OVERCOMING THE BARRIERS OF GREEN INNOVATION IN CONSTRUCTION PROJECTS THROUGH ITS SUCCESSFUL MANAGEMENT

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The construction industry has a significant opportunity to mitigate the harmful effects construction has on the natural environment. However, green innovations are far from becoming customary in construction as the industry is recognised as slow to adopt innovation. Consequently, to overcome barriers to the adoption of green innovation, it is important to understand how green innovation is defined and what are the obstacles, drivers and influences that affect how it is successfully managed. Through this research, involving a literature review, the collation and analysis of four semi-structured interviews and 60 questionnaire responses, green innovation can be defined as: a process that aims to maximise performance, while minimising environmental degradation, triggered by the need for a new outcome. The research indicates firstly that green innovation barriers consist of organisational, stakeholder and contractual obstacles and that to overcome these barriers and to increase demand, the industry needs more green innovation information available in order to define the ownership and balance cost and quality. Secondly, green innovation management and its adoption are also affected by the attitude, demographic and cognitive characteristics of the manager concerned. The research also shows that successful management of green innovation can be promoted by a culture that involves the whole project team and the evaluation of the project's management in order to document the success factors. Finally, the formation of a new green contract, or the amendment of the design build procurement path to outline the ownership of risk and the alignment of the construction aims and objectives, will promote green innovation adoption.

Keywords: green, innovation, environment, procurement.

INTRODUCTION

The construction industry is resource intensive and a major environmental pollutant generator (Zhang and Wen, 2008). This has raised global concern on how to adopt and implement greener construction practices (Cole, 1999) as the industry has the greatest opportunity to mitigate the harmful effects it is having on the natural environment (Addis and Talbot, 2001). Even with negative coverage in the media, green practices are far from becoming an industry standard (Matar *et al*. 2008), *"the construction industry is infamous for the barriers it places in the way of innovation"* (CERF, 1998). Zairi (1994) and Jones and Saad (2003) both argue that construction is failing to innovate compared to other industries.

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The barriers to green innovation in construction are seen as 'general barriers' and 'technical barriers'. 'General barriers' are factors such as 'Cost' and 'Demand' (Matar, 2007), while the 'technical barriers' include managerial barriers (Hambrick and Mason, 1984). Successful innovation management is therefore integral to the adoption of innovation in the construction industry (McQuater *et al*., 1998).

Little research has been carried out into the barriers of green innovation and specifically, overcoming these barriers through successful green innovation management. Hoffman and Henn (2008) propose that the construction industry would benefit from a study focusing on overcoming the barriers against the adoption of green innovations. This study therefore aims to fill this gap within green building literature by providing information for both the industry and academia in the UK and Ireland.

The following research questions therefore formed the basis of this investigation:

RQ1. What effect do the relationships between the barriers of green innovation have on the adoption of green innovation in construction?

RQ2. What effect do the relationships between the characteristics of a manager have on the adoption of green innovation in construction?

RQ3. What is the definition of the term *"green innovation"*?

RQ4. What effect do the relationships of the factors contributing to overcoming green innovation barriers have on the adoption of green innovation in construction?

RQ5. What effect do the relationships of the factors contributing to successfully managing green innovation have on the adoption of green innovation in construction?

Hypothesis: At the outset the authors hypothesised that: Successful innovation management mitigates the barriers of green innovation in construction projects.

LITERATURE REVIEW

Green Innovation Management

Innovation: This can be defined as the implementation of a new process, system or product aimed at enhancing competitive advantage, project feasibility, safety and/or quality, while decreasing the cost and time of a project (Slaughter, 1998; and Jones and Saad, 2003). What makes innovation adoption difficult is lack of clarity on whether innovation is a process or an outcome (Zairi, 1994). Slaughter (1998) suggests that an innovation does not need to be new, it may exist elsewhere, but be new to a particular industry. Nevertheless, Jones and Saad (2003) argue that construction is slow and failing to innovate compared to other industries.

Green construction: Hoffman and Henn (2008) suggest that green construction encompasses *"strategies, techniques, and construction products that are less resource intensive or pollution producing than in regular construction"*. Jones and Saad (2003) say that green construction involves all of these strategies and includes the responsible management of a buildings demolition waste at the end of its life cycle. ISO (2008) states that green construction practices are an attempt to achieve maximum performance with minimal impact to the environment.

Green innovation management: Benmansour and Hogg (2002) propose that successful innovation management is a managerial responsibility that should balance the empowerment and accountability of an organisation. Hambrick and Mason (1984) and Gambatese & Hallowell (2011) argue that the characteristics of an innovation

manager are one of the most significant factors in successful innovation. Equally, Sharma (2000) offers that the scope for the adoption of green innovation is significant, however, its interpretation is largely down to a manager's characteristics.

Competitive advantage is the *"ability to innovate and learn"* (Teece *et al*., 1997) and according to Slaughter (1998) innovation is the catalyst for competitive advantage.

Pervaiz (1998) and Dulaimi *et al*. (2002a) propose that organisations with successful green innovation management have corporate structures that allow flexible team sizes to prioritise projects with more innovations; the adoption of a 'no blame' culture; and the use of incentives to promote green innovation. Quinn (1985) says innovation champions are key to innovation success in small organisations; and that top management isolation in larger firms can lead to intolerance of innovation champions.

Kuczmarski (1990) argues that innovation managers have trouble shifting to new technologies, decision making and learning from past experiences. Gambatese and Hallowell (2011) say that the key to successful innovation management is awareness of the innovation process and its barriers. Another problem to be overcome is the risk that the aims and objectives of different stakeholders in co-innovation will not align. Accordingly, Dulaimi *et al*. (2002b) say that successful co-innovation relies on the effective management of the firm initiating the innovation and other stakeholders.

Barriers to Green Innovation

Clients' Needs: Overcoming 'the client' as a barrier to green innovation is important, as construction has many different types of clients (Jones and Saad, 2003). Gambatese & Hallowell (2011) state that one of the biggest barriers to green innovations is the failure of organisations to extend innovations form one project to the next. Laborde and Sanvido (1994) suggest that the client plays a more significant role in green innovation adoption compared to project team members with technical knowledge.

Construction aims and objectives: Organisations in a construction project are independent of each other, with their own aims, objectives and cultures, yet they are inter-dependent in the success of the project (Jones and Saad, 2003). Similarly, Rothwell and Dodgson (1991) propose that the aims and objectives of different organisations involved in co-innovation projects must be aligned if they are to successfully implement green innovation into their construction projects.

Contracts and Procurement: The success of a green innovation is proportional to the type of contract used within a project (Tagaza and Wilson, 2004). For example, lump sum contracting leads to adversarial relationships (Jones and Saad, 2003); Dulaimi *et al*. (2002a) say design-build procurement can led to a rise in green innovation. The incentive for firms to innovate is lost when tendering for new projects as previous relationships and managerial styles cannot be continued (Wood, 1975). Bowley (1960) says the two biggest barriers to innovation adoption are the type of contract and the inability to measure innovation success. However, academics suggest that innovation success can be measured by maintaining a client relationship.

Cost: Williams and Dair (2007) argue that anything other than traditional practices will lead to significant cost increases. However, Robichaud and Anantatmula (2011) argue that the cost premium on green projects is in the region of 0-10%. Comparably, BRECSU (1999) suggests that construction over-estimates the cost of a green innovation and under-estimates the potential savings attributed to it.

Demand: Williams and Dair (2007) suggest this is because the present economic climate has resulted in little demand for green construction, with cheaper construction technologies being favoured by industry stakeholders. Jones and Saad (2003) argue that a further barrier to demand is that slumps and booms are more common in the construction industry than in other sector of the economy.

Employee Knowledge: Qi *et al*. (2010) propose that employees are the single most important resource in an organisation. This is because the technological competence of employees is one of the most significant factors of successful green innovation management (Nam and Tatum, 1997). Laborde and Sanvido (1994) suggest that successful innovation management can be attributed to a project team's competency.

Location: The effectiveness and efficiency of an innovation is, in part, due to the source of an innovation and the market's opportunities (Tidd, 2001). Furthermore, McQuarter *et al*. (1998) argue that an organisation's geographical location is directly proportional to their ability to successfully manage innovations.

Risk: In the UK, construction companies are reluctant to change due to the litigious nature of the industry (Jones and Saad, 2003). Similarly, Benmansour and Hogg (2002) say organisations are unwilling to take the risks and uncertainties associated with green innovation adoption. Nevertheless, the OECD (1982) argues that larger firms can best absorb the risks of innovation failure.

Social and psychological: Hoffman and Henn (2008) argue that barriers to green innovation in construction can now include social and psychological effects.

Time: A significant weakness in construction is the unparalleled emphasis by the client on the schedule and cost (Jones and Saad, 2003). Ling (2003) says that short project schedules and tight budgets impede green innovation adoption in construction.

RESEARCH METHOD

A sequential analytic method was applied whereby the qualitative analysis was used to inform the quantitative analysis. It was decided that four interviews would be conducted. Eleven questions were developed using the information documented in the literature reviews. The interview form adopted was an open-ended, structured format and was chosen as it ensured the same eleven questions are asked to each interviewee. The next step was to interpret the interviews by performing a Central, Domain and Cluster analysis using Decision Explorer. Consequently, the results of this analysis were used to build a questionnaire in order to collect sufficient quantitative data.

The questionnaire was constructed around questions in five sections:

Section A: Demographic information.

Section B: Barriers of green innovation adoption in construction.

Section C: Most influential characteristic of a project manager.

Section D: Defining green innovation.

Section E: Overcoming green innovation barriers.

Section F: Managing green innovation:

The data collection followed two paths. First, the questionnaires link was sent to over 600 construction professionals throughout the UK and Ireland and second, using LinkedIn, the link was posted on a number of construction groups. After receiving 60

responses to the study's questionnaire, the raw quantitative data was analysed using SPSS to perform a Factor analysis and a Linear Regression analysis.

RESULTS AND ANALYSIS

Quantitative results and analysis:

Section A collected the demographic information of the 60 respondents (a response rate of less than 10%). The average respondent was a male aged between 20-39 working as either an architect or engineer with 0-9 year's construction industry experience in both the public and private sectors in Great Britain with an average project value of less than £500,000.

From Section B Factor analysis, it was observed that 'Building Regulations' are not a barrier to green innovation, they are a benchmark to improve upon and that the 'Cost' of a green innovation is not more expensive than the use of traditional practices.

From the Factor analysis of Section C - a surprise result was the exclusion of 'Seniority in organisation' and the inclusion of 'Age' and 'Long held position' in this component, as the assumption could have been made that older construction professionals will have held their position for a long time meaning that they will most likely be in senior positions within a organisation.

Section D proposed a series of statements to each respondent to try to get a definition of the term 'Green Innovation'. On the basis of mean score analysis green innovation can be defined as an innovation that aims to maximise performance, while minimising environmental degradation. This can be achieved by stepping away from normal conventions in order to substitute less polluting products. Green innovation is triggered by the need for a new outcome and may adopt an innovation from another industry. Green innovation is a process and not an outcome, therefore requiring constant review.

In section E, the Factor analysis demonstrated that the sample was still statistically significant. To further aid the discussion, a new name was assigned to each component identified to interpret the variance observed in the data. The four components include; 'More information', 'Stakeholders risk', 'Increased demand' and finally, 'Balancing cost and quality'.

In section F, the Factor analysis also demonstrated that the sample was still statistically significant and to further aid the discussion, a new name was assigned to each component identified to explore the variance observed in the data. The four components include; 'Management culture' 'Management evaluation', 'Manager evaluation' and finally, 'Team effort'.

Linear Regression analysis suggests that the four biggest barriers to green innovation are; the slowness of the construction industry to adopt green innovation, the lack of accurate information with regard to the savings, the length of time a manager has held their position and the fact that contractors are not willing to absorb the risk of green innovation failure. Furthermore, it also provides that 'green' means maximising performance, while minimising environmental degradation.

Qualitative results and analysis:

Table 1 details the first five results for the Central and Domain analysis performed on the group Decision Explorer cognitive map.

Table 1 - Group model - Central and Domain analysis

Central analysis - Group	Domain analysis - Group
Cost (50 from 101 concepts)	Cost (15 links around)
Proven track record (40 from 84 concepts)	Risk (11 links around)
Risk (39 from 81 concepts)	Proven track record (10 links around)
Marketing tool (33 from 70 concepts)	Marketing tool (9 links around)
Impedes (32 from 70)	Impedes (9 links around)

'Cost' ranked first in the Central and Domain analysis as each interviewee said it was one of the most significant barriers. 'Proven track record' ranked second in Central and third in Domain analysis as each interviewee thought more information on green innovations and a proven track record of implementing them correctly would increase demand and reduce risk. 'Risk' was second in Domain and third in Central analysis because two of the four interviewees suggested that risk of green innovation failure is a large barrier that must be overcome. 'Marketing tool' ranked fourth in Central and joint fourth in Domain analysis, as there is a need for more information on the benefits of innovations in order to drive green innovation adoption. Finally, 'Impedes' ranked fifth in the Central and joint fourth in the Domain analysis, as the interviewees believed that public sector tendering impedes the adoption of green innovation.

A Cluster analysis was also performed on the combined cognitive map. This showed seven significant Clusters indicating that there are many underlying relationships. Table 2 documents the underlying relationships observed in the clusters.

Table 2 - Underlying relationships identified in clusters

Cluster	Underlying relationships
1	Green innovation can create competitive advantage
2	Green innovation is a process and needs constant testing
3	There is a strong correlation between risk and a proven track record
4	The age and location of an organisation are barriers to green innovation.
5	The characteristics of a manager act as a barrier to green innovation
6	There is a strong correlation between management and employee knowledge
7	Green innovation relies on aligned aims and object of the stakeholders

DISCUSSION

Section A: Demographic information: Having previously described the average respondent, the results achieved can be attributed to younger professionals having a greater empathy to help out other young professionals. From further analysis of the proportion of males to females in construction, the percentage of females responding to this survey was much higher than the expected percentage of just 2.4%, they contributing 15%. Thus, these results may suggest that female construction professionals occupy more sustainable construction roles than their male counterparts.

Section B: Barriers of green innovation adoption in construction: 'Organisational barriers' suggested that the organisation itself could act as a large barrier or driver to green innovation as its location may demand more innovation, while its size could allow it to absorb more risk. This result endorses the views of the OECD (1982) who argue that larger firms can best absorb innovation risk and Tidd (2001) who proposed that innovation success is related to its geographical location. The component 'Green contractual barriers' confirms the opinions of Tagaza and Wilson (2004) who stated that the success of a green innovation is proportional to the type of contract used in its

adoption. This study suggests that there is a need for a new green contract. Likewise, 'Stakeholder barriers' mirror the views of Jones and Saad (2003) who argue that, although organisations are independent of each other, they are inter-dependent in the success of the project. Thus, green innovation will only be successful if the aims and objectives of different project stakeholders are aligned. The implication to practice is that the amendment of the design–build contract to align the aims and objectives of different project stakeholders will further encourage green innovation adoption.

Section C: Most influential characteristic of a project manager: 'Demographic characteristics' coupled the trivial demographics of a manager including 'Age' and 'Gender'. Consequently, the demographic characteristics of a manager can influence a manager's ability to adopt green innovations. Furthermore, the component 'cognitive characteristics' suggests that time can influence how a manager deals with problems/managerial issues. Sharma (2000) says that the interpretation of an innovation is largely down to a manager's characteristics. Comparably, 'Attitude characteristics' reason that a manager will suppress his/her views in order to fit in with an organisation's culture. Quinn (1985) proposes this is because top management isolation in larger firms can lead to an intolerance of innovation champions. The implication for practice from this result is that construction professionals are barrier driven, not wanting to do anything that could hamper chances of future promotion.

Section D: Defining green innovation: The definition of green innovation provided in section D and the Linear Regression analysis is similar to the definition provide by ISO (2008) who state that green construction practices are an attempt to achieve maximum performance with minimal impact. Consequently, any new green construction practice, technology or material can be classified as a green innovation. Its trigger is the need for a new outcome, as the construction industry is slow to innovate. Equally, Jones and Saad (2003) and the Linear Regression analysis argue that the construction industry is slow and failing to innovate. Finally, green innovation is a process and not an outcome. Consequently, the implication for practice is that green innovation success is dependent on constant review.

Section E: Overcoming green innovation barriers: 'More information' offers that past green innovation successes can be used to create a competitive advantage. Similarly, Slaughter (1998) proposed that innovation is the catalyst to an organisation's competitive advantage. The component 'Stakeholder risk' suggests that a further amendment needed to the design-build contract is the confirmation of green innovation risk ownership. This is because the Factor and Regression analysis stated that consultants, contractors and clients are not willing to absorb the risk of innovation failure. Likewise, Jones and Saad (2003) suggested that the litigious nature of the construction industry has resulted in an industry intolerant of risk. Moreover, the component 'Increased demand' reiterates the results of the Regression analysis proposing that an increase in demand for green innovation projects would drive its research, producing more accurate data of the savings involved. Lastly, 'Balancing cost and quality' argues that the need to balance cost and quality has occurred due to the boom and bust cycles, which the construction industry endures. Jones and Saad (2003) argue that slumps and booms are more common in the construction industry than in other sectors of the economy. The implication for practice is that more information on the savings of green innovation will increase demand and reduce risk.

Section F: Managing green innovation: The first component 'Management culture' suggests that the culture of an organisation has a large influence on a manager's

ability to adopt green innovations. Similarly, Pervaiz, (1998) offers that corporate culture has a huge effect on an organisation's/manager's ability to adopt new management techniques. The second and third components 'Management evaluation' and 'Manager evaluation' linked statements that could be used as management evaluation techniques to reduce the risk of innovation failure. Gambatese and Hallowell (2011) offer that understanding the innovation process and its success factors is key to successful innovation management. The implications to practice of this result is that organisations can evaluate management/managers by asking questions such as; where the aims and objectives of different stakeholders aligned and did the managers learn from his/her mistakes on the project? A further recommendation would be the use of the Serve-Qual/Serve-Perf models in order to measure the 'actual or perceived gaps between client expectations and perceptions of the service' (Shahin, 2004). Finally, 'Team Effort' offers that successful innovation management does not just involve the management of one organisation, but the successful management of all stakeholders in the project. Dulaimi *et al*. (2002b) proposes that successful co-innovation management relies on the effective management of the firm initiating the innovation and the other project stakeholders.

CONCLUSIONS AND RECOMMENDATIONS

The conclusion derived from RQ1 is that larger organisations should be encouraged to adopt more green innovation in their projects as they can best absorb the risks. The responses aligned with RQ2 suggest that younger, green innovation champions will encourage the adoption of green innovation in an organisation.

RQ3 defines green innovation as an innovation that aims to maximise performance, while minimising environmental degradation. It is triggered by the need for a new outcome and finally, is a process and not an outcome. RQ4 responses suggest that demand can be increased by organisations evaluating past green innovations in order to document their success. In turn, this will give more accurate information and create a competitive advantage by educating clients and staff of the innovations' benefits.

Finally, responses for RQ5 suggest that organisations wanting to implement green innovation should appoint green innovation managers to manage not only the green innovations within that organisation, but all of the stakeholders' organisations.

Hypothesis:
The researchers' hypothesis that successful innovation management mitigates the barriers of green innovation in construction projects is supported. The research has shown that the appointment of green innovation managers/champions can overcome the barriers of green innovation by evaluating the management/managers' techniques and clients' perception of the perceived service in order to assess the success factors.

Research Limitations:
The findings from this study intended to inform the UK and Ireland's construction industry and academic literature. However, around 1 in 8 of the responses declared their location as either EU or International. Nevertheless, as most countries face similar management failures it has been assumed that these responses have only aided this study by providing further quantitative data.

Further research:
This study recommends further research into the formation of a green construction contract, this should look at ways of promoting green innovation, allocation of risk and the alignment of the aims and objectives of the contracted parties. Until the

details of this green contract are finalised, a further area of study would be the effect of the amendment of the design-build procurement path to include these matters.

REFERENCES

Addis, B. and Talbot, R. (2001) Sustainable Construction Procurement: A Guide to Delivering Environmentally Responsible Projects, CIRIA Report C571, CIRIA, London.

Benmansour, C. and Hogg, K. (2002) an investigation into the barriers to innovation and their relevance within the construction sector. In: Greenwood, D (Ed.), *"Proceedings 18th Annual ARCOM Conference"*, 2-4 September 2002, Northumbria, UK. Association of Researchers in Construction Management, Vol. 2, 677–86.

Bowley, M. (1960) *"Innovation in Building Materials"*, London: Gerald Duckworth.

BRECSU (1999) *"Environmentally smart buildings – a quantity surveyor's guide to the cost-effectiveness of energy efficient offices"*, DETR Good Practice Guide 274.

CERF (1998) *"Commercialising Infrastructure Technologies – A Handbook for Innovator"*. Washington: CERF.

Cole, R.J. (1999) 'Building environmental assessment methods: clarifying intentions.' *"Building Research and Information"* **27**(4/5), 230–246.

Dulaimi, M.F., Ling, Y.Y. and Bajracharya, A. (2002a) 'Enhancing integration and innovation in construction.' *"Building Research and Information"*, **30**(4), 237–47.

Dulaimi, M.F., Ling, Y.Y. and Bajracharya, A. (2002b) A theoretical framework for understanding construction innovation: an organizational perspective, in Uwakweh, B.O. and Minkarah, I.A. (eds) *"Proceedings of the 10th International Symposium for CIB W55 and W65 Working Commissions: Construction Innovation and Global Competitiveness"*, CIB, Cincinnati, OH, 19–28.

Gambatese, J.A. and Hallowell, M. (2011) 'Enabling and measuring innovation in the construction industry', *"Construction Management and Economics"*, **29**(6), 553–567

Hambrick, D.C. and Mason, P.A. (1984) 'Upper echelons: the organizations as a reflection of its top managers.' *"Academy of Management Review"*, **9**(2), 193–206

Hoffman, A.J. and Henn, R. (2008) 'Overcoming the Social and Psychological Barriers to Green Building', *"Organization & Environment"*, **21**(4), 390-414.

International Organization for Standardization (ISO) (2008) ISO 15392. 2008-05-01. Sustainability in Building Construction– General Principles, ISO, Geneva.

Jones, M. and Saad, M. (2003) Managing innovation in construction: Thomas Telford.

Kuczmarski, T. D. (1996) 'what is Innovation? The Art of Welcoming Risk.' *"Journal of Consumer Marketing"*, **13**(5), 7-11.

Laborde, M. and Sanvido, V. (1994) 'Introducing new process technologies into construction companies. *"Journal of Construction Engineering and Management"*, **120**(3), 488–508.

Ling, F. (2003) 'Managing the implementation of construction innovations.' *"Construction Management and Economics"*, **21**(6), 635–49.

Matar, M.M., Georgy, M.E. and Ibrahim, M.E. (2008) 'Sustainable construction management: introduction of the operational context space (OCS)', *"Construction Management and Economics"*, **26**(3), 261-275

Matar, M.M. (2007) *"An integration framework for sustainable construction"*, MSc thesis, Cairo University, Egypt.

McQuater, R.E., Peters, A.J., Dale, B.G., Spring, M., Rogerson, J.H. and Rooney, E.M. (1998) 'The management and organisational context of new product development: diagnosis and self-assessment.' *"International Journal of Production Economics"*, **55**(2), 121–31.

Nam, C.B. and Tatum, C.B. (1997) 'Leaders and champions for construction Innovation.' *"Construction Management and Economics"*, **15**(3), 259–70.

OECD (Organization for Economic Co-operation and Development) (1982) *"Innovation in Small and Medium Firms"*. Paris: OECD.

Pervaiz, A. (1998) 'Culture and Climate for Innovation European.' *"Journal of Management"*, **1**(1), 30-43

Qi, G.Y., Shen, L.Y., Zeng, S.X., Jorge, O.j. (2010) 'The drivers for contractors' green innovation: an industry perspective', *"Journal of Cleaner Production"*, **18**, 1358-1365.

Quinn, J. B. (1985) 'Managing Innovation: Controlled Chaos.' *"Harvard Business Review"*, **53**(May-June), 73-84.

Robichaud, L. and Anantatmula, V. (2011) 'Greening Project Management Practices for Sustainable Construction', *"Journal of Management in Engineering"*, **21**(1), 48-57.

Rothwell, R. and Dodgson, M. (1991) 'External linkages and innovation in small and medium-sized enterprises.' *"R&D Management"*, **21**(2), 125–37.

Shahin, A. (2004) SERVQUAL and Model of Service Quality Gaps: - EPI, Available at: http://epi.univ-paris1.fr/servlet/com.univ.collaboratif.utils.LectureFichiergw?ID_FICHE=44733&OBJET=0008&ID_FICHIER=121065 (Accessed: 17 Jul 2013).

Sharma, S. (2000) 'Managerial interpretations and organizational context as predictors of corporate choice of environmental strategy.' *"Academy of Management Journal"*. **43**(4), 681-697.

Slaughter, S. (1998) 'Models of construction innovation'. *"Journal of Construction Engineering and Management"*, **124**(3), 226–31.

Tagaza, E., Wilson, J.L. (2004) Green buildings: drivers and barriers e lessons learned from five Melbourne developments. Report Prepared for Building Commission by University of Melbourne and Business Outlook and Evaluation.

Teece, D J, Pisano, G and Shuen, A (1997) 'Dynamic Capabilities and Strategic Management.' *"Strategic Management Journal"*, **18**(7), 509-533.

Tidd, J. (2001) 'Innovation management in context: environment, organization and performance.' *"International Journal of Management Review"*, **3**(3), 169–83.

Williams, K. and Dair, C. (2007) What is Stopping Sustainable Building in England? Barriers Experienced by Stakeholders in Delivering Sustainable Developments, Sustainable Development.

Wood (1975) *"The Public Client and the Construction Industries"*. London: HMSO.

Zairi, M (1994) 'Innovation or Innovativeness? Results of a Benchmarking Study.' *"Total Quality Management"*, **5**(2), 27-44.

Zhang, K.M., Wen, Z.G. (2008) 'Review and challenges of policies of environmental protection and sustainable development in China.' *"Journal of Environmental Management"*, **88** (4), 1249-1261.