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TECHNOLOGY****PROJECT MANAGEMENT INFORMATION SYSTEM IN CONSTRUCTION
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ABSTRACT

Project management information systems (PMIS) are widely regarded as an important building block and today's project management. The nature of these systems has changed considerably during the last decade they are in fact still developing from single-user single-project management systems to complex, distributed, multi-functional systems that no longer only cover project planning. Information systems research has to date only partly reflected this PMIS evolution. Typical fields of research are algorithms in respect of operation research problems related to project management, the assessment and comparison of commercial project management solutions and corresponding assessment frameworks, the development of prototypes to test new kinds of functionality and research into the usage of project management software systems. Two specific problems are very rarely addressed, PMIS are become increasingly complex. Therefore, firstly, information system designers are facing a growing number of business processes that have to be supported with project management software. Secondly, information system users have difficulties in setting up corresponding organizational systems and selecting corresponding software products PMIS are become increasingly complex. This paper deals with some important factors affecting the cost of the construction incorporated in PMIS.

KEYWORDS: PMIS, Construction Management, Cost, Schedule, Quality**I. INTRODUCTION**

A PMIS provides information so the team has a common understanding of the facts: a prerequisite for collaboration. It's the cheapest way to gather information because it's only done once. And it's the most reliable way to host information because many eyes scrutinize centralized data and mistakes are more likely to be found and corrected. It's the first line of defenses against political or legal attack. It's a clear window into the project that leaders can use instead of relying on delayed or biased reports filtered through layers of management. It improves performance because it measures it; it's a report card for both team members and management. And most important, it educates the team and makes better managers because it tells true stories

The PMIS defines the program and the projects: cost, time, scope and quality. It defines the team: people, organizations and their roles. It helps manage agreements: contracts, permits, approvals and commitments. It manages documents. It produces standard and custom reports. It presents vital signs on dashboards. It guides collaboration and communicates best practices with policies, workflow diagrams and document management.

A PMIS is built around documentation and communication of project-specific information so most of the engine is devoted to that purpose. Basic project information includes the project location, a current calendar and the project goals. There may be web cameras that record on-site activities for public relations or for evidence in case of conflict. There may be general public relations web pages with access for the community, users or other stakeholders. The PMIS maintains project status from the initial idea for a new facility to its completion. Such project data may be rolled up for portfolio management and for planning future projects.

As the PMIS develops it will accumulate detailed project information on:

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Cost - Each contract and each project will have the budget, estimates, contract amounts, changes orders, contingencies and forecasts of completion cost. There may be a capital plan with projects scheduled over future years. It may include funding sources.

Schedule - There will be a master schedule, design schedules, procurement schedules, global “push” construction schedules, short interval “pull” schedules, closeout schedules, occupancy schedules and commissioning schedules. Or there may be a project-specific calendar so the extended project team can coordinate their work. It may display meetings that the user must attend, show deadlines for the user’s work products and send automatic reminders. There may be a user-customized calendar for specific responsibilities.

Quality - Given that most owners choose to define quality as “conformance to requirements,” the PMIS may include space programs and other requirements. The PMIS may include procedures for quality control or quality assurance programs, post evaluation data and include checklists to meet regulatory requirements.

The team: people, organizations and their roles - Within the PMIS database there is a simple list of the projects with contact information for each company, its key people and their project role. Since so many people deliver a project it makes sense to have a resource where everyone can find everyone else. And it sure helps to know how they fit into the project. A web-accessible database with that information improves communication. That speeds the project. It also adds to the quality of the work. When starting a new project, it helps to know what companies have done similar work and how they performed.

PMIS

Modern organizations have gradually transformed from single-project ventures to the management symmetry of numerous global projects. Managers are now mandated to integrate many and highly complex projects managed simultaneously and with unprecedented level of accuracy and detail-specific precision. Not only are projects requisite, but also an assortment of such projects at any one time, given that modern “organizations are continually been involved in many projects as a competitive tactic to ensure that they remain relevant in their respective fields”. In contemporary organizations, projects management has now emerged as a multifaceted process of implementing assorted initiatives, all whose planning and control need a simultaneous nerve center. Globalized management of projects in an extremely competitive world market and the fact that such projects now encompass real-time information technology (IT), biological innovation, engineering, complex construction requirements, assembly of policy requirements, and pioneer context-specific adaptation, has redefined the art of contemporary project management.

Projects now compel managers to seamlessly interlink and aggregate planning, organization, scheduling, inter-party collaboration, monitoring, accountability, and control to a level that was impossible to imagine a few years ago. Consequently, project management has had to adapt to the needs of modern managers in terms of how projects are initiated, implemented, and administered. From relying on exclusive human potential, project management now requires advanced software solutions whose reliability and potential in the management of projects is as infinite and globalized, as modern business. complexity of worldwide organizations have giving confidence to management scientists to search for extremely reliable and more dependable support tools that can assist project managers in managing challenges of high complex projects. Advances on the IT industry have offered perhaps the most reliable solution for modern project managers. Software development and IT has been adopted in “current project management,” at a time when reorganizing business processes, advancing research and innovation, as well as implementing unprecedented levels of development is the very lifeline of business. This reality is the very background upon which the project management information systems (PMIS) have become a popular project management tool, and an essential instrument of ensuring the efficiency, effectiveness, and performance of contemporary projects. PMIS has been defined in different words, though with consensus of thought, by numerous schools in the literature. Project Management Knowledge (2010) defined PMIS as “system tools and techniques used in project management to deliver information.” According to Project Management Knowledge (2010), PMIS ensures that project are implemented, controlled, and sustained to completion in a manner that achieves “all of the project goals and objectives while honoring the preconceived project constraints of time, budget, quality, and scope as well as optimizing the allocation and integration of inputs needed to meet pre-defined objectives while mitigating any risks.” Nearly four decades ago, define PMIS from a user perspective as software solutions that provide “essential information on the cost-time performance parameters of a project and on the interrelationship of these parameters.” For the present article, PMIS denotes: A user-based interface of electronic information systems employed by managers in contemporary organizations

as custom-made software solutions to plan, schedule, implement, control, report, communicate, forecast, review, and handle the cost of all aspects of a project, in pursuit of optimal project performance.

In construction projects, activities are typically divided into functional areas, which are performed by different disciplines (e.g. architects, engineers, and contractors) and that therefore operate independently. Invariably, each discipline makes decisions without considering its impact on others. Moreover, these functional disciplines often develop their own objectives, goals, and value systems. As a result, each discipline has become dedicated to the optimisation of its own function with little regard to, or understanding of, its effects on the performance of the project with which they are involved. In fact, the interfaces that exist between functional disciplines have become a potential barrier for effective and efficient communication and co-ordination in projects. When a breakdown in communication is identified, the source of the problem can be typically traced back along the supply chain and it often becomes evident that there were 'informational flow mishaps' in the process. This is linked to information sharing and channeling. Information that is inaccurate or delayed is seldom filtered and delegated to specified parameters. Consequently, quality failures may occur as a result of ineffective decision-making. This is often exacerbated by the absence of an integrated and systematic information system (IS) to support quality management (QM) activities in construction projects. Moreover, the absence of such a system has caused many organizations to develop local insular ways to maintain control over their own domains of responsibility. Thus, information gathering, reporting, and management in a project become uncoordinated and multiple re-drawing and re-keying of information must be undertaken. Ultimately, this leads to time waste, unnecessary costs, increased errors, and misunderstanding, and thus rework, which has been found to be the primary factor of time and cost overruns in construction projects. Furthermore, the ineffective use of information technology (IT) in managing and communicating information exacerbates the amount of rework that occurs in a project. There is therefore a need for an IS that can be used to manage quality so that the performance of organizations can be monitored and quality costs determined. This will enable organizations to determine their quality failure costs (in particular rework) and therefore implement strategies for preventing it. The design and development of quality costing systems for construction projects has been limited, to date, because of the complexity associated with having to manage information from a number of organizations with different approaches to managing quality.

II. QUALITY COSTS

To acquire knowledge and learn about quality costs, a project quality IS should form an integral part of an organization's approach to managing its construction projects. To do so, it is necessary to collect, measure, and analyze quality. However, this is complex and problematic, because of the sheer number of activities and organizations involved with procurement. Moreover, organizations vary in size and technological capabilities, and this makes it difficult to manage project-related information, particularly data about quality costs. In fact, many construction organizations have no system in place or even collect quality cost data. A project management IS with quality costing added could provide the project team members and clients with information about quality failures and the activities that need to be designed to prevent their future occurrence. This can then be used to suggest quality improvement initiatives directed at achieving significant cost savings and quality breakthroughs. Quality-related costs have been found to range from 5 to 25% of an organization's annual turnover or operating costs. Of this, 90% is expended on appraisal and failure costs. Quality costs can be reduced by a third when a cost-effective QM system is implemented.

• Calculating Quality Costs

There are numerous methods for calculating quality costs. For example, costs can be classified as either cost of conformance or non-conformance. Conformance costs include: training, indoctrination, verification, validation, testing, inspection, maintenance, and audits. Non-conforming costs include: rework, material waste, and warranty repairs. However, the most widely accepted method of determining quality costs in construction is the traditional prevention–appraisal–failure (PAF) model, which classifies costs as follows:

1. Prevention — all amounts spent or invested to prevent or reduce errors or defects, that is, to finance activities aimed at eliminating the causes of defects;
2. Appraisal — the detection of errors or defects by measuring conformity to the required level of quality: issued architectural and structural drawings, work in progress, incoming and completed material inspection (e.g. reinforcement, door hardware, etc.);

3. Internal failures — due to scrapping or reworking defective product or compensation for delays in delivery; and
4. External failures — after the delivery of a product to the customer: costs of repairs, returns, dealing with complaints, and compensation.

These relate only to preventing and correcting errors of a poor product/service quality. In fact, they only represent the direct, tangible, and visible portion of the costs. Some quality costs can be estimated with a high degree of precision, while others can be only estimated. Examples of prevention and appraisal techniques used in construction are shown in Table 1. As Banks points out, costs will rise as more time is spent on prevention. As processes improve, appraisal costs should then reduce, as inspection is no longer necessary.

Prevention And Appraisal Activities	Description
Quality Systems	Developing quality improvement programs, standards, and goals. Data collection, analysis and reporting
Supplier Certification	Evaluating the ability of suppliers, vendors, contractors and subcontractors, to perform capably. Developing a certification system and compiling rating scores to measure supplier performance
Personnel Qualification,	Testing and training Testing personnel's ability to perform work according to specified standards. Craft certification and training for QA/control activities
Expediting	Activities prior to delivery to ensure on-schedule delivery of all purchased materials, equipment, services and third party engineering information
Constructability Review	Activities to ensure that the most efficient design and planned construction methods are used to maximise the chance of building perfect facilities. Construction site layout is used to maximise the chance of building perfect facilities. Construction site layout studies, de-watering studies, prefabrication studies, etc.
Operability, Safety And Value Review	Determining if the design is in compliance with client, industry, and government requirements in terms of operability, safety, value engineering, safety analysis, process hazards, and operability reviews, value engineering studies, etc.
Examinations, Internal	Reviewing, checking, inspecting, testing and observing services/product internally in the organisation. Reviewing designs, drafting and documentation. Soil testing, concrete testing, hydro-testing piping, etc.
Examinations, External	Reviewing, checking, inspecting, testing and observing products/services produced externally by others. Inspection of material/equipment received, vendor document reviews, etc

Thus, the greatest savings could be derived from reducing internal failure area. increases in expenditures will not show immediate reductions in failure costs, primarily because of the time lag between cause and effect. Appraisal and prevention costs are unavoidable costs that must be borne by design and construction organizations if their products/services are to be delivered 'right' the first time. Failure costs, on the other hand, are almost avoidable in construction, as most originate from ineffective management practices. Notably, quality costs can account for 8–15% of total construction costs.

The Construction Industry Development Board (CIDB) in Singapore, for example, stated that an average contractor was estimated to spend 5–10% of the project costs doing things wrong and rectifying them. They concluded that an effective QM IS would cost about 0.1–0.5% of total construction cost and produce a saving of at least 3% of total project cost (about five times the original outlay). Studies have shown that more than 25% of the costs can be cut through the use of an effective quality program. This clearly points to the importance of knowing how to prevent recurrence, not only benefiting the contractor, but also the client and end-users. Spending 1% more on prevention, failure costs could be reduced by a factor of five. Direct costs are readily measurable, often quoted in evaluating quality of workmanship, and represent a significant proportion of total project costs. Indirect costs are not directly measurable and include loss of schedule and productivity, litigation and claims, and low operational efficiency. In addition, labour costs for QM, which includes full-time QM personnel and others occasionally involved with quality-related activities need to be identified.

- **Quality costing project management information systems**

Several quality costing project management IS have been developed and implemented to determine quality costs: Quality Performance Management System (QMPS), Quality Performance Tracking System (QPTS), and Quality Cost Matrix (QCM).

1. Quality performance management/tracking system

Patterson and Ledbetter used the QPMS to track the cost of QM by activity on four projects. They assumed that direct rework costs were 12.5% of project cost and found that quality costs were 25% of project cost. The cost of rework was then related to the QM cost by the cause of the error. While this system was simple and flexible, it did not consider the effect of failure on time-related cost. In addition, the system did not identify specific causes of failure. The QPTS, an updated version of the QPMS, was developed to characterize quality cost for the purposes of quantitative analysis and tracking deviations. Here deviation costs included rework, impact, liability, and warranty work. To track a quality failure a series of questions needed to be asked, such as:

What subcontract?

Who was affected?

What was the cost?

When was it detected?

Who was the cause?

What QM involvement was there?

What type was it?

In the QPMS, quality failures are characterized by type, cause, and time of detection. In categorizing QM activities, Davis et al. noted that the definition of QM varies from one design firm to another, and the distinction between design practice and QM is blurred. So if any QM activity is repeated because of an earlier failure, its cost becomes part of the failure cost and not QM cost. For example, if formal design and drafting checks/reviews, constructability reviews, and inspections were needed again, then they would be included as a failure cost. The total quality cost of quality (TQC), the cost of prevention and appraisal plus the cost of failure and deviation correction was 12% of total labour expenditures for design and construction. This was made up of 8.7% prevention and appraisal and 3.3% deviation correction. internal and external examinations accounted for 76 and 12% of prevention and appraisal costs, respectively. In addition, the sources of deviation correction causes were attributable to design error (38%), vendor error (30%) and designer change (29%). prevention and appraisal techniques were effective in reducing deviation corrections. They were able to show that more emphasis on prevention activities could reduce appraisal and internal failures. Ultimately, the goal of an organization should be to eliminate failure/deviation correction costs and prevention and appraisal expenditures at the same time.

2. Quality cost matrix

Abdul-Rahman acknowledged the limitations of the QPTS and developed a QCM, which took into account the effect of a failure on time, particularly, the costing of accelerating work and specific causes of a nonconformance. The QCM sought to address the following questions:

What category of non-conformance should be used and which activity is affected?

What is the specific problem?

What is the cause of the problem?

How long will it take to rectify the problem?

What is the cost to remedy the situation?

Is any other cost spread elsewhere?

Each of these formed a category of the QCM. Defect notices, daily reports, site instructions and variation orders coupled with interviews with key site personnel were used to identify non-conformances in selected engineering

projects. In a water-treatment plant, 62 non-conformances were identified. These were found to account for 2.5% of contract value. Not all nonconformance's could be identified due to resource constraints and availability of site personnel. Thus, Abdul-Rahman states, "assuming that the rate at which the cost of non-conformances occur is constant throughout construction then the total cost of nonconformance is estimated to be 6% of the estimated project cost." This figure did not reflect the full extent of rework that occurred, as many client-initiated variations were not included. Design errors or omissions contributed to 30% of the cost of non-conformance. Three construction-related costs were identified. These were associated with the subcontractor, coordination and planning, and construction. The three most frequent non-conformance categories were

III. CONCLUSION

The purpose of this paper was to discuss the design of a prototype project management quality costing IS. A review of the quality costing and the quality costing systems that have been developed was presented and discussed. The development process of PMIS included the problem identification, design of the information architecture and the testing of the system to determine the type of information needed so that it could be implemented in practice. While PMIS can be used to determine quality costs, the lack of information made available by organizations during the testing phase meant that the research focused on rework (often considered as a quality failure). The information architecture was considered to effective by participating organizations for determining and managing quality costs in projects. In fact, the testing of the system has enabled a series of benchmark metrics to be developed. A challenge facing PMIS is its development into an effective software program that all organizations involved with a project can use. With some minor modifications, we suggest that PMIS could also be used to monitor quality costs in software projects. the study until now was performed on analyzing and predicting the system manually used to manage the construction work on site. Many researchers derived the logical algorithm to reduce the time and increase the effectiveness of work on site and ultimately deal with the cost effective project. Some questions regarding the output and effectiveness and flexibility to use the system on the site are unanswered. The effectiveness of the designed system in practical usage by studying the case study and comparing cost benefit with PMIS and conventional system.

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