesses are responsible for taking measures to achieve sustainable development. In fact, achieving sustainability through business could be more successful. In addition, corporate practices, especially manufacturing companies are responsible for the majority of carbon dioxide emissions and excessive demand for natural resources and energy. Therefore, by enhancing the sustainability performance of these companies, it is possible to achieve a significant reduction in carbon dioxide emissions, the impact of climate change and make huge strides towards a more sustainable development (Labuschagn & Brent, 2007; Linnenluecke & Griffiths, 2010). Achieving sustainability at the company level, however, is not an easy task as most of these companies and businesses are profit oriented.

Benefits of Integrating Sustainability into Project Management

The benefits of integrating sustainability into project management could be seen in many ways. According to Clarkson et al. (2011), it could help to increase the value of the organization, create opportunities, eliminate / reduce risk, increase profit as well as reduce costs.

It is now becoming clear that sustainable project management will be the replacement of traditional project management as it includes future impacts that are considered when thinking about the project life cycle. The drive to integrate sustainability into project management varies but is highly influential in organizations. These drivers can be classified into environmental drivers that could improve the supply chain, social and ethical drivers related to the public image of the organization, legislative drivers as the number of countries implementing sustainability laws in their legal system increases and to their laws and finally to economic ones, such as cost savings that come from reducing materials and

energy use as well as better waste recycling. Many organizations are moving to incorporate sustainability into project management as the benefits of this application are more apparent.

ECONOMIC COST OF GREEN MANAGEMENT

It is important to explain the distinction between cost and profitability. Cost, in the context of construction projects, refers to the efficiency with which the project team constructs the deliverable. On the other hand, the profitability of the installation speaks to how well the business case of the project was developed and how well the cost / benefit of the deliverable was studied before the construction of the deliverable went live.

While most of the mainstream attention for green building focuses on its positive environmental impacts, research shows that a builder's decision to go green remains at the root of its economic viability. A survey of more than 400,000 architects, engineers and contractors by McGraw-Hill Construction (2006) found that the potential to reduce energy costs was chosen by 54% of respondents as the top reason for building green. In this study, only 24% of respondents stated that the value of green building to the environment was the driving force behind their involvement in the industry. When asked about barriers to green building, respondents chose higher upfront costs as the biggest barrier. Davis Langdon's (2004) study found that there are large differences in costs associated with sustainable projects and conventional projects.

Although the initial cost of green construction may be higher than conventional projects, it is widely believed that long-term cost savings in operations and maintenance can help recover these costs. Green buildings are expected to reduce operating costs between 8-9%, increase total building value by approximately 7.5%, and increase occupancy rates by 3.5% (U.S. Green Building Council, 2006). However, the benefits of operational savings may be less important to a for-profit developer who has no long-term interest in operating or leasing a building. For this reason, it is important that project managers develop strategies to contain costs during the initial phases of a project.

Green Project Management in the Construction Sector

A variety of terms are used for what "green" means in the construction industry, including green building, sustainable design, high performance buildings, whole building design, sustainable building and integrated design.

There is no single, widely accepted, definition of "green building", but in all definitions there are many common themes, such as: a) to minimize or eliminate the impact on the environment, resources and non-renewable energy sources to promote of the sustainability of the built environment, b) improve the health, well-being and productivity of residents and communities as a whole, and c) generate economic growth and economic returns for developers and entire communities.

RERSEARCH METHODOLOGY

The purpose of the research is the clear presentation of the current situation regarding the application of green administration and management of technical projects and the highlighting of the importance of this application in terms of limiting environmental pollution. Also, the investigation of specific ways to encourage or prevent a green management of construction projects.

Research Questions

The following questions are investigated:

o what extent is green management adequately implemented by Greek construction companies?
an the environmental footprint (environmental pollution) be significantly reduced by implementing (before, during and after) green management in construction projects?
hich practice emerges as the most important for limiting environmental pollution from the construction of technical works?
hich factor(s) influence the implementation of green management during the construction of technical projects?
hat are the reasons limiting the successful implementation of technical projects based on green management?

Considering the content of the research questions asked, it was deemed more appropriate for the needs of the study to conduct quantitative research based on a structured questionnaire. Our research sample consisted of 60 employees, engineers of Greek technical companies in the construction sector, with experience in the management of Technical Projects.

The questionnaire is divided into 4 parts. Initially, the first part concerns the demographic characteristics of the sample, such as gender, age, educational level, specialized studies in technical project management, position of responsibility in the service and work experience. The second part includes questions related to the current state of application of Green Management methods of technical projects in Greece. The third part includes questions related to pollution and the environmental footprint left by technical projects in Greece, while the fourth part of the questionnaire includes questions related to the factors influencing the Green Management of Technical Projects in Greece. The last 3 parts of the questionnaire contain Likert scale questions with graded options 'Not at all', 'A little', 'Moderately', 'Quite a lot', 'Very much' to provide better results.

RESEARCH RESULTS

The results of this research are based on the quantitative analysis of the responses of 60 participating engineers from the construction sector. In this section, the responses of the participants are presented with percentages and by section of questions, concerning demographic data, existing situation, technical projects and environmental pollution and factors affecting the green management of technical projects.

Demographics

In terms of gender, of the total of 60 participants, 70% were male and 30% were female, which may indicate that it is a more male than female industry. Regarding the age groups of the participants, it appears that ages 35 to 50 occupy 65% of the sample, while people under 34 years employ 25% with the remaining 10% being people over 50 years old. These results show that many participants can consciously answer and cover the research questions.

Regarding the level of education of the participants, it emerged that 67% have completed university or TEI level studies, while 30% prove that some of the participants hold postgraduate degrees. Holders of a doctorate degree amount to 3%, data showing that this industry requires more knowledge than basic education depending on a certain job position. Furthermore, their work experience in the construction industry is demonstrated by the fact that 42% of the participants have been working between 6 and 15 years, while 38% have been working for more than 15 years in the specific sector. Finally, 20% have been working for less than 5 years. In a general context, these data reveal a sufficient work experience of the participants in the construction sector, which shows that they are knowledgeable about the work subject and the situations and conditions that prevail in this work.

On the other hand, 64% of the participants revealed that they do not hold a position of responsibility, but 26% work or have worked as a department head. At the same time, 10% answered that they have been or are in a managerial position in their field. The fact that the majority is not in a position of responsibility may indicate that they are not dealing with situations from their base but combined with the years of experience of the participants, it appears that they are concerned with issues and settling specialized rather than broader issues. This means that participants can provide a variety of information on specific and general topics.

Current Situation in the construction sector

The second section of questions concerns the level of the degree to which they believe that the green management of technical projects is applied by the country's construction companies. 40%, which is a respectable percentage, responded that green management is applied to a small extent, while 23% to a normal extent. At the same time, 20% answered that it is not applied at all, while 10% said that it is applied a lot. Finally, 7% answered that green management is applied to a very large extent. These results indicate that there is a relative variety in the answers, which is justified by the respective company and the undertaking of projects it carries out. Despite this, the data show that the green management of technical projects in the country is not applied to a sufficient extent by the respective construction companies.

Regarding the companies' compliance with the upcoming legislation, 38% of the respondents answered that there is a large degree of compliance, while 29% that there is a very large extent, data that reveal the companies' compliance with the legal framework of such green applications administration. At the same time, 25% responded that there is compliance to a normal degree, 8% to a small degree, while none responded that there is no compliance with the relevant legislation.

Regarding whether the working groups are sufficiently informed about the coordination of their responsibilities, 43% of the participants answered that they are informed to a very great extent and 32% to a great extent. 12% answered that they are informed in a regular context, 6% to a small extent, while only 3% believe that the working groups are not informed at all. In a more general context, it seems that the companies sufficiently inform the work groups regarding the coordination of their work, a result that indicates the smooth functioning of the tasks.

Regarding the use of software for monitoring each project, 43% respond that there is little use, while 33% do not use it at all. Then, 21% answered that there is a normal use, 3% a high use, while no one answered that they think there is a very high use. These percentages demonstrate that the technological

use for the surveillance and control of such projects is particularly insufficient, since it occupies most of the participants.

Also, 32% of the respondents regarding the appropriate use of raw materials to save costs responded that a little appropriate use is made, resulting in no cost reduction and 28% that it is not used properly at all. Then, 21% considered that there is normal use, while 16% that it is mostly done. Finally, only 3% answered that the use of raw materials is done to a very large extent, which shows that in a wider context, raw materials are not used to reduce the labor costs of the projects.

Regarding the use of systems for the management of factory waste in each project, 39% respond that there is little use, while 36% do not use it at all. Then, 21% answered that there is a normal use, 4% heavy use, while no one answered that they think there is a very heavy use. These percentages show that the use of industrial waste management systems is particularly insufficient.

Regarding energy savings during the construction phase of each project, 39% respond that there is little use, while 27% do not use it at all. Then, 26% answered that there is a normal use, 8% a high use, while no one answered that they think there is a very high use. These percentages show that the energy saving during the construction phase is insufficient.

Technical Works and Environmental Pollution

This section aims to collect additional information on technical projects and environmental pollution. More specifically, the first question of this thematic section concerned the extent to which they believe that there is a limitation in the environmental footprint of a technical project through their adoption of green management, after the completion of its construction. Of the engineers surveyed, 55% responded that green management reduces the environmental footprint to a very large extent, with 32% agreeing that it reduces it to a very large extent. Importantly, only 13% answered that it limits it to a normal extent, while none answered that the environmental footprint is not affected at all or a little, an element that indicates the importance of green administration and management of technical projects.

In relation to the question to what extent they believe that the application of green management of a technical project affects the environment after delivery and the duration of its operation and use, 40% answered that it affects to a very large extent and 30% usually degree. 20% of the participants believe that it affects to a normal extent and only 10% believe that it affects a little. From the majority of the answers, it follows that the green management of the projects has a direct effect on the limitation of environmental pollution.

The last question of this section concerns the classification of some green management practices regarding the construction of a technical project and regarding their importance in limiting the environmental footprint of each project. Of the participants, 45% classified as the most important practice the initial design of the project, while 35% the use of appropriate construction materials and construction techniques. 13% considered the use of appropriate software to monitor the project as an important practice, while 7% identified informing, training and collaborating with construction teams as an important practice. Although all the practices are important and key, the small percentage regarding the use of appropriate software is also justified by the absence of this practice as revealed in the above presentation of the results. Furthermore, the fact that 7% considered the information,

specialization and cooperation of the construction teams as important is also justified by the fact that this practice seems to be applied largely by the respective company and, therefore, for the majority it is not practice of current importance.

Influencing Factors of Green Engineering Project Management

This thematic section is related to the factors that possibly influence the green management of engineering projects and by extension the first question concerns the extent to which certain factors can ensure a better application of green management in the construction of an engineering project in the opinion of the participants. Therefore, regarding the factor of the current legislative framework and the element to what extent it affects green management, 35% answered that it affects it a little, 28% that it does not affect it at all, 20% that it affects it to a normal extent and 10% that it affects her a lot. This may be since the legislation does not fully cover such green management tasks.

Regarding the factor of the company's conscientiousness, 40% of the respondents consider that it influences the implementation of green management, with 22% revealing that it influences it to a normal degree. At the same time, 17% consider that it affects it to a very large extent, 13% to a small extent and only 8% consider that conscientiousness does not affect the effectiveness of the implementation of green management at all. These percentages show that the attitude of each company affects the efficiency of the way of applying green management in the construction of technical projects.

Another factor that was analyzed is that of the public being informed about environmental issues, for which 43% consider that it influences to a normal extent, 22% to a small extent, 20% to a very large extent, 8% to a very large degree and finally 7% believe that it does not affect at all. In a more general context, the factor of conscientiousness is judged to be particularly important for the sample participants.

The last question relates to the extent to which the respondents consider that some other specific factors can be an obstacle to the application of green management in the construction of a technical project. More in detail, the factor of the existence of competition between the various construction companies was judged as not at all important by 35% and as a little important by 33% of the participants. On the other hand, the factor of the insufficient funding of each project affects to a very large extent the implementation of green management as answered by most of the sample, which amounts to 52%. 37% of them considered that it affects her a lot and, finally, 12% that it affects her to a significant extent.

Another factor is the bargaining power of suppliers, which normally affects the implementation of such projects as 30% emphasizes. On the other hand, 23% report that it affects a lot, 20% a little, 15% very much while 12% not at all. The fact that the answers vary, and the percentages are quite close can be justified by the fact that each company manages the negotiations differently. Finally, the last factor that can influence the successful implementation of the green management of a technical project is the suffocating project delivery schedules, since 45% consider that it influences to a very large extent and 38% agree judging that this factor affects greatly. Still, 13% consider it to influence to a normal degree and, finally, only 3% that it influences a little. These data imply that the factor of strict schedules can

be an important limiting factor for the application of green management in the construction of technical projects.

CONCLUSIONS

From the quantitative analysis of the responses of the 60 participants in the sample of this research, the importance of green administration and management in the construction of technical projects emerged with the aim of limiting the existence of an environmental footprint and pollution. In the first stage, the respondents are characterized by basic to advanced experience in their subject and therefore they can answer with competence and completeness, since they often encounter the management of such projects. Initially, it seemed important to have more applications of green management in the construction of technical projects, because it proved to be a relative lack.

Furthermore, participants largely recognize the importance of green project management. However, most of engineers identified the absence of the use of software to monitor the projects, which can hinder the smoothness of the technical project progress. Despite the absence of such use, it appears that there is sufficient awareness of the working groups regarding the coordination and execution of such tasks. This condition is particularly important and positive, as it is one of the key success factors of such a project.

At the same time, it emerged that the companies do not use the raw materials correctly, with the result that this type of technical work is particularly expensive. Combined with the major influencing factor in the implementation of such projects, which is the underfunding of the green management of technical projects, it could be said that the projects end up being characterized by very high costs. This results in the reluctance of companies to implement such practices.

Another important finding is that the implementation of green administration and management of the projects greatly reduces the environmental footprint, a fact of prominent importance since these projects have a direct impact on the environment through the effect of pollution. Within this context, it emerges that the most important practices, expressed by the participants, to limit the environmental footprint are the initial planning of the coordination and implementation of the technical project, but also the use of appropriate construction materials and construction techniques.

Another important element that became apparent is that the conscientiousness of each company, along with its attitude, greatly influences whether green management will be applied at the start, process and end of the technical project. Finally, the effectiveness of green management implementation is equally affected by tight schedules, as they can negatively affect the progress and quality of the project.

Research Limitations & Future Research

Finally, it is considered necessary to point out that the present research has clear limitations since, due to the relatively small sample, the conclusions for all Technical Companies in Greece can only be indicative. To draw universal conclusions, it is necessary to carry out wider research covering all the Technical Companies of the construction industry in Greece.

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