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PPMS: a Web-based construction Project Performance Monitoring System

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Abstract

This paper describes the development of a Web-based construction Project Performance Monitoring System (PPMS) that aims to assist project managers in exercising construction project control. With the aid of a panel of project management specialists, the following project performance measure categories are identified for inclusion in the PPMS: People, Cost, Time, Quality, Safety and Health, Environment, Client Satisfaction, and Communication. For each of the performance measure categories, performance indicators and their measurements are also established. The monitoring process is automated through the use of the World Wide Web and database technology. Data collection and dissemination are similarly automated. The use of the PPMS can help senior project management, project directors, project managers, etc., in monitoring and assessing project performance.

Keywords: Performance monitoring system; Project performance indicators; World Wide Web; Database technology

1. Introduction

The success of a construction project depends on a number of factors, such as project complexity, contractual arrangements, relationships between project participants, the competency of project managers, and the abilities of key project members [1–4]. Undisputedly, the key project members, including the architects, the quantity surveyors, and the engineers, are the central figures throughout the duration of a contract in terms of executing and supervising construction processes and related activities. However, it is the project manager that has been identified as the most important person in a project team [2,5]. Successful project delivery requires the concerted effort of the project team to carry out the various project activities, but it is the project manager who, at the center of the project network, is responsible for orchestrating the whole construction process [6]. A part of his responsibilities include project goals setting, overall project coordination, planning and management, and the resolution of disputes [7,8]. In fact, his duties cover a wide range of areas, such as dealing with social, technical, legal, and political issues; therefore, the input of the project manager is paramount with respect to successful delivery of the project [8,9]. The project manager has to maintain the project network and monitor against slippages in cost, time, and quality for the duration of the project [5]. In achieving this, the project manager relies heavily on a reliable monitoring system that can provide timely signaling of project problems, whether they are real or potential. A Web-based Project Perfor-

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mance Monitoring System (PPMS) has been developed to assist project managers in this respect. PPMS includes eight categories of project performance measures: People, Cost, Time, Quality, Safety and Health, Environment, Client Satisfaction, and Communication. Project performance data are stored in a centralized database with inputs provided by different contracts via the Internet. The performances of projects are evaluated and compared by activating the built-in query strings and output functions.

2. Project performance measurement tools

The majority of existing project performance measurement tools focus on financial aspects such as the return on investment and profit per unit [10] argued that financial parameters are useful, but there are inadequacies, such as lagging metrics [11,12], a lack of strategic focus, and a failure to provide data on quality, relationships, and the environment [13–15]. In Australia, the New South Wales Public Works Department launched a Project Performance Evaluation (PPE) framework, which covers a wide range of performance parameters. The selected parameters include time, cost, quality, safety, contractual, communication, environment, and dispute resolution elements [16,17]. The main purpose of PPE is to extend project performance measures to cover soft parameters also, such as communication and dispute resolution [16]. In the UK, a project performance measurement tool referred to as the Key Performance Indicators (KPIs) was developed by the KPI working group [18] under the UK Construction Industry Best Practice Programme. The launching of the KPIs was an answer to the Egan report's recommendation of developing an industry performance standard [18]. The three major steps in implementing KPIs are as follows:

1. Decide what to measure. This vital first step is to determine the performance measure categories that are relevant to the construction industry. Seven main categories are used in the KPIs: time, cost, quality, client satisfaction, client changes, business performance, and safety and health.
2. Collect data. Project performance data is collected from both the contractor and the client according to their nature. Data collection forms are used and this process is mainly manually completed.
3. Calculate KPIs. Based on a set of predetermined formulae, performance indicators are calculated. The industry averages are taken as benchmarks. These tasks are performed by the KPI collector who calculates and disseminates the results to the subscribers.

Both the PPE and KPIs are valuable tools for measuring project performance over a period of time. However, several issues remain to be addressed:

1. *Time factor*—A tedious collection process is involved in the PPE and KPI systems. For instance, the use of PPE relies on manual collection, retrieval, and interpretation of the data provided by project participants. Such a process is time-consuming and expensive, especially for projects involving a large number of participants that are geographically distant from the project control unit. Consider a typical large-scale international construction project team consisting of: stakeholders (clients); consultants (engineers, designers, cost controllers, etc.); main contractors; and subcontractors (specialist and nominated contractors) with operation centers located at different parts of the world. The difficulty in assembling a data pool for project monitoring is self-evident. Even if this is resolved, the pressure on the project administrator to analyze and resolve the collected data into meaningful information is immense.
2. *Confidentiality*—KPIs require data to be submitted by the KPI collector who then carries out data interpretation and provide summary reports. Contractors and clients may be hesitant to provide to the KPI collector sensitive data such as cost information.
3. *Post-Evaluation*—Traditional performance monitoring is usually carried out by evaluation forms filled by project members at regular intervals. It is often the case that the project manager can only examine the project status several weeks after completion of the data collection process. This type of post-evaluation is inadequate given the rapid progress of most construction projects.

In view of the above, an automated construction PPMS is proposed. In essence, the PPMS makes use of the Internet and database technologies to streamline the monitoring process and therefore enables speedy and convenient data input and dissemination. Fig. 1 shows the development framework of the proposed PPMS.

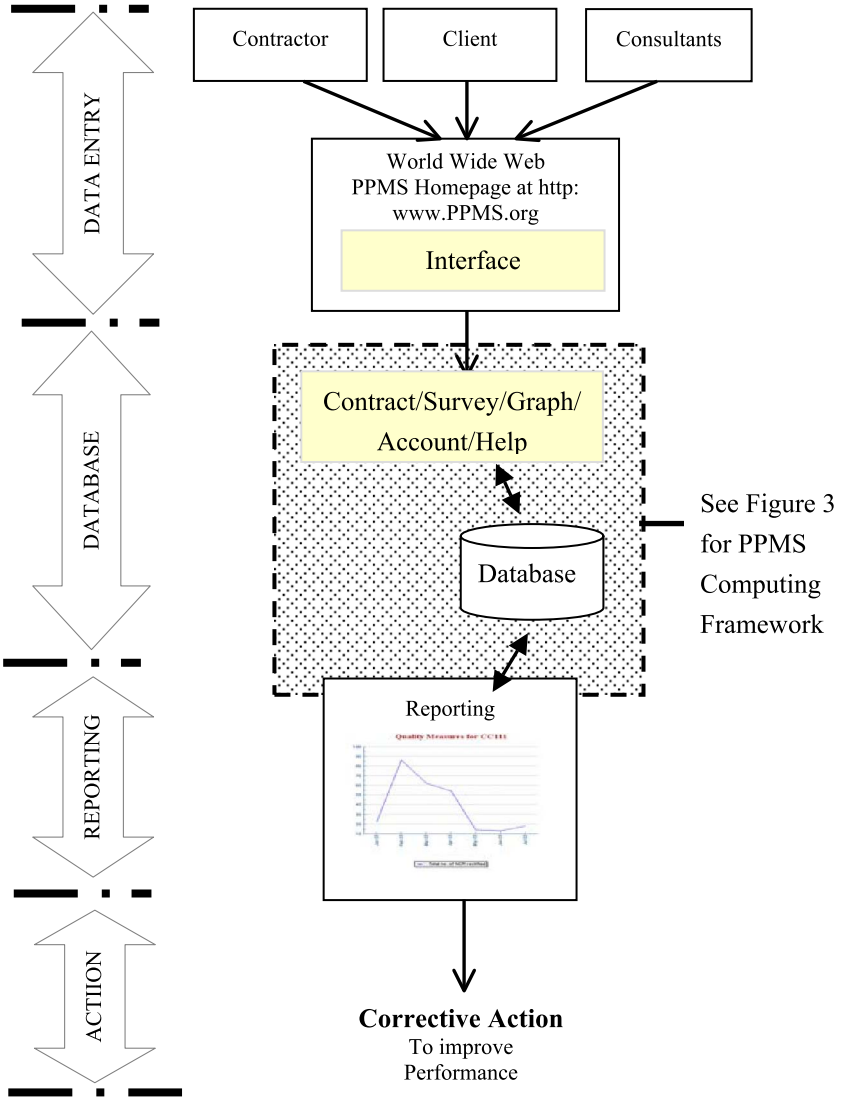

Fig. 1. Development framework of PPMS.

As shown in Fig. 1, important project data are manually input into the database by various data holders through a Web-based interface. The Web-based interface serves as a single point of control and reference, giving the user the following options:

- search project data and enter new contract details (under CONTRACT function, see Fig. 5);
- fill-in new project data in the standard forms (under SURVEY function; as an illustration, see Figs. 6 and 7); and
- plot different forms of graphs: overall; comparison; and measures (under GRAPH function; as illustrations, see Figs. 8–11).

The number of performance parameters to be used depends on the degree of sophistication of the project and the extent of monitoring sought. Project data in relation to each parameter are then stored in the database for later use, i.e., reporting and data analysis. The following sections describe the development of the PPMS.

3. Development of the PPMS

Like all other performance measurement tools, the PPMS, as a project monitoring tool, comprises a list of construction project performance measures.

3.1. Construction project performance measures

PPMS requires a set of project performance measures as the basis for evaluation. The key performance parameters used in the PPE [16] and KPIs [18] form the basis for the design of PPMS. Table 1 summarizes the performance parameters used in PPE and KPIs.

With the assistance of five project management specialists (committee members of the Association of Project Managers in Hong Kong), a total of eight critical project performance measure categories were identified, including People, Cost, Time, Quality, Safety and Health, Environment, Client Satisfaction, and Communication. It is self-evident to include measure categories for time, cost, quality, and safety and health. The inclusion of measures of the environment and people is a response to the increasing concern for environmental issues and the use of the partnering approach in contracting [19,20]. With the increase in "Green design", more stringent environmental standards and policies are now implemented to protect the environment. Green construction is now a part of the key agenda of construction project management. Likewise, partnering is now commonly applied in the construction industry. Traditional adversarial approaches are now being replaced by the partnering approach, designed to achieve "win–win" results and reduce confrontation. The eight performance measure categories form a basis for designing the performance indicators, which are the elements of performance within the ambit of each measure category. For example, the category "Quality" consists of quality performance indicators as follows: *Inspection*, *Non-Conformance*, *Work Rejection*, and *Survey (Samples) Rejection*. Within each performance indicator, there are sub-performance indicators (refer to Appendix A). The collective effect of all measure categories reflects the overall project performance. The key performance measure categories are displayed in Fig. 2.

Table 1
Performance parameters used in PPE and KPIs

Project management tools	Performance parameters
PPE	communication, time, cost, quality, safety, claims and issues resolution, environment, contract relations
KPIs	time, cost, quality, client satisfaction, change orders, business performance, health and safety

3.2. Category 1—People

This is an overview of how project members 'feel' about project performance with respect to time, cost, quality, safety and health, etc., over a period of time.

3.3. Category 2—Cost

Project cost performance is used to show how well the project adheres to the agreed budget. It is important because resources are often limited and cost overruns are to be avoided. As suggested by the experts, the four areas that are highly relevant to project cost control are: Interim Payments, Variation Orders, Cost and Prolongation Claims, and Final Account Forecasts.

3.4. Category 3—Time

Monitoring project time is one of the many challenges for the project manager. Time monitoring seeks to assess how well the project adheres to the planned schedule over a period of time. Three areas of time management are given special attention: achievement of critical dates, achievement of milestones, and the turnaround time for submission in the period.

3.5. Category 4—Quality

The quality category helps to ensure that projects will achieve the quality standard set out in the contract. It should therefore cover the areas of quality control, viz. the number of non-conformance report, works rejection rates and survey (sample) rejection rates.

3.6. Category 5—Safety and Health

The Safety and Health category covers four key areas: Monitoring and Compliance; Education and Training; Inspection and Audit; and Complaints and

Category 1 **People**	*Category 2* **Cost**	*Category 3* **Time**
Category 4 **Quality**	**PPMS**	*Category 5* **Safety & Health**
Category 6 **Environment**	*Category 7* **Client Satisfaction**	*Category 8* **Communication**

Fig. 2. Performance measure categories for PPMS.

Prosecutions. These serve to uphold safety and health standards and to prevent industry accidents or injuries.

3.7. Category 6—Environment

The Environment category is intended to monitor nuisances caused by construction activities, including air pollution, noise pollution, water pollution, and waste management.

3.8. Category 7—Client Satisfaction

The Client Satisfaction category is designed to seek the clients' degree of satisfaction with the project performance.

3.9. Category 8—Communication

The Communication category is used to assess the effectiveness of communication among project participants as suggested by the number of meetings held, the number of requests for information, and the number of correspondences measured.

3.10. Identifying performance indicators for each of the performance measure categories

A panel of project management specialists assisted in establishing the list of performance indicators for

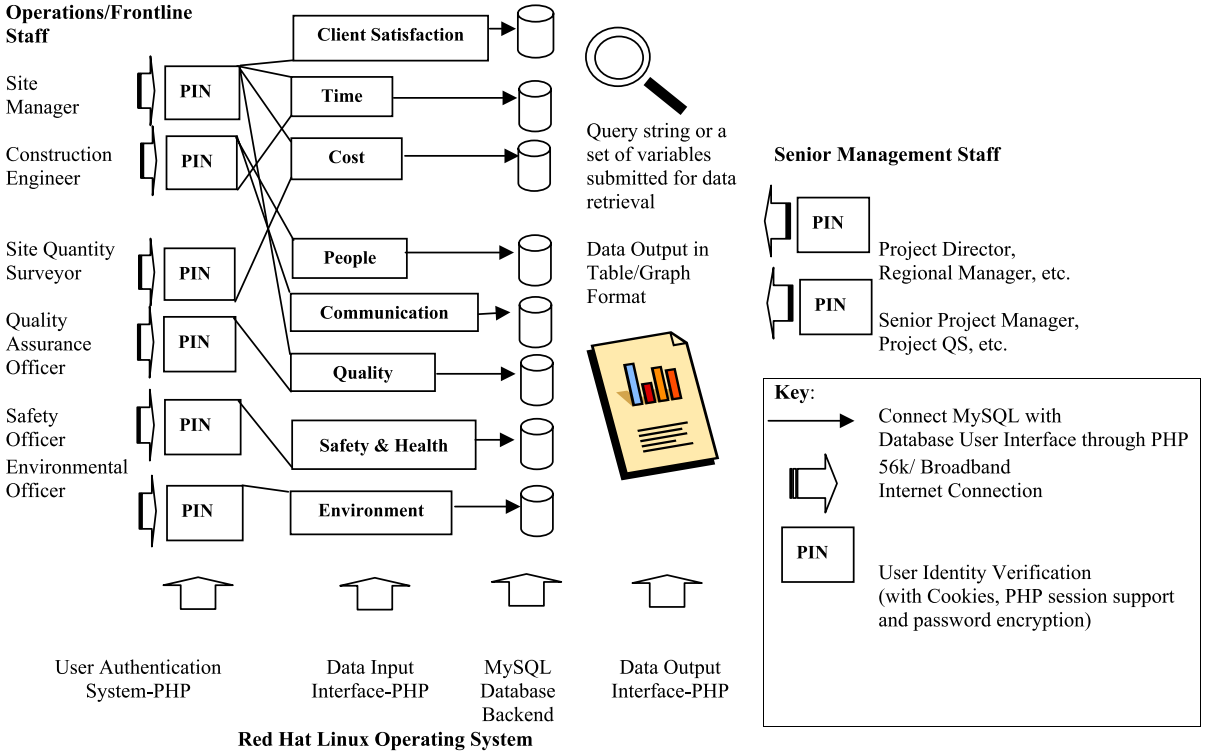

Fig. 3. PPMS computing framework.

each of the performance measure categories, as well as their corresponding measurements. The indicators used in the PPMS together with their measurements are given in Appendix A.

4. Computing components

The World Wide Web and database technologies have been employed to facilitate the functions of PPMS. Fig. 3 shows the computing framework of PPMS, with key components including a Web Interface (template), PHP Scripting, a MySQL Database Backend, and a Graphical Presentation module.

4.1. Programming

To construct the PPMS, a database support with a user-friendly interface, a security system, and a stable Internet connection is required. The PHP Hypertext Processor, an advanced programming language that facilitates interactive interfaces and supports powerful databases, thus requiring relatively low resources, was adopted as the programming language for the PPMS.

PHP is a widely used open source scripting language that is especially suited for Web development. The advantages of using PHP are the capacity for it to be embedded into HTML and to enable Web designers to write Web pages quickly. The greatest advantage in using PHP is that it is extremely simple for the beginner, but still offers many advanced features for more sophisticated Web designers. Another advantage of using PHP is its compatibility with many operating systems such as Linux, Unix, Microsoft Windows, MacOS X, and RISC OS. PHP can also be supported by many Web servers, such as Apache, Microsoft Internet Information Server, Personal Web Server, Netscape and iPlanet servers, and many others. Therefore, the use of PHP can provide the freedom of choosing an operating system and a Web server. Furthermore, PHP can be supported by a wide range of databases, including Adabas D, dBase, Empress, MySQL, Oracle, and Solid. With these advantages in mind, PHP was selected as the programming language for the PPMS.

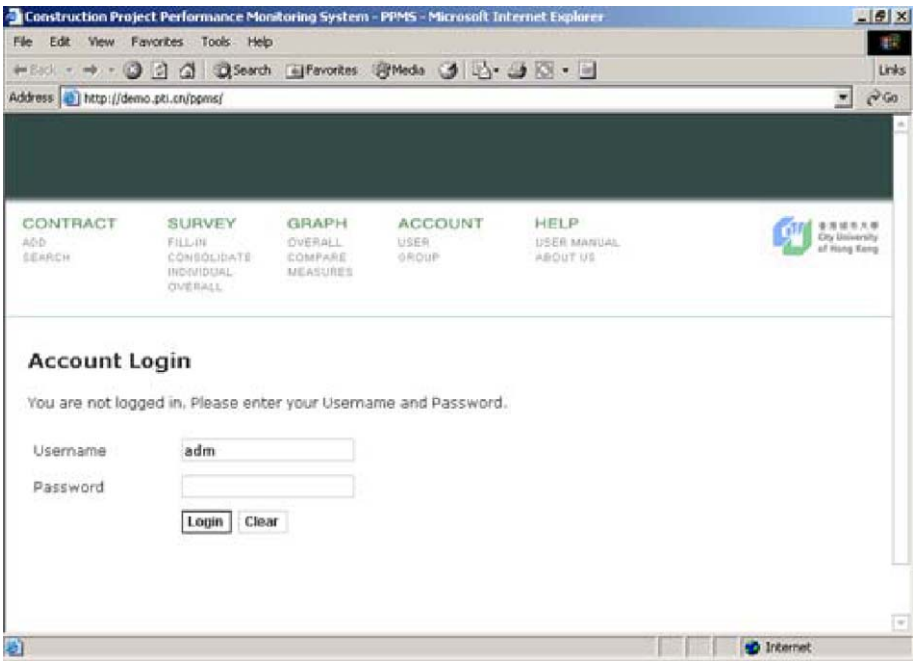

Fig. 4. PPMS—user login and key functions.

4.2. Database backend—MySQL

To support the use of PHP in constructing a database, a structured data collection and retrieval system is needed. In this instance, an Open Source Database known as 'MySQL' has been used. It is one of the most popular Open Source Database systems, having been designed for speed, power, and precision in mission critical, heavy load use applications.

MySQL is a relational database management system that stores data in separate tables rather than putting all of the data in one big store room. This helps to improve speed and flexibility. MySQL is free, open-source software, available for use and modification to suit individual needs. The MySQL software can be down loaded free from the Internet. The following list describes some of the key characteristics of the MySQL database software.

- Security—The password system is very flexible and secure, and allows host-based verification. Passwords are secured by encrypting all password traffic connected to a server.
- Scalability and Limits—MYSQL can handle large databases, with some databases capable of handling 50 million records, 60,000 tables, and 5,000,000,000 rows.

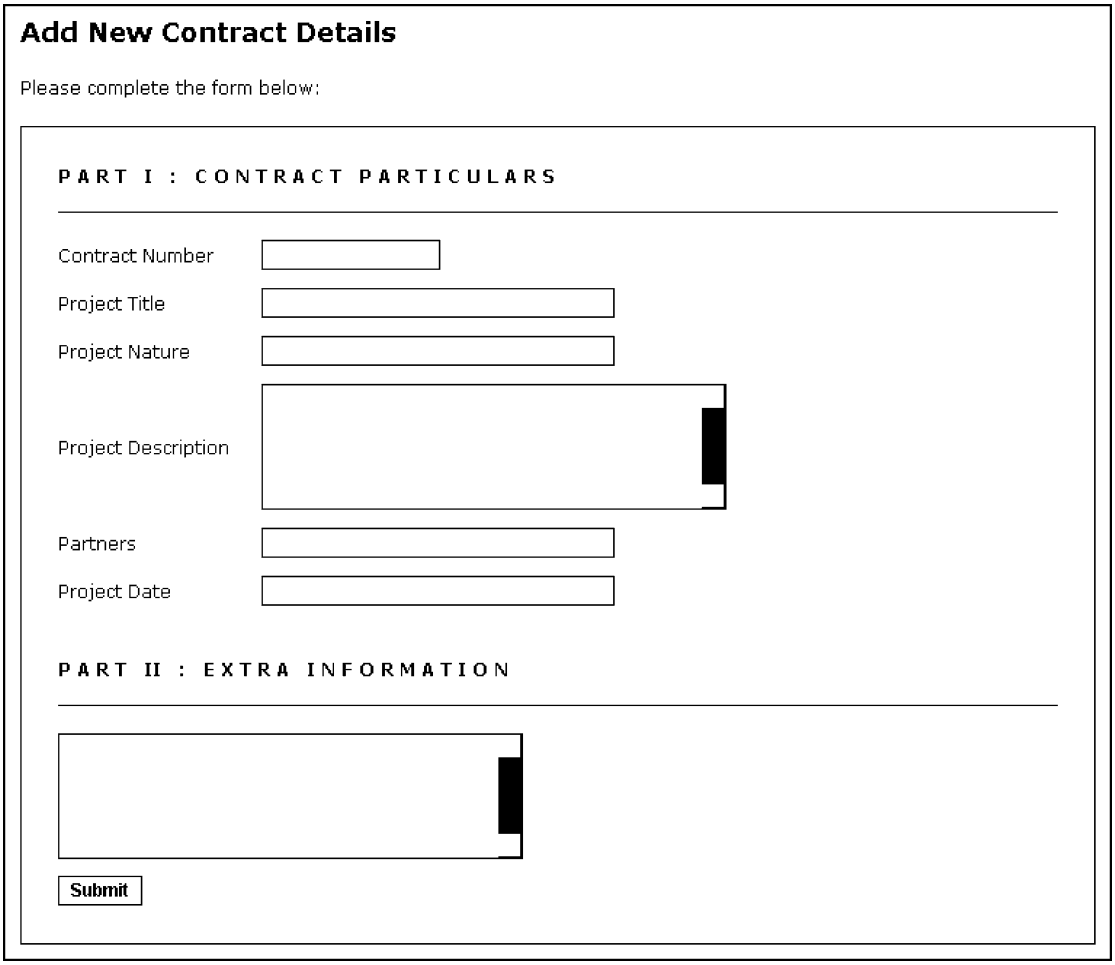

Fig. 5. PPMS—contract details.

- Connectivity—Clients have the choice of connecting to the MySQL server by using TCP/IP sockets, Unix Sockets (Unix), or Named Pipes (NT).
- Stability—Constant assessment of the MYSQL occurs to ensure bugs are closely monitored and fixed in the latest version.

5. PPMS in use

The PPMS is operated through a user interface, to which access is via the Internet domain address. By entering the correct username and authorized password, the user can access the various built-in functions. In the default screen, five key functions are displayed at the top of the User Login page: Contract; Survey; Graph; Account; and Help. These serve to provide assistance to the user in entering, reading, and comparing project data. Fig. 4 shows the User Login Page and the key functions of PPMS.

5.1. Contract details

The Contract icon links with the contract details. The Contract Details page allows the user to insert specific project details (Refer to Fig. 5). These details

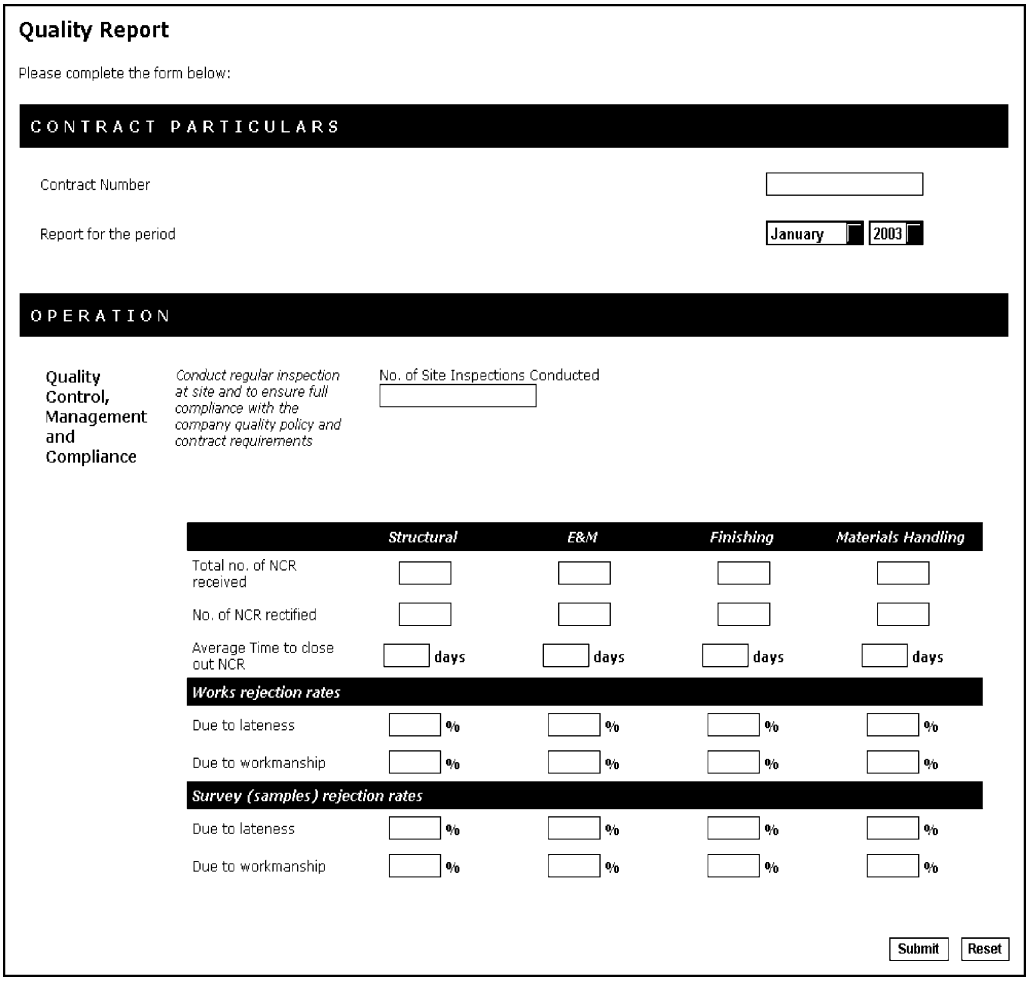

Fig. 6. Input screen for the quality performance measure category.

are useful as a basis for the retrieval and comparison of project information.

5.2. On-line data collection

After successfully completing the contract details, a portion of the database is designated for this particular project. Entry of data for performance indicators can then be completed through the on-line Questionnaire for the performance measure categories. Fig. 6 shows the Input screen for the Quality performance measure group.

5.3. Dissemination of collated data: graphical presentations

In Fig. 7, a summary report of the Quality performance measure category for Contract Number 111, for the month of January 2003 is displayed.

The PPMS is also equipped with the capability to present information in graphical form. For example, important information such as the total number of non-conformance performance reports over a period can be found by clicking on the 'Graph' function, which is provided in the function bar (Fig. 4 refers). Two sub-

Quality Report

Contract Number **111** **January 2003**

KEY

Total no. of NCR received	**78**
Total no. of NCR rectified	**22**
Total no. of NCR outstanding	**56**

OPERATION

Quality Control, Management and Compliance	*Conduct regular inspection at site and to ensure full compliance with the company quality policy and contract requirements*	No. of Site Inspections Conducted 2

	Structural	*E&M*	*Finishing*	*Materials Handling*	*Total*
No. of NCR received	41	25	8	4	78
No. of NCR rectified	12	5	4	1	22
Total no. of NCR outstanding	29	20	4	3	56
Percentage of NCR rectified	29%	20%	50%	25%	Average 31%
Average Time to close out NCR	1 days	3 days	2 days	2 days	Total Average 2 days
Works rejection rates					
Due to lateness	1%	1%	2%	3%	
Due to workmanship	1%	2%	1%	2%	
Survey (samples) rejection rates					
Due to lateness	2%	4%	5%	4%	
Due to workmanship	4%	2%	2%	5%	

Fig. 7. Summary report.

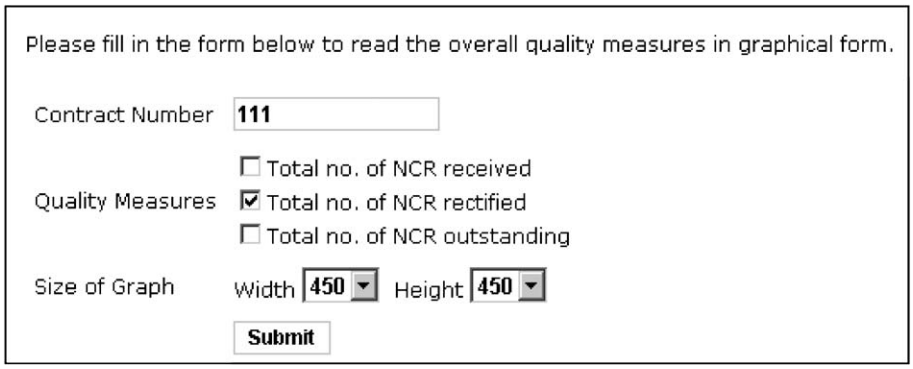

Fig. 8. Overall quality measures.

options are available under the 'Graph' function: *Overall Quality Measures* and *Contracts Comparison*.

(i) *Overall Quality Measures*. This option enables instant reading of the key quality measures, including the total number of Non-Compliance Records (NCRs) received from the engineer, the total number of NCRs rectified, and the total number of outstanding NCRs. The project manager simply enters the contract reference number and the quality performance indicators that he/she wants to examine and the relevant information is displayed automatically on the screen, as shown in Fig. 8. In Fig. 9, the total number of NCRs rectified for Contract 111, from January 2003 till July 2003, is illustrated.

(ii) *Contracts Comparison*. In addition to the ability to reflect upon trends/overall performance, the PPMS

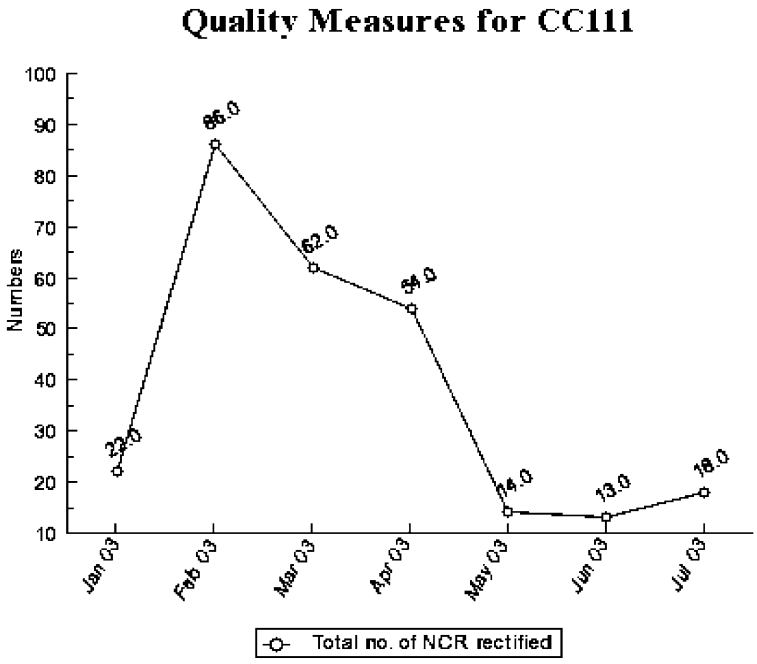

Fig. 9. Total number of NCRs rectified over a period of time.

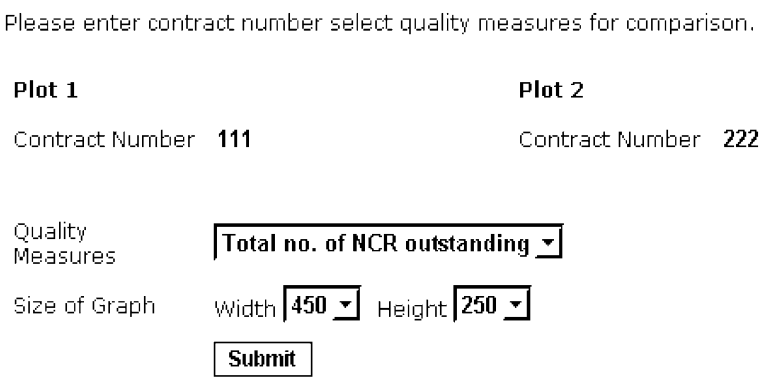

Fig. 10. Contracts comparison.

allows the user to compare data within and/or between projects. In Fig. 10, the comparison function is illustrated on the default screen. This function enables data to be compared between different contracts. As shown in Fig. 11, by studying and comparing the movements of the two curves, the project director can evaluate the performance of projects under his control. In this instance, from the period April 2003 to July 2003, it appears that Contract 111 handled NCR claims more effectively than Contract 222, as indicated by fewer outstanding NCRs. As such, the project director can address the respective project managers to identify ways to improve the problem.

6. Case study—a railway project in Hong Kong

In order to evaluate the effectiveness of PPMS, a case study was conducted on a railway project in Hong Kong. The project involves the construction of a railway network and (covering a total distance of 30 km) is packaged into 17 civil construction contracts and 20 railway operation systems contracts, with a project sum in excess of HK$45,000 million. A number of project management tools, both off-the-shelf products and built-in-house systems, as well as IS/IT systems (see Table 2), were employed.

The research team interviewed a member of the senior management of the project. During the interview, the manager was first introduced the PPMS. He

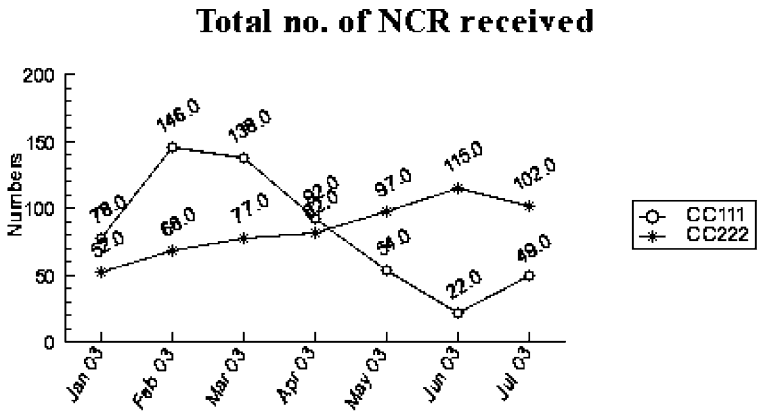

Fig. 11. A comparison of NCR periodic movement between contracts.

Table 2
Summary of IS/IT systems and tools used in the railway project

Name of system/tool		
Civil/construction	Railway systems	Project support
Geotechnical Instrumentation Monitoring System (GIMS), Environmental Management System (EMS), Geotechnical Integrator (gINT)	Primavera Expedition, DOORS(requirement and specification management software), Web-board (Internet communication forum software), Rational Rose (model-driven development tool), Matlab and Simulink (engineering computing tool), RailPlan and Power Plan	Primavera Project Planner (P3)

was then requested to complete a questionnaire designed for the case study. The questionnaire consisted of two parts: Part I—Relevance of Performance Indicators; and Part II—System Effectiveness.

In Part I—Relevance of Performance Indicators, the manager was requested to evaluate the relevance of the performance indicators included in the PPMS. The results confirm that the performance indicators of the PPMS are appropriate, in particular the Client Satisfaction category, which is concerned with the client's assessment of: the finished product; the project manager's performance; and the contractor and suppliers. As for Part II—System Effectiveness, the manager was asked to evaluate the effectiveness of the PPMS as a project management tool by comparing it with those tools and systems currently being used in the railway project. Scores on effectiveness were assessed against a number of parameters, including Process Benefit, Time Benefit, Cost Benefit, Quality Benefit, Information Benefit, and Overall Effectiveness. The results indicate that the PPMS is compatible with the project management tools used in the railway project. The Internet-based and database-organized arrangement of the PPMS affords ease of set-up and system maintenance. These also reduce software/built-in system installation costs. However, it is acknowledged that the PPMS is designed purely for the monitoring of several key aspects of project performance, whilst commercial project management software packages can serve other purposes. The use of a centralized database also presents fewer problems with data compatibility. The Web-based feature was considered instrumental where a major project includes a number of contracts geographically separated from the management control unit located in the head office. The scores given by the manager are summarized in Appendix B.

7. Discussion

The PPMS streamlines the data collection and dissemination of collated data. It assists project managers and administrators in assessing project performance in a timely manner. Project performance measure categories can be added and removed according to the project objectives. More importantly, the use of the PPMS enables the project manager to compare and present data in user-friendly graphs and curves. It can compare the perceptive views of the various project participating groups. The system provides a means of identifying areas where performance is failing, allowing trouble areas to be addressed promptly. From a management point of view, the system can be used as a sounding board for contracting parties to air their concerns. The system allows tailor-making to suit the individual needs of organizations. This means that the number of performance indicators can be project and/or organization specific.

7.1. Limitations of the PPMS

The smooth functioning of the PPMS relies heavily on the Internet and the database system. As such, PPMS users need to be equipped with Internet access and a reliable database system. Despite the costs involved in setting up the Internet and the database system, the PPMS requires constant monitoring and good security to prevent 'down-time' and 'hacker-attack'.

8. Future development

The aim of PPMS is to reduce the time needed for data collection and dissemination of collated data. Performance measures can be added or reduced to reflect the needs of organizations. The use of PPMS can also facilitate instant graphical presentation of performance data. Further development may be focused on the following issues.

8.1. Developing benchmarks

Benchmarks are useful as indicators of performance standards as well as in comparing performance between projects within the same industry. As such, a centralized database can be established to generate benchmarks for project performance evaluation.

8.2. Extending the scope of the PPMS

The indicators identified in each of the performance measure categories should be adjusted from time to time so as to embrace advancements in construction technologies, changes in law, and practices. These require the inclusion of new project performance measure categories and/or indicators.

8.3. Set up a PPMS working group

A working group should be set up to promote the use of PPMS throughout the industry. Interested users can contact members of the author group about details of PPMS use within the construction industry.

9. Concluding remarks

The design of the PPMS aims to streamline the project performance monitoring process, from data input to the presentation of results. Eight categories of project performance measures have been included: People, Cost Time, Quality, Safety and Health, Environment, Client Satisfaction, and Communication. Convenience is accorded by combining the monitoring of different aspects of project management onto one single platform, through a central database. This reduces the problem of data incompatibility that may arise in the case of different systems/software. The automated process of the PPMS narrows the gap between data input and information output. This facilitates prompt managerial responses to real or potential problems. It is also suggested that benchmarking can be achieved if the system can be adopted as an industry platform wherein benchmarks developed from project performance data are contributed by contracting organizations.

Acknowledgements

The research team would like to express their gratitude to the people and organizations who have participated in the research project. The authors are grateful for the constructive comments received from the reviewers.

Appendix A. Eight performance measure categories and their corresponding performance indicators (adopted from KPIs [18] and PPE [16])

Performance measure categories	Performance indicators
People	Perceptive views on the following aspects of the project. Time, Cost, Quality, Safety, Environment, Communication, Contract Relations, Claims, and Issue Resolution
Cost	*Interim Payment* – this month's certified value vs. accumulated certified – certified Interim Payment amount out of submission amount (%) – % of work done (compared with the certificate forecast in the budget estimate or opined by the architect) – % of contract sum certified *Variation Order* – certified value amount out of submission amount (%) – variation amount vs. original contract sum – estimated total variation order amount vs. variation order amount in this Interim Payment – certified variation order amount paid by daywork content vs. total certified variation amount (%) *Cost Claims* – certified amount of additional cost claims (other than variation order vs. original contract sum – certified additional cost claims vs. submitted additional cost claims by contractor – certified extension of time out of original contract period – certified extension of time claims vs. extension of time claims by contractor – amount set-off, including liquidated damages from retention money – total duration of delay out of original contract period – average time taken to resolve a claim(days)

(continued on next page)

Appendix A (*continued*)

Performance measure categories	Performance indicators
	Final Account Forecast
	– final estimated contract sum vs. original contract sum
Time	*Achievement of Critical Dates*
	– planned number of critical dates
	– actual number achieved on time
	– % achieved on time
	Achievement of Milestones
	– planned number of milestones
	– actual number achieved on time
	– % achieved on time
	Turnaround Time for Submissions in the period
	– average (days)
	– maximum (days)
Quality	*Inspections*
	– number of site inspections conducted
	Non-Compliance Records
	– number of non-compliance records received
	– number of non-compliance records closed
	– total number of non-compliance records rectified
	– average time to close out non-compliance records
	Work Rejection
	– due to lateness
	– due to workmanship
	Survey (Samples) Rejection
	– due to lateness
	– due to workmanship
Safety and Health	*Statistics*
	– number of accidents reported
	– number of man–days lost
	Monitoring and Compliance
	– safe work practices
	– tools and machinery
	– personal protective equipment
	– fire precautions
	– electrical safety
	– housekeeping
	– hygiene and first aid facilities
	Education, Training, and Campaigns
	– number of meeting
	– number of toolbox talks
	– number of introduction courses
	Inspections and Audits
	– number of in-house inspections
	– number of audits conducted
	– number of government inspections/visit
	Complaints and Prosecutions
	– number of complaints received from staff
	– average time taken to close out the complaint (days)
	– number of prosecutions issued by Government Departments
	Complaints and Prosecutions
	– average time taken to close out the case (days)
Environment	*Compliance*
	– number of site inspections conducted
	– number complying
	– air quality
	– noise level
	– waste
	– discharge water
	Material Control and Waste Management
	– the right amount of raw materials are ordered
	– surplus materials are returned to store
	– construction and demolition wastes are reused and recycled
	– construction and demolition wastes are sorted
	Meetings
	– number of meetings held
	Education, Training, and Campaigns
	– number of workshops
	– number of people participating
	Inspections and Audits
	– number of public complaints received
	– average time taken to close out the complaints (days)
	– number of prosecutions issued by the EPD
	– average time taken to close out the case (days)
Client Satisfaction	*Product*
	– finished product (up to the month)
	Project Manager
	– overall performance
	– ability to identify and resolve problems
	– leadership skills
	– speed and reliability of service
	– attention to detail
	– overall value for money
	Contractor and Supplier
	– overall performance
	– speed and reliability of service
	– ability to keep promises
	– ability to complete work on time
	– resolution of defects
Communication	*Communication and Management*
	– number of meetings held with contractors/consultants in the month
	– number of change orders approved by the client
	– number of day work orders issued
	– number of Requests For Information (RFIs) raised
	– number of letters/Engineer Reply Forms (ERFs) issued to contractor/consultant
	– number of letters/Contractor Submission Forms (CSFs) received from contractor/consultant

Appendix B. Summary of results—effectiveness of the PPMS

B.1. Part II: System Effectiveness

To what extent do you agree or disagree with the following statements about the effectiveness of PPMS and the project management tools being used in the Railway Project?

	PPMS					**Railway Project**				
Effectiveness in providing information on project performance in terms of:	***Strongly agree***				***Strongly Disagree***	***Strongly agree***				***Strongly Disagree***
	5	*4*	*3*	*2*	*1*	*5*	*4*	*3*	*2*	*1*
Cost	●	○	○	○	○	●	○	○	○	○
Time	●	○	○	○	○	●	○	○	○	○
Quality	○	●	○	○	○	○	○	●	○	○
**Safety & Health*	○	●	○	○	○	●	○	○	○	○
**Environment*	○	●	○	○	○	○	●	○	○	○
**Client Satisfaction*	○	○	●	○	○	○	○	●	○	○
**Communication*	○	○	●	○	○	○	○	●	○	○
Process Benefit										
Improves data collection/retrieval	●	○	○	○	○	●	○	○	○	○
Assists tracking of project activities	●	○	○	○	○	●	○	○	○	○
Time Benefits										
Reduces time to prepare project data/information	○	●	○	○	○	○	●	○	○	○
Enables real-time report and feedback	●	○	○	○	○	●	○	○	○	○
Reduces number of meetings	○	○	○	●	○	○	○	○	●	○
Enables prompt management actions	○	○	●	○	○	○	○	●	○	○
Cost Benefit										
Reduces paperwork	○	○	○	●	○	○	○	○	●	○
Reduces postage/carriers	○	○	○	●	○	○	○	○	●	○
Quality Benefit										
Reduces number of errors	○	○	●	○	○	○	○	●	○	○
Improves presentation quality	○	●	○	○	○	○	●	○	○	○
Information Transfer Benefit										
Reduces barriers in information transfer	○	○	●	○	○	○	○	●	○	○
Improves coordination among project members at all levels	○	●	○	○	○	○	●	○	○	○
Overall Effectiveness in monitoring project performance	○	●	○	○	○	○	●	○	○	○

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