



CHALMERS

Chalmers Publication Library

Approaches to Safeguarding Sustainability Requirements in Public Construction Projects – the Client’s Perspective

This document has been downloaded from Chalmers Publication Library (CPL). It is the author’s version of a work that was accepted for publication in:

CIB World Building Congress 2016

Citation for the published paper:

Adam, A. ; Lindahl, G. (2016) "Approaches to Safeguarding Sustainability Requirements in Public Construction Projects – the Client’s Perspective". CIB World Building Congress 2016

Downloaded from: <http://publications.lib.chalmers.se/publication/237351>

Notice: Changes introduced as a result of publishing processes such as copy-editing and formatting may not be reflected in this document. For a definitive version of this work, please refer to the published source. Please note that access to the published version might require a subscription.

Chalmers Publication Library (CPL) offers the possibility of retrieving research publications produced at Chalmers University of Technology. It covers all types of publications: articles, dissertations, licentiate theses, masters theses, conference papers, reports etc. Since 2006 it is the official tool for Chalmers official publication statistics. To ensure that Chalmers research results are disseminated as widely as possible, an Open Access Policy has been adopted. The CPL service is administrated and maintained by Chalmers Library.

(article starts on next page)

Approaches to Safeguarding Sustainability Requirements in Public Construction Projects – the Client’s Perspective

Abderisak Adam

Construction Management, Chalmers University of Technology
email: abderisak.adam@chalmers.se

Göran Lindahl

Construction Management, Chalmers University of Technology
email: goran.lindahl@chalmers.se

Abstract

In recent years, the concept of sustainability has penetrated much of modern political, social and industrial discourse. Its recent popularization, stemming from the Brundtland report of 1987, has led to sustainability becoming a household term in nearly every industry, of which the construction sector is no exception. Considering the importance that sustainability has in the construction industry, and how it is particularly emphasized in construction financed by public funds, questions need to be raised in terms how capable the construction client is in meeting and achieving the sustainability requirements, often set by politics, that exist whilst safeguarding project delivery. The study is based on four interviews targeting public clients in Sweden and it investigates how sustainability requirements are managed in large public construction projects. What is of particular interest is the degree to which public client organizations either develop or procure systems/staff to ensure that the criteria for social, environmental and cultural sustainability are maintained and that the consequences of different approaches are managed. The results support the idea of having a multifaceted approach to sustainable construction, arguing that terms such as social and cultural sustainability may instead be dealt with separately from the more strictly defined sustainability terms of toxicity, waste and energy consumption. There is also a suggestion that once the client organization begins incorporating a sustainability mind-set in all of its affairs, members of that organization may begin working with sustainability on a perfunctory basis without necessarily understanding the underlying reasons for their actions. Finally, the challenge with sustainability is perhaps not so much that there is a lack of capability as much as there is a lack of resources for working with sustainability.

Keywords: sustainability, public client, requirements, capability

1. Introduction

It would be hard put to find an industry which does not find itself affected by the requirements that follows from the sustainability concept. As a strategic issue, sustainable development alongside social responsibility are now important considerations for companies in nearly every industry (Fiksel, 2006). In light of the movement toward sustainability, it has become commonplace for governmental institutions to conceive of grand visions and plans relating to sustainability, but as Wheeler (2000) points out, these are unlikely to come to fruition absent the necessary external pressure from social movements, nongovernmental organizations and the development of a coalition of interest that serves to strengthen the necessary political backing. More significantly, while there has been strong interest in sustainability as it relates to urban development, there has been a lack of clarification as to what constitutes as sustainable in the public construction context, most notably in relation to infrastructure projects. Questions regarding how sustainability can be quantified and the key contributors of sustainability in the urban context have all, to a large degree not been dealt with (KPMG, 2012).

Sustainability in construction is a comprehensive topic with many different facets; it includes a range of topics from air, water and noise pollution to ecological impacts (Shen, et al., 2007). Time delays have a direct impact on sustainability since as an increase in project delivery time is associated with traffic congestion, economic activities being disrupted, increased pollution, damage to ecosystems, and an impact on existing infrastructure systems (Gilchrist & Allouche, 2005). The sheer scale of the industry offers further testimony to the importance of considering the impacts of sustainability. In the European Union alone, it is estimated that the construction industry employs 11.8 million people directly, making it Europe's largest industrial employer accounting for approximately 28 % of industrial employment in the EU-15 (Ortiz, et al., 2009). In addition to this, the construction industry is responsible for nearly 40 % of the total energy consumption thereby cementing its role as a major contributor to the proliferation of greenhouse gas emissions (Abbas, et al., 2009). By the same token, the construction sector is responsible for other types of environmental problems, including both internal and external pollution as well as environmental damage and resource depletion (Ortiz, et al., 2009). With steadily rising populations, and significantly larger shares of people relocating to cities as urbanization rates continue to soar, one can only expect the environmental impact to become further exacerbated in the years to come. This sentiment is certainly shared by the UN as shown in a recent report stressing the sustainability challenges that continued urbanization will pose on society and its disproportionate effect on urban dwellers in the lower socio-economic strata (UN, 2014).

Contractors and consultants are primarily concerned with financial gains. It is therefore hardly noteworthy that these actors opt to adhere to sustainability regulations on the basis of it being a secondary concern. After all, current research shows no direct correlation between short-term business competitiveness and sustainability performance although there are certainly grounds for contending that such an advantage could emerge from a long-term perspective (Tan, et al., 2011). It has been a standard belief among contractors that environmental performance accrues more costs than the proposed benefits it brings. Despite this, improvements in environmental

performance in construction has been on the rise, specifically with respect to the handling of waste and its harmful effects on the environment (Shen & Tam, 2002).

This leaves the public client, the one actor whose prime objective is to represent the public interest of which the concept of sustainability plays an increasingly more important part (Raisbeck & Wardlaw, 2009). There has been a growing interest for investigating the role that the client has in relation to sustainability. Although there is no shortage of studies investigating the client's role in this regard, the research space has been dominated by studies focusing on sustainability policies that occur at a macro-level, in the realms of politics. This is made evident by likes of Chen and Chambert (1999), Deakin et al. (2002) and Melchert (2007). The importance to address sustainability at this level seems fairly intuitive due to the vast influence of governmental institutions, its importance is thus hardly a matter of contention. The study of sustainability related issues at a lower level than that of politics, as in examining the role of local public client organizations, does not occur in lieu of studying the political level but rather in addition to it. It is vital to ensure that sustainability issues are properly managed by the public recipients of said policies just as it is important for the policy makers themselves to formulate sensible requirements. Authors such as Ugwu and Haupt (2007) and Bröchner et al. (1999, p. 371) have examined the usefulness of the performance concept vis-à-vis sustainability and in the case of the former found that indicators for sustainability performance constitute an important first step in bridging the gap between global sustainability aspirations and local micro-level decision-making; and in the case of the latter that "there is an inescapable need for competence among those who formulate, monitor and follow performance requirements." This echoes the broader call that has been made for improving the capabilities of the client organization (Adam et al., 2014; Manley, 2012). In light of this inescapable need for competence, questions need to be raised in terms how capable the construction client is in meeting the sustainability requirements that are often dictated by politics without jeopardizing project delivery. This study attempts to address this inquiry. What is of particular interest is the degree to which public client organizations either develop or procure systems/staff to ensure that the criteria for social, environmental and cultural sustainability are maintained and how the consequences of different approaches are understood and managed.

2. Research method

The study is based on a set of interviews targeting public clients in Sweden and it investigates how sustainability requirements are managed in large public construction projects. What is of particular interest is the degree to which public client organizations either develop and organize or procure systems/staff to ensure that the criteria for social, environmental and cultural sustainability are maintained and that the consequences of different approaches are managed. In order to investigate this, a large public Swedish client organization was studied, henceforth referred to as PubClient. The study consisted of interviewing the manager responsible of energy and environmental related concerns. The results of the one-hour interview took place in one the facilities of PubClient and were then transcribed and analyzed. Additionally, three supplementary phone interviews were conducted for three different client organizations active in the Swedish construction industry. The objective of these phone interviews was to provide additional information and also assess to which degree the results obtained from PubClient were relevant in

other public construction client organizations. Although a small sample of interviewees, the respondents were all representatives on a management level in a large city and thus covered the main organizations in this particular context. There is a risk of low validity of the data, however, as one key aspect of the data is descriptive the complementing telephone interviews can be seen as triangulation of the main interview data.

2.1 Overview of PubClient

PubClient procures and manages the construction of public facilities and the refurbishment of facilities on behalf of the municipality. With a combined floor space exceeding two million square meters and a total land area exceeding five million square meters, PubClient stands as one of the nation's largest public construction organization with a yearly expenditure hovering around one billion SEK. PubClient objectives include a variety of tasks, the main ones can be reduced to five:

- i. Ensure good property management, which includes the management of land, buildings, installations and maintenance.
- ii. Provide appropriate business premises and good service.
- iii. Develop energy-saving measures.
- iv. On behalf of the municipal government and customers, plan and build/rent new facilities or rebuild existing ones.
- v. Administratively coordinate the Municipality's common building processes.

Aside from stating energy saving measures as one of its chief objectives, PubClient has consistently worked to initiate environmentally conscious procedures in all of its projects. This is due to a number of reasons, chiefly that they as a public organization should "do good" as they build and run their own maintenance with a long time perspective. Beginning from 2009-2010, all of PubClient's newly built facilities were required to be of the low-energy consumption variety. This follows a larger trend in the country of building facilities that utilize less energy and that are more environmentally friendly. However, what sets PubClient apart in this area is not merely its scrupulousness in following government stipulated regulations but its insistence to follow internal regulations that are even more stringent than those demanded by the government. As such, the organization has received accolades for its role in actively working with sustainably issues in all of its affairs.

3. Sustainability as a concept

The modern concept of sustainability is based on the Brundtland commission report of 1987. It cemented the importance of sustainability in social and environmental affairs and gave birth to the commonly accepted definition of sustainable development as the development "that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Toman, 2006, p. 3).

Not long thereafter, the rising discourse on sustainability began to find its place in the area of construction. It also began to alter the established nomenclature, terms such as "green" building,

became readily available and began to be associated with a number of positive outcomes, from lower overhead costs to higher employee productivity. This development can trace its origins to the idea of “sustainable construction”, a term coined in conjunction with the first world conference for sustainable construction held in Tampa, Florida in 1994 (Miyatake, 1996). It was there where Kibert (1994), the convener of the conference, suggested that sustainable construction consisted of six principles: I). Reducing resource consumption. II). Improving resource reuse. III). Begin using renewable or recyclable resources. IV). Safeguard the natural environment. V). Maintain a healthy, nontoxic environment and VI). Strive towards achieving quality in construction.

Like much of the discourse surrounding sustainability, the term sustainable construction has been contested. Though widely adopted by the construction community, as exemplified by the works of Ding (2008), Hill and Bowen (1997) and Kibert (2012) it has not been without detractors. Much of the critique rests on the apparent incompatibility of the phrase “sustainability” on the one hand which carries the connotation of something infinitely replenishable and the term ‘construction’ on the other hand which is by its very nature finite (Goodland, 1995). In order to avoid potential semantic disputes of what sustainability actually refers to and how it ought to be conceived in the context of construction, we opt for the definition put forward by Presley and Meade (2010) where sustainable construction is used to describe not only the construction phase of the actual projects but also all of the aspects surrounding it such as those imposed on social systems, transportation, waste management and so forth. The term ‘green building’ is used interchangeably, as is conventionally the case (Kibert, 2012; Presley & Meade, 2010; van Bueren & Broekmans, 2013).

3.1 Systems for complying to sustainability criteria

A range of different methods/systems have been developed to allow construction organizations to build in accordance with sustainable construction. These frameworks, such as the one developed by Presley and Meade (2010) is geared primarily toward contractors as a way to evaluate their sustainability performance by taking into account both strategic and activity-based criteria using well-established practices such as activity-based management, balanced scorecard, and multi-attribute decision models. Similarly, various organizations have begun issuing certifications ensuring that its holder have met certain criteria for the energy consumption of the building project as well as its water use, material use and indoor environmental quality. In Sweden, FEBY provides one such framework. Other certifications include, among others: Green Star (Australia); LEED Canada (Canada); DGNB Certification System (Germany); IGBC Rating System (India); Comprehensive Assessment System for Building Environmental Efficiency (Japan); Green Star NZ (New Zealand); Green Star SA (South Africa), BREEAM (UK), and LEED (US) (Azhar, et al., 2011). In a similar vein, Environmental Management Systems (EMS) have become a significant tool for achieving sustainable development in construction. As important as it may be, one should be weary of treating it as a panacea. Although EMS have been linked with a positive influence on environmental outcomes, it is also apparent that abiding by an EMS alone is not sufficient in guaranteeing optimal environmental performance (Lam, et al., 2011). Aside from its apparent use as a way to improve environmental performance, these systems are also employed in order to maintain compliance with environmental regulations, curb environmental costs, reduce risk and train employees. Typically, an EMS contains guidelines on

policies, goals, systems for handling information, task lists, emergency plans, audits, regulatory requirements, and annual reports (Christini, et al., 2004). Although numerous EMS have been proposed, none have had an impact as great as the ISO 14000 series. This series of standards emerged as a by-product of the General Agreement on Tariffs and Trade (GATT) negotiations and the 1992 Rio de Janeiro summit on the environment (Kein, et al., 1999). The ISO 14001 constitutes the standard for developing an EMS, the rest of the standards in the series offer guidance and supporting documentation. In total since the end of 2013, over 300,000 certificates for ISO 14001 had been granted in 171 countries of which China, Italy and Japan stood out as the most prolific receivers of certificates (ISO, 2013).

4. The clients' responses

The importance of upholding sustainable ideals, especially with respect to the environment has become of paramount importance for construction clients. In the case of PubClient, the interviewee insisted that public client organization need to be at the forefront of the sustainability issue leading the way for the other actors in the industry. The client, and the public client in particular has the opportunity to play a significant role in advocating for the benefits of green construction, both through regulatory mechanisms as well as through raising awareness of 'best practices' with green construction. The challenges in upholding sustainable construction lies partly in the vastly different skillset, resources and capabilities that are required when adhering to green construction principles (Mokhlesian & Holmén, 2012). However, for PubClient, this viewpoint was somewhat contested:

A project manager is supposed to know lots of other things, why shouldn't they be able to know these questions [i.e. sustainability]? It's not that much... It's not like you need to be a chemist or anything. It's fairly basic capabilities that one needs. But one has a bit of... I like to say that sometimes the "environment ghost" is looming in the corner and as soon as it is about the environment, everyone is all: I can't do this! But then you start to talk about it: but it's about these things! O, but I think I've got this, is this all that is to it? I think that in my field, it [i.e. sustainability] must become a natural part of everyone's roles, to know these areas. (*Development Manager of Energy and Environment for PubClient*)

The main contention here being that although environmental issues may demand a different skillset, nonetheless, project managers are inherently expected to have a varied skillset. Why then should sustainability not fall under this already wide umbrella?

The challenge of capability improvement becomes an even greater concern when taking into consideration the emergence of the performance approach. This approach essentially shifts governmental regulations from specifying technical requirements for products and materials to instead specifying the desired outcome of those products. The performance approach has been described as conducive to increasing the propensity for innovation in that it allows contractors a higher degree of freedom in how they wish to meet the stated requirements (Pries & Janszen, 1995). The reason why the development of capabilities becomes a great concern in regards to the performance approach is due to heightened need for competence in expressing, interpreting and monitoring the requirements that have been stated in terms of performance. This argument is echoed by Bröchner et al. (1999) who further add that the performance approach demands both acquiring and managing technical, environmental and administrative knowledge. Additionally, test methods and acceptance criteria need to be defined, a process that requires competence. The construction client can thus tackle the issue of sustainability from different angles, depending on the level that is of interest. Essentially, these measure can be grouped into either external actions that relate to parties outside of the inherent organization or internal actions that seeks to address the organization's own internal procedures.

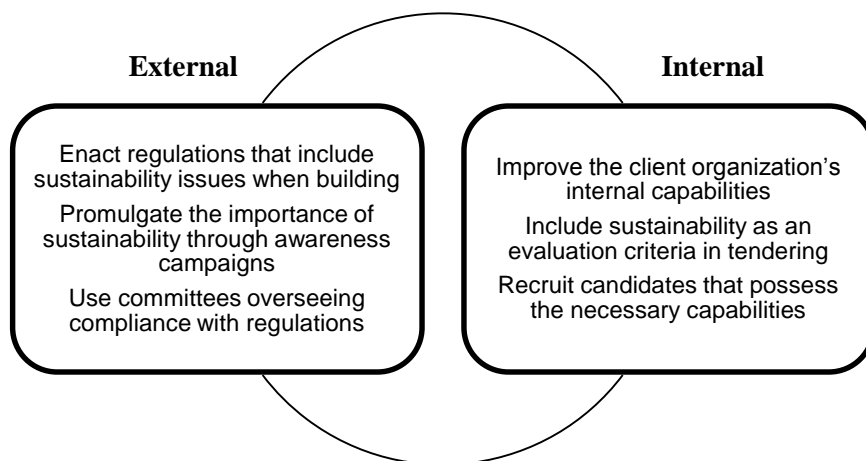


Figure 1: Approaches to safeguarding sustainability requirements, external and internal.

Bröchner (1999) as well as Mikhlesian and Holmen (2012) among others make the point that competence is at the heart of a successfully implemented environmental system. Building on this notion, one might take it further and state that the given EMS that the client organization uses is merely a reflection of its competencies. The more competent the organization and the individuals who partake in it, the more pertinent the environmental systems ought to be for its intended purposes. Therefore, it would seem that the optimal solution would be one that incorporates the different systems that are available to the client. It is not a singular holistic approach, but rather a diversified strategy that employs different systems where they are appropriate. This line of thinking goes against what seems to be the prevalent paradigm for clients in the Swedish construction sector where sustainability is often regarded as a monolithic issue, as made evident by the common structure of having widely different areas such as energy efficiency, toxicity, safety, social sustainability and cultural sustainability in the same division. The latter two are

particularly difficult to grasp as they seem to involve a subjective dimension which is more difficult to comprehend.

It is as you say, a lot more difficult [to manage social/cultural sustainability]. It seems to be about primarily perceived values that are much more difficult to grasp than if one has used this type chemical or not, that's more black and white. (*Development Manager of Energy and Environment for PubClient*)

You have no metrics [on social/cultural sustainability] what so ever. It is a bit of trumpery, really! The energy issues are a lot easier [...] it is easier to place a metric on it. (*Environment and Energy coordinator for the Municipality*)

A proposed response to this is to specify separate personnel that deal exclusively with those issues or the more preferred option of creating an environment in which these sustainability considerations become an accepted part of the project manager's role.

I feel that everyone still needs a lot of support in regards to environmental and energy related issues and [they] regard it as a separate issue whereas I would argue that it is a natural part of any type of role. In the long term, I would say that we need far less support for capabilities in those areas. As project managers, most environmental issues should be obvious. (*Development Manager of Energy and Environment for PubClient*)

This shift in mentality would essentially reduce or do away with specialized organizational units that deal with these issues. Instead opting for a solution where the project managers are expected to possess the capabilities needed to safeguard sustainability requirements themselves. This can also be viewed in light of the past changes that has occurred in the construction industry in regards to environmental concerns. Initially, such questions were often met with resistance by actors in the industry who questioned the soundness of more sustainable ways of building.

The trend is essentially the same in the construction industry or the real estate industry. Although the public sector had even prior to this had it easier in discussing these types of questions, I think that there is a huge difference today. For example, energy-efficient construction, when we started there were many who did not believe in it at all, [claiming] you would construct bad buildings. That debate is surely not as prevalent. [...] Now, I'd say that there's a great upswing regarding all these environmental issues for everyone. No one thinks it's weird to talk about biodiversity anymore which if you were to mention it in 2008, it was almost a bit nonsensical. But certainly in public organizations, I do not think that there is a single public [organization] that we have contact with, a property owner, who is not working with these questions and considers them important. (*Development Manager of Energy and Environment for PubClient*)

There are two notes that relate to this quote, firstly that although public organizations may be working with these issues, it would seem that the private sector has a more organized way of working as evident by one interviewee saying:

Large [contracting] companies have worked with sustainability questions in a more structured way. (*Sustainability strategist for a municipal company*)

Secondly, that the state of the sustainability issue went from being something that is questioned to something that is obvious and part of every task in the organization. What occurred beyond this, however, shows a rather peculiar shift. Once environmental concerns had become a natural part of the organization, it was no longer viewed as a differentiating attribute of that organization. Initially, PubClient's project managers were fully cognizant of the importance of keeping sustainability in mind in all matters as this was a core issue that permeated much of the organization.

There are a lot of new project managers [of ours] who can barely understand that we build the most energy efficient buildings in Sweden! We have very clear instructions and requirements [internally] and so on which they adhere to, but they do not get an understanding for what it is and what it really means. (*Development Manager of Energy and Environment for PubClient*)

From this, there seems to be an indication that as the organization becomes more capable in working with sustainability related issues, the more fluent it is in formulating stipulations and requirements to adhere to sustainability requirements. However, once the organization has worked with these issues for a sustained amount of time, they become part of the everyday mode of operation as opposed to something novel. This shift may then result in the members of the organization working with these issues in a perfunctory fashion without much forethought in why the work is carried out in the way that is.

Another reoccurring theme in the interviews was the tendency to regard the sustainability issue as one that could be easily managed if there was more awareness of the issue. The interviewees mostly rejected the notion that there was a lack of capability in the organization for how to work with the sustainability. There seemed to be an insistence on downplaying the technical skills required to work with sustainability related issues. Instead, they would point to a lack of awareness as the primary issue that needed to be addressed.

Yes, I think so (i.e. that the organization is capable to handle sustainability issues). However, I do think that if one wants to get more results then there is a need for more people to work with these matters [...] I mean it's not a difficult science [...] I believe that the capability exists, that's my experience at least. If you look at [client organizations] in the city, I think there is tremendous capability [...] we have knowledge, I think everyone knows what it is about. I don't think we can get more knowledge, it is about finding more in the organization and really go through with it and receive enough resources and money to be able to go through with it. (*Environment and Energy coordinator for the Municipality*)

Instead of viewing the challenge of sustainability as a capability issue, perhaps it should be viewed as a questions of resource allocation. In order to work with this issue in an efficient matter, more resources, basically, need to be allocated to it. Or, by embedding sustainability in everyday work it becomes a discreet capability, it becomes something that is simply a part of the everyday work's starting point.

5. Concluding thoughts

Sustainable construction is essentially an umbrella term that contains a wide range of different activities that aim to improve the production and the outcome of construction projects in a way that ensures that long term effects are considered. Not only with respect to the environment but also to society. Although issues such as waste management, noise reduction and preserving the biodiversity of a local ecosystem could all fall under sustainable construction, these issues have few things in common both in their technical details as well as their strict relevance to construction. This invites one to ask: does it make sense to feature social sustainability, cultural sustainability and environmental sustainability under the same department? Much of environmental sustainability can be measured in hard figures, particularly with respect to pollution, and could essentially fall under quality assurance, whereas social and cultural sustainability cannot be measured easily and are handled using more qualitative assessments.

This study would also suggest that although the capability required to manage sustainability issues does not necessarily need to be extensive, there is however a need for increasing the resources required for managing sustainability in a more efficient manner.

The construction industry's fragmented structure dictates that any change that occurs needs to do so in the entire supply chain of actors for it to have any fruitful effect on the industry as a whole. It would similarly seem that a multifaceted approach for managing sustainable construction would too require that the different actors be involved. Environmental issues are treated as constraints, a necessary evil that must be addressed instead of a factor of equal importance to that of financial concerns and project delivery. At the same time, it is important not to downplay the shift towards a more sustainability-driven thinking that has slowly but unrelentingly found its way into the practices of the construction industry. From energy efficient houses to methods of production that involve burning fewer amounts of fossil fuels. This is all commendable and few would argue the contrary. The point of interest lies in finding ways to continue the trend of incorporating and embedding sustainability to the operations of the organization. However, what this study shows is that when the client organization does so and working with sustainability issues becomes part of the established modus operandi, there is a risk that the members of the organization work with these issues in a perfunctory way without understanding what they are doing and why they are doing it. If this is a development that should be regarded as troubling or merely the expected culmination of incorporating sustainability in all affairs remains to be seen. What can be said however is that the increased incorporation of sustainability will significantly alter the way in which that organization operates and the way that it is structured.

References

- Abbas, E., Czwakiel, A., Valle, R., Ludlow, G. and Shah, S., 2009. The practice of sustainable facilities management: Design sentiments and the knowledge chasm. *Architectural Engineering and Design Management*, 5(1-2), pp.91-102.
- Adam, A., Lindahl, G., & Josephson, P. E. (2015). Developing Capabilities for Public Construction Clients. In *Proceedings of the 19th International Symposium on Advancement of Construction Management and Real Estate* (pp. 737-745). Springer Berlin Heidelberg.
- Azhar, S., Carlton, W. A., Olsen, D. & Ahmad, I., 2011. Building information modeling for sustainable design and LEED® rating analysis. *Automation in construction*, 20(2), pp. 217-224.
- Bröchner, J., Ang, G. K. & Fredriksson, G., 1999. Sustainability and the performance concept: encouraging innovative environmental technology in construction. *Building Research & Information*, 27(6), pp. 367-372.
- Chen, J. J. & Chambers, D., 1999. Sustainability and the impact of Chinese policy initiatives upon construction. *Construction Management & Economics*, 17(5), pp. 679-687.
- Christini, G., Fetsko, M. & Hendrickson, C., 2004. Environmental management systems and ISO 14001 certification for construction firms. *Journal of Construction Engineering and Management*, 130(3), pp. 330-336.
- Deakin, M., Huovila, P., Rao, S., Sunikka, M. and Vreeker, R., 2002. The assessment of sustainable urban development. *Building Research & Information*, 30(2), pp.95-108.
- Ding, G. K., 2008. Sustainable construction - The role of environmental assessment tools. *Journal of environmental management*, 86(3), pp. 451-464.
- Fiksel, J., 2006. Sustainability and resilience: toward a systems approach. *Sustainability: Science, Practice, & Policy*, 2(2), pp. 14-21.
- Gilchrist, A. & Allouche, E. N., 2005. Quantification of social costs associated with construction projects: state-of-the-art review. *Tunnelling and underground space technology*, 20(1), pp. 89-104.
- Goodland, R., 1995. The concept of environmental sustainability. *Annual review of ecology and systematics*, Volym 26, pp. 1-24.
- Hill, R. C. & Bowen, P. A., 1997. Sustainable construction: principles and a framework for attainment. *Construction Management & Economics*, 15(3), pp. 223-239.

ISO, 2013. The ISO Survey of Management System Standard Certifications – 2013: Executive Summary, u.o.: International Organization for Standardization.

Kein, A. T. T., Ofori, G., IV, B. & E, C. L., 1999. ISO 14000: its relevance to the construction industry of Singapore and its potential as the next industry milestone. *Construction Management & Economics*, 17(4), pp. 449-461.

Kibert, C. J., 1994. Establishing principles and a model for sustainable construction. Tampa, United States, Proceedings of the First International Conference on Sustainable Construction (pp. 6-9)

Kibert, C. J., 2012. *Sustainable Construction: Green Building Design and Delivery: Green Building Design and Delivery*. 3rd red. Hoboken, US: John Wiley & Sons.

KPMG, 2012. *Cities Infrastructure: A Report On Sustainability*, u.o.: KPMG International Cooperative.

Lam, P. T. o.a., 2011. Environmental management system vs green specifications: How do they complement each other in the construction industry? *Journal of Environmental Management*, 92(3), pp. 788-795.

Manley, K., 2006. The innovation competence of repeat public sector clients in the Australian construction industry. *Construction Management and Economics*, 24(12), pp. 1295-1304.

Melchert, L., 2007. The Dutch sustainable building policy: A model for developing countries? *Building and Environment*, 42(2), pp. 893-901.

Miyatake, Y., 1996. Technology development and sustainable construction. *Journal of Management in Engineering*, 12(4), pp. 23-27.

Mokhlesian, S. & Holmén, M., 2012. Business model changes and green construction processes. *Construction Management and Economics*, 30(9), pp. 761-775.

Ortiz, O., Castells, F. & Sonnemann, G., 2009. Sustainability in the construction industry: A review of recent developments based on LCA. *Construction and Building Materials*, 23(1), pp. 28-39.

Presley, A. & Meade, L., 2010. Benchmarking for sustainability: an application to the sustainable construction industry. *Benchmarking: an international Journal*, 17(3), pp. 435-451.

Pries, F. & Janszen, F., 1995. Innovation in the construction industry: the dominant role of the environment. *Construction management and economics*, 13(1), pp. 43-51.

Raisbeck, P. & Wardlaw, S., 2009. Considering client-driven sustainability in residential housing. *International Journal of Housing Markets and Analysis*, 2(4), pp. 318-333.

Shen, L. Y., Li Hao, J., Tam, V. W. Y. & Yao, H., 2007. A checklist for assessing sustainability performance of construction projects. *Journal of Civil Engineering and Management*, 13(4), pp. 273-281.

Shen, L. Y. & Tam, V. W., 2002. Implementation of environmental management in the Hong Kong construction industry. *International Journal of Project Management*, 20(7), pp. 535-543.

Tan, Y., Shen, L. & Yao, H., 2011. Sustainable construction practice and contractors' competitiveness: A preliminary study. *Habitat International*, 35(2), pp. 225-230.

Toman, M. A., 2006. The difficulty in defining sustainability. *The RFF Reader in Environmental and Resource Policy*, Volym 2.

Ugwu, O. O. & Haupt, T. C., 2007. Key performance indicators and assessment methods for infrastructure sustainability—a South African construction industry perspective. *Building and Environment*, 42(2), pp. 665-680.

UN, 2014. *World Urbanization Prospects: The 2014 Revision, Highlights (ST/ESA/SER.A/352)*, New York, USA: Department of Economic and Social Affairs, Population Division.

van Bueren, E. & Broekhans, B., 2013. *Individual Projects as Portals for Mainstreaming Niche Innovations. i: Constructing Green: Sustainability and the Places We Inhabit*. Boston, US: MIT Press, pp. 145-167.

Wheeler, S. M., 2000. Planning for metropolitan sustainability. *Journal of planning education and research*, 20(2), pp. 133-145.