

UNDERSTANDING PRODUCTION MANAGEMENT OF REFURBISHMENT PROJECTS OF A HOUSING ASSOCIATION – AN EXPLORATORY CASE STUDY

Sergio Kemmer¹ and Lauri Koskela²

ABSTRACT

This paper aims at better understanding on how the production phase of housing refurbishment projects is managed in the context of a housing association in the UK. This refers to the way that refurbishments are carried out, the typical problems faced at the construction stage, the influential factors affecting planning and control effectiveness, and the identification of the current managerial practices adopted by construction companies for managing production. Information was collected through semi-structured interviews, non-participant observations of project management meetings and works on site, and documental analysis. The information gathered was validated through a workshop involving project participants. The paper concludes presenting the good managerial practices identified and the opportunities for improvement.

KEYWORDS

Refurbishment, production, management, lean construction.

INTRODUCTION

Refurbishment is one of the most important topics in the current research agenda in the UK. This is because of two main reasons. First, the crucial role that the refurbishment of the existing stock has to meet the sustainable targets set by the government (DECC 2008, Itard et al. 2008, Ravetz 2008). Second, the significant part, more than a third, that refurbishment projects represent in the total output of the construction industry (ONS, 2014).

As a result, a considerable amount of studies have been developed around a number of topics related to the broad subject of refurbishment. This refers, for instance, to studies on the analysis of the building stock (Itard et al. 2008), the government's policies for sustainable refurbishment and related issues (HM Government 2010, HM Government 2011, Mansfield 2011), the use of information technology (Okoroh and Torrance 1999, Ho 2009), the engagement of users (Miller and Buys 2008), among others.

¹ PhD Candidate, School of the Built Environment, 7th Floor, Maxwell Building, Phone +44 1612956898, The University of Salford, Salford M5 4WT, United Kingdom, S.Kemmer@edu.salford.ac.uk; sergiokemmer@gmail.com

² Professor, School of the Built Environment, 5th Floor, Maxwell Building, Phone +44 1612956378, The University of Salford, Salford M5 4WT, United Kingdom, L.J.Koskela@salford.ac.uk

Nevertheless, the research on the production management of refurbishment projects is scarce. There are few studies delving into the way construction companies have been managing production in such projects (Egbu 1994, Krizek et al. 1996, Egbu et al. 1998, McKim et al. 2000, Henrich 2009). Consequently, further investigation is necessary to better understand the characteristics of the production phase in such projects in order to improve its performance.

It is worth mentioning the existence of material presenting the characteristics of refurbishment projects (CIRIA 1994, Egbu 1994, Singh 2007, Ho 2009). However, these studies have usually approached those projects from a general perspective, thus overlooking the fact that refurbishments are carried out in different sectors of the construction industry such as housing, hospitals, offices, department stores, etc. Presumably, there are different approaches to different projects. Therefore, it is contended here that the characterisation of different types of refurbishment projects is necessary and will be useful to assist managers in the selection of the appropriate management system.

Following this line of thought, this paper seeks to better understand how the production phase of housing refurbishment projects is managed in the context of a housing association. To this end, an exploratory case study was carried out to investigate the intrinsic characteristics of such projects in this specific setting. This study is part of the initial phase of a doctoral research which looks at how the lean philosophy can be used to improve production performance of refurbishment projects.

IS LEAN PHILOSOPHY SUITABLE TO REFURBISHMENT PROJECTS?

Refurbishment projects have different features in comparison with new build projects. The management of refurbishment works is complex, highly specialized, risky, and uncertain, hence more difficult to manage than new build. It contains elements of works which are unique to refurbishment and different from new building work (CIRIA 1994, Egbu 1994, Egbu et al. 1998).

The authors of this paper argue that the lean philosophy is the appropriate way to deal with the complexity and uncertainty inherent to refurbishment projects, given that this management philosophy integrates the transformation, flow and value views (Koskela 2000). The lean philosophy has also a better approach regarding waste in comparison with traditional management (Ohno 1988, Koskela 2004). Waste reduction is primary in lean systems. Besides, lean theory presents a set of methods, tools, and techniques such as Last Planner System™, Target Value Design, Production System Design, Line of Balance, Prototyping, Visual Management, among others, which have already been successfully implemented in construction projects. Therefore, it is worth to investigate the applicability of lean solutions across the different types of refurbishment projects.

HOUSING ASSOCIATIONS IN THE UNITED KINGDOM

According to the Department for Communities and Local Government housing associations are defined as “independent societies, bodies of trustees or companies established for the purpose of providing low-cost social housing for people in housing need on a non-profit-making basis”. The terms Registered Social Landlords and Private Registered Providers of Social Housing are also used to represent these

organisations, but currently the term Housing Association has been used as the generic name for all social landlords not covered by local authorities (DCLG, 2012).

Despite not making part of the public sector, many housing associations receive government funding in order to build new homes and to regenerate communities. These organisations are highly involved in the refurbishment of the existing stock. Therefore, it is worth to understand how these projects are currently undertaken in order to promote the necessary improvements.

APPLICATION OF LEAN TO THE REFURBISHMENT OF PROPERTIES IN THE CONTEXT OF HOUSING ASSOCIATIONS

Despite the importance of the refurbishment sector, it is safe to say that there is not much evidence of the application of lean in this specific setting, especially in comparison of what is found concerning new building projects. Recently, a list containing a number of studies that addressed the use of lean principles to refurbishment projects was published (Kemmer and Koskela 2012). While these studies indicate the applicability of lean in such projects, none of them had tackled the particular case of refurbishments in the context of housing associations.

Kempton (2006) endeavours to check how suitable lean would be to the refurbishment in the context of a housing association. However, he adopted a very specific focus which is the refurbishment of void properties. Besides, in his view the opportunity to apply lean would be directly associated to the possibility of defining works as a process which means that in order to reduce waste and increase value in void works a process must be defined.

Following this line of thought, Kempton points out the difficulty to adopt a process-based approach in the refurbishment of void properties because of the *ad hoc* manner (non-routine and illogical) in which these voids occur, the dispersed location of the houses, and due to the lack of knowledge of what works are required to be undertaken, especially in the case of the older stock (houses built before 1980). The combination of these aspects causes difficulty with programming, makes logistics problematic, therefore challenging the application of process driven principles.

The case study presented in this paper adds to this discussion by showing a different circumstance existing at this specific setting. This refers to the planned refurbishment of occupied buildings. It is argued that this scenario is the most common situation of refurbishments encountered in the context of housing associations and therefore deserves further investigation.

RESEARCH METHOD

The constructive research (also called design science research) approach is adopted in this study. The use of this method has been recommended by several authors in the literature (March and Smith 1995, Lukka 2003, Van Aken 2004, Koskela 2008, Holmström et al. 2009). Basically, it seeks to produce innovative solutions for relevant practical problems as well as to contribute to the theory in the field of the study.

The research process is organised into two phases. The first phase comprises the identification and understanding of a relevant practical problem while the second involves the development and testing of a solution devised to solve the problem as well as the assessment of the theoretical contribution of the solution.

This paper reports findings from the first phase of the research process, namely, it focuses on the deep understanding of the production management of refurbishment projects in the context of a housing association. It involves the investigation of the intrinsic characteristics of such projects. This refers to the way that refurbishments are carried out, the typical problems faced at the construction stage, the influential factors affecting planning and control effectiveness, and the identification of the current managerial practices adopted by construction companies for managing production.

The study conducted in this research focused on the refurbishment of kitchens because it is considered by the managers of the housing association, contractors, and consultant as one of the most disruptive and time consuming refurbishments in houses. Normally, a kitchen's refurbishment lasts 10-15 working days whereas the replacement of windows or doors takes only 1 or 2 working days, for example.

Information was collected through 10 semi-structured interviews with representatives from the housing association, contractors, and consultant, non-participant observations of 5 project management meetings and 2 weeks of works on site during the refurbishment of 3 kitchens, besides the analysis of documents such as work programme, production plans, information pack for residents, choice menu (i.e. design options, including layout and material specifications), satisfaction surveys, etc. The information gathered was validated through a workshop involving project participants. The case study was carried out between December 2012 and May 2013.

It is worth mentioning that apart from the data presented in Table 1, which contains records from both contractors (here named A and B), all the information provided in the section "existing production planning and control system" refers to the process conducted by contractor A. The contractor B contributed to the initial phases of the study, but became unavailable along the development of the research.

DESCRIPTION OF THE COMPANY

This research was carried out within a housing association responsible to over 16,000 homes and supported homes in 32 areas across the North West of England. A significant number of properties, over a thousand, are refurbished each year. According to the managers of the housing association, approximately 98% of the properties are occupied during the refurbishment work.

The housing association investigated in this study works with two contractors and one consultant. The former work for the housing association carrying out works on site while the latter works as a building surveyor conducting surveys in order to produce the schedule of works for the refurbishments and as a clerk of work carrying out post-inspections and checking the quality of workmanship at the handover phase. Both of them, contractors and consultant, are also involved in the consultation process conducted by the housing association.

The core project team assembled for the development of the refurbishments planned yearly is formed by representatives from the housing association, contractors, and a consultant. Tenants, subcontractors, and suppliers complete the list of people or organisations involved in the refurbishments.

CHARACTERISTICS OF REFURBISHMENTS IN THE CONTEXT OF A HOUSING ASSOCIATION

TYPES OF REFURBISHMENTS

There are different types of refurbishments within the context of a housing association. Basically, they involve works in specific areas of a house such as kitchens and bathrooms or upgrades in terms of building components such as windows and doors. Other types might include replacement of fences, boilers, heating systems, and repair in roofs.

As described before, the types of refurbishment vary according to the scope of works needed to be carried out which depends on the information held by the housing association about the situation of the house. In this respect, managers of the housing association use an asset management database, which contains information derived mainly from the stock condition surveys, but also coming from operatives who work for the maintenance team as well as from feedback provided by the Housing Management Team, a department that logs the complaints made by tenants. The information held in this database is updated by surveyors who are constantly visiting homes and gathering data such as when the property was built, how old is the kitchen and other areas as well as building components like window and doors, for example. If they do not know the exact date they judge using their experience. This information will serve as a base for planning future refurbishments.

PLANNING STAGE

The refurbishment of houses has a specific challenge which is to work in an occupied building. This requires a high level of coordination and communication in order to avoid disturbances to the tenants and disruptions in the workflow. Therefore, before going on site, there is a planning stage which involves meetings with representatives from the housing association, contractors, and the consultant. It is noteworthy that the contractors work with subcontractors such as plumbing and electrical systems, wall tiling, flooring, and decoration, but these do not attend the meetings at this stage.

There is an initial meeting called “pre-contract meeting” which takes place at the beginning of each financial year. At this time, the housing association has already set the list of properties subject to refurbishment for the entire year based on the information available in the asset management database. This meeting is set up to go through the contractual documents and to make it clear what the housing association expects from contractors and consultant. Basically, they get told about the works they have to perform and the specifications they should use in terms of flooring, paints, tiles, among other technical matters. In addition, the housing association sets some ground rules on the communication side such as information on what time is allowed to work, quality standards of the works, how long in advance a company should give a notice to tenants informing about the visits, how to protect tenants belongings, etc.

There is also a meeting called “kick start meeting”. Basically, it aims to reduce any possibility of things going wrong on site and it involves the same participants from the “pre-contract meeting” plus the Housing Management Team (HMT). The HMT is a section within the housing association which is responsible for letting properties, managing rent, and for looking at general wellbeing at a particular area. The kick start meeting is not focused on technical aspects of the refurbishments, but it

is the moment when contractors and consultant get told by the HMT about any tenant issues before they get on site. For example, they become aware of anti-social behaviour in specific areas, types of complaints filled by tenants (e.g. “doors are not working properly”), supportive needs, etc.

Another type of meeting is the “progress meeting”. Basically, the contractor and the consultant report to the housing association the progress made at the current refurbishment schemes¹. Also, the issues around forthcoming schemes are discussed. Additional topics addressed include: health and safety, requests for information, and the assessment of tenants satisfaction rate. This meeting takes place on a monthly basis and it is carried out separately for each contractor.

Consultations are also carried out by the core project team (housing association, contractor, and consultant). They give choices to the residents with regards to material’s styles (e.g. types of sink and tap, wall tiles, etc.) and designs (e.g. kitchens, fences, windows, handle, etc.). Some consultations are conducted in an individual basis (e.g. refurbishment of kitchens and replacement of fences) while others are carried out in a collective basis (e.g. windows installation). Visual aids such as choice menus containing pictures of the different types of materials that will be fitted in the kitchen (e.g. sinks and taps, handles, flooring, etc.) and small prototypes (e.g. mini doors) are used in this process to help tenants to make decisions.

TYPICAL PROBLEMS ENCOUNTERED IN THE PRODUCTION PHASE OF REFURBISHMENT PROJECTS

The main issues regarding to the refurbishment of occupied houses in the context of a housing association are described below. This information was gathered through interviews with representatives from the housing association, contractors, and the consultant (building surveyor).

Tenants

A number of problems can stem from the tenant side, for example, tenants not being available at certain dates, forgetting to let the keys to allow workers to work, or simply not showing up as agreed. Also, there are situations where tenants change their mind in terms of the scope of works or specifications that have been agreed with the housing association, for instance, tenants demand extras requests or design changes late in the process, i.e., when works on site have already started or when they are close to the end. Finally, in some cases, there is a need for preparing documents in different languages to communicate with tenants from different cultures.

Communication or lack of understanding

Problems related to communication or lack of understanding can be noted in two instances. First, it refers to the communication between the housing association and the subcontractors. The housing association sets the specifications at the outset during the initial meetings. These meetings intend to specify to the contractors and consultant what works need to be done, what material should be used, what the quality of the work, standards, what are the working times, etc. In sum, it is informed

¹ A refurbishment scheme refers to a group of houses in a certain area.

what the client actually wants to achieve at the end of the programme. Uncertainties at this point on what kind of solutions or specifications should be adopted in a certain case (e.g. inaccurate or incomplete design brief, lack of details) can lead to problems downstream in the process such as late design changes, hence driving alterations in cost or/and time.

Second, it refers to the communication between the contractor's manager and the site personnel. During the initial meetings it is also provided information about how contractors should deliver what is expected from them. This refers to practical guidelines such as the need for making contact with tenants prior any service be carried out on site, how long in advance the tenant should be informed about an appointment, how to protect tenant's belongings, etc. This information is provided by the housing association to the contractors during the initial meetings, but when this gets to a site level this information tends to get diluted, especially in the case when it is a new contractor. Therefore, problems related to communication can result in a lack of compliance from operatives to the basic procedures on site such as making sure dust sheets are in place to avoid damages to tenants' belongings, using a badge to identify themselves, handling materials accordingly, workers turning up without notice or even with notice but not saying what kind of works they are going to conduct on site, etc.

Variability

Variability is another issue faced in the refurbishment of houses. It refers to unforeseen works (e.g. defective wall) and cost of these works and to variations in the quantity of works that need to be done. For example, according to the project manager plastering is one of the most variable things. He said it is hard to quantify before you start a job.

Other, minor issues

Minor issues refer to problems that happen occasionally and affect the flow of works on site. For instance, design not being done correctly, location of the houses (waste of time to move from one house to another), lack of materials (delays) or suppliers delivering wrong materials on site (e.g. kitchen kits), and weather.

EXISTING PRODUCTION PLANNING AND CONTROL SYSTEM

The production planning process starts with a list of properties provided by the housing association. This list contains the number of houses subject to refurbishment during the year. Based on that, the project manager who works for the contractor sets a plan which takes into account the geographical location of the houses and the scope of works related to each of them. The output from this first analysis is a master plan containing the number and sequence of refurbishment schemes that will be undertaken throughout the year. In average, the number of houses within a scheme ranges from 5 to 20 houses. In some cases this number can go up to 50 properties, but there are also cases when the contractor has to go to some areas to refurbish just four, two, or even one house. The next step is the development of production plans for each refurbishment scheme.

The basic organisational structure deployed by the contractor to manage the production phase of the refurbishment schemes usually involves a project manager,

site manager, a tenant liaison officer (TLO), a foreman, and the operatives. In the refurbishment of kitchens, the contractor is in charge of executing rip out (i.e. removing kitchen units, tiles, and flooring), plastering, kitchen's fitting, and snagging. Subcontracted services include: strip out (i.e. removing wall paper), plumbing and electrical systems, wall tiling, flooring, and decoration. Table 1 refers to a refurbishment of a single kitchen (the scheme investigated in this research comprised 3 houses) and indicates, for both contractors, the items of work conducted along with their respective cycle times. Also, the last column of the table indicates the day in which each task is performed during the execution of the refurbishment.

Table 1: Planning parameters for the refurbishment of a single kitchen.

| Contractor A | | | | Contractor B | | |
|--------------|---|--------------------|-----|---|--------------------|-----|
| Item | Item of work | Cycle time (hours) | Day | Item of work | Cycle time (hours) | Day |
| 1 | Rip Out & Strip Out | 2 | 1 | Strip Out | 4 | 1 |
| 2 | Plumbing | 2 | 1 | 1 st fix electrics | 8 | 2 |
| 3 | Electrics | 7 | 2 | Plastering | 4 | 3 |
| 4 | Plastering | 7 | 3 | Fit kitchen & Plumbing | 8 | 4 |
| 5 | Fit kitchen | 6 | 4 | Tile kitchen | 4 | 5 |
| 6 | Tile kitchen | 4 | 5 | 2 nd fix electrics | 2 | 6 |
| 7 | Screed floor (dry time) | 1 (2) | 6 | Decoration 1 st phase (dry time) | 4 (4) | 7 |
| 8 | Lay floor | 2 | 7 | Decoration 2 nd phase | 4 | 8 |
| 9 | Decoration 1 st phase (dry time) | 4 (4) | 8 | Screed floor (dry time) | 2 (4) | 9 |
| 10 | Decoration 2 nd phase | 8 | 9 | Lay floor | 4 | 10 |
| 11 | Handover (snagging & cleaning) | 8 | 10 | Handover (snagging & cleaning) | 2 | 11 |

As shown in Table 1, a refurbishment of kitchen is planned to take ten and eleven working days for contractor A and B, respectively. However, the contractors normally inform tenants that the works are going to take 15 days. This buffer is added to cope with any unforeseeable situation that might disrupt works on site. Also, it is possible to note that contractors consider in their planning partial days of work. According to them, this happens mainly because of the uncertain nature of the refurbishment work which makes difficult to have a perfect synchronization of trades on site.

According to the site manager (contractor A), the company normally finishes works within the 10 days as planned. This could be verified by the researcher during the visits he made on site. The site manager is responsible for devising a plan for each refurbishment scheme set in the master plan produced by the project manager. This plan contains the properties and their addresses, items of works, and dates. It is also used as progress sheet. The site manager uses colours to indicate which tasks have already been done. Based on this plan, the site manager develops a production plan for the week. The week plan is displayed on the wall at the site office and it is also

communicated to foremen and subcontractors through a formal document which is distributed by the site manager every Monday morning. Also, design drawings (e.g. electrical, plumbing, kitchens) are provided for the tasks scheduled for the week.

The foreman works closely with the operatives on site to make sure the works are being done up to the standard set by the housing association and to ensure the total accomplishment of tasks assigned in the week production plan. The site manager assists the foreman by providing whatever information he needs to keep the crews working continuously. He is also responsible for managing health and safety, workforce, programme, and quality issues. The TLO is responsible to deal with any sort of issue from the tenant's side and to make sure communication has been done appropriately, namely, tenants are fully aware of what is going on in their houses. The site manager and the TLO also make constant visits to the site in order to ensure the plan for the week is going to be fully accomplished.

DISCUSSION

This section presents an analysis of the data gathered in the case study. First, the good managerial practices adopted by the housing association and its project partners will be mentioned, and then the opportunities for improvement will be presented.

GOOD MANAGERIAL PRACTICES

Structured and collaborative planning process is in place

The collaborative meetings set at the outset of the refurbishment process (e.g. pre-contract and kick start meetings) help to reduce uncertainty and disruptions on site. Also, it makes clear for the consultant and contractors what the housing association expects from them in terms of both the technical details of the refurbishments (e.g. designs, materials specifications, quality standards, etc.) and the non-technical aspects involved in the projects (e.g. rules of communication between contractors and tenants, expected behaviour of workers on site, tenant's supportive needs, etc.).

Several channels of communication are open for dealing with tenants

The housing association seeks to maintain a close relationship with its tenants in order to avoid any kind of miscommunication and to promote a smooth flow of works on site. To this end, people and processes are deployed to maintain an effective and constant communication with tenants. For instance, specific roles such as the Property Services Coordinator (who works for the housing association) and the Tenants Liaison Officer (who works for the contractor) are in place to make sure tenants are satisfied with the services provided. In addition, tenants can also report any problems to the Housing Management Team. Also, tenants' preferences are taken into account through the consultations carried out by the core project team.

Long-term relationship with experienced project partners

Two contractors work for the housing association. Both of them have been working in the refurbishment sector for over 40 years, so they have got considerable experience on how to carry out works in this context. Besides, the housing association seeks to establish a long-term relationship with its partners. It is the third year that the same contractor is working for the association, so he is familiar with the system in place.

Use of visual aids and detailed information to improve communication

Visual aids are used to help residents to make decisions regarding the materials that will be installed in their houses. This refers to choice menus containing pictures of materials that are going to be installed in the kitchens and small prototypes. Another example is the adoption of a color-coded progress sheet which is used on site to indicate the status of production. Besides, an information pack containing all the details with regards to the production phase (e.g. scope and sequence of works, expected lead time, complaints and handover procedures, etc.) is provided to tenants before works are due to start on site, so they know exactly what to expect from the contractor and how to proceed in case of any deviation emerges along the way.

OPPORTUNITIES FOR IMPROVEMENTS FROM A LEAN PERSPECTIVE

Compress lead time

Although the lead time for refurbishing a kitchen has not been mentioned by the interviewees as a problem, it is argued that it could be compressed. As can be noted in Table 1, there are several days during the refurbishment in which the house stays empty after an operative finishes his job until the following day when the next trade comes into action. Also, during the observations on site it was noted that some cycle times are overestimated (contractor A). For instance, decoration (2nd phase) took less than five hours instead of eight as indicated in the planning. The same was verified with regard to handover, it took three hours rather than eight as planned. The time compression should be seen as the basis for continuous improvement since its pursuit leads to the elimination of wastes such as move and wait time. Besides, it is particularly appropriate for this context because it would minimize tenants' annoyance due to hassle in one of the most used area in a house, i.e., the kitchen.

Further improvement on transparency

During the observations conducted on site, also minor reworks due to the lack of details on the drawings were noted. For instance, the electrician did not have a view on a drawing to indicate the height of the switch, so he positioned it incorrectly therefore making impossible for the tile fitter to finish his job. As a result, the electrician had to redo the job (lift up the switch) in order to let the next trade complete his work. Managers of the housing association said that the electrician should know details like the height of the switches since they are standard for every house, but it is argued that more detailed drawings could help to avoid disruptions and reworks like that.

Standardized cycle times and the sequence of works on site

Currently, contractors adopt different sequence of works and cycle times. For instance, while one contractor prefers to execute decoration prior to flooring the other one chooses the opposite. Also, while one contractor plans eight hours for the handover and seven for plastering the other estimates only two and four hours to the respective works. Since the refurbishments carried out are similar, the standardization of these parameters could be interesting in order to enable the creation of a baseline for improvement as well as providing a basis for employee training.

CONCLUSIONS

The refurbishment of houses in the context of a housing association presents particular characteristics and challenges that should be properly understood if one wants to promote improvements. This was the main objective of the exploratory study presented in this paper, i.e., to better understand how the production phase of housing refurbishment projects is managed in this specific setting.

One of the main characteristics of this type of refurbishment is the fact that works are carried out in an occupied building. Therefore, maintaining effective and constant communication with tenants is primary in this context. In this respect, it is fair to say that the companies investigated have an excellent approach in place.

In terms of improvements from a lean perspective, the main waste to be tackled is the work in progress on site. Based on the analysis of the planning parameters used by the contractors and the observations made, it was possible to note that there is room for compressing the lead time allotted for the refurbishment of a kitchen.

However, the advantages and disadvantages of this lead time compression should be fully understood from the perspective of all participants of the project (tenants, housing association, contractors, subcontractors, consultant) prior to any change be made to the current system. In line with this, further work is necessary to identify the enablers and barriers to achieve such time compression not only from the perspective of one house, but mainly from the point of view of the production system as a whole.

ACKNOWLEDGMENTS

The authors would like to thank the companies (housing association, consultant, and contractors) for supporting this study and the CNPq, National Council of Technological and Scientific Development - Brazil, for sponsoring this research.

REFERENCES

- CIRIA – Construction Industry Research and Information Association (1994). A guide to the management of building refurbishment. Report 133. London, UK.
- DECC - Department of Energy and Client Change (2008). “Climate Change Act” <http://www.decc.gov.uk/en/content/cms/legislation/cc_act_08/cc_act_08.aspx>
- DCLG – Department for Communities and Local Government (2012). Definitions of general housing terms. (available at <https://www.gov.uk/definitions-of-general-housing-terms#housing-associations>).
- Egbu, C. O. (1994). “Management education and training for refurbishment work within the construction industry.” Thesis, The University of Salford, Salford, UK.
- Egbu, C. O., Young, B. A., and Torrance, V. B. (1998). “Planning and control processes and techniques for refurbishment management.” *Construction Management and Economics*, 16, 315-325.
- Henrich, G. (2009). “Development of a tool for diagnosing production management efficiency on construction sites.” Thesis, The University of Salford, Salford.
- HM Government (2010). “Final Report. Low Carbon Construction.” Report.
- HM Government (2011). “Action Plan. Government response to the Low Carbon Construction – Innovation and Growth Team.” Report.
- Ho, P. (2009). “An automated method to identify occupant interactions in renovations of occupied buildings.” Technical Report #185, Center for Integrated Facility Engineering, Stanford University, Stanford.

- Holmström, J., Ketokivi, M., & Hameri, A. (2009). Bridging practice and theory: a design science approach. *Design Sciences*, 40(1), pp. 65-87.
- Itard, L., Meijer, F., Vrins, E., and Hoiting, H. (2008). Building renovation and modernisation in Europe: state of the art review. Final report. OTB Research Institute for Housing, Urban and Mobility Studies. Delft University of Technology. Netherlands.
- Kemmer, S. and Koskela, L. (2012). Developing a lean model for production management of refurbishment projects. In *Proceedings of the 20th Annual Conference of the International Group for Lean Construction*, San Diego, USA.
- Kempton, J. (2006). "Can lean thinking apply to the repair and refurbishment of properties in the registered social landlord sector?" *Struct. Survey*, 24(3) 201-211.
- Koskela, L. (2000). "An exploration towards a production theory and its application to construction." Thesis, Technical Research Centre of Finland, VTT.
- Koskela, L. (2004). "Making-do – The eight category of waste." *Proc., 12th Annual Conf. of the Int. Group for Lean Const.*, IGLC, Copenhagen, Denmark.
- Koskela, L. (2008). Which kind of science is construction management? In *Proceedings of the 16th Annual Conference of the International Group for Lean Construction*, Manchester, UK.
- Krizek, R.J., Lo, W., Hadavi, A. (1996). "Lessons learned from multiphase reconstruction project". *J. of Constr. Engrg. and Mgmt.*, v.122(1) 44-54.
- Lukka, K. (2003). The constructive research approach. In Ojala, L. & Hilmola, O. (eds.). Case study research logistics, p. 83-101.
- Mansfield, J. (2011). "Sustainable refurbishment: some practical regulatory hurdles." *Structural Survey*, 29(2) 120-132.
- March, S.T., & Smith, G.F. (1995). Design and natural science research on information technology. *Decision Support Systems*, 5, pp. 251-266.
- McKim, R., Hegazy, T., Attalla, M. (2000). "Project performance control in reconstruction projects". *J. of Constr. Engrg. and Mgmt.*, v.126(2), 137-141.
- Miller, E., and Buys, L. (2008). Retrofitting commercial office buildings for sustainability: tenants' perspectives. *Journal of Property Investment & Finance*, 26 (6) 552-561.
- Okoroh, M. I., and Torrance, V. B. (1999). "A model for subcontractor selection in refurbishment projects." *Construction Management and Economics*, 17, 315-327.
- ONS - Office for National Statistics (2014). Output in the Construction Industry. Table 10 – Value of construction output in Great Britain. (available at <http://www.ons.gov.uk/ons/taxonomy/index.html?nscl=Output+in+the+Construction+Industry#tab-data-tables>).
- Ravetz, J. (2008). "State of the stock – What do we know about existing buildings and their future prospects?" *Energy Policy*, 36, 4462 – 4470.
- Singh, Y.P. (2007). "A framework for production management of renovation projects". Thesis, MSc., Construction Management, Michigan State University.
- van Aken, J.E. (2004). "Management research based on the paradigm of the design sciences: the quest for field-tested and grounded technological rules." *Journal of Management Studies*, 41(2), pp. 219-246.