

UNDERSTANDING LEAN IMPLEMENTATION: PERSPECTIVES AND APPROACHES OF AN AMERICAN CONSTRUCTION ORGANISATION

Brianna Chesworth¹, Kerry London² and Thayaparan Gajendran³

^{1,3} *School of Architecture and the Built Environment, Faculty of Engineering, University of Newcastle, University Drive, Callaghan, NSW, 2203, Australia*

² *School of Property, Construction and Project Management, Design and social Context College, RMIT University, Melbourne, Vic, Australia*

Lean, its principles and implementation rationale are characteristically interpreted as a means to reduce waste and increase productivity. Representation of the approach is typically supported by deductive perspectives. Deductive representations of the decision rationale underpinning lean implementation in construction organisations is cause for concern; particularly in understanding culturally the principles guiding lean implementation and the impact on management, contractual relationships and the organisational environment. A qualitative methodological and inductive approach encompassing face-to-face and focus group interviews has been used to explore lean rationale, implementation and practice within a singular in-depth case study. The analysis of the case has identified two further emerging lean perspectives and approaches of lean implementation that assist in addressing cultural neglect within lean theory. The first is the implementation of lean as means to establish efficient, effective and meaningful industry and contracting relationships. The second is the implementation of lean as a means to improve internal organisational and managerial practice. The study highlights the importance and need to understand the lean implementation process within construction organisations culturally rather than a process of tool implementation versus cultural change.

Keywords: case study, diffusion theory, lean implementation, organisational culture, United States of America.

INTRODUCTION

Implementation of lean principles within construction organisations is typically viewed deductively; focusing on waste reduction through tool based productivity improvement (e.g. Koskela, Ballard, Howell and Tommelein). Lean implementation specific deductive research quantifies the process in line with tool orientated management strategies; this is evident in the distinct prominence of production and manufacturing tools forming lean theory development (see Koskela, Ballard, Howell and Tommelein). Two distinct problems emerge as a result of deductive approaches of lean implementation in construction. The first is an 'industry' problem which is the focus on tool selection and implementation versus implementation related cultural change; as opposed to the 'research' problem which is the lack of knowledge about the cultural characteristics of companies that implement lean. The study is significant as it is attempting to understand the 'research' problem in greater depth by

¹ Brianna.Chesworth@newcastle.edu.au

investigating common misconceptions of lean implementation and lean cultural awareness; from an organisational perspective. The study is therefore considering an inductive and qualitative methodology as a means to further understand lean implementation within a construction organisation undergoing a lean transformation. Further underpinning the study is need to investigate and explore lean implementation from a multi-reality perspective or constructivist stance; exploring varying knowledge, experience and exposure to lean. Diffusion influenced data typing and qualitative considerations are used as a conceptual framework to explore perspectives and awareness of lean implementation within a construction organisation environment. The consideration of lean implementation from qualitative and inductive ideologies provides a theoretical foundation to further identify emerging cultural perceptions of lean implementation in construction organisations.

APPROACHES OF LEAN IMPLEMENTATION

Lean construction has its fundamental principles founded in production and manufacturing sectors primarily through the Toyota Production System (Koskela, 1992; Howell, 1999). Theoretical ideology guiding lean construction are the elements of transformation, value and flow underpinned by tool centric waste elimination and productivity improvement strategies; illustrated by Lean Last Planning (see Ballard, Howell, Macomber, etc). Tool base strategy designed interpretations of lean implementation (such as LLP) assist in the continual viewing of lean as a strategy essentially about waste reduction (Koskela, 1992; Egan, 1998; Howell, 1999) and productivity improvement (Koskela, 1992; Howell, 1999; Pavez *et al.*, 2005) without consideration of the cultural impact (the ‘industry’ problem).

The deductive nature of tool specific lean implementation presents the cultural change occurring explicitly. The cultural change is represented as either empowering the workforce (Buch and Sander, 2005; Garcia *et al.*, 2006; Orr, 2005) or exploiting the workforce (Green, 1998, 1999, 2000, 2002; Green and May, 2003, 2005). Such interpretations of ‘cultural change’ are guided by frameworks supporting an explicit shift from traditional ‘hierarchical’ or ‘dictatorial’ management models to ‘flow/conversion’ or ‘adaptive’ management models (see Koskela, 1992; Egan, 1998, Howell, 1999; Ballard *et al.*, 2001). Explicit cultural shifts experienced within the organisational environment associated with the lean implementation process suggests lean is not about short term organisational gains but a long term ‘cultural’ transformation of the organisation (the ‘research’ problem’); through lean leadership (Orr, 2005); contractual relations (Buch and Sander, 2005) and sub-culture awareness (Coffey, 2001; Zuo and Zillante, 2006). Although ‘cultural awareness’ associated with lean implementation is becoming more prevalent the reliance on deductive methods to understand ‘cultural change’ raises concern. An alternate inductive approach will now be considered.

NEW LEAN APPROACHES: EDUCATION AND DIFFUSION

A recent study by Alves et al 2010 identified education as a new ‘cultural’ pathway to diffuse and explore lean implementation in construction organisations. Alves et al highlighted that the implementation of lean within the organisational environment is linked to the ‘cultural’ eagerness and want to embrace lean or learn about the lean innovation. Success rates of lean implementation from this perspective however are detracted due to time and effort constraints (Alves *et al.*, 2010). Hirota et al (1998) also identified education as part of a systematic implementative framework to introduce lean into construction organisations. The nature and approach of education

as part of Hirota's lean implementation framework is underpinned by the development of organisational learning and the presence of action learning as the 'implementative tool'. The educational pathway as an implementative process is concerned with the collective learning process and/ or competencies achieved through group specific meetings and discussions driven by issue and solution assessment (Hirota *et al.*, 1998; Alves *et al.*, 2010). The focus of education as a 'cultural' pathway to understand the lean implementation process links in with the nature and approach of Rogers' Diffusion Theory. Diffusion theory is a theoretical framework designed to explore the process of innovation implementation through the study of key characteristics associated with the process (Rogers, 1971, 1995). In terms of this study four elements of Rogers' diffusion theory will be used to facilitate the investigation of lean implementation;

1. Lean construction to be viewed as a form of innovation;
2. Social systems: identifying and following movements of the social system groupings within the organisation
3. Communication structures: focusing on how communication is transferred and transferable between social system groupings; and
4. Time: investigating the process of lean implementation over a given period of time.

The overarching definition for the diffusion of innovation process according to Rogers' (1995) refers to the implementation or introduction of a new idea, concept or technology within a social system over a period of time. From a construction perspective, Larsen and Ballal (2005) suggest an effective approach to innovation diffusion is triangulation, in which the social system, communication and innovation are incorporated during the process of implementation. However, what rarely is addressed is the identification of steps involved in the diffusion of innovation process. Wolfe (1994) provides one of the most comprehensive guides on the streams of the diffusion of innovation or diffusion processes. The guide highlights three main constructs underpinning diffusion of innovation processes:

- Diffusion of innovation: addresses patterns of innovation and how the innovation is spread throughout a groups of adopters;
- Organisational innovativeness: addresses the occurrence of determinants within the process of innovation; and
- Process theory: addresses the diffusion of innovation process and the how and why adopters carry out innovation.

In terms of the diffusion of innovation process, two main interpretations are typically presented. The first is Wolfe's interpretation of the process to incorporate 10 stages, encompassing idea conceptualisation, persuasion, adoption decision, routinisation and confirmation. The second and most widely recognised approach is Rogers' interpretation which encompasses 5 stages, knowledge, persuasion, decisions, implementation and confirmation. Both approaches to the implementation process suggest knowledge underpins the entire diffusion of innovation process. What isn't addressed in detail is how the process uniquely and culturally impacts on internal organisation groups and their behaviours, attitudes and perceptions of the process. Of interest in the study is how the lean implementation process influences the organisation holistically.

METHODOLOGY AND APPROACH

A qualitative methodological approach underpins the investigative study concerning understanding lean implementation within an American construction organisation. Underpinning the conceptual and investigative framework of the study is the need to view the environment of the construction environment from multi-reality or constructivist perspectives. A multi-reality perspective or constructivist approach (Lincoln and Guba, 1985; Denzin and Lincoln, 2003 and 2005; Bryman, 2008) enables the environment of the construction organisation to be explored in-depth and from varying personal and therefore cultural perspectives. The focus towards cultural understanding of the lean implementation process assists in being able to approach lean implementation from a perspective that is less about ‘challenging lean theorists’ and more about ‘understanding lean implementation’ within construction organisations; assisted through diffusion theory. The focus of the data collection is towards gaining an understanding of the implementation of lean within an American construction organisation from multi-sources within that organisation.

As the research framework is focused towards investigating and exploring multi-realities of the construction organisational environment, face-to-face and focus group interviews were selected as the data collection tools. The purpose of the face-to-face and focus group interviews was to provide a multi-layered perception and awareness of lean implementation within a construction organisation undergoing lean implementation. The basis of this research is to be used as a means to critically reason and explore the cultural complexities which emerge within construction organisational environments as part of the lean implementation process. The questions forming the interview schedule were directed towards three core organisational groupings:

- G1:CEO, Senior Executives/Management–key organisational decision makers
- G2:Middle Management-individuals applying/enforcing org. decisions
- G3:Project Teams-individuals conducting the majority of the work.

The nature of the interview questions were similarly focused around four core lean implementation ideals; organisational environment, implementation process, communication and culture. Questions were specific to targeted organisational groupings and perceived levels of understanding within the organisational environment; however there were similarities present in questions across the core lean implementation ideals. The approach undertaken in the collection of data has enabled the emergence of multi-reality perceptions concerning lean implementation.

The strategic nature of the research investigation is concerned with understanding lean implementation and the perception and awareness of lean within 1 construction organisation. The larger nature of the research is representative of holistic directed multiple-case design with considerations present for both literal and theoretical replication to be present within the data (Yin, 2010). Using the strategic nature of the investigation as a basis, 5 individuals representing all organisational groupings within 1 construction organisation were included in this research. Further guiding the research is thematic analysis principles and three specific data types addressing:

- The organisation and management environment;
- Implementation process and rationale; and
- Communication.

The case study results will now be presented and discussed.

RESULTS

The organisation is located in Northern California, USA, and delivers public infrastructure through intensive lean strategies. 5 participants were interviewed representing 3 of the 4 senior management groups of the organisation, including 2 senior executives, 1 champion and innovator, 1 project manager and 1 project team member. Participants were asked a series of closed and open-ended questions addressing three data types, including:

- The organisation and management environment;
- Implementation processes and rationale; and
- Communication.

Tables 1, 2 and 3 highlight the themes emerging within the organisation in relation to the above data groupings.

Table 1: Organisation and Management Environment

Feature	Organisational Characteristics
Implementation Timeframe	10 years
Environment	Adaptive
Formal Social Structure	Matrix organisational structure: Senior management and trade partnerships
Informal Social Structure	Homophily communication ² : Tertiary working groups ³ Hetrophily communication ⁴ : Tertiary working groups; Study action teams; Enhanced relations (external)
Social Norms	Advocacy (self, project, organisation); Integration; Stability; Education
Opinion Leaders and Change Agents	Opinion Leaders: Organisational Change Agents: Innovation

Table 1: Organisation and Management Environment identified the primary and secondary themes forming the organisational managerial environment. The above table highlights the following trends:

- The structure of the organisation is a matrix style which is characteristically resilient to change;
- Hetrophily and homophily communication networks are present within the presence of tertiary working groups;
- The organisation encourages advocacy, integration, education and stability of all employees and trade partners.

Table 2: Implementation Process and Decision Rationale identified the primary and secondary themes emerging as part of the thematic analysis undertaken on the organisation concerning lean implementation. The above table highlights the following trends:

- Senior management group of the organisation are prone to intensive applications of lean;
- The organisation has been undertaking a lean transform in some form for a period of 10 years;
- A willing and committed client and owner is essential to successful lean implementation; and

² Communicative networks in which a pair of individuals who communicate are similar

³ A form of project team

⁴ Communicative networks in which a pair of individuals who communicate are different

- Implementation is influenced by multiple lean and educational strategies developed and utilised by the senior management group.

Table 2: Implementation Process and Decision Rationale

Feature	Organisational Characteristics
Innovation Decision	Authority-based, implementation for a period of 10 years with implementation intensive in nature. Shared (organisational) strategies incorporated as part of the application Approach is supported by wishes and commitment of the client and owner.
Knowledge (Individual)	High exposure level (x2); Moderate exposure level (x1); Low exposure level (x2)
Persuasion	Informal social structure: Homophily and heterophily communication Social norms: Advocacy; Integration; Education
Decision	Education: Plus/Delta learning; Lunch and Learns/The Big Room; Study action teams; Visual training management
Implementation Confirmation	Not Specified Education; Stability/Reliability; Lean awareness; Acceptance

Table 3: Communication

Feature	Organisational Characteristics
Verbal Communication	Communicative tooling: Project specific learning (plus/delta learning); Reflective learning; Integrated learning; Learning culture
Visual Communication	Communicative tooling: Study action teams; Reflective learning; Learning culture
Written Communication	Not Specified

Table 3: Communication identified the primary and secondary communication specific themes. The above table highlights the following trends:

- Management encourage open collaboration and communication through project specific, reflective and integrated learning strategies;
- Verbal and visual communication is essential in lean project delivery within the organisation; and
- Management promotes the presence of a learning culture.

The tables will now be discussed further.

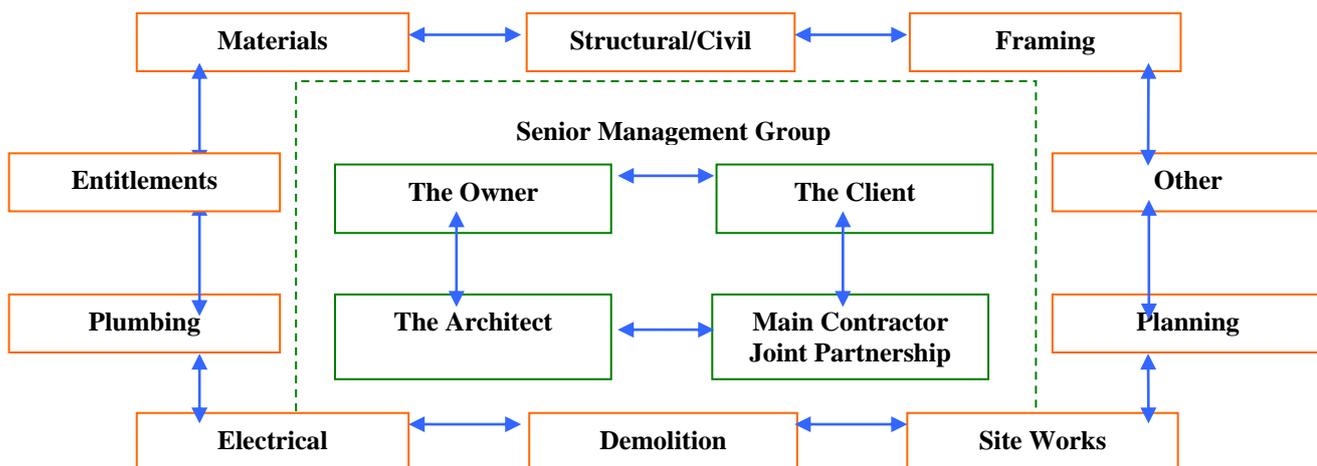


Figure 1: Organisational structure

DISCUSSION

The organisation is in a unique situation in terms of lean project delivery. The organisation and management environment is underpinned by a mutual contracting relationship which incorporates a senior management team of 4 parties and secondary

project teams of 13 trade partners (refer to figure 1). Blue arrows are indicative of communicational relations within the organisation.

A third tier organisational level emerges with the presence of tertiary working groups or parties, combining employees within senior management and trade partner groupings. These tertiary working groups provide an intense integration of the existing matrix organisation structure. The client and owner forming 2 of the 4 senior management group utilise a mutual and cooperative contracting agreement to bind all organisational parties. The cooperative contractual agreement is underpinned by mutual a partnership that requests all parties to be committing to the implementation of lean within their own organisational environment, Senior Executive 1 stated:

Text Box 1: Contractual Partnership – SE1

“The project under, well actually, within this office, partners and projects are managed through a mutual contractual partnership of a senior management group”.

Currently the partnership commitment has three implementing categories with which trade partner organisations fall into:

- Organisations who are lean established;
- Organisations undergoing a lean transformation; and
- Organisations about to undergo a lean transformation.

The style of contractual agreement utilised by the organisational management is also underpinned by a number of organisational and managerial social specific sub-ordinates including social norms, communication and education. The way in which the social sub-ordinates framework is structured the cooperative agreement has assisted in the identification of two additional lean implementation perceptions to emerge.

Buch and Sander (2005) studied the need to address the presence of the middle manager in becoming pivotal in supporting the implementation of lean particularly at a project level. The nature of Buch and Sander’s research is about change management and the ‘cultural’ change middle managers undertake in the lean implementation process. The study did not highlight the importance of contractual or mutual agreements as part of the process in influencing ‘cultural’ change on-site. Within the case study organisation the implementation of lean has emerged in line with the need to establish more efficient industry and contracting relationships both within an office environment and on-site. Underpinning this perception and rationale approach is the presence of the cooperative agreement between senior management and trade partners according to project manager 1, assists in the ‘cultural’ desire to establish and maintain innovation:

Text Box 2: Innovation Maintenance – PMI

“The presence of an integrated team environment in the organisation lead by cluster groups of individuals assists in the creation of innovation for management”.

The nature of the contractual environment guided by external requests by senior management of lean commitment of trade partners encourages open communication and collaboration. For senior management open communication and collaboration is reflective of the organisation's social norms particularly advocacy and the promotion of integration and stability through the open sharing of information, experiences and knowledge concerning lean and implementation, project manager 1 stated:

Text Box 3: Knowledge – PMI

“In this process everybody is at the table at the same time you get your plumbing perspective, you get your mechanical perspective, you get your architectural perspective, your planning perspective, your design perspective and they all come together”.

Furthermore core to the cooperative agreement is the setting out of specific contracting goals and requirements of each individual to become a self, project, organisation and lean advocate. Such an approach is supported by the introduction and management of employees through organisation specific education programming and heterophily/homophily communication networks. For the organisation the incorporation of education specific programming and communicative networks encourages the maturing of the culture towards a learning environment and ‘culture’ guided by such ideas as project specific learning, reflective learning, study action team learning and plus/delta learning. Senior executive 2 stated:

Text Box 4: Culture – SE2

“...I’ve seen a culture which really, truly is a learning culture, one which specifically went out of its way to provide training and to increase peoples’ knowledge and to improve their skills....there were people that were in the organisation that are dedicated to the continuing education of people and they have truly made a great investment of it and a number of those techniques and methodologies have been implemented here and I have been particularly impressed at you know the effectiveness of bringing in people either from the outside or drawing on the experiences of the people that are here in the team...”.

The presence of organisational specific educational programmes and mechanisms highlights a link between Hirota et al and Alves et al studies concerning the interpretation or investigation of lean implementation in line with education.

The educational approach presented by Hirota et al (1998) and Alves et al (2010) is further present and highlighted in the second ‘cultural’ understanding of lean implementation in the improvement of internal organisational and managerial practices. The second rationale present within the organisation is also guided by the social subordinates of social norms, education and communication. Again the cooperative contractual agreement used by the client and owner supports the presence of the rationale perspectives. Social norms including advocacy, integration and stability for instance are present in the bonding of employees through the embracing of self knowledge and awareness of the project, organisation and innovation. Champion and innovator 1 reflected on this saying:

Text Box 5: Project Structure – CII

“There are people that are working on [project 1], that also work on [project 3] and there are people who are working on [project 3] and [project 1] that are also working on the [project 4] there is a constant cross culture. Not everyone at every single level the same but there is a constant cross cultural interaction. It’s not monitored rigorously, it just happens. It’s expected by us and it just happens”

For this organisation advocacy is central in the delivery of successful lean projects with management encouraging advocacy through open collaboration, communication and integration of tertiary working groups. Further underpinning the cooperative contractual agreement is the presence of specific organisational programming and communication networking which has been developed as a means to educate and train individuals concerning lean and its application within the organisational and project environments [quote]. Again for the organisation the incorporation of education

specific programming and communicative networks encourages the maturing of the culture towards a learning environment guided by such ideas as project specific learning, reflective learning, study action team learning and plus/delta learning. The presence of specific educational and communicational programming provides a framework basis enabling organisational management to educate and train individuals to specific applications of lean within their own environments.

The presence of two emerging implementation perceptions highlights a maturing of organisational awareness of lean applications within the construction industry. The emergence of the differing lean implementation approaches has been supported by the establishment of a unique cooperative agreement binding a variety of organisations to the lean innovation. The cooperative agreement also provides a platform for trade partner to have access to differing implementation processes, educational and communication strategies. For the owner and client the cooperative agreement is essential for the commitment for industry wide lean implementation.

CONCLUSION

Primarily lean implementation at an organisational level is approached as a tool-based management strategy. Central to the approach is the application of the lean last planner system as a means to control and reduce waste, while providing a platform to increase productivity. The analysis of the American case study has highlighted the presence of two additional implementation approaches, as a means to:

- Further strengthen and create new contractual relationships; and
- Improve internal organisational and managerial practice.

Supporting and guiding the approaches of lean implementation within the organisation are a number of social sub-ordinates including social norms, education and communication which form part of the cooperative contractual agreement. The nature in which these sub-ordinates underpin the cooperative contractual agreement creates implementation understanding and awareness that is organisational specific.

REFERENCES

- Alves, T.D.C.L., Milberg, C. and Walsh, K.D., (2010), "Exploring Lean Construction Practice, Research and Education", *Proceedings of the 18th Annual International Group for Lean Construction Conference*, July 2010, Haifa, Israel.
- Ballard, G., Koskela, L., Howell, G. and Zabelle, T. (2001), "Production System Design in Construction", *Proc. of the 9th Annl Group for Lean Construction*, Singapore.
- Bryman, A. (2008), *Social Research Methods*, 3rd Edition, Oxford University Press, Oxford, UK.
- Buch, S. and Sander, D. (2005), "From Hierarchy to Team-barriers and Requirements in relation to a new Organisation of Building Sites", *13th Annual proceedings of International Group for Lean Construction*, Sydney, Australia.
- Coffey, M. (2001), "Developing and Maintaining Employee Commitment and Involvement in Lean Construction", *Proc of the 9th Annual Lean Construction*, Brighton, UK.
- Cox, A., Ireland, P. and Townsend, M. (2006), *Managing in Construction Supply Chains and Markets*, Thomas Telford, London, UK.
- Denzin, N.K. and Lincoln, Y.S., (2003), *The Discipline and Practice of Qualitative Research, Handbook of Qualitative Research*, 2nd Edition, Sage Publications, Thousand Oaks.

- Denzin, N.K. and Lincoln, Y.S., (2005), *The Discipline and Practice of Qualitative Research, Handbook of Qualitative Research*, 3rd Edition, Sage Publications, Thousand Oaks.
- Garcia, S., Romero, A. and Diaz, H. (2006), "Incentive plans for Mexican construction workers", *14th Annual International Group for Lean Construction conference*, Santiago de Chile.
- Green, S.D. (1999), "The Missing Arguments of Lean Construction", *Construction Management and Economics*, **17**(2), 133-137.
- Green, S.D. (2000), *The Human Resource Management Implications of Lean Construction: Critical Perspectives and Conceptual Clauses*, www.personal.rdg.ac.uk/~kcsgrst/Lean-hrm.htm [Date accessed 19 February 2008].
- Green, S. D. (2002), "The Human Resource Management Implications of Lean Construction: Critical Perspectives and Conceptual Chasms", *J. of Con. Research*, **3**(1), 147-165
- Green, S.D. and May, S.C. (2003), "Reengineering Construction: Going Against the Grain", *Building Research and Information*, **31**(2).
- Green, S.D. and May, S.C. (2005), "Lean Construction: Arenas of Enactment, Models of Diffusion and the Meaning of Leanness", *Building Research and Information*, **33**(6).
- Hirota, F.H. and Formoso, C.T. (1998), "Some Directions for Developing Construction Management Training Programmes on Lean Construction", *Proceedings of the 18th Annual International Group for Lean Construction Conference*, Guaruja, Brazil.
- Howell, G. (1999), "What is Lean Construction", *Proceedings of the 8th International Group for Lean Construction Conference*, Berkeley, USA.
- Howell, G. and Ballard, G. (1998), "Implementing Lean Construction: Understanding and Action", *Proc of the 6th Annual Lean Construction Conf*, Guaruja, Brazil.
- Koskela, L. (1993), *Lean Construction, Chapter 1: Lean Production in Construction*, Brookfield, Rotterdam, the Netherlands.
- Orr, C. (2005), "Lean Leadership in Construction", *13th Annual International Group for Lean Construction conference*, Sydney, NSW, Australia
- Pavez, I. and Alarcon, L.A. (2006), "Qualifying People to Support Lean Construction in Contractor Organisations", *Proc. 14th Annual Lean Construction Conference*, Chile.
- Rogers, E.M. (1971), *Communication of Innovations: A Cross Cultural Approach*, 2 ed. Collier-Macmillan Ltd, London, UK.
- Rogers, E.M. (1995), *Diffusion of Innovations*, 4 Ed. Simon and Schuster, New York, USA.
- Zuo, J. and Zillante, G. (2005), "Project Culture within Construction Projects: A Lit Review", *Proc. 13th Annual International Group for Lean Construction Conference*, Sydney, Australia.