



CHALMERS

Chalmers Publication Library

Corporate environmental strategies and performance: A longitudinal study.

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:

Proceedings 29th Annual ARCOM Conference, 2-4 September 2013, Reading, UK

Citation for the published paper:

Gluch, P. ; Gustafsson, M. ; Thuvander, L. (2013) "Corporate environmental strategies and performance: A longitudinal study.". Proceedings 29th Annual ARCOM Conference, 2-4 September 2013, Reading, UK

Downloaded from: <http://publications.lib.chalmers.se/publication/182862>

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)

CORPORATE ENVIRONMENTAL STRATEGIES AND PERFORMANCE: A LONGITUDINAL STUDY

Pernilla Gluch¹, Mathias Gustafsson¹, Liane Thuvander², Henrikke Baumann³

¹ *Construction Management, Dept of Civil and Environmental Engineering, Chalmers University of Technology*

² *Architecture, Chalmers University of Technology*

³ *Environmental Systems Analysis, Energy and Environment, Chalmers University of Technology*

This paper focus on four environmental strategy aspects: 1) stakeholder relations, 2) management systems, 3) environmental staff, roles and responsibilities and 4) integration of environmental work. The paper aims to identify trends related to these four aspects and explores the relationship between them and environmental and business performance. The paper is based on a longitudinal and cross-sectional empirical study covering all Swedish construction companies with at least 50 employees (for architects 20 employees). Questionnaire surveys covering environmental attitudes, management practices and performance was carried out in 2002, 2006 and 2010. Respondents were environmental manager/officers in each company. Response rates for the three surveys were between 41-45%. The results show that the environmental work is on its way to be institutionalized as a strategic part of the companies. Environmental staff is increasing and environmental managers are part of top management and often also members of the management board. We can also see that communication and cooperation with stakeholders is getting more intensified and more diverse. So is the use of EMS as driver for a more active environmental work. It is concluded that a key to successful environmental and business performance is that environmental work is integrated with a variety of other corporate business areas/issues.

Keywords: environmental management, integration, stakeholder, performance, questionnaire survey, Sweden

INTRODUCTION

A search in the Web of Science resulted in a total of 104 hits for *greening of firm surveys*. Here we found surveys that study corporate leaders' (in US Fortune 500 companies) perceptions of corporate environmental strategies (Andrews, 1998), motivation and commitment to sustainability in business (Hahn and Scheermesser, 2006), and effects from environmental management systems on international business performance (manufacturing companies) (Darnall et al., 2008a, Darnall et al., 2008b). However, few studies provide longitudinal empirical data so that it is possible to identify and predict trends and change in corporate environmental management. One exception is Lee and Rhee's study that investigated trends in environmental strategic change in South Korean pulp and paper industry (Lee and Rhee, 2007). An interesting result from their study was that they found a lack of relationship between environmental strategy, environmental performance and financial performance.

For the construction industry there are some studies that have focused on attitudes and perspectives to sustainable development in especially construction companies. Myers, for example, reviewed public disclosures of 42 UK construction companies searching for information about Corporate Social Responsibility and found that although a majority of the companies *lacked respect for sustainability* (Myers, 2005) some of the larger companies at that time were beginning to acknowledge sustainability in their reports (Myers, 2005). Based on their survey of the level of awareness of sustainable construction in US and Korea, Son et al. (2009) saw a similar tendency and concluded that there is a positive outlook for sustainable construction. Also Ahn and Pearce (2007) came to a similar conclusion in their survey regarding contractors' past experience, perceptions and expectations of green construction in the future. Thus, these studies have in common that they signal a positive development within sustainable building.

Other scholars present a less optimistic view. In a cross-sectional survey Häkkinen and Belloni (2011) explored building professionals' perceptions on barriers for sustainable building. Obstacles for management of green construction projects in Singapore were also surveyed by Hwang and Tan (2010). Both surveys identified major hindrances, by Hwang and Tan described as a *vicious cycle*; of high costs, lack of client demand, lack of R&D, and lack of collaborative efforts and communication between various stakeholders. Similar observations was made in 2006 by the authors' of this paper, when it was concluded that there was an environmental inertia within the Swedish construction industry (Gluch et al., 2009). However, there seem to be very few surveys that have followed this issue over a long period of time by collecting longitudinal empirical data. One exception is Sayce et al. (2007), which over a ten-year period have undertaken three surveys tracking investors' attitudes towards green and sustainable buildings. They concur with Hwang and Tan's less optimistic view (Hwang and Tan, 2010), calling for increased industry communication but also for an increased need for government intervention (Sayce et al., 2007).

In order to track environmental strategies and change in the Swedish construction sector (technical consultants, building contractors/ executing construction companies, property owners and managers, and companies within architecture) over time, this paper is based on three environmental barometer surveys, carried out in 2002, 2006 respectively in 2010. Each survey covers four years back in time. Thus, a period of twelve years is taken into account, from 1998 to 2010. The surveys covered a large variety of aspects related to environmental management in the construction industry. For a comprehensive account of results from the surveys see Baumann et al. (2003), Baumann et al. (2002), Gluch et al. (2007a), Gluch et al. (2007b), Thuvander et al. (2011) and Gluch et al. (2011). This paper is based on a longitudinal empirically based analysis focusing on four environmental strategy aspects: 1) stakeholder relations, 2) management systems, 3) environmental staff, roles and responsibilities and 4) integration of environmental work. The paper aims to identify trends over time related to these aspects and also explores the relationship between them and environmental and business performance.

METHOD

Data collection

In all three surveys the companies were selected from Statistics Sweden's company register according the Swedish Industrial Classification industry codes (SNI, corresponding to the European industrial activity classification – NACE). The surveys

2002, 2006 and 2010, cover all companies in Sweden with at least 50 employees within technical consultants, building contractors/ executing construction companies, property owners and managers, and companies within architecture, i.e. a total survey. The final population is presented in Table 1.

Table 1 Data collection, population and response rate.

	2002	2006	2010
Population (companies)	534	542	461
Responses (No. answers)	217	246	195
Response rate (%)	41	45	42
Distribution of questionnaire	Mail	Mail	e-mail
Questionnaire form	Paper	Paper	Online form
Reminders	1 (mail)	3 (mail)	4 (e-mail)
Number of questions	32	39	23

In 2002 and 2006, the questionnaires were sent out by mail to each company in the final population together with an introductory letter and directed at environmental managers or alike. In the 2010 survey, the questionnaire was sent out by e-mail to environmental managers or alike using the online software SurveyMonkey™.

Preparation of questionnaires

The aim and scope of all the surveys has been consistent over time. Keeping the questionnaire as similar as possible has been a deliberate move in order to be able to make comparisons over time. The questions measured the opinion of the respondents by using a Likert scale with a four to seven-point range, a binary scale only allowing yes or no answers (with some modifications) and questions concerned demographic and more general and descriptive information.

To reduce biases in the result caused by interpretation problems and non-response several measures were taken. The questionnaires were pretested on practitioners, an instructive cover letter together with detailed contact information in case of questions accompanied the questionnaire, multiple reminders were sent out, and the reasons why some respondents failed to respond were investigated.

Data analysis

Data has been compiled and analyzed with the purpose to identify significant changes over time. In the surveys 2002 and 2006, the data was been entered manually; stored in and analyzed by using the statistical data programme SPSS®. In the 2010 survey, the data was entered by the respondents directly in the database of the online software SurveyMonkey™. From there, the data was exported and analysed in SPSS®.

For the analysis over time, data from all three surveys have been merged into one data set with the 2006 survey as reference. The 2006 survey has most questions and functions well as a link to both the 2002 and 2010 survey. For Likert scale variables, mean values have been calculated and one way analysis of variance (ANOVA) was performed followed by post hoc tests to statistically verify the significance of observed changes. For dichotomous variables (binary scale), cross-tabulation has been chosen for detailed analysis. For some of the questions, Likert scale variables have been translated into dichotomous variables to enable comparison over time.

In order to investigate drivers for perceived environmental performance and business performance we have also conducted two linear regression analyses.

RESULTS

The results presented in this paper is focusing on four environmental strategy aspects: 1) stakeholder relations, 2) management systems, 3) environmental staff, roles and responsibilities and 4) integration of environmental work. How these areas have been changed over time is firstly described and thereafter analysed in relation to environmental and business performance.

Stakeholder relations

Clients together with *managers* are seen as the most influential stakeholders on companies' environmental work in all three surveys. Also, the *final customer* and the *employees* are considered as important stakeholders. Seen out of an environmental research and knowledge perspective, in the early surveys it was noticed that *research institutions*, *environmental organizations*, *mass media* and *politicians* were assumed to have a very low influence on the companies' environmental work. This seems to have changed as these groups now are reported to be more influential. A similar trend shows *local citizens/groups* that were perceived to have very little influence on the companies' environmental work in the 2002 and 2006 and that now are considered as more influential. There is also a significantly increasing tendency that financial actors, such as *banks*, *insurance companies* and *financial analytics* and controlling instances such as *accountants* are perceived as more influential on the companies' environmental work than previously. Overall, the variety of stakeholders that are perceived as having influence on the companies' environmental work has increased over time. In fact, all stakeholders, beside politicians, are now perceived to have a significantly increasing influence.

Environmental Management Systems

Many of the companies within the construction industry work in accordance with an environmental management system (EMS). It was a considerably increase of the percentage of companies that adopted EMS as a way of working between 2002, when 46% had an EMS, and 2006 (70%). This rather high figure had in 2010 remained on a about the same level (73%).

Environmental staff, roles and responsibilities

Over the whole period companies report that they have personnel that specifically handle environmental issues within the company. However the extent (number of full-time employees) significantly increased between 2002 and 2006 to thereafter be stabilised.

The respondents were asked to what extent they agree to a number of statements concerning their perceived level of influence and their role as an environmental manager. As seen in Figure 1, the agreement is quite high for most statements (mean value around 3='agreement to a large extent'). However, the only significant increase concerns the respondents' perceived ability to influence strategic decisions, meaning that their strategic position seem to have been reinforced.

A large majority of the respondents in all three surveys answer they have, at least partly, enough knowledge to influence practice. In 2002 (28%) and 2006 (25%) a relatively large share of the respondents stated that they were not authorized to stop environmentally damaging processes, which has decreased to less than 10% in 2010.



Figure 1: Mean values of environmental managers' perception of their role as environmental manager in the company. The scale ranges from 1='total disagreement' to 4='full agreement'. The variable marked *bold* indicates a significant difference. *NOTE 1:* The differences were tested by means of *t-test* and significant at $p < .05$. *NOTE 2:* The questions were not included in the 2002 survey.

The respondents were asked about the extent of influence they had on environmental issues in the companies. About half of the environmental managers were in 2010 members of the corporate management board, which were a significant increase from 2006 and 2002. This might indicate that environmental issues have gained higher status within the companies. It might also be a sign that environmental issues are on the way to be handled as a regular part of the companies' business.

Integration of environmental work

In comparison with the two first surveys the environmental work is to a higher degree integrated with other business areas in 2010. Table 2 and 3 presents mean values for 2010 year's study that shows which business areas where environmental measures has been undertaken (Table 2) respectively with which business areas that has been organisationally integrated with environmental management (Table 3). Not surprisingly most environmental measures has been done within the area of recycling and waste management but environmental considerations has also been undertaken in the design, production, purchasing and training. Finance and R&D is the areas where least environmental measures have been undertaken.

Table 2 Mean values (M) of the degree of environmental measures taken within other business areas (Q15). The scale ranges from 1 = "not at all" over 3 = "some" to 5 = "much".

Areas	M	Sd
Design	3.22	1.50
Production	3.18	1.58
Facilities Management and Maintenance	2.62	1.88
Logistics	2.85	1.29
Recycling and Waste Management	3.65	1.26
Purchasing	3.33	1.08
Marketing/Sales	2.81	1.42
Accounting	2.27	1.52
Finance	1.67	1.43
Staff policy	2.52	1.43
R&D	1.84	1.66
In-service training	3.08	1.28

On an organisational ground the areas where environmental work has been integrated to a higher degree can be related to the EMS which may witness of that many companies today use management systems where environmental, health and safety and quality issues are handled in a similar way. Overall the degree of integration is quite high for most business areas (Table3).

Table 3 Mean values (M) to what degree environmental work has been organizationally integrated with measures taken in other areas (Q16). The scale ranges from 1 = "not at all" over 3 = "some" to 5 = "much".

Areas	M	Sd
Health and safety	3.33	1.15
Quality	3.67	1.00
Social issues	2.67	1.10
Strategy work	3.18	1.15
Marketing	3.01	1.12
Productivity	2.94	1.13
Project Management	3.14	1.10
Operations Management	3.32	1.13
Management by objectives	3.20	1.14
Motivation	2.91	1.14
Internal Relations	2.84	1.05
External relations	3.02	1.12

Predictors for environmental and business performance

The results show that the respondents perceive that environmental activities have had an effect on especially the use of non-renewable materials, forestalling risks from environmental accidents and decreasing environmental impact from transport.

A stable trend shown in all three surveys is that the companies mostly see either long-term and/or intangible business advantages. It is believed to bring advantages for principal stakeholders, such as staff, management and owners/shareholders. There is also a significant trend that environmental activities mainly are perceived to have positive effect on ‘soft’ values, such as company image, pleased personnel, pleased management, product image and recruitment. None of the more ‘hard’ values, such as short-term profit, productivity, market shares, show a significantly positive trend over time.

We performed two regression analyses in order to investigate what predicts environmental performance respectively business performance (Figure 1). The analyses are based on the 2010 survey. In the analyses we used index variables¹ (i.e. means of a number of individual items).

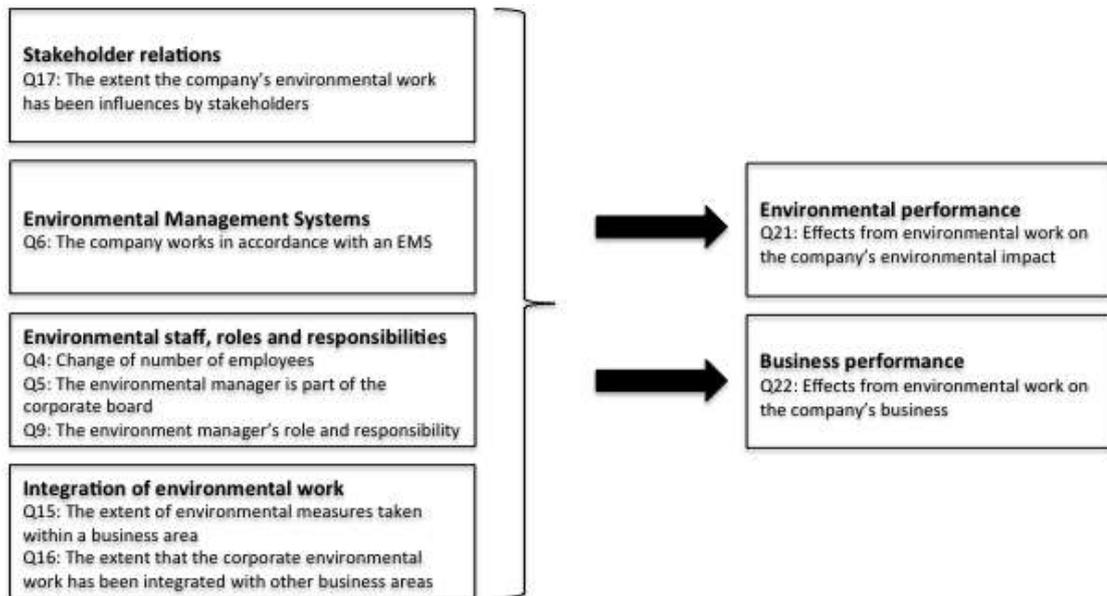


Figure 2 Interrelation between environmental strategies and measures and environmental and business performance.

In the analyses we regressed stakeholder relations (Q17), the degree of environmental measures undertaken in other business areas (Q15), degree environmental work has been organizationally integration with measures taken in other areas (Q16), the presence of environmental management systems (Q6), changes in environmental department staff numbers (Q4), whether the environmental officer were part of the company's management group (Q5) and finally the environmental manager's role and responsibility (Q9) on environmental performance (Q21) and business performance respectively (Q22). Due to space limitations we are unable to present all individual items in the paper and we only present the items (Table 2 and 3) from the two predictors that came out significant in the regression analyses.

When it comes to business performance we found that only the degree of environmental measures undertaken in other business areas were a significant predictor ($b=.38$, $p=.003$, $R^2=.44$, $F(7,109) = 11.34$, $p<.00001$), thus the more measures undertaken the higher perceived level of business performance.

¹ All index variables had alpha coefficients exceeding .80 thus all being reliable measures.

When it comes to reported environmental performance the only significant predictor were degree of organizational integration of environmental activities ($b=.38$, $p=.009$, $R^2=.21$, $F(7,110) = 3.90$, $p<.001$), thus the higher degree of reported integration the higher perceived environmental impact.

DISCUSSION AND CONCLUSIONS

Based on a longitudinal empirically based analysis of the sectors environmental work this study has identified trends over time. Four areas were investigated: 1) stakeholder relations, 2) management systems, 3) environmental staff, roles and responsibilities and 4) integration of environmental work. These areas were further explored regarding their correlation with environmental and business performance.

Respondents perceive that stakeholder pressure is getting stronger over time. Over the studied period, it becomes clear that opinions of stakeholders are increasingly recognized and heard. The pressure is now also perceived as more contextual and to a higher degree driven by local stakeholders. Work related to EMS is getting intensified and we could also see that over the years there has been a change of the environmental managers' responsibilities and positions. A higher number of responding environmental managers perceive having increased influence on their companies' strategic decisions. Effects from this will be focus in another paper.

Even if environmental managers now are part of companies' top management organization and although a higher number of environmental managers perceive having increased influence on their companies' strategic decisions, we could in our data not see that this had led to improved environmental performance or greater business advantages. Neither could we in our data find a relationship between stakeholder relations and EMS with these two parameters. The only factor that we found to be influencing environmental performance was the degree of integration of environmental work into the functional organizations of a company. Similarly the degree of environmental measures undertaken in different business areas was predictor for improved business performance. As such this study partly aligns with the results of Lee and Rhee (2007), showing a lack of direct relation between environmental strategies and performance, with the exception that we have found a relationship between performance and environmental strategies of integrative kind. Integration can most certainly not happen without personnel working with the issue (Gluch, 2009, Gluch et al., 2009, Ludvig et al., 2013) neither can it be isolated from stakeholder demands (Cole, 2011, Heiskanen and Lovio, 2010) nor from management systems and practice (Gluch and Räsänen, 2012, Brunklaus, 2009, Guy and Shove, 2001), so these types of strategies must not be disregarded just based on these results. Thus, the relative lack of observations explaining perceived business performance demands further analysis to better understand the business justifications for environmental efforts that are now quite extensive in the Swedish construction sector.

Based on this study we conclude that companies nor internal environmental units can carry out environmental work in an isolated bubble; both are dependable on and must cooperate and interrelate closely with others (Bansal and Clelland, 2004, Gluch et al., 2013). It is also clear from this study that a key to positive environmental as well as business performance is that environmental work is integrated within the organization. This is in line with previous research which holds collaborative and interdisciplinary actions within the field of sustainable development as crucial for the development and implementation of proactive, holistic and innovative green solutions (Brown et al., 2003, Vergragt and Brown, 2007, Quist et al., 2011, Bossink, 2007). The same logic

applies to the field of sustainable building (Brown and Vergragt, 2008, Cole, 2011, Glad, 2012, Heiskanen and Lovio, 2010, Hartenberger et al., 2013). Consequently, to address increased and more diverged pressure there will be a need for new types of organizational logics that enables integrative actions as well as cooperation between various actors involved in construction; cross-disciplinary as well as inter-organisational. This focus on change in complex multi-actor organizational environments is an interesting and under-researched area (Whyte and Sexton, 2011, Cole, 2011, Phua, 2013, Summerfield and Lowe, 2012) deserving more attention in future research.

REFERENCES

- Ahn, Y. H. & Pearce, A. 2007. Green construction: Contractor experiences, expectations, and perceptions. *Journal of Green Building*, 2, 106-122.
- Andrews, C. J. 1998. Environmental business strategy: Corporate leaders' perceptions. *Society & Natural Resources*, 11, 531-540.
- Bansal, P. & Clelland, I. 2004. Talking trash: Legitimacy, impression management, and unsystematic risk in the context of the natural environment. *Academy of Management Journal*, 47, 93-103.
- Baumann, H., Brunklaus, B., Gluch, P., Kadefors, A., Stenberg, A.-C. & Thuvander, L. 2003. Byggsektorns miljöbarometer 2002. Göteborg: Chalmers.
- Baumann, H., Brunklaus, B., Gluch, P., Kadefors, A., Stenberg, A. C., Thuvander, L. & Widman, J. 2002. Environmental drivers, management and results in Swedish building industry. A survey within the International Business Environmental Barometer. *Proceedings of International Conference of Sustainable Building 2002*.
- Bossink, B. 2007. The interorganizational innovation processes of sustainable building: a Dutch case of joint building innovation in sustainability. *Building and Environment*, 42, 4086-4092.
- Brown, H. S., Vergragt, P., Green, K. & Berchicci, L. 2003. Learning for sustainability transition through bounded socio-technical experiments in personal mobility. *Technology Analysis & Strategic Management*, 15, 291-315.
- Brown, H. S. & Vergragt, P. J. 2008. Bounded socio-technical experiments as agents of systemic change: the case of a zero-energy residential building. *Technological Forecasting and Social Change*, 75, 107-130.
- Brunklaus, B. 2009. Does organising matter? Tracing connections to environmental impacts in different housing estates. *Progress in Industrial Ecology*, 6, 120-134.
- Cole, R. J. 2011. Motivating stakeholders to deliver environmental change. *Building Research & Information*, 39, 431-435.
- Darnall, N., Henriques, I. & Sadorsky, P. 2008a. Do environmental management systems improve business performance in an international setting? *Journal of International Management*, 14, 364-376.
- Darnall, N., Jolley, G. J. & Handfield, R. 2008b. Environmental management systems and green supply chain management: complements for sustainability? *Business Strategy and the Environment*, 17, 30-45.
- Glad, W. 2012. Housing renovation and energy systems: the need for social learning. *Building Research & Information*, 40, 274-289.
- Gluch, P. 2009. Unfolding roles and identities of professionals in construction projects: exploring the informality of practices. *Construction Management and Economics*, 27, 959-968.

- Gluch, P., Baumann, H., Gustafsson, M. & Thuvander, L. 2011. Miljöbarometern. 12 års miljöarbete i bygg- och fastighetssektorn – vad har hänt och vart är vi på väg? *Chalmers report, CMB-report*.
- Gluch, P., Brunklaus, B., Johansson, K., Lundberg, Ö., Stenberg, A. & Thuvander, L. 2007a. Miljöbarometern för bygg- och fastighetssektorn 2006 - en kartläggning av sektorns miljöarbete. *Chalmers University of Technology. Göteborg, Sweden*.
- Gluch, P., Brunklaus, B., Johansson, K., Lundberg, Ö., Stenberg, A.-C. & Thuvander, L. 2007b. What makes it slow? A questionnaire survey of environmental attitudes, management and performance. *4th Nordic Conference in Construction Economics and Organisation. Luleå*.
- Gluch, P., Gustafsson, M. & Thuvander, L. 2009. An Absorptive Capacity Model for Green Innovation and Performance in the Construction Industry. *Journal of Construction Management and Economics*, 27, 451 – 464.
- Gluch, P., Johansson, K. & Räisänen, C. 2013. Knowledge sharing and learning across community boundaries in an arena for energy efficient buildings. *Journal of Cleaner Production*, 48, 232-240.
- Gluch, P. & Räisänen, C. 2012. What tensions obstruct an alignment between project and environmental management practices? *Engineering, Construction and Architectural Management*, 19, 127-140.
- Guy, S. & Shove, E. 2001. *The sociology of energy, buildings and the environment: Constructing knowledge, designing practice*, Routledge.
- Hahn, T. & Scheermesser, M. 2006. Approaches to corporate sustainability among German companies. *Corporate Social Responsibility and Environmental Management*, 13, 150-165.
- Häkkinen, T. & Belloni, K. 2011. Barriers and drivers for sustainable building. *Building Research & Information*, 39, 239-255.
- Hartenberger, U., Lorenz, D. & Lützkendorf, T. 2013. A shared built environment professional identity through education and training. *Building Research & Information*, 41, 60-76.
- Heiskanen, E. & Lovio, R. 2010. User– Producer Interaction in Housing Energy Innovations. *Journal of Industrial Ecology*, 14, 91-102.
- Hwang, B. G. & Tan, J. S. 2010. Green building project management: obstacles and solutions for sustainable development. *Sustainable Development*, 20, 335-349.
- Lee, S. Y. & Rhee, S.-K. 2007. The change in corporate environmental strategies: a longitudinal empirical study. *Management Decision*, 45, 196-216.
- Ludvig, K., Stenberg, A.-C. & Gluch, P. 2013. The value of communicative skills for developing an energy strategy. *Building Research & Information*, 1-11.
- Myers, D. 2005. A review of construction companies' attitudes to sustainability. *Construction Management and Economics*, 23, 781-785.
- Phua, F. T. T. 2013. Construction management research at the individual level of analysis: current status, gaps and future directions. *Construction Management and Economics*, 31, 167-179.
- Quist, J., Thissen, W. & Vergragt, P. J. 2011. The impact and spin-off of participatory backcasting: From vision to niche. *Technological Forecasting and Social Change*, 78, 883-897.
- Sayce, S., Ellison, L. & Parnell, P. 2007. Understanding investment drivers for UK sustainable property. *Building Research & Information*, 35, 629-643.

- Son, H., Kim, C., Chong, W. K. & Chou, J.-S. 2009. Implementing sustainable development in the construction industry: Constructors' perspectives in the US and Korea. *Sustainable Development*, 19, 337-347.
- Summerfield, A. & Lowe, R. 2012. Challenges and future directions for energy and buildings research. *Building Research & Information*, 40, 391-400.
- Thuvander, L., Gluch, P., Gustafsson, M. & Baumann, H. Twelve years of environmental work in the Swedish construction industry. Proceedings from the International Sustainable Building Conference SB11 in Helsinki 18-21 October 2011, 2011.
- Vergragt, P. J. & Brown, H. S. 2007. Sustainable mobility: from technological innovation to societal learning. *Journal of Cleaner Production*, 15, 1104-1115.
- Whyte, J. & Sexton, M. 2011. Motivations for innovation in the built environment: new directions for research. *Building Research & Information*, 39, 473-482.

