UNCERTAINTY AND CONTINGENCY: IMPLICATIONS FOR MANAGING PROJECTS

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ABSTRACT

Uncertainty about what to build and how, is reduced as projects move from concept to completion through conceptual planning, design, and construction. Owners, designers, contractors and suppliers include additional time and money in their estimates to absorb uncertainty. Likewise, owners may include addition space or capacities in their program to cope with changes, and architects and engineers make provisions for the unexpected and unknown in their designs. These contingencies[2], established to absorb uncertainty, may be reduced as the project matures, as what and how become clearer and more stable. The Last Planner® System (LPS) reduces uncertainty by improving the predictability of workflow on a project, in effect reducing the uncertainty caused by the way work is managed. Collaborative design and management practices reduce conflicts, missing information and change the structure of work to improve constructability. A relationship between uncertainty in projects and the provision of contingencies such as time, money, additional capacity to resist forces or other forms of 'insurance' for reasonably expected if unknowns so seems reasonable and normal. Data on the extent of uncertainty faced on projects was collected in 1990 in research conducted for the Construction Industry Institute and again at the end of 2011 using the same instrument. This data is reviewed and discussed. Implications for the application of contingencies are discussed and the question is asked: Is contingency waste to be eliminated or value to be protected? The paper closes with a proposal for a larger research initiative.

KEYWORDS

Uncertainty, Planning, Risk, Project Management, Last Planner® System (LPS)

INTRODUCTION

This paper is about the connection between two broad classes of uncertainty faced on projects and the relationship between uncertainty and the application of contingencies, the 'padding' or buffers that absorb the impact of that uncertainty. Data first collected in the late 1980s and again in 2011 is reviewed and discussed. Then another source, unpredictable workflow produced on both projects managed on a tradition basis and still present but reduced on projects managed with the Last Planner® System (LPS), is explored.

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[2] The term 'Contingencies' is used in this paper as a provision for an unexpected event, padding or buffer. 'Contingency Theory,' which claims that there is no one right way to organize, is a different subject.

UNCERTAINTY IN PROJECTS

EARLY RESEARCH

Uncertainty related research was conducted in the late 1980s with results published in a Source Document prepared for the Project Organization Task Force (POTF) of the Construction Industry Institute (CII) (Howell 1990). The POTF then prepared and the CII published "Organizing for Project Success," a report that proposed how project organizations should be structured to cope with uncertainty (Carrol et al. 1991). These results foreshadow Integrated Project Delivery (IPD). Data for these documents was collected by asking project managers both face to face and in larger meetings and workshops to mark their assessment of the degree of uncertainty as to 'What' was to be built (Uncertainty in Objectives) and 'How' (Uncertainty in Means) it was to be constructed. The first set of data, collected in 1988 & 1989 reported about 100 such the assessments. Participants were asked to mark the location their typical project on the 'Uncertainty Matrix' in Figure 1. The percentage of projects in each quadrant is noted in red.

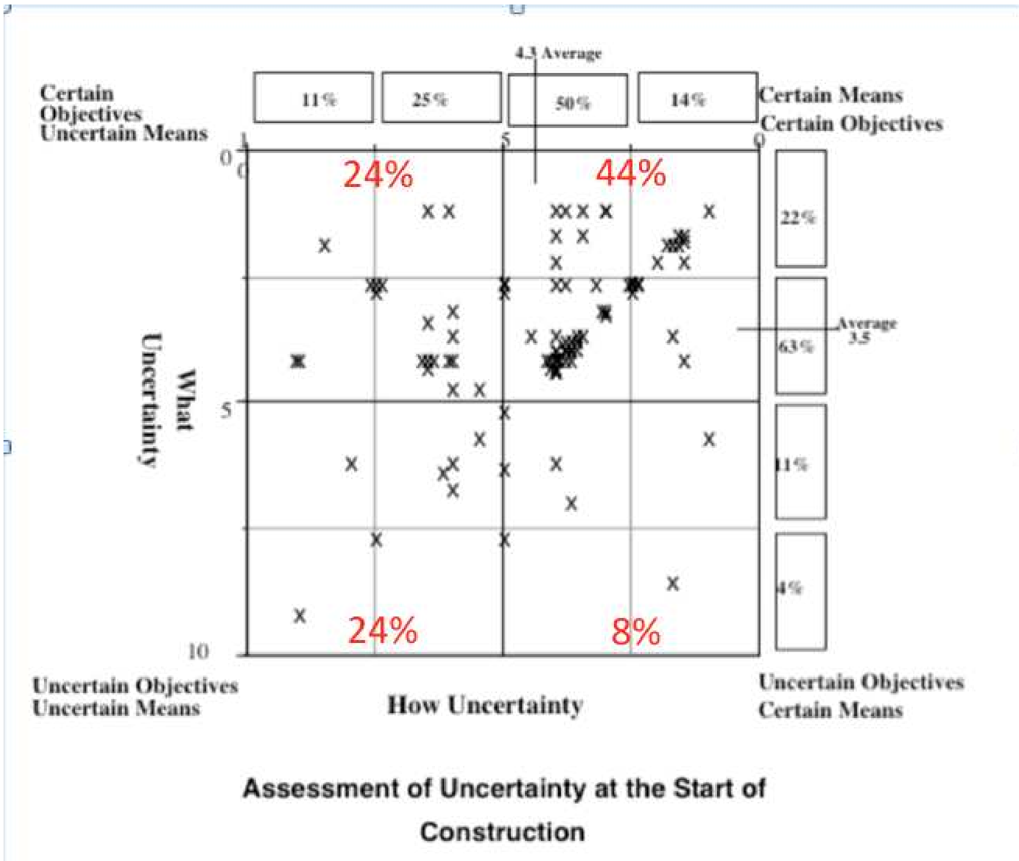

Figure 1: Uncertainty Matrix

The average of both forms of uncertainty are marked in Figure 1. "The owners, who comprised two-thirds of the sample, included large chemical production companies, electric utilities, and governmental agencies. All of the contractors surveyed were ranked in Engineering News-Record's 1991 list of the 400 largest construction companies. The data was collected in workshop settings in Albuquerque, NM; Houston, TX; and Reno, NV. Project size averaged about $40 million, ranging from less than $1 million to more than $200 million. Approximately two-thirds of the contracts were lump-sum; the rest were cost-plus. About half of the projects were industrial with the remainder divided between building, heavy/highway, and R&D facilities" (Howell and Laufer 1993). The averages of various groups such as size of project, workforce, industry segment were quite close to that reported for all projects. The distribution of points within each group was much larger than the difference in their averages.

This data was provocative at both the project and industry levels. The CII Project Organization Task Force suggested this matrix be used to reveal the extent of uncertainty experienced in projects and the differences of opinion about its nature and source in order to build a shared understanding of the situation. Used in Partnering meetings, individual assessments of the project at hand sparked rich and important discussions. People usually held widely different and well-grounded opinions about the nature and extent of uncertainty; they could explain the basis of their assessment and the action needed to change it.

The level of uncertainty reported in the data demonstrates project objectives are not determined at the beginning of a project. Rather objectives change as unpredicted events unfold and/or upstream planners fail to completely specify what they want. Uncertainty about means, or how the project will be delivered, must also be reduced. Objectives and the means to achieve them develop in concert as uncertainty is reduced.

Then the author, using the Uncertainty Matrix in a seminar, mistakenly changed the instructions from marking the location of a 'Typical Project' to 'Your Most Recent Project.' A workshop participant instant raised a question. "Should I mark where I thought it was at the start of construction or where I later learned it really was?" Making the best of a bad situation, the participant was instructed to place a "T" where he thought it was and an "R" for where it was later determined to have been. The data from that mistake, shown in Figure 2, suggested that optimism or blindness was a deeper and more dangerous problem than misalignment and imprecision.

There are 48 building and industrial projects reported on this matrix developed in the early 1990s. 11 of the projects are marked with a dot to show that the initial assessment did not change. The level of uncertainty 5 on projects was initially overestimated. 3 of those projects were later reported to be less uncertain terms of both 'What' and 'How.' The uncertainty on the two projects was different; each was less uncertain on one, but different, dimension and more on the other. All this suggested that project managers correctly assessed the level of uncertainty about 25% of the time, underestimated it 70% of the time and overestimated it in 10% of the cases.

Perhaps the optimism gene is turned fully on in people who manage construction projects. Even so, it is interesting to reflect on how such a realization might affect project management in general and the necessity for contingencies in budgets and schedule to protect companies involved.

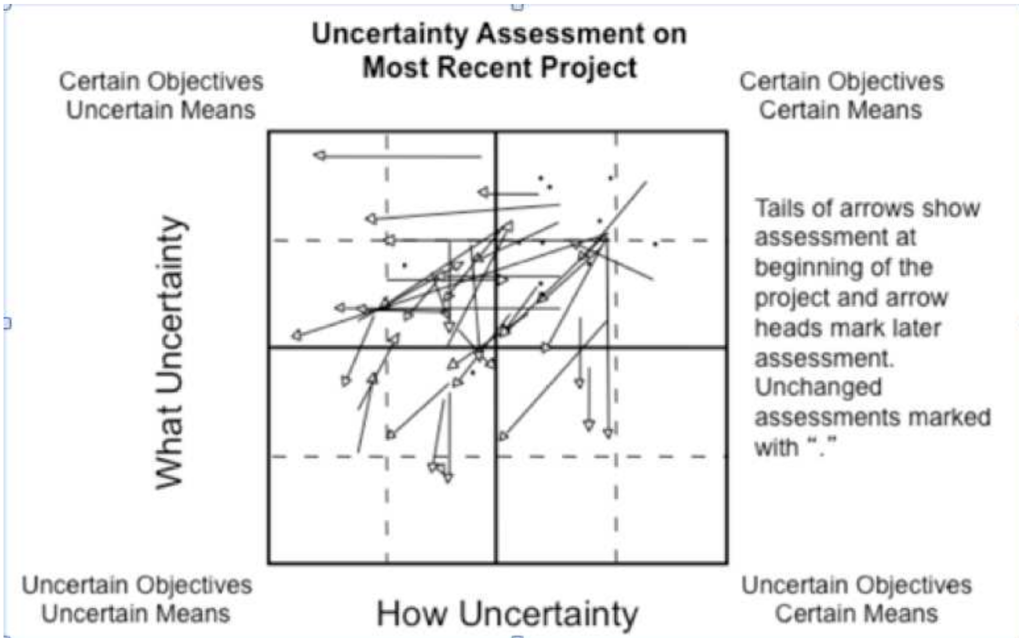

Figure 2: Uncertainty Matrix: Assessment on Most Recent Project

NEWER DATA

The Lean Construction Institute next explored the relationship between uncertainty and risk in workshops held in Seattle, Washington (Figure 3), and Portland, Oregon (Figure 4), in late 2011. Both workshops replicated the data collection process reported above. Participants were first asked to mark the location of their typical project at the start of construction.

The data samples from Seattle and Portland meetings are somewhat different although the average project appears near that shown in the original data. The cluster in the upper right of the Portland data is tight by comparison to the early data or that from Portland. Workshop participants attributed this to the increase in residential and hotel projects. The percentage of projects in the top right quadrant (the lowest uncertainty) is higher in Seattle than in the CII study and lower in Portland. Similar comparisons can be made in all quadrants but the data set is not large. No projects using Lean Construction principles and practices were reported. Remember, these marks are reports of people's opinions. These opinions may or may not be well grounded and people may interpret the same set of circumstances in different ways.

As in the earlier data collection, a second set of data was then collected in both Seattle and Portland. Here as before, the assignment was changed from a 'Typical Project' to 'Your Most Recent.' Blue dots mark where the participant placed the typical project sat the beginning of construction. Yellow marks identify where they later realized the project really was at the start of construction. Red lines connect 'Thought' and 'Really'.

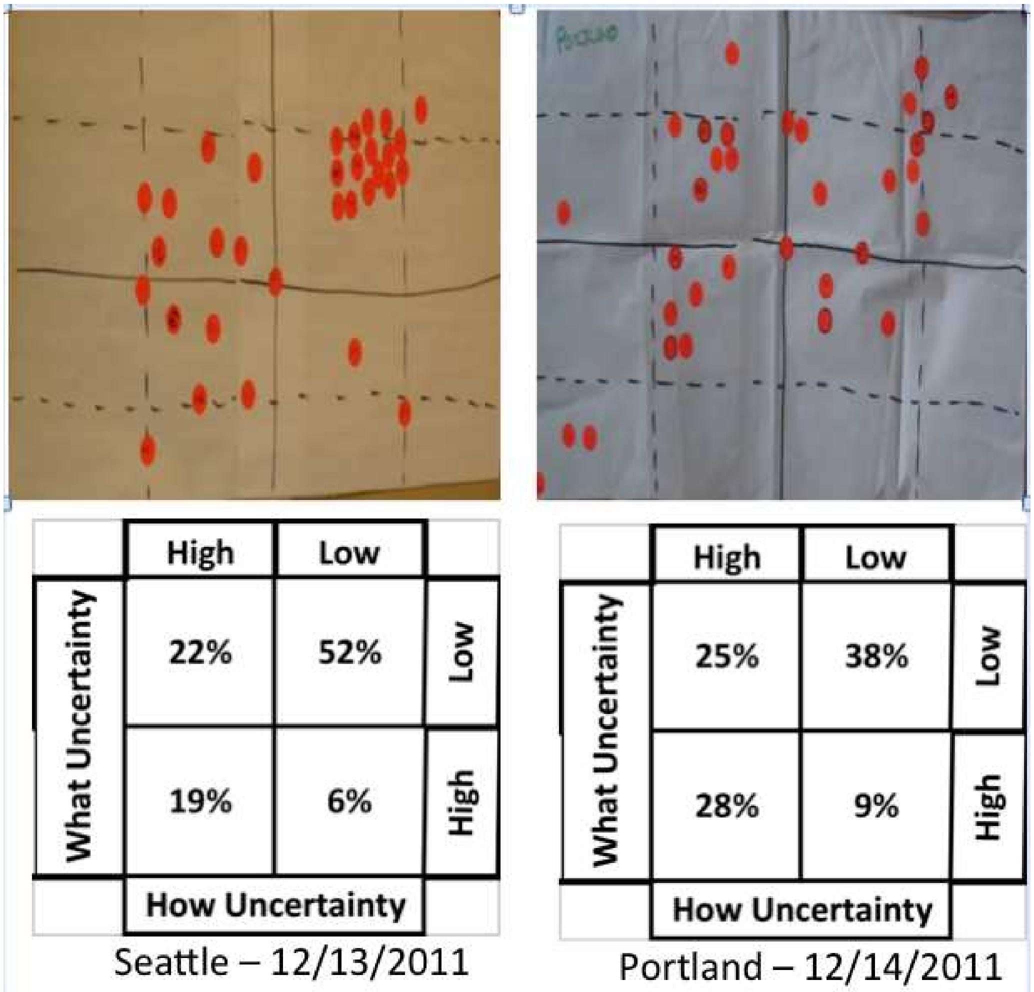

Figure 3: 2011 Uncertainty Assessment on Typical Projects

In Seattle, only 1 of the 31 participants showed no change between Thought and Really. The extent of uncertainty at the beginning of the project was overestimated by 5 managers and underestimated by 25. Uncertainty as to 'What' was to be built was most frequently and severely underestimated.

The Portland data is more challenging (Figure 5). Two participants reported that they had accurately assessed the level of uncertainty. Both were low in the bottom right corner of matrix where uncertainty was very high. 16 of 26 projects were located in the top right quadrant at the start of construction and only 10 were later understood to be in the same quadrant. All others show that the initial assessment of one or both forms uncertainty was optimistic. 8 projects were assessed to be in the bottom left quadrant.

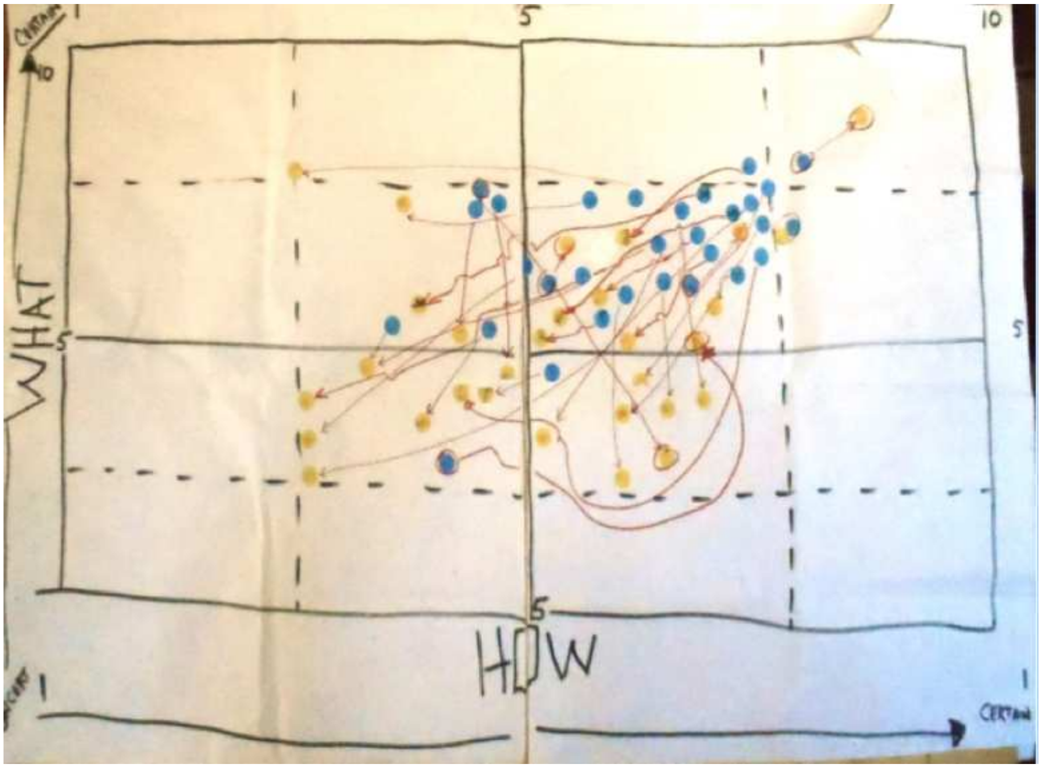

Figure 4: Seattle Uncertainty Assessment on Most Recent Project

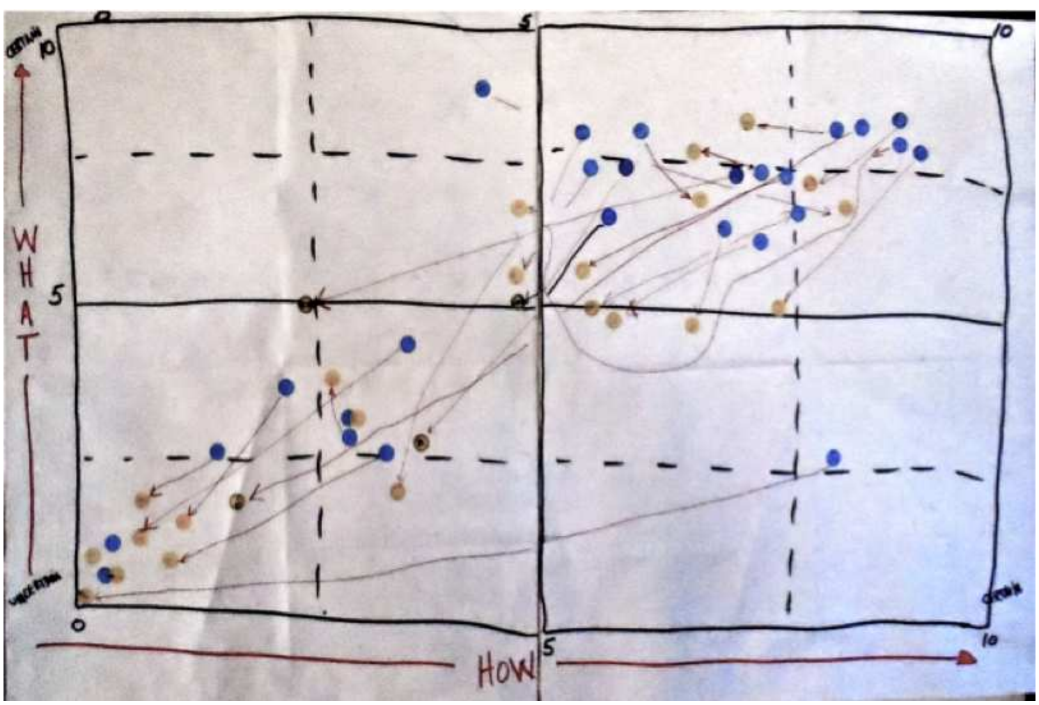

Figure 5: Portland Uncertainty Assessment on Most Recent Project

The difference between the Seattle and Portland data is likely because the Seattle Projects were predominately commercial buildings and those in Portland were mostly high-tech manufacturing projects. Even so, the pattern of underestimating the extent of uncertainty on projects is significant and pervasive.

UNPREDICTABLE WORKFLOW

The Last Planner® System (LPS) was developed when the inability of traditional project management to deliver predictable workflow was measured by Glenn Ballard and reported in a presentation to 'The Northern California Construction Institute' in March of 1994. Projects using traditional CPM-based planning typically delivered just over half, 54% of the tasks planned at the Last Planner—typically a foreman—level. Unreliable planning meant that downstream crews faced significant uncertainty as to when they could begin and complete the next task.

COPING WITH UNCERTAINTY

The sources and extent of uncertainty reported above present a significant challenge to those responsible to assure project completion on time and to budget. As Todd Zabelle of Strategic Project Solutions said in the early 1990s, "Uncertainty must always be absorbed." Contingencies, additional time and/or money and other resources or capacities must be available if projects are to be delivered on time and within budget. Contingencies must be included in owner budgets and contractor budgets and schedules and orders for materials, resources, the wherewithal for project delivery. Going forward without the security provided by contingencies is courting disaster.

Reports of the percentage of projects managed on a traditional basis that fail to be completed on time and within budget suggest that projects are undertaken either without careful assessment of uncertainty or the allowance of sufficient contingency to absorb it. As a result, Owners who buy projects will not be able to fund as much work as they want, and the costs of various forms on insurance and bonding will be large. It is safe to say that the total amount of contingencies applied on traditionally managed projects is large; it must be to absorb the uncertainty reported here.

The author has asked ±20 people experienced in Lean Construction whether they believe the improvements in cost and duration are the result of people working more productively, turning wrenches faster or longer, or the result of freeing hidden contingency. 1 in 5 attribute the improvement to increased worker productivity alone, a few say the improvement is due to both productivity improvement and the release of contingency, but well over half attribute improved performance to the release of unused contingency. In a sense, Lean Construction may be turning contingency into 'profit.' From this perspective, contingency is waste but the practices that create it are invisible and difficult to trace or understand. One project exploring contingency related practices of managers in construction is now underway by Prof. Min Liu at North Carolina State University and is reported in "Causes of Time Buffers in Construction Project Task Durations" (Liu and Howell 2012).

What is the relationship between uncertainty and contingency? Is there a rational way to understand or calculate the most economic or effective amounts in different circumstances? Careful and cleverly designed research might tell us more; how managers at every level assess the circumstance and absorb uncertainty by adding contingency to budgets and schedules or making other provisions. This might help us understand practice today and open new lines of research. Such research might explore how Lean Construction principles and practices serve as countermeasures and how they might be improved. For example, challenging teams applying Target Value Design with below-market budgets could lead them to reduce contingencies required to absorb uncertainty in traditional designs or to simply do the work more efficiently.

A CAUTION

In practice, reducing contingency may be an easy path to improvement but only for a while. Competition will soon squeeze contingency and then improvement will require more innovative or radical innovations. And there is a caution. Reducing contingencies makes organizations less resilient, that is, their ability to respond to the unexpected is limited by the resources they have available. Sidney Dekker in his recent book "Drift Into Failure" identifies 'scarcity and competition' as the first of five concepts that characterize drift (Dekker 2011). Reduce allowed durations and people will innovate in ways that are often unsafe when faced with less time to complete work. From this perspective, can we characterize contingency as waste? There is much left to learn here.

REFERENCES

Ballard, G. (1994). "The Last Planner System." Presentation to the Northern California Construction Institute, March 19, Monterey, California.

Carroll, J., Howell, G., Hopper J., Rowings, J., White T. (1991). "Organizing for Project Success." Construction Industry Institute Publication 12-2, Feb., Austin, Texas.

Dekker, S. (2011). "Drift Into Failure." Ashgate Publishing.

Howell, G. (1990). "How owners and contractors organize project teams." Source Document 53, Construction Industry Institute, Austin, Texas.

Howell, G. and Laufer, A. (1993). "Uncertainty and Project Objectives." *Project Appraisal*, 8, pp. 37-43, Guildford, England.

Liu, M. and Howell, G. (2012). "Causes of Time Buffers in Construction Project Task Durations." In Tommelein, I.D. and Pasquire, C. (editors). *Proceedings of the 20th Annual Conference of the International Group for Lean Construction*, San Diego, CA.