

EFFICIENCY IN CONSTRUCTION PROCESS

TAHRINA TAIB

UNIVERSITI TEKNOLOGI MALAYSIA

EFFICIENCY IN CONSTRUCTION PROCESS

TAHRINA TAIB

A project report submitted in partial fulfillment of the
requirements for the award of the degree of
Master of Science (Construction Management)

Faculty of Civil Engineering
Universiti Teknologi Malaysia

APRIL 2010

ABSTRACT

Construction industry currently is facing with a lot of problems mainly associated to its inefficient work process. This phenomenon has been manifested by frequent news and critics about project delay and inferior quality. Therefore there is an urgent need for construction industry to improve this situation. Many efforts have been done to improve the performance of the construction industry reputation such as using alternative procurement system, adoption of tools and management philosophy from other industry and using to new technological advancement such as the used of modular construction in Malaysia. In view to these problems face by the industry, this study has been undertaken with the aim to determine the strategies to improve the efficiency in construction process. The methodologies adopted for this study are the interview with expert panels and the distribution of questionnaires survey. The findings from this study confirmed that the construction industry particularly in Malaysia need to be improved with regards to its efficiency. There are also a lot of problems associated to construction such as poor site management, redundancy of activities, project delay and lack of focus to customer/end users' requirement. The study also determined that the main strategies currently promoted to achieve the improvement are by using Industrialized Building System (IBS). Many organizations also integrate the quality management system such as ISO 9001 and Total Quality Management System (TQM) in their business process. The used of management tools and philosophies from other industry is not a popular strategy.

ABSTRAK

Industri pembinaan kini menghadapi pelbagai masalah yang berhubung kait dengan proses kerja yang tidak efisien. Fenomena yang seringkali dikhabarkan di dalam berita ialah mengenai kritikan kelewatan projek dan masalah kualiti. Sehubungan dengan itu, terdapat keperluan untuk memperbaiki perkara tersebut. Pelbagai usaha telah dijalankan bagi meningkatkan tahap prestasi dan reputasi di dalam industri pembinaan. Ini adalah termasuk mengenalkan sistem pemerolehan baru, kaedah dan filosofi daripada industri lain seperti perkilangan dan juga pemakaian teknologi baru seperti sistem modular di Malaysia. Oleh yang demikian, kertas kerja ini disediakan bertujuan untuk mengenalpasti strategi yang dapat meningkatkan tahap efisien di dalam pengurusan pembinaan. Dua kaedah yang telah digunakan di dalam kertas kerja ini ialah temubual dengan panel pakar dan borang soal selidik. Hasil daripada kajian ini didapati industri pembinaan di Malaysia perlu ditingkatkan lagi tahap efisiennya. Terdapat juga pelbagai masalah yang berkaitan dengan pembinaan seperti masalah pengurusan tapak, aktiviti yang berlebihan, kelewatan projek dan kurang menitikberatkan kepuasan pelanggan. Kertas kerja ini juga telah mengenalpasti strategi yang telah digunakan untuk meningkatkan tahap efisien di dalam proses kerja oleh industri pembinaan di Malaysia adalah penggunaan sistem perindustrian pembinaan (IBS) serta pengurusan kualiti seperti ISO 9001 dan Total Quality Management System (TQM). Hasil kajian juga mendapati penggunaan sistem pengurusan baru yang telah digunakan oleh industri lain kurang popular untuk diadaptasikan di dalam industri pembinaan.

TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	DECLARATION	i
	DEDICATION	ii
	ACKNOWLEDGEMENTS	iii
	ABSTRACT	iv
	ABSTRAK	v
	TABLE OF CONTENTS	vi
	LIST OF TABLES	xi
	LIST OF FIGURES	xii
	LIST OF APPENDICES	xiii
1	INTRODUCTION	
	1.0 Introduction	1
	1.1 Problem Statements	2
	1.2 Aim and Objectives	3
	1.3 Scope of Research	3
	1.4 Methodology	4
	1.5 Study Outline	6

CHAPTER	TITLE	PAGE
2	LIMITATIONS AND PROBLEMS OF TRADITIONAL CONSTRUCTION PROCESS	
2.1	Introduction	7
2.2	Traditional construction process	8
2.3	Efficiency in construction process	9
2.4	Inefficiencies in Construction Process	10
	2.4.1 Poor Time Management	10
	2.4.2 Construction waste	12
	2.4.3 Communication breakdown	20
	2.4.4 Lack of project control and monitor	21
	2.4.5 Uncertainty handling approaches	24
3	METHODOLOGY IN ACHIEVING THE EFFICIENT CONSTRUCTION PROCESS	
3.1	Introduction	26
3.2	Construction process improvement	27
	3.2.1 Adapting Project Management Perspective to Construction Management	27
	3.2.2 Using Theory and Philosophy from Other Industry	32
	3.2.2.1 Lean Construction	33
	3.2.2.2 Supply Chain Management	34
	3.2.2.3 Materials Management	35

CHAPTER	TITLE	PAGE
	3.2.2.4 Kaizen Philosophy	36
	3.2.2.5 Kanban Philosophy	38
	3.2.2.6 JIT (Just in Time) Method	44
	3.2.3.1 Buildability/Constructability Concept	45
	3.2.3.2 Controlling Work Flow	47
	3.2.3 Technological Advancement Perspective	48
4	RESEARCH METHODOLOGY	
	4.1 Introduction	50
	4.2 Identification of research topic and scope of study	50
	4.3 Data Collection	52
	4.3.1 Interview with expert panels	52
	4.3.2 Survey Questionnaire	53
	4.3.3 Respond to questionnaire survey	56
	4.3.4 Frequency analysis	57
	4.3.5 Average Index Analysis (A.I)	57
	4.4 Research findings	60
	4.5 Make conclusion	60
	4.6 Conclusion and recommendation	60
5	DATA COLLECTION AND ANALYSIS	
	5.1 Introduction	61
	5.2 Interview With Expert Panels	61
	5.3 Questionnaires Survey	71
	5.4 Demographic of Respondents	72
	5.4.1 Respondents' Position	72

CHAPTER	TITLE	PAGE
	5.4.2 Respondent's Working Experience	73
5.5	Major Causes to Project Delay	73
5.6	Problems and Limitation in Traditional Work Process	74
5.7	Strategies used to improve construction process	77
5.8	Element of Improvement in Enhancing Construction Improvement	78
6	DISCUSSION OF THE RESULTS	
	6.1 Introduction	80
6.2	Rationale needs to improve efficiency of construction process	80
6.3	Urgent need to improve the current performance	85
6.4	Strategies to improve construction process	85
6.5	Definition of efficiency concept	88
6.6	Element of improvement	89
7	CONCLUSION AND RECOMMENDATIONS	
	7.1 Introduction	90
7.2	Achievement of this study	90
	7.2.1 Objective No. 1	91
	7.2.2 Objective No. 2	91
	7.2.3 Objective No. 3	92
7.3	Limitation of studies	92
	7.3.1 Time limitation	93
	7.3.2 Cost limitation	93
	7.3.3 Area of coverage limitation	93

CHAPTER	TITLE	PAGE
7.4	Recommendations	94
	7.4.1 Recommendations based on findings	94
	7.4.2 Recommendations for further research studies	95
	LIST OF REFERENCES	96
	APPENDIX A	103
	APPENDIX B	110

LIST OF TABLES

TABLE NO.	TITLE	PAGE
2.1	Waste generated from construction	16
2.2	Pre-construction people involved in materials management	19
2.3	Construction site people involved in materials management	20
2.4	Off-site people involved in construction materials management	21
5.1	Content Analysis of current construction process	65
5.2	Questionnaires delivered	73
5.3	Respondents Position	74
5.4	Respondent Working Experience	75
5.5	Results of most causes due to project delay	76
5.6	Results of problems and limitations in construction process	77
5.7	Results of needs to improve construction process	78
5.8	Results of practical and widely used strategies to improve construction process	79
5.9	Results on the most important elements of improvement in construction process	81

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE
1.1	The flow chart of the research methodology	5
2.1	Construction waste percentage by volume and weight	17
3.1	Target of improvement	31
3.2	Basic Ingredients in Project Management	33
3.3	Generic configuration of a supply chain in manufacturing	38

LIST OF APPENDIXES

APPENDIX	TITLE	PAGE
A	Interview Question	106
B	Survey Questionnaire	113

CHAPTER 1

INTRODUCTION

1.1 Introduction

The term traditional work process can be literally understood as the common practice inherited from the long established custom of delivering the construction project based on fragmented work process. In general this practiced has dominated the industry with the separation of design and construction function. There are a lot of definitions about efficiency in construction. In general, efficiency in construction process can be defined as the project constructed within time scheduled and cost budgeted. It is also were defined as process that produced less or no construction waste with a good quality project, no redundancy activities, good construction management and good monitoring and controlling construction process. Traditional construction process always been related with inefficiencies because it produced a lot of problems. Traditional construction process is always indicated as poor in management such as site management (resources and materials), quality management, communication management, waste management and personnel management. Traditional construction process always been connected with the inefficiencies in terms of project time.

Traditional construction method generally adopted by past experience or project. Furthermore there is no standard measurement in enhancing traditional construction process such as monitoring and controlling method for construction progress. Contractor used their past experience in predicting the project time. In reality, they faced a lot of problem in engaging the project and project time will be behind the schedule. It is very important to improve the efficiencies of construction process. Generally by enhancing the efficiencies in construction process, project time will be reduced, improved construction quality, eliminated waste and saved cost.

1.2 Problem statement

Many issues were raised in traditional construction process due to its inefficiencies. People do aware about issues and problems in traditional construction process but do not try to find the right solutions. Traditional work process usually is associated with problems and limitations. A lot of implications that been outline in this study such as project delay, redundant works and activities, poor management, and communication breakdown. They also are related to abandoned projects. Current construction industry also was sometimes not achieved the expectation of end user and customer. Problem of delay and low quality project seem to be happened in construction project. A serious actions need to be taken but there is no indicator can be measured towards the efficiencies of construction projects. Many new strategies and methodologies were introduced to the industry but the practicality of the strategies still cannot be assured.

1.3 Research aim and objectives

The main aim of this study is to determine strategies to improve construction process.

Below are the objectives of this study:

- To review the rationale and the need to improve the efficiency of the current construction process
- To evaluate the methodology used currently by the industry to improve the construction process
- To propose strategies to improve construction process.

1.4 Scope and limitation

The scope of this study was focused on the process of construction project in Klang Valley. It is limited on the construction stage/phase and time factor. Data analyzed were from the project manager, project management consultant (PMC), engineer and other construction players involve directly in construction process.

1.5 Brief Research Methodology

This project conducted through several phases that included literature review, data collection, data analysis, findings, and recommendations. Literature review is to compile and determine the idea, theory and common practices in achieving the efficient construction process. Two methods were used in collecting data. They are through interviews and questionnaire survey.

The panels interviewed are those directly in-charge in construction projects either in private or government sector. They include personnel from private and public agencies such as JKR, consultant firms and contractors. Then, the results from the interviews were used as a guide to develop the questionnaire survey form. Apart from that the findings from the literature review has been used as well to develop the questionnaire.

A questionnaire is a series of questions submitted to a number of people to obtain data for a survey or report. This is a valuable method of collecting a wide range of information from a large number of individuals, often referred to as respondents. Good questionnaire construction is critical to the success of a survey. Inappropriate questions, incorrect ordering of questions, incorrect scaling, or bad questionnaire format can make the survey valueless.

The analyses of the results were applied by using average index analysis. Upon the data provided from the face to face interviews and questionnaire, strategies on improving construction process were determined. Figure 1.1 showed the methodology of this study.

Basically objectives of this study were achieved as the flow shown below:-

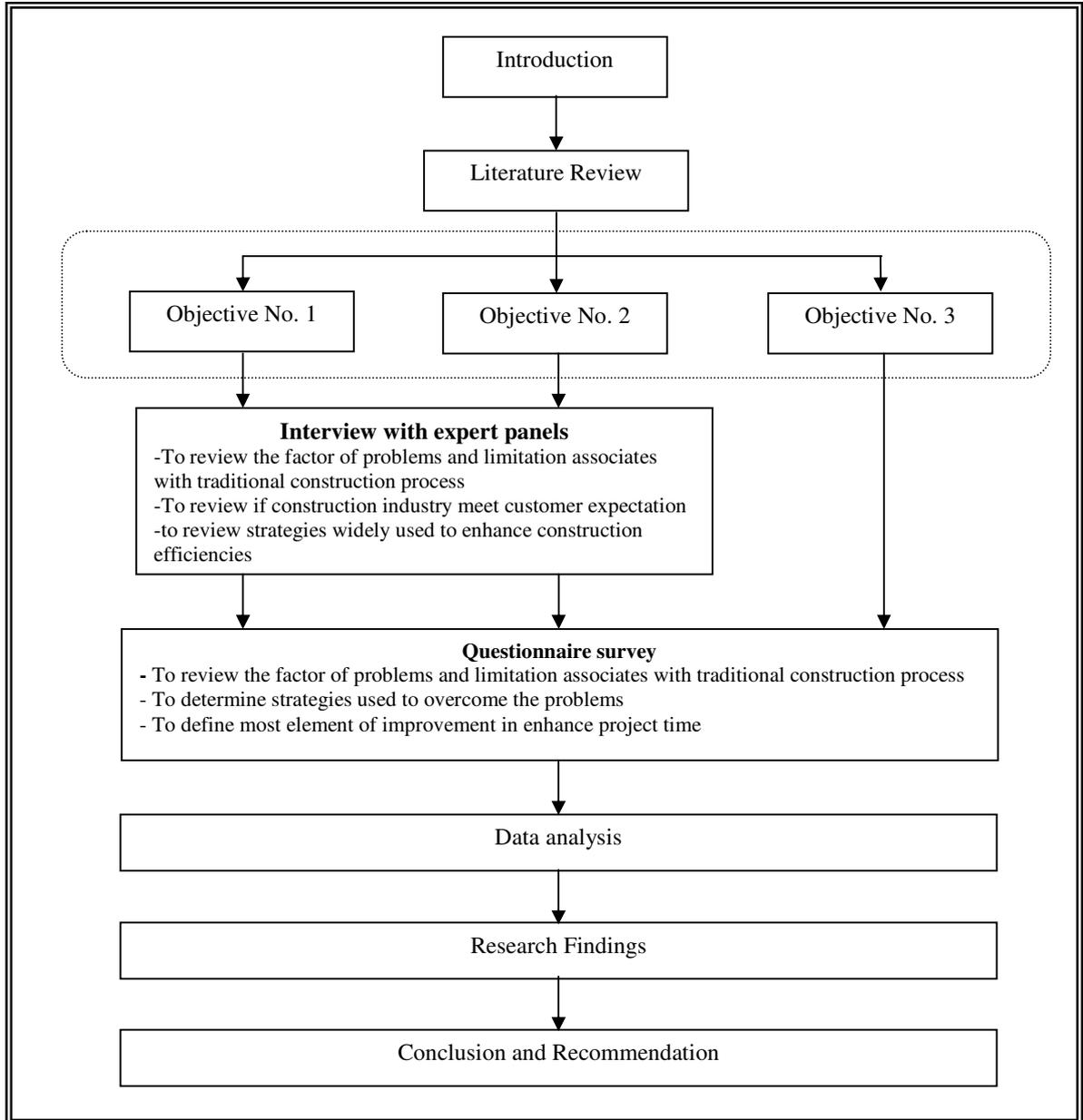


Figure 1.1: The flow chart of the brief research methodology.

1.6 Study Outlined

The study is presented in seven (7) main chapters.

Chapter One introduces the report outlining aims and objectives and general overview of the paper. This chapter is very crucial because it provides the overall information about the research besides the subsequent process is derived from the research problem.

Chapter Two described the problems faced in current construction process and its limitations.

Chapter Three discussed on the improvement of construction process by using collaborative teamwork concept, integrating design and construction and using tool and philosophy from other industry.

Chapter Four discusses on the type of study methodology and its procedures. The process of data collection and analysis is also explained in this chapter.

Chapter Five presented data collected in this study. They are analyzed and presented in appropriate table.

Chapter Six is on the discussion of results or research findings.

Chapter Seven is the conclusion, which meets the objectives stated earlier and recommendation for future study.

LIST OF REFERENCES

- Abdelhamid T. (2007). *Lean Construction Principles*. PhD Thesis. Graduate class offering at Michigan State University
- AIA Houston (1994). *Construction Materials Management Guidelines for Economy And Ecology In Design And Construction*, Houston, Texas
- Akinci B., Fischer M., Levitt R. and Carlson R. (2002). Formalization and automation of time-space conflict analysis, *Journal of Computing in Civil Engineering*, Vol. 16, No. 2, 124-134.
- Arditi D., Sikangwan P. and Tokdemir O.B. (2002). Scheduling system for high rise building construction, *Construction Management and Economics*, Vol. 20, No. 3, 353-364.
- Bakeren, W. and Willems, P. (1993). Capturing and structuring the meaning of communication in the building and construction industries: a symbolic relationship, *Management and Information for Construction*, World Scientific Publishers.

- Baldwin, A.N.; Thorpe, A. and Carter, C. (1996). The construction alliance and electronic information exchange: a symbolic relationship, CIB-65, Strathclyde University, Glasgow.
- Ballard G. (2000). The last planner system of production control, PhD Thesis, University of Birmingham, UK.
- Ballard G., Castern M. and Howell G. (1996). PARC: a case study, Proceedings of the Fourth Annual Conference of the International Group for Lean Construction, Birmingham, UK.
- C.F Gray and E.W Larson (1999). "Project Management The Managerial Process", Mc Graw Hill, USA
- Chan, D.W.M. and Kumaraswamy, M.M. (1996) An evaluation of construction time performance in the building industry. *Building and Environment*, 31(6), 569–78.
- Chan, D.W.M. and Kumaraswamy, M.M. (1999a) Forecasting construction duration for public housing projects: a Hong Kong perspective. *Building and Environment*, 34(5), 633–46.
- Chan, D.W.M. and Kumarawamy, M.M. (1999b) Modelling and predicting construction duration in Hong Kong public housing. *Construction Management and Economics*, 17(3), 351–62.
- Cherneck J., Logcher R. and Sriram D. (1991). Integrating CAD with construction schedule generation, *Journal of Computing in Civil Engineering*, Vol. 5, No. 1, 64-84.

- Choo H.J., Tommelein I.D., Ballard G. and Zabelle T. R. (1999). WorkPlan: constraint-based database for work package scheduling, *Journal of Construction Engineering and Management*. 125, No. 3, 151-160. , Vol 125, No. 3, 151-160.
- Dawood N., Sriprasert E. and Mallasi Z. (2002a). 4D visualisation development: real life case studies, *Proceedings of CIB w78 Conference 2002*, Aarhus, Denmark, 53-59.
- Goldratt E.M. (1997). *Critical chain*, The North River Press, Great Barrington, MA.
- Hadikusumo B.H.W. and Rowlinson S. (2002). Integration of virtually real construction model and design-for-safety process database, *Automation in Construction*, Vol. 11, No. 5, 501-510.
- Harris F. and McCaffer R. (1989). *Modern construction management*, Collins, London.
- Halpin D.W. and Riggs L.S. (1992). *Planning and analysis of construction operations*, John Wiley and Sons, NC.
- Halpin D.W. and Martinez L.-H. (1999). Real world applications of construction process simulation, *Proceedings of the 1999 Winter Simulation Conference*, 956-962.

- Herroelen W. and Leus R. (2001). On the merits and pitfalls of critical chain scheduling, *Journal of Operations Management*. 19, 559-577. , Vol 19, 559-577.
- Horman M., Kenley R. and Jennings V. (1997). A lean approach to construction: a historical case study, *Proceedings of the Fifth Annual Conference of the International Group for Lean Construction*, Gold Coast, Australia.
- Iris Communications, Inc. (1995). *Green Building Sources: Construction Site Waste Management*, Bend
- Jaafari A. (1984). Criticism of CPM for project planning analysis, *Journal of Construction Engineering and Management*. 110, No. 2, 222-233. , Vol 110, No. 2, 222-233.
- Jaafari A. (1996). Time and priority allocation scheduling technique for projects, *International Journal of Project Management*, Vol. 14, No. 5, 289-299.
- J.E. Diekmann and K.B. Thrush, *Project Control in Design Engineering*, A Report to the Construction Industry Institute, The University of Texas at Austin, Texas, May 1986
- J. M. Dowdall CB (2005), *Modernising Construction Procurement in Northern Ireland*, Northern Ireland Audit Office
- Junior J. A., Scola A. and Conte A.S. (1998). Last planner as a site operations tool, *Proceedings of the Sixth Annual Conference of the International Group for Lean Construction*, Guarujá, Brazil.

- Kartam N.A., Levitt R.E. and Wilkins D.E. (1991). Extending artificial intelligence techniques for hierarchical planning, *Journal of Computing in Civil engineering*, Vol. 5, No. 4, 464-477.
- Kähkönen K. and Leinonen J. (2001). Visual product chronology, Presentation given to the Workshop on Virtual Construction, Organised by ENCORD, 26-27 November 2001, Essen, Germany.
- Koo B. and Fischer M. (2000). Feasibility study of 4D CAD in commercial construction, *Journal of Construction Engineering and Management*, Vol. 126, No. 4, 251-260.
- Koskela, L. and Howell, G., (2002). "The Underlying Theory of Project Management is Obsolete." *Proceedings of the PMI Research Conference*, 2002, Pg. 293-302
- L. C. Stuckenbruck, "Project Management Framework," *Project Management Journal*, Vol. 17, No. 3, August 1986, pp. 25-30.
- Lichtig, W. (2005). "Ten Key Decisions to A Successful Construction Project." American Bar Association, Forum on the Construction Industry, September 29-30, 2005, Toronto, Canada
- Lacouture and M. J. Skibniewski. *E-Work: The Next Iteration In Construction Materials Management Systems*, Purdue University, West Lafayette, Indiana, 47907-1294, USA.

- Martinez J.C. (1996). STROBOSCOPE: state and resource based simulation of construction processes, PhD Thesis, University of Michigan, Ann Arbor, MI.
- McKinney K. and Fischer M. (1998). Generating, evaluating and visualizing construction schedule with CAD tools, *Automation in Construction*, Vol. 7, No. 6, 433-447.
- Mawdesley M., Askew W. and O'Reilly M. (1997). *Planning and controlling construction projects: the best laid plans* Wesley Longman, Essex. ,
Addi
- M.P Spinner, (1997). "Project Management Principles and Practices", New Jersey, USA
- M.R.A Kadir, W.P. Lee, M.S. Jaafar, S.M. Sapuan, A.A.A. Ali (2005). Factors affecting construction labour productivity for Malaysian residential projects
- Preece, C.N.; Moodley, K. & Smith, A.M. (1998). *Corporate communications in construction: public relations strategies for successful business and projects*, p. 119, Blackwell Publishing, Oxford
- Pultar M. (1990). Progress-based construction scheduling, *Journal of Construction Engineering and Management*. 116, No. 4, 670-688. , Vol 116, No. 4, 670-688.
- R. M. Wideman, "The PMBOK Report -- PMI Body of Knowledge Standard," *Project Management Journal*, Vol. 17, No. 3, August 1986, pp. 15-24.

R.Vrijhoef and L. Koskela, (1999). "Roles Of Supply Chain Management In Construction, 26-28 July 1999, University of California, Berkeley, CA, USA

Skitmore, R.M. and Ng, S.T. (2003) Forecast models for actual construction time and cost. *Building and Environment*, 8(8), 1075–83.

Sriprasert E. and Dawood N. (2001). Potential of integrated digital technologies for construction work-face instruction, *Proceedings of AVRII and CONVR 2001*, Chalmers, Gothenburg, Sweden, 136-145

Steyn H. (2000). An investigation into the fundamentals of critical chain project scheduling, *International Journal of Project Management*, Vol. 19, 363-369

Thomas, U.R., Smith, G.R. and Cummings, D.J. (1995) Have I reached substantial completion? *Journal of Construction Engineering and Management*, 121(1), 121–9.

Winstanley G., Chacon M.A. and Levitt R.E. (1993). Model-based planning: scaled-up construction application, *Journal of Computing in Civil Engineering*, Vol. 7, No. 2, 199-217.