Improve Documentation Quality for Engineering: Leap Forward Through Project Learning

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Abstract- **The documentation used in the construction industry remains problems such as inadequate detail; confusing, conflicting and voluminous; coordination problems; insufficient information; erroneous information, and conflicting information. This research aims to study the potentials in improving documentation quality through project learning. A postal questionnaire survey was conducted and 279 questionnaires were distributed to the registered quantity surveying firms in Malaysia in order to identify the causes of poor documentation quality and to determine the good project learning practices in improving the documentation quality. Four semi-structured interviews were conducted in the later stage to validate the findings of questionnaires. The findings indicate that the accuracy, clarity and timeliness issues were the most serious problems in documentation quality, and "insufficient time" was the main cause of poor quality in documentation. Good project learning practices such as "inter project evaluation", "set formal learning goals", and "intra project evaluation" are recommended to improve the documentation quality. Benefits of implementing project learning in documentation include "increasing staffs' ability to provide better services", "increasing customer's satisfaction", and "improving decision making processes".**

Keywords- Project Learning; Quality of Documentation; Engineering Documentation; Construction Documentation

I. INTRODUCTION

The documentation used in the construction industry has problems such as inadequate detail in documentation; confusing, conflicting and voluminous documentation; general documentation quality problem; general coordination problems; insufficient information; erroneous information; and conflicting information [1-3]. Since the quality of the documentation produced has a major influence on the overall performance and efficiency of construction projects, any improvement in documentation can only lead to corresponding improvements in the efficiency of the construction process [4]. Therefore, there is a need for the construction industry to find ways to improve the quality of design and documentation in order to enhance the overall quality of construction projects in future [5-7]. Many construction organizations apply project improvement initiatives to improve their performance [8]. In this context, project learning appears as a vital approach in knowledge-based development, which concerns with the set of actions used by project teams in creating and sharing knowledge within and across projects [9, 10]. Learning creates changes in system and it produces a more or less permanent change in its capacity for adapting to its environment [11, 12]. This research aims to study the potential in improving the documentation quality through project learning. Through a combination of a quantitative approach and a qualitative approach, which uses a questionnaire survey and four semi-structured interviews, the authors have identified the causes of poor quality in documentation. By studying the existing project learning practices, some approaches for improving documentation quality through project learning are recommended. Finally, the benefits of implementing project learning in documentation are presented.

II. LITERATURE REVIEW

Project learning practice can be defined as a set of actions that the project teams use to create and share knowledge within project (intra-project) and across projects (inter-project) [13]. Intra-project learning focuses on tasks within a single project and supports the delivery of a successful project by identifying the problems and solving them during the project life cycle [14]. On the other hand, inter-project learning refers to the transfer of knowledge and experience from one project to other projects within the same time frame or to different projects over a period of time [15]. It involves the combining and sharing of lessons learned across projects to develop a new knowledge [13]. Experience accumulation and knowledge creation and sharing have notable advantages to the projects or the organizations [8]. Besides reducing the repeatable mistakes and 're-inventing the wheel', learning from project has many benefits which include: a) Firms can guaranty competitive advantages if they learn faster than the others [16]; b) Learning is one of the key success and improvement factors of project-oriented organization [13]; c) Learning increases project performance, mitigates delay, hinders project failure and lowers the total cost of projects [17]; d) Learning is one of the ways to offset the limited career span of employees [18]; e) Learning and lessons learned help in making quality decision through knowledge gain and experience accumulation [14]; f) Learning, knowledge harvesting and learning net study improve innovation [19].

Project learning review can be classified into two main methods; they are process-based methods and documentation-based methods [20] as illustrated in Fig. 1. Process-based methods are the gathering of lessons learned from concluded projects and explaining the relevant steps and sequences of a project's time line through Post Project Appraisal (PPA) or After Action

Review (AAR). The PPA represents a special type of project review that includes a strong learning element. On the other hand, the AAR helps team members learn immediately from errors and successes. Meanwhile, the documentation-based method is about learning from the project experience and the storage of contents within the organization. This method consists of micro articles, learning histories and recall. Micro articles are introduced to secure the experience after completion of a project. It is the process of transferring the experience to explicit form via the authorizing of small articles. Learning history is a written story which consists of the main events of a project that are arranged in a chronological order [20]. Finally, recall is the method that every staff can submit based on their lessons learned directly using an Internet browser [21]. The usage of this method is to facilitate and automate the capture and the retrieval of the lessons learned.
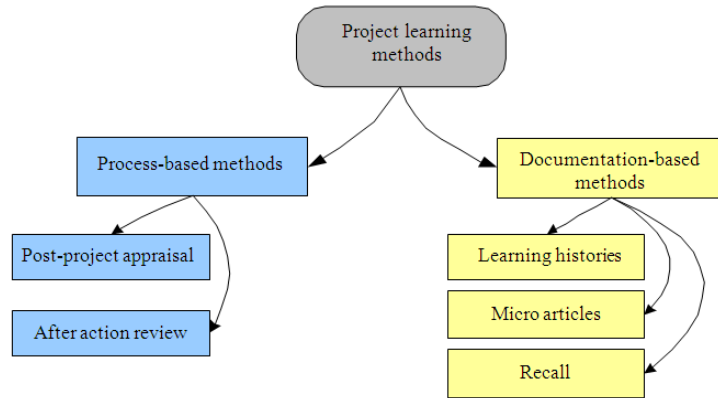

Fig. 1 Methods of recording knowledge and learning from projects

III. METHODS AND PROCEDURE

Questionnaire survey was employed as the data collection method for this research. In order to obtain a high validity of results, 279 questionnaires were distributed to registered Quantity Surveying firms in Malaysia, which are registered with Board of Quantity Surveyors Malaysia (BQSM). The questionnaire form contained totally 83 questions that were used to identify the problems in documentation quality and the causes of poor documentation quality. These questions were also aimed to identify existing project learning practices and the impact of project learning in improving the quality of documentation. For data analysis, the descriptive statistics method was selected as it is the simplest method of analysis which provides a general overview of the results [22]. SPSS for Windows version 11.5 was used to facilitate the analysis for the questionnaire survey. In order to validate the findings of the questionnaire survey, the author supplements the questionnaire with four semi-structured interviews. As a qualitative approach, semi-structured interview was selected as it refers to situations of the questionnaire that had been analyzed prior to the interview [22]. Moreover, it has more freedom to probe various areas and to raise specific queries during the interview session. Interviewee A is an associate director in one of the established international QS firms in Malaysia. He has 30 years of experience working as a consultant in the construction industry as he started his career in this industry since 1978. He is both the member of Malaysian Royal Institute of Chartered Surveyors (MRICS) and Institute of Surveyors Malaysia (ISM). Interviewee B is a director from one of the QS firms in Malaysia. She has 16 years of experience in the construction industry as she started her career in this industry after graduating from University of Salford at 1992. She is not only the member of Malaysian Royal Institute of Chartered Surveyors (MRICS) and Institute of Surveyors Malaysia (ISM), but she also obtained the post-nominal ICECA which stands for "International Cost Engineering Council Accredited". The ICEC is another world body representing quantity surveyors, cost engineers and project managers beside MRICS. Interviewee C is the head of quantity surveyor department in one of the well-known developers in Malaysia. She has 9 years experience in the Malaysia construction industry. She has 3 years experience working in a consultants firm, 2 years experience in a contracting firm, and 4 years experience in the current organization. Interviewee D is the senior project executive in one of the reputable quantity surveying firms in Malaysia. He has handled a variety of construction projects in Malaysia.

IV. ANALYSIS AND DISCUSSION OF FINDINGS

A. Analysis of Survey

Questionnaires were distributed to 279 quantity surveying firms in Malaysia and 60 valid responses were received representing a response rate of 21.43%. As shown in Fig. 2, 17 respondents were principals in quantity surveying firms. Additionally, top management personnel or decision makers including principals, directors, and partners composed 32 (53.5%) of the respondents.

Besides, 38 (63.3%) of the responses hold more than 10 years experiences in quantity surveying. Both figures show that the data were obtained from experienced people with high competence, thus the reliability of the results is guaranteed. There are respondents who had good understanding in the methods to ensure project success and 76.7% of respondents had good

understanding in the methods to avoid documentation problems. 39.0% of respondents have encountered the documentation problems and 37.9% respondents have "reinvented the wheel" in latter projects as shown in Fig. 3.
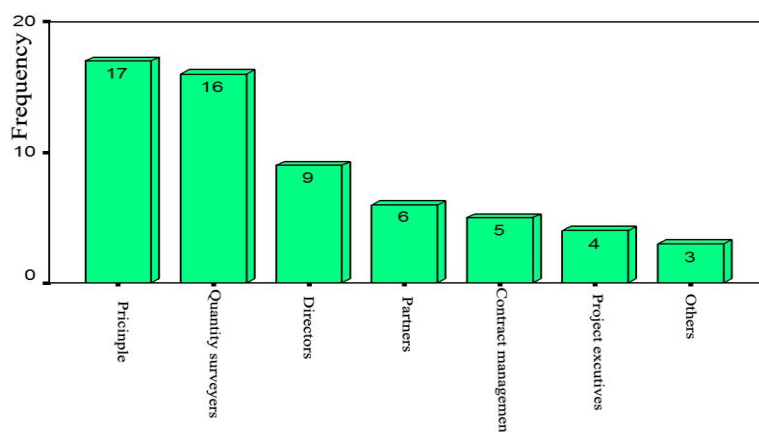

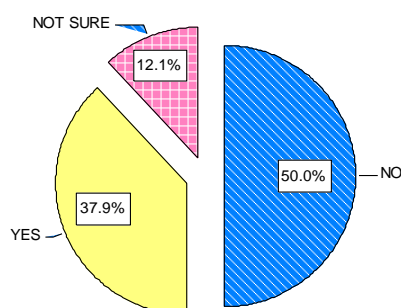Fig. 2 Distribution of respondents' positions

Fig. 3 Distribution for respondents who have "reinvent the wheel"

Table 1 identifies the key problems in documentation quality. Table 1 demonstrates that the problems are ranked by their seriousness to the construction projects. Scales from 1 to 5 demonstrate the seriousness from low to high. "Accuracy, clarity and timeliness issues" ranked as the most serious problem with the mean value at 4.1167, followed by "insufficient information" with the second highest mean value at 4.0977.

TABLE 1 SERIOUSNESS OF THE PROBLEMS IN DOCUMENTATION QUALITY

Problems of poor quality documentation	Mean	Std. Deviation	Variance	Rank
Accuracy, clarity and timeliness issues	4.1167	0.78312	0.613	1
Insufficient information	4.0977	0.86095	0.741	2
Erroneous information	4.0667	0.93640	0.877	3
Inadequate detail in documentation	4.0357	0.93640	0.877	3
Conflicting information	4.0333	0.91996	0.846	5
Confusing, conflicting & voluminous documentation	3.8667	0.94719	0.897	6
General coordination problems	3.6000	0.94241	0.888	7
General documentation quality problems	3.2167	0.90370	0.817	8

Table 2 identifies the main causes of poor documentation quality. "Insufficient time" is the most influential cause of poor quality in documentation with the highest mean value at 4.3729, followed by "inadequate coordination between project participants" with the second highest mean value at 3.9492.

TABLE 2 CAUSES OF POOR DOCUMENTATION QUALITY

Factors of poor quality documentation	Mean	Std. Deviation	Variance	Rank
Insufficient time	4.3729	0.78561	0.617	1
Inadequate coordination between project participants	3.9492	0.83921	0.704	2
Changing/inadequate project briefs	3.9322	0.84821	0.719	3

Poor staff quality	3.7966	1.06317	1.130	4
Poor communication between project participants	3.7119	1.00088	1.002	5
Reluctance to seek clarification	3.6102	0.96520	0.932	6
Lowest bid selection strategy rather than value for money	3.5424	1.05572	1.115	7
Devaluing of professional ethics	3.5085	0.95363	0.909	8
Constructability of the project	3.3220	0.97274	0.946	9
Inadequate risk allocation and management	3.3220	0.81876	0.670	10
Inappropriate procurement methodologies	3.0339	0.92785	0.861	11
Low professional fee	3.0169	1.26616	1.603	12
Inappropriate reliance on technology	2.9831	0.88066	0.776	13

Good project learning practices in improving the documentation quality are collected as shown in Table 3. It shows that 76.7% of respondents agree that "inter project evaluation" is one of the learning practices in their projects, followed by "set formal learning goals" agreed by 67% of respondents and "intra-project evaluation" agreed by 65% of respondents. Majority of the respondents have fully applied project learning practice (>50%).

TABLE 3 GOOD PROJECT LEARNING PRACTICES IN IMPROVING THE DOCUMENTATION QUALITY

Project Learning Practices	Yes		No		Partly	
	No	%	No.	%	No.	%
Inter project evaluation	46	76.7	4	6.7	10	16.7
Set formal learning goals	39	67.0	2	3.3	19	31.7
Intra project evaluation	39	65.0	3	5.0	18	30.0
Project knowledge stored centrally	33	55.0	9	15.0	18	30.0
Knowledge used for improvements	45	75.0	5	8.3	10	16.7
Application of lesson learned	21	35.0	14	23.3	25	41.7
Experienced people are selected in similar project	31	51.7	11	18.3	18	30.0
Exchange of experiences between individuals	39	65.0	5	8.3	16	26.7
Share about project failures	39	65.0	6	10.0	15	25.0
Share about project success	47	78.3	2	3.3	11	18.3
Believe that project is an opportunity for learning	43	71.7	3	5.0	14	23.3
People tell the truth	28	46.7	8	13.3	24	40.0
Record steps to complete project	22	36.7	15	25.0	23	38.3
record problems encountered in project	17	28.3	14	23.3	29	48.3

The benefits of implementing project learning in documentation are listed in Table 4.

TABLE 4 BENEFITS OF IMPLEMENTING PROJECT LEARNING IN DOCUMENTATION

Benefits	Mean	Std. Deviation	Variance	Rank
Increasing staffs' ability to provide better services	4.1833	0.83345	0.695	1
Increasing customer's satisfaction	4.1600	0.86013	0.740	2
Improving decision making processes	4.1500	0.79883	0.638	3
Increasing staffs' ability in project management	4.0333	0.84305	0.711	4
Promoting better communication	4.0000	0.75913	0.576	5
Achieving continuous improvement	3.9500	0.81146	0.658	6
Increasing accuracy of project budget estimation	3.9500	0.85222	0.726	7
Reducing disputes	3.9333	0.84104	0.707	8
Reducing variations in later stage	3.9333	0.82064	0.673	9
Increasing reliability of project schedule	3.7797	0.89188	0.795	10
Saving cost	3.7000	1.04638	1.095	11
Reducing time to respond to queries and complaints	3.6333	0.82270	0.677	12
Shortening the period to obtain authorities' approval	3.0847	1.11862	1.251	13

According to Table 4, "increasing staff's ability to provide better services" is the most significant benefit of implementing project learning in documentation with the highest mean value at 4.1833, followed by "increasing customer's satisfaction" and "improving decision making processes" with mean values at 4.16 and 4.15, respectively.

B. Discussion on Findings

The practitioners comment that accuracy, clarity, and timeliness issues will be the most serious problems as they will have big impact on the later stage of the project if these problems are not rectified in the early stage. As a consequence, the presence of these problems will also have an effect on the overall time, cost and quality of the whole project. Time is the main factor of the poor documentation quality problem. Time becomes critical especially when it is required to prepare Bill of Quantities (BQ) in just two weeks' time and the conditions change worst when the drawings come late. Moreover, prepared document in the shortest time is one of the competitive advantages in the business. Although project learning practices are known to be important, they were seldom practiced in the project due to lacking of time, staff and money. The poor quality documentation factors can be improved with project learning practices as they increase knowledge of the jobs and enhance the communication and coordination with other practitioners. The practitioners can speed up their works in accordance with increase of familiarity with the works. However, the problems of poor quality documentation cannot really be improved as there will be new management personnel, new workers, and unforeseen risks in the project. Increasing staff's ability, client's satisfaction and improving decision making are the major perceived changes of implementing project learning in the local construction project.

V. CONCLUSION

Project learning contributes considerable positive impact on the documentation quality in construction projects. The most serious problem in the documentation quality identified in the Malaysia construction industry is the "accuracy, clarity and timeliness issues". Besides, "insufficient time" is identified as the main cause of poor quality in documentation, followed by "inadequate coordination between project participants", "changing/inadequate project briefs", "poor staff quality", "poor communication between project participants", and "reluctance to seek clarification". In improving the documentation quality, good project learning practices such as "inter project evaluation", "set formal learning goals", and "intra project evaluation" are recommended to be optimized. Project learning in documentation delivers significant benefits including "increasing staffs' ability to provide better services", "increasing customer's satisfaction", and "improving decision making processes", and so on. This research recommends further studies on quantification of tacit knowledge in documentation and difficulties in implementing project learning in documentation.

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