

Information Paper for Legislative Council LegCo Panel on Planning, Lands and Works

System Development and Implementation of the Public Works Programme Information System for the Environment, Transport and Works Bureau

PURPOSE

This paper informs Members of the development and implementation of the Public Works Programme Information System (PWPIS) for the Environment, Transport and Works Bureau (ETWB). The capital cost of the project is estimated to be \$28.767 million.

BACKGROUND

2. In order to meet the long-term planning and management requirements of the Public Works Programme (PWP), the Secretary for the Environment, Transport and Works has engaged a consultant to conduct a feasibility study on the redevelopment of the existing Public Works Management System (PWMS). The study, completed in July 2002, confirmed the necessity to replace the existing PWMS in order to meet the needs of ETWB and the relevant Works Departments (WDs)¹ for more effective management of PWP projects, the total expenditure of which amounted to \$23 billion in 2001-02. The new PWPIS will play an important role in enhancing the management of the PWP.

3. The study further concluded that the PWPIS would bring about net benefits to ETWB and all WDs. It estimated that the project will break even in less than three years after full implementation. Subject to funding approval we will invite tender in April 2003 with a view to completing the implementation by November 2004.

¹ Architectural Services Department, Civil Engineering Department, Drainage Services Department, Highways Department, Territory Development Department and Water Supplies Department.

CURRENT SITUATION AND PROBLEMS

4. The existing PWMS was designed to satisfy the programme management and project management needs of ETWB and WDs respectively. Rolled out in 1994 it served its intended purpose well during the initial years of operation. However, many changes to the operating environment and user requirements have occurred over the years. In addition, many WDs have put in place different practices and business rules in their daily operations and implemented various Departmental Information Systems (DISs) to cater for their own project management needs. As a result, the existing PWMS is no longer effective in meeting the needs of ETWB and WDs. Some of the major deficiencies are outlined below –

(a) ***Inflexibility for change***

PWMS is a large and complex system managed centrally by ETWB. Requests for changes by WDs are frequent, requiring considerable efforts from ETWB on their assessment, scheduling, testing and implementation. Being a proprietary system, its maintenance and operation are complicated and resource-demanding. Hence, it is not able to meet the changing business needs of individual departments in a timely manner.

(b) ***Inconvenience and inflexibility in reporting***

The reporting tool is designed for use by technical persons. Hence, ordinary end-users would have difficulty in using it. Assistance from technical support staff is normally required for changes in the report format and data items required by users.

(c) ***Lack of interface with other systems***

The existing PWMS cannot exchange data with other computer systems including the various DISs in WDs. This entails duplicated efforts in data entry and increases the chance of data entry errors.

The Proposed System

5. In addition to addressing the deficiencies identified above, the proposed system will have a much larger capacity and additional functions to enable ETWB and WDs to more effectively manage the expenditure and progress of PWP projects. Moreover, WDs can continue to use their existing and planned DISs together with their own business logic most suitable to them in project

management. Repetitive data entry will be minimised. Besides, data from other government information systems, such as the Ledger Accounting and Financial Information System (LAFIS) of the Treasury, will be extracted electronically and updated to the databases of the new system. Access to the new system will be available for use by ETWB and other bureaux as well as other users of the six WDs using their own desktop computers via the Government Communication Network. The essential business functions of the new system and its major components are given at **Enclosures 1 and 2** respectively.

RESOURCE IMPLICATIONS

Non-recurrent

6. Implementation of the project will be outsourced. The management of the project will be undertaken in-house by a team of permanent and contract staff. The estimated requirement of 19.9 man-months in-house permanent staff (3.5 Chief Engineer man-months and 16.4 Senior Engineer man-months) for tender preparation, tender evaluation, co-ordination and contract management will be met by redeployment of the existing staff resources in ETWB.

7. Contract IT staff efforts of 21.85 man-months (7.5 Contract Senior Project Manager man-months and 14.35 Contract Senior System Analyst man-months) will be hired to provide technical advice and support to ETWB in overseeing and controlling the project progress and expenditure, and monitoring the performance of the contractor.

Recurrent

8. The recurrent resources required from ETWB and ITSD for the ongoing support and maintenance of the new system will be met by redeployment of the existing resources operating the existing PWMS as follows –

Rank of Staff	Estimated Annual Effort in Man-months
Chief Engineer	12.0
Senior Engineer	24.0
Technical Officer	12.0
Senior Systems Manager	6.0
Systems Manager	11.2
Analyst Programmer I	18.5
Total	83.7

COST AND BENEFIT ANALYSIS

COSTS

Non-recurrent and Recurrent Costs

9. The total non-recurrent cost for implementing the proposed system is estimated to be \$28.767 million. The estimated annual recurrent cost, to be absorbed by ETWB, will be \$1,363,000 for the first year (partial financial year) and then \$5,947,000 a year thereafter. A breakdown of the non-recurrent and annual recurrent costs is at **Enclosure 3**.

ANTICIPATED BENEFITS

Tangible Benefits

10. The total estimated tangible savings amounts to \$16,062,000, of which \$10,240,000 is realisable. The realisable savings will mainly come from reduction in operation and maintenance expenditure as well as staff efforts in project and programme management.

11. The balance of \$5,822,000, being notional savings, represents the fragmented staff savings in operating the system and fragmented savings in accommodation. Details of the savings are at **Enclosure 4**.

12. The tangible staff savings will be realised by natural wastage, retraining or redeployment as appropriate. No forced redundancy is anticipated.

Intangible Benefits

13. The proposed system will generate the following intangible benefits –

(a) ***Improved flexibility in accommodating changes in WDs' requirements***

A downsized approach (that allows extraction of data from WDs' DISs) will be adopted to enhance the flexibility of the new system in adapting to changes in WDs' requirements. More importantly, the new system will provide WDs with a choice of project management tools that best suit their situation.

(b) ***Improved flexibility in accommodating business changes in programme management***

With the inclusion of a programme management tool in the new system, the flexibility to provide different perspectives of data analysis and reporting will be improved. Users may define different groups of projects as Programme Management Profiles (e.g. projects under individual heads or different departments), so that projects within a profile could be managed and analysed as a whole.

(c) ***Enhanced user friendliness of system interface***

Users may customise the screen layout and navigation flow of the reporting tool, as well as the business logic for the generation of charts and reports to support decision-making. Users may use the report generation tool to meet their ad-hoc reporting needs in programme management. Users will also be able to export the data for further analysis and reporting.

(d) ***Enhanced data ownership and accountability***

Measures will be put in place in the new system to ensure clear duty demarcation and data accountability among the user organisations. Procedures can also be established to control the WDs' users in updating the data already submitted to the new system.

(e) ***Improved accessibility of the new system***

The use of the intranet-based system will facilitate the provision of services to WDs and ETWB. In other words, users may access the new system through their desktop PCs without having to install dedicated terminals. In addition, the system will have the potential to expand system accessibility through mobile computing so as to provide timely information anywhere at any time.

(f) ***Improved timeliness of project information***

The new system will capture project information from WDs on an as-required basis. The data gap between WDs and ETWB will therefore be minimised. Timely and comprehensive statistics can be produced.

(g) ***Reduced redundant manual data entry***

The new system will provide the function of automatic data transfer, thus minimising duplicated data entry and the risk of data entry error. Examples of electronic interfaces to be established include downloading of project data from WDs' DISs, information of actual expenditure from the LAFIS, etc.

14. A cost-benefit analysis shows that the system will yield an annual net benefit of \$10.115 million on full implementation and will break even in three years after commissioning as detailed at **Enclosure 5**.

IMPLEMENTATION PLAN

15. We estimate that implementation of the systems will be completed in 20 months as follows –

	Activity	Period	
		Target start date	Target completion date
(a)	Tendering	April 2003	August 2003
(b)	System development, site preparation, system installation, testing, data conversion and migration as well as user training	September 2003	July 2004
(c)	System trial run	August 2004	September 2004
(d)	System live run	October 2004	November 2004

Way Forward

16. Subject to the views of Members, we shall present the proposed system development to the Finance Committee on 7 March 2003 for funding approval.

Environment, Transport and Works Bureau
January 2003

Summary of Major Functions of the Proposed System

1. Data Capture and Input

- Facilitate collection of the necessary data from WDs.
- Provide a variety of means to facilitate data capture and input, including electronic transmission of the data extracted from WDs' DISs, uploading from other related systems and data entry facilities.
- Capture different types of project data including Pre-Category C, Category A, B, C and D projects, and Gantt charts.
- Allow ETWB to maintain additional information related to projects and the Land Acquisition Prioritisation Exercise.
- Upload actual expenditures incurred on projects from the Ledger Accounting and Financial Information System of the Treasury.
- Upload financial information and Printed Estimates on works projects.
- Provide mechanism to load the captured data into a centralised Analysis Database.
- Validate, cleanse and transform the captured data to ensure data integrity and consistency.

2. Data Query and Reporting

- Provide pre-defined on-line enquiry facilities to retrieve general project and contract information to support users in project monitoring.
- Allow users to drill-down or drill-up on certain data or drill-through to the raw data. The user should be able to define the queries interactively.
- Allow signaling or alarming on the deviation from the project plan. Attributes for monitoring of projects include project cost, expenditure and significant events (such as project start date, completion date and tendering date).
- Allow highlighting current project attributes that have been updated since last data transfer.
- Generate exception reports.
- Enable generation of non-predefined reports – allow users to specify the report criteria, contents and layout.
- Enable secure on-line report viewing, printing and downloading of data.

3. Programme Management

- Allow users to monitor the PWP from different perspectives such as under individual heads of expenditure, policy areas, controlling officers, project categories or by different levels of the organisation structure. The users may aggregate project information to programme level, or (vice versa) to expand programme information to detailed project level.
- Allow users to group different projects into programme profiles for their own monitoring and reporting purpose.
- Provide users with a tool to generate charts as well as to customise the screen display, business logic, navigation flows and data export.

Summary of Major Components of the Proposed System

- (a) **A DIS Interface Server** will be installed in each WD to –
1. Provide an Intranet-based data entry system for WD users to input data.
 2. Accept data extracted from DIS. In case the DIS is only partially compliant to the Common Data Gateway, the data will be loaded into the manual data entry system for users to input the missing data.
 3. Transmit the data captured in each WD to the Common Data Gateway.

Data to be transferred between the DIS Interface Server and the Common Data Gateway can be kept secured using the standard Hyper Text Transmission Protocol over Secure Socket Layer (HTTPS) or Secured Socket Layer (SSL) protocol.

- (b) **The Common Data Gateway** will act as a central hub to capture data from the DISs via the DIS Interface Servers using Extensible Markup Language.
- (c) **The Extraction, Transformation and Loading (ETL) Server** will transform and load data from different data-sources to the Project Database and the Analysis Database.

Data received from DIS by Common Data Gateway will be firstly decoded and passed to the ETL Server. The data will then be cleaned, transformed and loaded by the ETL Server into the Project Database. WDs or Data Providers will enter supplementary data into the Project Database through the central manual data entry system

- (d) **The Database Server** will store the Project Database that contains up-to-date project, contract and finance data.
- (e) **The Analysis Server** can be built on top of a traditional Relational DataBase Management System engine coupled with an Online Analytical Processing service to provide a ready-to-use, multi-dimensional and analytical view of information.

To meet with the user requirements, the size of the Analysis Database is expected to be large. Therefore, the Analysis Server should support

multiple Central Processing Units and have fast input/output (I/O) paths. The storage system connected to the Analysis Server should provide superior I/O performance, fast I/O path and large storage capacity.

It is suggested that the Analysis Server can form a cluster pair with the Database Server so that they co-backup with each other. If one of these servers fails, the remaining one can take over the failed services to continue service. This arrangement will provide better value on investment.

- (f) **The Web Application Server** will implement the application logic.
- (g) **The Web Server** will perform as a proxy server to access the Web Application Server on behalf of the users.

As restricted information will be transmitted, data encryption will be required for communication sessions between browsers and web servers. The web server software must support HTTPS, SSL and X.509 v3 e-certificate.

- (h) **The Project File Repository Server** will provide a centralised storage for Gantt charts captured from WDs and Data Providers.
- (i) **The Virus Scanning Server** will scan the files uploaded by users before the files are stored in the system.
- (j) **The Query and Reporting Server** will support standard reports and creation of ad hoc queries or reports including building analytical cubes from the data retrieved, generating reports and distributing reports.
- (k) **The E-mail Server** will receive e-mail messages generated by the Web Application Server and the Common Data Gateway with Simple Mail Transfer Protocol (SMTP). The SMTP messages will then be converted to Notes messages and sent to the intended users via existing Government Office Automation Lotus Notes Server.
- (l) **The Storage Area Network**, which is a specialised, high-speed network attaching storage device to cater for the large amount of data to be handled by the Analysis Database can be considered. Efficient I/O interface technology and data storage technology will be required for data processing and data backup.

**Breakdown of Non-recurrent Cost and Recurrent Cost of
the implementation of the PWPIS
for the Environment, Transport and Works Bureau**

A. Non-recurrent Cost

		\$'000
(a)	Hardware	4,834
(b)	System Software	2,348
(c)	Package Software	4,610
(d)	Hardware Relocation	299
(e)	Departmental Information System Enhancement	493
(f)	Project Management Office	3,589
(g)	System Implementation Service	5,544
(h)	Data Conversion	1,106
(i)	Site Preparation	1,177
(j)	Communication Lines	237
(k)	Computer Operation	61
(l)	Consumables	363
(m)	Training	1,050
(n)	Security Audit	441
	Sub-total	26,152
<u>Add</u>	10% contingency	2,615
	Total	28,767

B. Recurrent Cost

	Year 1	Year 2 onwards
	\$'000	\$'000
(a) Hardware		702
(b) System Software		364
(c) Package Annual License Fee		1,383
(d) System Maintenance and Support Service	856	2,054
(e) Communication Lines	205	492
(f) Computer Operation	302	725
(g) Consumables		66
(h) Training		105
(i) Security Audit		56
Total	1,363	5,947

**Summary of Savings Expected from
the Implementation of the PWPIS
for the Environment, Transport and Works Bureau
(from 2005-06 onwards)**

Department/Bureau	Notional Savings					Realisable Savings
	Annual Staff Effort Saved			Accommodation	Sub-total	
	No. of Man-years	Rank of Staff Involved (Note 1)	Staff Cost Saving			
			\$'000	\$'000	\$'000	\$'000
Department						
Architectural Services	0.67	E, SSO, TO	676	29	705	
Civil Engineering	0.42	E, TO	496	20	516	
Drainage Services	0.42	E	567	37	604	
Highways	1.22	E, AE	1,019	28	1,047	
Territory Development	1.46	CE, E, AOII, TO	1,273	170	1,443	
Water Supplies	0.79	E, STO, TO	936	33	969	
Sub-total	4.98		4,967	317	5,284	
ETWB						
Staff Effort	1.00	SE	1,762			1,762
Accommodation				154	154	
Hardware and Network Equipment Maintenance						2,094
Application and System Software Maintenance						2,923
Hired Services (NMMS/OFTA) (Note 2)						1,280
Data Lines						2,181
Sub-total				154	154	10,240
ITSD						
Staff Effort	0.5	API	384		384	
Sub-total	0.5		384		384	
TOTAL ANNUAL SAVINGS					5,822	10,240

Note 1

CE	Chief Engineer	E	Engineer	AE	Assistant Engineer
SSO	Senior Survey Officer	STO	Senior Technical Officer	API	Analyst Programmer I
AOII	Accounting Officer II			TO	Technical Officer

Note 2

NMMS	- Network Management and Monitoring System
OFTA	- Office of the Telecommunications Authority

**Cost and Benefit Analysis of
the Implementation of the PWPIS
for the Environment, Transport and Works Bureau
(at October 2002 price level)**

	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10
	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000
Cost							
Non-recurrent Expenditure	4.846	23.921	0	0	0	0	0
Recurrent Expenditure	0	1.363	5.947	5.947	5.947	5.947	5.947
Total Cost	4.846	25.284	5.947	5.947	5.947	5.947	5.947
Savings							
Realisable Savings	0	4.267	10.240	10.240	10.240	10.240	10.240
Notional Savings	0	2.426	5.822	5.822	5.822	5.822	5.822
Total Savings	0	6.693	16.062	16.062	16.062	16.062	16.062
Net Savings	(4.846)	(18.591)	10.115	10.115	10.115	10.115	10.115
Net Cumulative Savings	(4.846)	(23.437)	(13.322)	(3.207)	6.908	17.023	27.138