

INFLUENCE OF WEB-BASED PROJECT MANAGEMENT SYSTEM ON PROJECT DELIVERY

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Abstract

This paper aim to highlight potential benefits of Web-based Project Management Systems (WPMS) on project delivery; this is achieved by reviewing literature on features and benefits of WPMS for project delivery. Semi-structured interviews were conducted on 15 registered professionals and questionnaires distributed to 49 others to evaluate awareness and perceptions on WPMS benefits. 41 copies of questionnaires was retrieved and used for analysis representing 84% response rate. Literature revealed 13 shortcomings and highlighted 17 potential benefits of WPMS. Interview respondents (80%) revealed little are known about WPMS amongst professionals in Nigeria but agree it will enhance project delivery by facilitating new collaboration areas, improving communication, coordination and management. Another 27% insist the shortcomings are fundamental to adoption of WPMS but all (100%) interviewed have positive attitude towards WPMS adoption. Survey results reveals WPMS impacts on project delivery with enhancement of communication and collaboration activities having a mean score of 4.29 while cost reduction & time saving activities has a mean score of 4.06. It is concluded that embracing new project management methods through use of WPMS will enhance project delivery. It is therefore recommended that increasing awareness of WPMS will expose its potential benefits and impact on project delivery.

Keywords: *Built-Environment, Collaboration, Project Delivery, Project Management Methods, Web-based Project Management Systems*⁺⁺

1. Introduction:

Ko (2011) describes the aim of project management as to efficiently and effectively meet unique goals that add value using available resources, hence it can be inferred that project managements' primary focus is to achieve projects in the most efficient and effective way. Bhazad (2012) however outlines negative issues that still affect management of construction projects to include use of inappropriate tools and systems for communication, coordination and management. The construction industry has recognised the need to increase the efficiency of information management by exchanging massive volumes of information at high speed and at relatively low cost (Deng, Tam, Shen and Love, 2001). Similarly researchers have recommended the need to enhance project management tools and techniques through the use

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of internet-based solutions to construction project management (Deng *et al.*, 2001 citing Garcia *et al.*, 1998 and Walch *et al.*, 1998).

The simplest way of describing the delivery process in construction is as described by Ashworth (2002) consisting of inception, design, construction and handover. During these stages, professionals in the built environment employ different management functions and skill to ensure prompt delivery. Chan *et al.* (2004) posited that the success of a construction project through these processes is affected by a number of factors among these and of significance is the project management actions and procedures which comprises communication systems, control mechanisms, feedback capabilities, planning efforts, and overall managerial actions. Wamelink *et al.*, (2002) categorized Web based services into four: Information portals, enterprise portals, electronic marketplaces and web-based project management systems. These systems which are products of the proliferation of Internet based technologies have been reported to be used by construction project team for communications, information sharing and solving problems that help manage time and cost (Alshawhi and Ingirige, 2003). Bhzad (2012) opines that Communications and Project Management Systems (CPMS) such as mobile and Web-based Project Management Systems (WPMS) have helped fulfill project objectives such as quality, scope, time, and cost. Contemporary developments in the field of information technology (IT) and emergence of new concepts and philosophies (Bhzad and Sanad, 2010, Alreemy *et al.*, 2016) are a pivotal reason for prominence of WPMS. Obradovic *et al.* (2014) observed that more sophisticated IT tools help Project Managers to effectively capture information in all meridians throughout the world. Hence, employing WPMS to manage construction projects should enhance the turnout of project management functions and ultimately improve construction project delivery. The emergence of web-based technologies and applications to human businesses and daily activities has helped several industries migrate from traditional ways of achieving objectives because of how they improve processes; advances were made in various professions when such professions took advantage of technological tools available (Li, 1996; Pollack-Johnson *et al.*, 1998; Oyediran and Odusami, 2005).

The main idea of this paper is to highlight the potential benefit of WPMS on construction project delivery. This is achieved through identifying the features of WPMS and benefits of employing WPMS for project management; examination of WPMS awareness level amongst construction professionals in Nigeria and evaluating built environment professionals' perception of the impact WPMS has on project delivery.

2. Literature Review:

WPMS are applications that focus on the effective implementation of project management methods. (Bhzad and Sanad, 2012) explains that the system uses wireless, satellite, internet-based or mobile tools and networks to function therefore obliterating paper trails. WPMS provides a central website, or project portal, where everyone involved in a project can have access to up-to-date project information, share documents, and participate in planning and problem solving using collaboration tools (Zou and Roslan, 2005).

2.1 Features of WPMS:

WPMS can be likened to the modern day Facebook of the Construction Industry. Zou and Roslan, (2005) citing several authors (Sifri, 2000; Doyle, 2001; Becerik, 2004), documented tools that form the content of WPMS to include the following:

- Document management tool: creates and customizes file cabinets, drawers and documents specifically to members of the project while creating security features to restrict/grant access.
- Workflow management tool: the tool enables definition of workflow process, ordering of sequence tasks, document distribution, tracking tasks, giving direction to the teams, tracking time and updating schedules within a workspace.
- Collaborative tools: this tool gives team members the ability to virtually meet when they are geographical apart and collaborate without holding face to face meetings or conference calls.
- Organizational tool: this tool enables all the project information to be organized with features like news board, contacts, links and keywords.
- Reporting and data exporting tools: the reporting manager facilitates reporting on tasks, events, news, documents and progress while data exporting tool allows data to be converted from one format to another.
- Maintenance tool: the system administrator uses the maintenance tool to add and remove users of the WPMS site as needed and also to monitor hard disk space, archive files, set up system parameters, and maintain databases and searching catalogues. The administrator can define access control lists, and assign different permissions to users.

The tools provide platforms that have multiple user functions to improve processes of project management.

Skibniewski and Zhang, (2005) identified three choices available in current market for companies to implement WPMS as either to: develop the system in-house; to purchase packaged software from vendors and install it on company's own server or; to subscribe to an application service provider (ASP).

2.2 Identified Benefits of WPMS:

Literature documented significant benefits of WPMS to project delivery. Most significant of the reports categorised the benefits of WPMS into four main areas: Cost reduction and time saving; Enhancement of communications and collaboration; Improvement of productivity and partnership and; Supporting e-commerce and customer relations (Nitithamyong and Skibniewski, 2004). Other identified advantages include: avoiding delays because of the arrival of updated drawings documents, reducing visits to site and traveling time to meeting, avoiding drawings mistakes, reducing time and money spent on disputes, sharing and exchanging project information, automate repetitive routine processes and elimination of paper reports (Wamelink et al., 2002; Alshawi and Ingrige, 2003; Stewart *et al.*, 2004).

In a related research, a number of benefits from using WPMS technology that aim to improve project management methods were identified as: a) Enhancement of productivity of face to face meetings between project participants by providing timely and concise information in order to make more effective decisions; b) Reduction in project delays; c) Heightens all parties awareness of the project issues, and; d) Ease of access and retrieval of project information (Bhzad and Sanad, 2010 citing Wamelink *et al.*, 2002 and; Bowden, 2005). Furthermore, Bhzad and Sanad, (2010) posited that WPMS enhances project communication, documentation and control, and overturns the way in which a construction project team traditionally conducts business. They also highlighted that WPMS allow project team members to communicate and exchange project information in a fast, cost-effective, and efficient manner. Similarly, Ozorhon *et al.* (2014) opines that Web-based database systems may be used to enhance the control of knowledge flow and make better decisions because those systems are considered to increase Operational Learning (OL) based on the acquisition of data, storage of useful information in databases and retrieval of knowledge when needed. Finally, Cartlidge (2011) opined that the objective of using ICT to enhance E-commerce is primarily in order to lower cost, improve efficiency and productivity, shorten lead-in times and provide better customer service.

2.3 Shortcomings and Constraints to the use of WPMS:

Identified shortcomings from literature were described more as limitations that require attention. For instance Bhzad and Sanad, (2010); citing Dossick, (2008); Chan *et al.*, (2004); Yang *et al.*, (2007), Stewart and Mohammed, (2004); Nitithamyong and Skibniewski, (2006) perceived probable limitation to the full realization of potential benefits from implementing electronic information systems includes that businesses may incur extra direct and indirect cost because the road to learn how to properly use IT is rough and staff training will be required. Other limitations identified (Bhzad and Sanad, 2010) includes that it is difficult for the staff to adapt to new procedures; system reliability and security; IT applications have various critical masses; the effects might be indirect; the tangible are often short-lived; IT benefits cannot merely be measured in financial profits; IT is merely a tool that can be used either rightly or wrongly, but on its own, it does not do anything. Bhzad and Sanad, (2010) identified further shortcomings associated with communication and information systems to include that they are: time consuming, error inclined and highly dependent on human initiative and expertise.

In a study of the use of WPMS carried out in Australia, Zou and Roslan, 2005 posited that a large number of construction firms do not use WPMS. This is mainly because they do not see the need for such systems, plus the constraints of their limited financial capabilities, small turnover and limited IT skills. Cartlidge (2011) also outlined the main disadvantages of using e-technologies as initial set-up cost, loss of personal contact and retraining of staff.

2.4 Impact of WPMS on Project Delivery

A construction project like any other product is conceived and delivered through processes and stages with success through the stages sacrosanct. Chan *et al.*, (2004) identified communication as part of the management actions that affect success of a construction project. Davidson and Moshini, (1990) posited that the cost of construction can be reduced by 25% through the efficient transfer of information between the construction teams. Construction professionals require different types of information during project delivery which includes; reports, material management, equipment management, cost management, schedule means and methods, jobsite record keeping, submittals, safety and quality control and quality assurance (Garza and Howitt, 1998). Thus, the amount of information and documentation generated and exchanged during the construction process is massive, even on small projects (Chassiakos and Sakellariopoulos, 2008). The information from these activities cannot be undertaken effectively and efficiently using traditional communications and information management systems as it has shortcomings in fulfilling project duties (Yang *et al.*, 2007). One of the shortcomings is that it provides limited access to information which is considered as one of the key barriers to project management practices (Vadhavkar and Pena-Mora, 2002; Pena-Mora *et al.*, 2009). It is anticipated by a number of researchers that WPMS will replace traditional project management methods (Becerik, 2005; Zou and Roslan, 2005). Several reasons support this claim including increased competitive pressures, expectations of revenue growth, the ability to compete globally, and the desire to reengineer the business to respond to market challenges (Nitithamyong and Skibniewski, 2006). Therefore, an exploration into new ways of managing construction projects to improve the current practice is necessary (Zou and Roslan, 2005). Several studies by authors e.g. Patanakul *et al.* (2010); Lappe and Spang, (2014) confirmed that the project success rate increases if project management methods are used. A lot of failures in project delivery has been attributed to be caused by inadequate organization / management of the construction process, e.g. a weak coordination of processes and uncertainty about available information (Sweis, 2008). Biggs (1997) noted that the latest web-based solutions which can be linked with email or collaborative software can reduce the incidence of people related issues and overall communication problems which lead to project failures. This would ensure the smooth flow of project work, providing accurate, speedy and updated information and sorting out constructions problems quickly (Charoenngam *et al.*, 2004; Davidson and Moshini, 1990).

The willingness to collaborate between professionals is assumed a direct reflection of the inherent benefits and impact it has on project delivery. Siti *et al.*, (2013) conducted a research on the factors that lead to willingness to collaborate in the industry and the important drivers found include that; collaboration will encourage teamwork, collaboration develops cooperation, stimulate information sharing, improve quality and project completion time, enhances service quality, and better communication among project members. In a related research, (East *et al.*, 2004) posited that web collaborations have been seen to impact economically on the design review process which is an improvement over traditional manual

methods of comment collection and resolution by reducing time required to conduct a design review, number of participants, meeting times and travel cost by up to 73%.

3. Materials and Methods:

This study was carried out among construction professionals in the built environment employed by firms registered with the University of Ilorin to offer construction services. The research is designed to obtain secondary information from literature and primary information from a spectrum of practicing built environment professionals through interviews and questionnaires. University of Ilorin was selected as the study area because over the years the university consistently delivered construction projects on annual basis. The sample size comprises the list of One Hundred and Fifty - Eight (158) registered Firms with the Physical Planning Unit (PPU) of the University of Ilorin.

Literature was reviewed to excise the features of WPMS, the potential benefits and impact of WPMS on project delivery. Fifteen (15) semi-structured interviews were conducted to obtain information from built environment professionals on the level of awareness of WPMS and their perception on the shortcomings, constraints and benefits of using the systems. Convenience sampling was used to select professionals interviewed but ensuring they cut across several work spectrums (Table 1). Creswell (2012) defines convenience sampling as a method where the researcher selects participants because they are willing and available to be studied.

Table 1: Schedule of Interviews

Work Spectrum	Profession Interviewed	Face-to-Face	Telephone
Architectural firm in practice	Architect	2	2
Quantity Surveying firm in practice	Quantity Surveyor	3	1
Civil engineering firm in practice	Civil & Structural Engineer	1	1
Services engineering firm in practice	Mechanical Engineer	2	
Building Contracting Firm	Structural Engineer	2	1
TOTAL		10	5

Source: Researchers Field Work, (2018)

All professionals interviewed are registered professionals with relevant professional institutions. Principal partners or senior managers were interviewed in the firms. The face-to-face interview took about twenty-five (25) minutes each, while telephone interviews took an average of fifteen (15) minutes each. All the interviews were recorded, and then transcribed verbatim for content analysis and discussion. Content analysis is used for revealing the significant positions from the professionals interviewed.

A survey of built environment professionals was also carried out. Professionals were purposively selected from forty-nine (49) firms, comprising a homogenous sample because of their involvement in construction projects with the University of Ilorin. Creswell (2012) explains that in homogeneous sampling the researcher purposefully samples individuals or sites

based on membership in a subgroup that has defining characteristics. The questionnaire used was constructed to elicit responses to determine the perception of professionals on the impact of WPMS on project delivery based on Seventeen (17) project activities WPMS can improve individually and subsequently impact on four (4) primary project benefit factors. Respondents were requested to measure their perception of the impact WPMS has on the project activities on a five-point Likert scale. Questionnaires were distributed by hand and via email to construction professionals employed by the firms selected. A total of 49 questionnaires were distributed while 41 was retrieved and used for analysis representing 84% response rate. Data for the study was processed and analysed with the aid of Statistical Packages for Social Science (SPSS 20.0).

The survey instrument consists of two (2) sections. The first section sought information on the personal and organizational characteristics of respondents while the second section elicited information on the perception of built environment professionals on the impact WPMS has on project activities identified from literature. The test-retest method was adopted as reliability test on the research instrument: this allows the instrument to be administered at two different times.

4. Data Analysis & Research Findings:

4.1 Interviews Results:

The first set of interview questions investigated awareness of WPMS in the industry. Twelve (12) of the respondents (80%) have limited knowledge of WPMS and were not aware of any firm or agency that uses WPMS hosted by an ASP. The other three (3) respondents (20%) have limited knowledge. All the respondents however revealed that they are familiar with using multiple web technologies in an attempt to achieve similar objectives as obtainable with WPMS.

The second set of questions investigated the perception of professionals on the shortcomings, constraints and benefits of WPMS. Eleven (73%) of the respondents interviewed agreed that in the face of the benefits the shortcomings can be seen as challenges to be solved. However 4 (27%) of the respondents insist that the constraints would be fundamental and strategic to firms and client agencies willing to employ WPMS for construction projects.

The third set of questions examined the perception of the professionals on the impact WPMS will have on project delivery. Ten respondents (67%) agree that WPMS will impact greatly on project delivery, however five respondents (33%) disagree on the perceived impact WPMS can have on project delivery.

The final set of questions investigated professionals' willingness to adopt WPMS for their projects and the likely future for it in Nigeria. All the respondents (100%) agree that where it is affordable, they are disposed to adopting it. However five (33%) respondents believe it is yet a sustainable system in Nigeria.

4.2 Main Survey Results

4.2.1 Personal and Organizational Characteristics of Respondents

Experience of professionals for the study was sacrosanct and the distribution shows a good percentage of matured professionals with 85% of the respondents above 35 years of age and 75% having more than ten years' experience in the industry. In addition the distribution showed that 55% has additional degrees with 71% being corporate members or fellows of their respective professional institutes. Hence, this confirms that majority of the respondents have requisite amount of experience to provide information for the study.

Quantity surveyors, Civil/structural engineers, and architects rank highest amongst the professionals selected with 26%, 25% and 23% respectively; mechanical services engineers are 11%; and electrical services engineers are 15%. Majority (51%) of the respondents organizations are contracting firms while 49% are consulting firms. All the organisations sampled have more than 5 years' experience in the industry.

4.2.2 Perception of Respondents on the Impact of WPMS on Project Delivery:

The respondent's perception was measured on a five point Likert scale with respondents who strongly disagree having a point of 1 and 5 points for respondents who strongly agree.

Table 2: Benefits of WPMS.

Primary Benefits	Project Activities Factors	1	2	3	4	5	N	Mean
Enhancement of Communication & Collaboration	Improves sharing & exchanging project information	1	4	5	13	18	41	4.05
	Eliminating paper reports and paper trails	2	1	0	14	24	41	4.39
	Improves parties awareness of project Issues	0	1	0	18	22	41	4.49
	Easy access and retrieval of project Information	1	1	2	21	16	41	4.22
	Mean Score of Benefit	4.29						
Cost Reduction and Time Saving	Eliminating delays due to updating of drawings	2	3	1	15	20	41	4.17
	Reducing visit to site & traveling time for meetings	7	5	3	18	8	41	3.37
	Reducing time & money spent on disputes	1	1	0	15	24	41	4.46
	Reduction of general project delays	4	1	1	16	19	41	4.10
	Quick solution to managerial challenges	3	1	1	16	20	41	4.20
	Mean Score of Benefit	4.06						
Productivity Improvement & Partnership	Reduces and avoids drawing mistakes	9	12	0	17	3	41	2.83
	Automate repetitive routine processes	5	2	2	18	14	41	3.83

Primary Benefits	Project Activities Factors	1	2	3	4	5	N	Mean
Supporting E-Commerce & Customer Relations	Providing timely & concise information to enhance productivity of face - to - face meetings	0	1	0	17	23	41	4.51
	Enhancing Knowledge Management (KM) & stimulating Organizational Learning (OL)	1	1	0	17	22	41	4.41
	Mean Score of Benefit	3.90						
	Re-engineers processes in organizations value chain	8	13	11	5	4	41	2.61
	Shorten lead-in times for material procurement	9	8	6	13	5	41	2.93
	Lower cost and input efficiency and productivity of commercial aspects of projects	5	2	1	13	20	41	4.00
	Improves customer service and e-procurement	0	0	5	17	19	41	4.34
	Mean Score of Benefit	3.47						

Source: Researchers Field Work. (2019)

5. Discussion of Findings:

Despite the existence of WPMS for over a decade, very little is yet known about it in the Nigerian Construction Industry as 80% of the respondents' clearly showed no knowledge of WPMS and the other 20% showed limited knowledge but argued that only multinationals employ WPMS on projects. This supports findings from similar research in other countries (Zou and Roslan, 2005, Bhazad and Sanad, 2010). It is encouraging that 100% of the respondents see the benefits of improved collaboration, communication, coordination and construction project management outweighing the shortcomings but 27% of the respondents observed the constraints of limited financial capabilities, apparent small turnover of individual firms, limited IT skills and the erratic power supply in Nigeria as fundamental. Thirty-three percent of the respondents believe the adoption of WPMS on projects may not improve aspects of delivery except communication, they argue that project delivery is largely dependent on the expertise of the managers and not the tools employed. They posited that despite the use of WPMS, project delivery may be hindered when the managers are not competent. However, 67% of the respondents agree that WPMS impact would be felt on project delivery by reducing time and cost. This is consistent with the main survey that revealed the perception of professionals on the impact WPMS has on project delivery. Professionals perceived that highest impact will be on enhancement of communication and Collaboration; closely followed by cost reduction and time saving activities with mean score of 4.29 and 4.06 respectively. All respondents agree that it will improve collaboration and exchange of information between organizations. This is predicated on the document management; collaborative; and data export

features of WPMS. The professionals also showed reasonable disposition to adopting WPMS where it is affordable. They however laid emphasis on the fact that ASPs are yet domiciled in Nigeria, hence foreign exchange may make it impractical to host. Professionals also expressed optimism that where funding and client agencies adopt WPMS, beneficiaries and other project participants will have to adopt because cost transfer to individual firms will be minimal.

6. Conclusions:

The potential benefits outweighing the shortcomings and the professionals' disposition to adopting WPMS despite the constraints supports the conclusion that WPMS provides benefits to construction, hence embracing new project management methods through the use of WPMS in Nigeria will enhance project delivery and improve collaborations. In addition, this research also revealed that it is generally agreed among all professionals, that WPMS could improve construction productivity and, in time, could become a primary Project Management system. It is recommended that improving awareness of WPMS will expose its potential benefits. Furthermore, encouraging funding agencies like the Tertiary Education Trust Fund (TETFund), and Client organizations like Universities to adopt WPMS will enhance its prominence amongst professionals. In short, although it is generally postulated that WPMS systems will be the dominant platform to manage and control projects and facilitate communication and collaboration in the future, more research is required to investigate limiting factors responsible for its slow adoption. Finally, it is necessary to encourage all firms, to improve on IT skills required for its adoption through skills education and training.

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