



This item was submitted to Loughborough's Institutional Repository (<https://dspace.lboro.ac.uk/>) by the author and is made available under the following Creative Commons Licence conditions.


C O M M O N S D E E D

Attribution-NonCommercial-NoDerivs 2.5

You are free:

- to copy, distribute, display, and perform the work

Under the following conditions:



Attribution. You must attribute the work in the manner specified by the author or licensor.



Noncommercial. You may not use this work for commercial purposes.



No Derivative Works. You may not alter, transform, or build upon this work.

- For any reuse or distribution, you must make clear to others the license terms of this work.
- Any of these conditions can be waived if you get permission from the copyright holder.

Your fair use and other rights are in no way affected by the above.

This is a human-readable summary of the [Legal Code \(the full license\)](#).

[Disclaimer](#) 

For the full text of this licence, please go to:
<http://creativecommons.org/licenses/by-nc-nd/2.5/>

CONSTRUCTION PROGRAMME MANAGEMENT - CURRENT CONTEXT

Mohamad Syazli Fathi¹, Chimay Anumba², Patricia Carrillo³ and Zeeshan Aziz⁴

ABSTRACT

The use of programme management systems by construction programme managers is critical nowadays. The increasing complexity of multiple construction projects require information and service delivery systems that are more effective and efficient in order for the programme manager to be able to achieve the business objectives or benefits.

This paper reports on the main findings from a study of programme managers in the United Kingdom and Malaysia concerning the challenges and issues in the delivery of information and services in multiple construction project environment and explores how the context of a user (such as role, location, time, preference, etc) may be utilised to provide personalised information. The discussion in the paper focuses on the key issues and requirements for programme managers to manage multiple projects using the existing programme management tools. Conclusions are drawn about the potential implementation of context-aware computing technologies in the current context of construction programme management.

KEYWORDS

Context-Aware Information Delivery, Construction Programme Management, Programme Manager, Programme Management Systems

INTRODUCTION

Construction is an information intensive industry, and as such, the management of a single or multiple construction projects depends on the accuracy and timeliness of that information. In addition, the programme manager (a person that always need to make important decision about the programme) are typically in physically different locations, further complicating the accessibility and transmission of critical project and programme information. It is well understood that the use of mobile information and communication technologies (ICT) is critical in managing construction projects as the right information needs to be delivered to the right person, at the right time, and at the right place (Bowden et al. 2006). However, the existing mobile applications in construction management only support the delivery of static modes of information (such as project data, technical drawings, risk assessment etc), they are pre-programmed and thus not able to take into account the workers' changing context and the dynamic project conditions (Aziz 2005).

Mobile applications could be made responsive to users' wishes if they were context-aware (using technology that is capable of inferring the users' true intentions by taking into account any relevant auxiliary information supplied for the purpose). Thus changes in different types of context

¹ Research Student, Civil and Building Engineering Department, Loughborough University, Loughborough, LE11 3TU, United Kingdom. email: m.s.fathi@lboro.ac.uk

² Professor, Civil and Building Engineering Department, Loughborough University, Loughborough, LE11 3TU, United Kingdom. email: c.j.anumba@lboro.ac.uk

³ Professor, Civil and Building Engineering Department, Loughborough University, Loughborough, LE11 3TU, United Kingdom. email: p.m.carillo@lboro.ac.uk

⁴ Research Associates, Civil and Building Engineering Department, Loughborough University, Loughborough, LE11 3TU, United Kingdom. email: z.aziz@lboro.ac.uk

information could cause a variety of actions to be initiated by the applications, just as a person might respond to the same signals.

This research focuses on a new interaction paradigm for programme manager by supplying the right information at the right time and at the right place. The authors would like to suggest that the delivery of context-specific information and services to construction programme managers may enhance the project and programme management activities by providing personalised information and services based on the programme managers' current context. The next section deals with an understanding of the construction programme management and identifies some of the requirements of the construction programme managers. This is followed by the research methodology. The results and discussions of the key findings from these case studies are outlined. The discussion also deals with the characteristics of the potential context-aware applications for construction programme managers. Conclusions are drawn about the current context of construction programme management and how context-aware applications are able to assist in accessing relevant information, making accurate decisions, monitoring and controlling the construction programme.

CONSTRUCTION PROGRAMME MANAGEMENT

Different programmes require different managerial approaches (Vereecke et al. 2003). The challenges, issues and requirements of information and services are different between construction programmes and others programmes such as agriculture, defence, or aerospace programme. This research project focused on the delivery of specific information and service to the programme manager that manages multiple construction projects. The many definitions and interpretations of 'programmes' all have some validity. Programme management need to be classified according to the field of used. Therefore, a specific and clear definition of the management of construction programmes management or multiple construction projects management is needed. In this paper, construction programme management is defined as follows:

***Construction Programme Management** is the co-ordinated management of a group of related or unrelated construction projects that together provide a certain elements that assist the organisation to achieve a define business goals, objectives and benefits.*

Construction programme management deals with the integration and management of a multiple-construction environment and complex resources utilisation with the intent of achieving benefits that would not be realised if they were managed separately. A multiple construction project or construction programme usually requires an expanded scope of construction management services, which should be referred to as construction programme management services. The services normally focus on managing the programme planning, design, performance and strategy for construction of a buildings or infrastructure programme. These involve the management of multiple projects at the multiple phases on either a single site or on multiple sites. These also could be related or unrelated projects. The Construction Programme Manager (CPM) is responsible for all the stages in the construction programme.

RESEARCH METHODOLOGY

Given the exploratory nature of the research, case studies have been conducted. A total of eight international and local companies located in the United Kingdom and Malaysia have participated in the research. Five companies are from the UK and three companies are located in Malaysia. The companies have been selected from different fields in the construction industry as shown in Table 1 below. The differences between these fields will give a variety of data for the requirements of information and services gathering.

Table 1: Background of the companies interviewed

Description	Company Business Background	Programme and Projects Location
R001	Facilities Construction and Project Management	UK and Dubai, UAE
R002	Railway Construction and Project Management	London, UK
R003	Oil & Gas Construction and Project Management	Malaysia
R004	Building Construction Project Management	United Kingdom
R005	Building Construction Project Management & Consulting	Malaysia
R006	Infrastructure and ICT Project Management and Services	Malaysia
R007	Highways Construction & Project Management	United Kingdom
R008	Water & Waste Water Programme Management	United Kingdom and International

Semi-structured interviews have been conducted with construction programme managers in each of the eight selected companies in the United Kingdom and Malaysia. The interviewed have been conducted through face-to-face interview in the UK and telephone interviews in Malaysia. In order to obtain rich insights into the approach taken to programme management for these programmes, some of the questions asked during the interviews were open-ended.

RESULTS

Respondents

The business background of the companies that responded to these studies are shown in Table 1. In each company, a construction programme manager was selected for the purpose of this study. Although the construction programme managers came from different company backgrounds, they shared similar roles and responsibilities in managing multiple projects as shown in Table 2.

All respondents led the programme and were currently managing and co-ordinating multiple projects (three or more projects). This gives a good sample of data specific to the information requirements from the respondents in construction programme management perspective that manage multiple construction projects. All interviewees work for private companies but are also, involved in various government and private sector contracts. All companies are involved in local projects or programme (in the UK or Malaysia) with two companies having construction projects or programme internationally.

Table 2: Programme and Project Management System Used

Description	Programmes Managers Responsibilities	Number of Programmes or Projects managed simultaneously	Number of Projects Responsible for	Is an Integrated Programme Management tool used?
R001	The management and construction of entertainment city components – includes retail, hospitality and entertainment facilities	1 programme	10	Yes – need to upgrade to a better system (evaluation stages)
R002	The management and construction of railway projects	1 programme	30+	No – combination of various on-the shelf softwares
R003	The management and construction of new oil and gas (O&G) facilities to the existing facilities for international O&G company	30-40 unrelated projects	5	No – combination of various on-the shelf softwares
R004	The management and construction of building of new schools and upgrading an airport	3 unrelated projects	3	Yes – In-house development of Integrated Programme Management System
R005	The management and construction of institutes and schools for Malaysian government	3 unrelated projects	3	No – combination of various on-the shelf softwares
R006	The management and construction of call center infrastructure and networking facilities for banks and IT companies	3 unrelated projects	3	No – ISO Standard & Paper based
R007	The maintenance and strengthening of bridges and highways for private companies	5 unrelated projects	5	No – combination of various on-the shelf softwares
R008	The development of water and waste water projects for clients around the world	3 programme with 300 related and unrelated projects	300	Yes – In-house development of Integrated Programme Management System

Programme and Projects Information

The results in Table 2 shows that four respondents (R001, R005, R006 & R007) are not using any integrated programme or project management tools. They are experiencing a huge problem with too much data and information flow involved in managing multiple projects. Some of the problems stated are:

- Manual filing (hardcopies) and organising multiple project data such as drawings, job sheet, manuals and project contracts is a challenging task for programme management office staff;

- Huge time consume in going through large amounts of multiple projects data; and
- Huge storage area or place are needed for keeping multiple projects data (hard copies) in the programme management office.

Whilst, the findings from two respondents (R004 & R008) using an integrated programme and project management system showed that their main problems regarding the programme information are:

- users unable to find information in the system itself;
- searching could be difficult for users that are not well trained or reluctant to use the new and complex information system management; and
- time consuming and poor quality training to use complex programme management system.

However, two respondents (R002 & R003) stated that they are able to manage the programme information with their current tools (the combination of planning and project management software) such as SAP, Microsoft Project, and Primavera etc. The integration problems and accessing the current information was stated as the main problems. Our research also finds that there were consensus among the respondents interviewed that there is limited software in the market that is able to provide a good total programme management system to any construction programme or projects. The findings strengthen the argument that programme management software developers have designed systems without having a thorough understanding of the differences between managing a programme and managing a project (Reiss 2006).

DISCUSSIONS

The above therefore supports the need for an effective programme management applications with the following features.

Simple and Easy Access of Programme and Projects Information

Almost all respondents value the use of IT in construction management. They also agreed that management of a programme can be more efficient if an integrated programme or project management system is used. However, one respondent does not agree that the use of software can increase project efficiency, but will only assist the project to be more documented (respondent R007). He argued that the tools or project management software available are more suitable for IT projects. The requirements by certain construction programmes (such as the infrastructure projects, water programme and road programme) are different compared to the requirements of IT projects. The programme management system used only supported managing of data and information, and not much on the engineering and management works for running the whole programme and projects. The programme management system used in his company is not user friendly and poses difficulties for some of his staff (especially senior staff).

Programme management system should be designed to be simple and easy to access by both programme and project managers. The system should enable the project manager with great technical knowledge to present their problems with more support (current project information) and enable the programme manager that required less technical information but with more programme information to understand the problems and have confidence in their decision.

Current and Real Time Project Information

Almost all programme managers agreed about the importance of current and real-time information in the future. They agree with the following arguments:

- control and overview of a programme or all projects may be more effective;
- real-time data may increase efficiency in programme monitoring and control; and
- accurate decisions can be made with the current or latest data.

However, a respondent (R002) did not agree about the needs to have real-time information, only current information is appropriate. He argued that as programme manager, he only required programme information (such as reports, drawings, etc) which was updated on the weekly or monthly basis by the project managers (in projects meeting). It is difficult to capture real time data with the current system available.

Accessing Programme and Projects Information Through Handheld Devices

Handheld or mobile computing devices have been used extensively and prove to be the must-to-have tools in the near future. This is clearly shown when all respondents interviewed use their handheld computer or personal digital assistant (PDA) for organising daily tasks or as a reminder for appointments. However, in accessing data through the handheld computer or PDA, there are disagreements between them. Although almost all respondents agreed the convenience of accessing data and information from handheld computers or PDAs, some of them did not agree and are not interested in accessing data. The main reasons are:

- The sizes of the screen of the handheld computer or PDA are relatively small. Limited information can be shown thus searching information through the limited screen sized on handheld devices is annoying;
- Searching information will take time, especially with the lower internet bandwidth thus making access to the information more frustrated; and
- Infrastructure and technology are not yet available on most construction sites.

Culture

Some people are reluctant to change, especially the senior management when it comes to using the complicated programme management system. Some senior construction programme managers interviewed clearly stated their reluctance to make an effort to use the system. The main reasons stated are related to the complexity of the systems and too much information to manage.

Changing the culture and perception of a person is not an easy job. One of the potential ideas considered was developing an application that is personalised, easy to use and can be adapted to user's daily activities. Such a personalised application will show its usefulness to users thereby increasing the frequency of use.

CONTEXT AWARE COMPUTING – THE POTENTIAL APPLICATIONS

In managing construction projects, construction project managers typically spend 70% of their time dealing with (generating, managing, sending, collecting and analysing) project data (Fisher et al. 1992). Therefore, a Construction Programme Manager who manages multiple projects may be deeply burdened dealing with huge volumes of project data. The ability to quickly convert data into information, while at the same time reducing the administrative tasks, may improve the Construction Programme Manager's efficiency. Context-aware information and services delivery may be undertaken by intelligently converting and delivering relevant project data (such as project planning, resources, cost, etc) and services based on the Construction Programme Manager's current context.

Having context-aware applications (location and activity context) allow the application to present information and services that are relevant to the Construction Programme Manager's current position, especially when he/she makes multiple site visits. The context-aware application may

supply information about the Construction Programme Manager's current location by using tracking technologies such as Global Positioning System (GPS), Assisted-GPS or Wireless Local Area Network (WLAN) technologies. The location coordinates (latitude, longitude and altitude) are then transmitted from the handheld computer or PDA-phone to the server so that it can automatically send appropriate information to the Construction Programme Manager (such as project information required, issues to be resolved at the project site, advice, coordination or overall overview of the project) based on his location. This flow of project information and services can be utilised by the Construction Programme Manager to monitor a programme plan, progress reports and efficiently manage a multiple-project environment. Thus, it increases the efficiency and productivity of the construction project delivery process in a multi-project environment.

Characteristics of the potential applications

The main problem in the delivery of information and services in construction management is that the information passed on is often wrong or inaccurate (Barber et al. 1999), there are differences in the interpretation of the information, and lack of information from previous project data. Huge volumes of project information especially in the multiple project environment, makes filtering important in order to avoid information overload. Thus, solutions to determine the information relevant to the mobile construction workers current context are needed to overcome these problems. Based on the analysis of the requirements of information by the construction programme manager, one of the important characteristics of context-aware applications is to have the experiencing situation (time of the event occur) in the context information. There are three categories of context information in experiencing the situation:

- **Past** - comprises context information from the past. This could be considered to be the context history, which contains all previous user contexts. For example information on the decision taken in the past meeting.
- **Present** - for the current context. This could be current location of a user and what are the urgent matters that he or she should look into.
- **Future** – for future context. This could be the prediction of the future events based on the programme plan and schedule. For example, the venue for tomorrow's meeting. The future context can include user contexts that either the systems or the users can predict and describe, for example activities in the programme managers' planner. Prediction of future user context would be useful when the user changes location or when subscribing to a new services.

The potential applications of context-aware computing for programme managers should be able to have the macro and micro view. In this context, macro relates to the whole view of programme management (which is at national/regional office level), rather than its parts (project management). While micro level is the project management or part of the programme management (which is at the site level). In previous research effort, Fathi et. al. (2006) briefly described the enabling technologies and the potential context-aware applications for programme managers. The discussions deal with applications that are intelligently able to provide a list of the current tasks and their status (to enhance the judgment and reporting process), context-aware resources allocations (enhance the utilisations of resources), context-aware searching (to assist in making fast and accurate decision) and context-aware browsing (reduce the time and enhance the effectiveness of the system in providing efficient browsing information). The combination of context-aware searching and browsing may overcome the problems of information overload by filtering the

information required especially when dealing with mobile devices with limited user interface, and where the current browsing quickly becomes tedious.

CONCLUSIONS

The importance of accessing previous and current projects and programme information are acknowledged by the programme managers interviewed. Construction programme managers need to shape and coordinate multiple projects and related activities in pursuit of organisational goals, requires an effective tool to support the monitoring and controlling the overall programme. One potential tool suggested is the use of context-aware computing technologies in the delivery of information and services in construction programme management.

Context-aware applications have the potential to overcome two of the important issues addressed by the programme managers (culture problems and information overload) by supplying personalised information based on the users' current context (such as role, location, time, preference, etc). The development of a prototype system to proof the concept are needed and will be the next task of this research.

ACKNOWLEDGEMENTS

The authors would like to thank the Ministry of Higher Education, Malaysia and Universiti Teknologi Malaysia for sponsoring this research. The authors acknowledges all programme managers from various industries who, in spite of having a very busy schedule, were willing to be interviewed. Without their generosity this study would not have been possible.

REFERENCES

- Aziz, Z. (2005). "Context-Aware Information Delivery for Mobile Construction Workers," PhD Thesis, Loughborough University, United Kingdom.
- Barber, P., Tomkins, C., and Graves, A. (1999). "Decentralised Site Management - A Case Study." *International Journal of Project Management*, 17(2), 113-120.
- Bowden, S., Dorr, A., Thorpe, T., and Anumba, C. (2006). "Mobile ICT Support for Construction Process Improvement." *Automation in Construction*, 15(5), 664-676.
- Fathi, M. S., Anumba, C. J., and Carrillo, P. "Context Awareness in Construction Management - Key Issues & Enabling Technologies." *The Joint International Conference on Construction Culture, Innovation and Management (CCIM)*, Dubai, UAE, 425-435.
- Reiss, G. (2006). "Multi-Project Scheduling & Management." Program Management Group, London, The Programme Management Specific Interest Group of the Association for Project Management and the British Computer Society.
- Verecke, A., Stevens, M., Pandelaere, E., and Deschoolmeester, D. (2003). "A Classification of Programmes and Its Managerial Impact." *D/2003/6482/08*, Vlerick Leuven Gent Management School, Gent, Belgium.