

New Solution for ICT/ELV Infrastructure Project Reporting Using Datalink Technique System

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Abstract—In infrastructure project, a failure on reliable project reporting will lead to Variation Order (VO) and Project Delay issues. It is now a normal phenomenon, which leads to many negative effects such as lawsuits, claims, loss of productivity and revenue, which may also lead to contract termination. Hence, the research aims to develop a new solution system program, called Datalink Technique System (DTS) to solve the problems that occur in an infrastructure project. The objective is to eliminate the loss and reduce the project cost. However, it is not limited to that as in future it can also be applied to others. DTS introduces the new advanced technologies system solution and reliable, yet it is still consistent with the current approach to manage the project. The program produces data/information correctly and precisely.

Index Terms— Datalink Technique System (DTS); Section Link Page Program (SLPP); Tabulation Detailed Project Reporting (TDPR); Variation Order (VO); Very Early System Program Alarm (VESPA).

I. INTRODUCTION

Variation Order (VO) issues, overrun budgets, and project delays are the leading causes of project loss. These are considered as a part of the major issues [1] that still persist in construction work today.

The existing method in Infrastructure Project is the 'Design and Built' concept. Currently a limited amount of information, data and unreliable project reports are frequently sent to project owners due to the ineffective methods used. These lead to project delays and VO issues [2], which unnecessarily cause inflation to project cost.

In other studies, Mokhtar et al. [3] identified that the most important methods to control variation order. Among them are clarity of variation order procedures in construction stage, which are an integral part of effective management of variation orders, the use of project scheduling/management techniques in the construction stage, and the utilization of work breakdown of the structure.

The most important method to control the VO is the clarity of its procedures in the construction stage. The clarity would help in reducing the processing time and other mishandling issues. A well-defined scope can assist the professional team in recognizing and planning, identifying variation logic and justification for implementation, identifying the involvement of the owner during the construction phase, valuing indirect effects essential to be acknowledged, and finally having the knowledge-base of previous similar projects.

In this research, a real simulation system solution in the Infrastructure Project industry is introduced. This new

system is called the Datalink Technique System (DTS) that aims to solve these problems, especially in Malaysia. It is consistent with the current approach in managing projects. The information will be managed and the project performance will be improved, especially in avoiding project loss.

The development of the system program focuses on the solution to eliminate the issues such as VO and project delay, mainly for but not limited to ELV & ICT, as it can also be applied on Building Structure, M&E, Project Maintenance, etc in the future.

The DTS consists of three main component system programs, which are the Section Link Page Program (SLPP), the Very Early System Program Alarm (VESPA), and the Tabulation Detailed Project Reporting (TDPR).

SLPP is a program that helps users to access all the documents needed in their project. These documents can be accessed from many different places and all of them are linked with each other. The system is developed entirely in Visual Basic Programming (VB) using Microsoft Excel Program. The system will be managed by the end user after it is completely developed according to their specifications. There will be no additional software or application required. The user is only required to run it on any computer machine with Microsoft Excel Program installed.

VESPA system is a program that helps identify project delays at the early stage. The program presents the project with accurate floor plan drawings, while significantly provide important information on the project progress such as the status of progress (Normal, Delay, and Critical) and the update of the percentage report. This information helps the project team or project owner to take early action before the problems reported reach a critical stage.

TDPR system program, is a systematic computerized system for project reporting. It uses Microsoft Excel formulas and tables to generate systematic calculation with unlimited data input. Due to its ease of use, it can be managed by any user using Microsoft Excel program. The main function of this system is to produce reliable and accurate project reports.

II. RESEARCH METHODOLOGY

The format structure for the system program was designed based on the projects that were supervised, where the result is carried out on real life scenarios, namely three Infrastructure Projects which are the *Politeknik Muadzam Shah Pahang* Project, Penang International Airport Infrastructure Project (PIA), and IPD PDRM Kuala Lumpur Infrastructure Project. The categories involved in this

project are: Completed project (Politeknik Muadzam Shah and PIA) and Ongoing project (IPD PDRM Kuala Lumpur).

The studies began with a comprehensive problem issue on VO and delay factor phenomena. The problem and the main factor issue are highlighted based on the actual problems happened in the projects. A pilot study was initially conducted on a project reporting program called TDPR, which is part of a new development project solution system. The pilot study was implemented in Penang International Airport (PIA) which has utilized this system with great success. The pilot study was aimed to test the reliability of the project reporting module and it has indicated that the output was appropriate and reliable on the actual project.

A. Project VO issue

The prolonged issues that still exist until now in the Infrastructure Project are called VO, a popular term used by the project team, and it is considered as a serious issue in almost every project. There are five major parts in every Infrastructure Project, which are Architectures, Building & Civil Structure, M&E, ELV & ICT. Each of these parts face the same issues for a long period of time; hence, money and effort are needed to solve these problems. This is mainly due the limitation of data and information provided.

The information provided is always misleading and contradicts with the actual design during the work progress of the project. This happens due to lack of communication, lack of coordination project design, incompetent employees, and the most commonly reason is the failure to follow the technical specification requirement during the tender and design stage, and as well as toward the end of the project. Infrastructure Project is involved with a lot of parties, authorities, huge materials, long period of time, project finance, and project claim. More importantly, they are related and connected to each others. Dealing and managing a lot of data and dealing with a few hundred thousands of items within the data sometimes will cost millions of Ringgit. Therefore, the data and information need to be centralized and controlled. The VO issue is highlighted because it will trigger the second issue, which is the Project Delay.

B. Project Delay issue

Project delay is one of the most famous issue in nearly every infrastructure project. Table 1 presents a project profile with a series of completed projects affected by the project delay.

Table 1
Project Profile Successfully Completed

Project Description	
1	Politeknik Muadzam Shah, Pahang
2	Penang International Airport (PIA)
3	Perbadanan National Berhad (PNB)
4	Gerbang Selatan Bersepadu Project
5	Suruhanjaya Syarikat Malaysia (SSM)
6	Jabatan Imigresen Malaysia
7	Universiti Pendidikan Sultan Idris (UPSI) Project
8	PNB Hotel Perdana Kota Bahru
9	Institut Jantung Negara (IJN)

Table 2 shows the project profile of the ongoing projects affected by project delays, with some of them expected to be completed by the end of 2017. Two of these projects are under Extension Over Time (EOT#1).

Table 2
Project Profile for ongoing project

Project Description
1. Kastam Diraja Malaysia New ELV/ICT Project for <i>Ibu Pejabat Diraja Kastam</i> , Kota Kinabalu, Sabah
2. Polis DiRaja Malaysia – PDRM New ELV/ICT Project for <i>Ibu Pejabat Polis</i> (IPD), Kuala Lumpur
3. JKR Workshop New ICT Project for Proposed Re-Development of <i>JKR Wilayah Persekutuan</i> Workshop, Jalan Chan Sow Lin.
4. Bahagian Hal Ehwal Undang-Undang, Jabatan Perdana Menteri New ELV/ICT Project Proposed for Development of <i>Kompleks Mahkamah Baru</i> Kota Kinabalu, Sabah

C. Project Reporting Issue

Another major issue in a construction project is the failure to produce reliable project reports. Producing reliable project reports is important because it defines the integrity of the project payment for the Work Progress Claim. The current practice used to produce and present the project report is inappropriate. Most project reports presented are not systematic and sometimes misleading. The report produced for actual work completed is not accurate and not precise because in the normal practice, the report is based on the actual work done at the site and is not really based on systematic calculation.

III. FINDING

A. VO Issue

The findings are illustrated in Table 3, Table 4 and Table 5. The three scenarios that show the project completion, where two of them (Table 3 and 4) had VO issues. The third table (Table 5) shows the ongoing project, which also faced VO issues.

Table 3 below shows the VO factor that leads to the additional cost for the *Politeknik Muadzam Shah*, Pahang project. The total VO cost for this project was 9.8% from the ICT/ELV total amount project.

Table 4 shows the main factor that caused the VO issues for Penang International Airport (PIA) Project The additional cost to recover from the VO issues almost reached 30% from the original amount of the contract project. A lot of areas were not properly designed at the early design stage and the discrepancies of an item between drawing and actual work at the project site. The main reasons that caused these problems are due to inadequate information and lack of coordination during the project design.

Table 5 lists the main factors that cause VO issues for an ongoing project in IPD-PDRM Kuala Lumpur, which is expected to end by 2017. The VO issues for the project delivery are due to the lack of information. This misleads and contradicts with the actual design during the work progress of the project. It happened mainly due to the failure of the project to follow the technical specification

requirement during the tender and design stage.

IV. RESEARCH SOLUTION

Table 3
Main factor that causes VO for Politeknik Muadzam Shah, Pahang project

N0.	VO Factor:	Lead to VO Cost (YES/NO)
1	Mistakes and discrepancies in design document	Yes
2	Incompetent or unskilled engineer	Yes
3	Poor Communication and coordination	Yes
4	Unclear details in drawing	Yes
5	Conflicts between consultant, contractor, and project owner	Yes
6	Inadequate details in drawing	Yes
7	Insufficient data information before design	Yes
8	Inadequate experience of consultant	Yes
9	Conflicts between consultant and design engineer	Yes
10	Conflicts between consultant and owner	Yes

Table 4
The main factors that lead to VO cost for Penang International Airport (PIA) project

N0.	VO Factor:	Lead to VO Cost (YES/NO)
1	Mistakes and discrepancies in design document	Yes
2	Poor Communication and coordination	Yes
3	Unclear details information	Yes
4	Conflicts between consultant, contractor, and project owner	Yes
5	Inadequate information before design Tender Project Requirement	Yes
6	Insufficient data information before design	Yes
7	Inadequate experience of project engineer	Yes
8	Conflicts between consultant and design engineer	Yes
9	Conflicts between consultant and owner	Yes

Table 5
VO main factor for IPD PDRM Kuala Lumpur

N0.	VO Factor:	Lead to VO Cost (YES/NO)
1	Poor Communication and coordination	Yes
2	Unclear details in project system requirement	Yes
3	Conflicts between consultant, contractor, and project owner	Yes
4	Inadequate information before design Tender Project Requirement	Yes
5	Insufficient data information before design	Yes
6	Inadequate experience of consultant	Yes

Pertaining to all these issues, problems such as inadequate information, lack of coordination project design, incompetent employees, and non-compliance with the technical requirement can be controlled and solved by using this proposed solution model -DTS. Based on the conventional method, the report is updated and presented manually and it relies on one program called Critical Path Method (CPM) [4]. This method is no longer appropriate by modern standards and needs to be computerized and centralized for all programs and project information.

The overall process of interconnection data is shown in Figure 1.

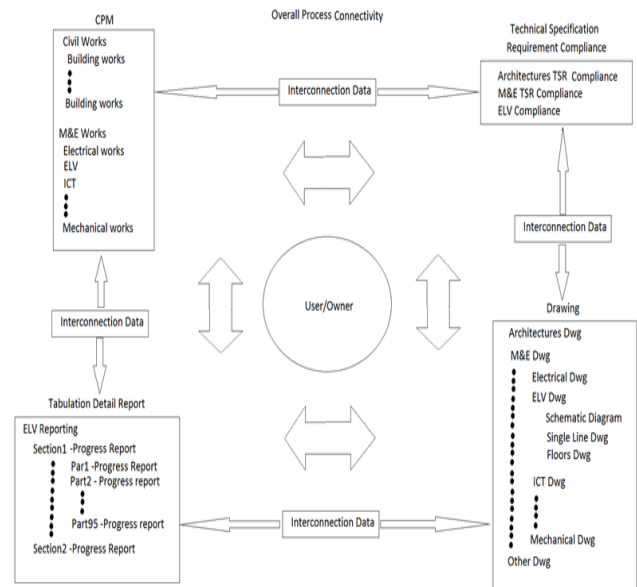


Figure 1: Overall Process of Interconnection Data

With the existing method of Design and Built concept for the Infrastructure Project, the project owner always has limited amount of information, insufficient data and unreliable reporting due to the improper system of project management. It always ends up with the project delay and VO issues. DTS will help to eliminate and reduce future losses in these projects.

Figure 2 and Figure 3 show the differences between the conventional method process and the new technologies system.

Existing Methodologies -> Design & Built Concept

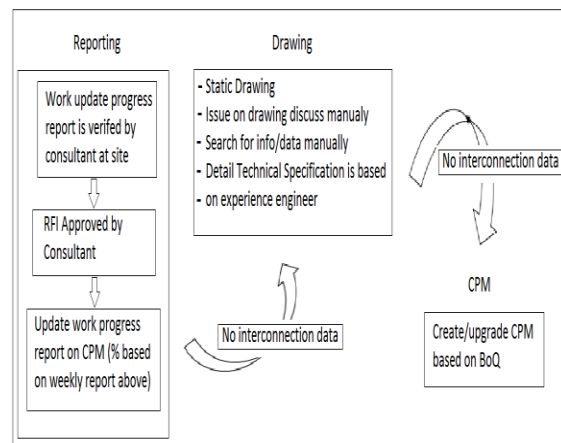


Figure 2: Conventional Method

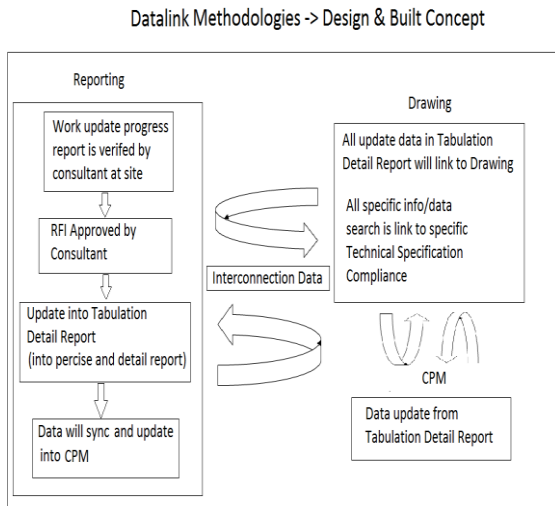


Figure 3: New Design & Built Concept

V. IMPLEMENTATION PROCESS

A. Detail process in DTS

The method proposed in this research aims to reduce the problem by introducing the concept of how the project team and consultant should work with some procedures and techniques. These procedures can gain good solutions, but it is just a theoretical concept based on work experiences [5] and it does not solve the issues presented. While dealing with the large-size data/information and a larger amount of project size, quantity unit for material/equipment, project team members, and amount of project financial cost, the procedures and techniques tend to fail in solving the prominent issues that lead to the increase in the project cost. Therefore, the idea of developing a systematic computerized program is introduced. This system program DTS can work with the computing complexity and provides unlimited and precise data/information for the project team. It also uses interconnection data with a different multi-category section in the department into one process; hence, providing data immediately after it is updated and able to cross-check information to maintain the integrity of the project.

The diagram for the DTS process from the top to the end level is shown in Figure 4.

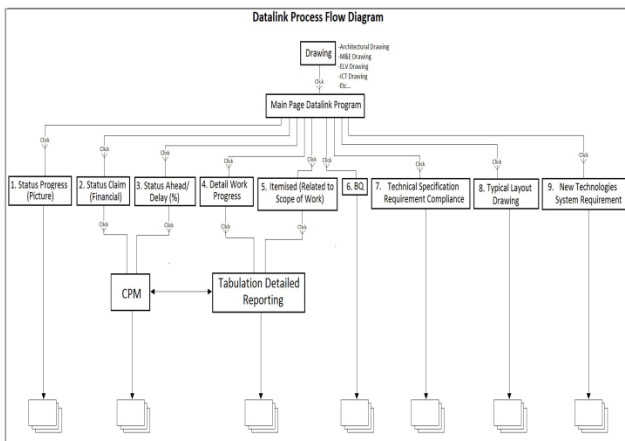


Figure 4: Diagram of the whole process

There are three main elements needed for the solution method to be processed inside the DTS. Starting from the SLPP (Section Link Page Program), for all updated

information to be linked together and correlate with VESPA program (Very Early System Program Alarm) and an update status work progress report using TDPR program (Tabulation Detailed Project Reporting) for the purpose of filing a Work Progress Claim Report.

a) SLPP (Section Link Page Program)

SLPP is built with Visual Basic Programming (VB) and can be accessed with Microsoft Excel because it is easy to use and can be easily found in most computers. Most of the targeted end-users in these industries (Project Infrastructure) do not have IT background. The development of SLPP aims to overcome this so that every one of our users can work on their own computer to update the data for the project without any additional tools or software in it.

In VBA, it can use all Excel worksheet functions. Many functions are defined in Excel as well as in VBA and can be used without additional keywords. Figure 5 shows the application (Microsoft Visual Basic) used in the SLPP Program.

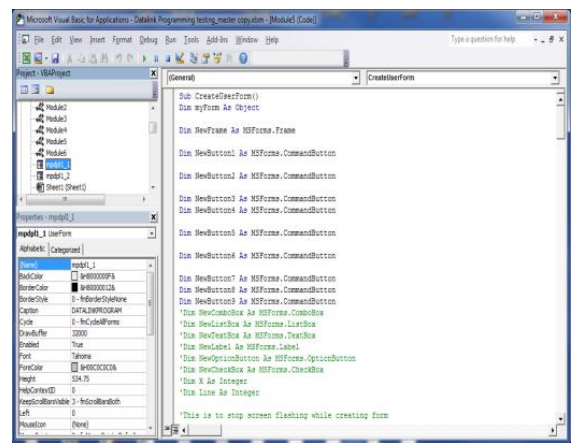


Figure 5: Microsoft Excel Visual Basic Application used in the SLPP Program

• UserForm Frame Object

The SLPP implementation structure process begins with the creation of an object frame called UserForm. A UserForm is a custom-built dialogue box that is built using the Visual Basic Editor. This object is supported by any Microsoft Office program that supports Visual Basic Application.

• Module

In a Module, the command button object acts as a link interface between the program and the specific file document in the folder or the subfolder.

• Multiple-layer UserForm Object

A source code to automatize multiple-layers of UserForm Object is developed. This programming technique is used to create a multiple-layers of UserForm objects by clicking the command button.

The user needs to identify the total number of the section in each floor. For example, after the user has confirmed the total section in Level 1 is 23 unit, the next step is the user needs to click the command button 23 times in order to get all the 23 sets of SLPP program in Level 1.

- **Hyperlink role in SLPP**

Another main part of interconnection process in SLPP program is the hyperlink technique function. It is applied into a command button object in the Module to make the connection between the program and the file document folders. All the documents, graphics, drawing, files, etc. are linked together using a hyperlink. This function is important because it helps the program to access the data/information across the live network in a different location.

Every folder or subfolder is attached with hyperlinks, each linking and sending related data/information or picture/file. By clicking the hyperlink, the user commands it to load the target page, ideally within seconds [6].

The SLPP program that has been completely developed based on the source code is shown in Figure 6.

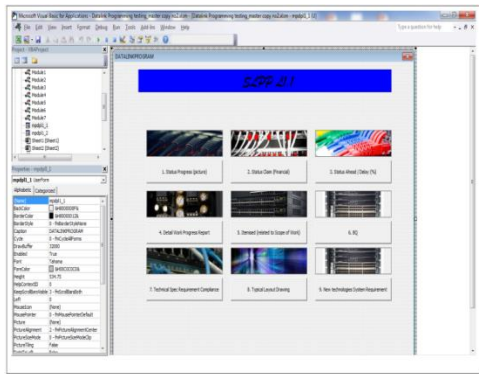


Figure 6: SLPP Program for L1.1 Link Section completely developed

b) **Very Early System Program Alarm (VESPA)**

A system has been developed to help solve the project delay issue in the infrastructure project at the early stages.

This is the core component of the whole process system development in DTS system program. The process will develop a new technique that creates project reporting status updated on very different style format on the infrastructure project drawing and the process has to be complex and unique. There are five main elements in VESPA Program that the project team/project owner can access through it or be alerted by the system. The five elements are:

- i. Alert Program (Normal/Delay/Critical) on Work Progress
- ii. Percentage (%) of Work Progress
- iii. Image/Picture reporting on Work Progress
- iv. Detail Typical Layout Design
- v. Technical Specification Requirement / Technical Specification Compliance

All the five main elements process above could be more, but it is up to the user's final customization on the design and the requirements of the specific project. The program aims to simplify the operation for its user. Detailed information of work status as per mentioned on the five elements above are all accessible with a few clicks from the user.

Next, the following is the process that takes part in the five elements:

- **Alert Program (Normal / Delay / Critical) on work progress**

In this system program, the floor plan is presented graphically together with the important and vital information

of the project status. These stages (Normal/Delay/Critical) of information prove to be very important for the project team and project owner to take an early action before the entire project falls into the delay stage. They can also prioritise which sections that should be focused.

For example in Figure 7, it shows the status of the Server Room (Red colour represents Critical Stages) is in 'Critical Stage'. In this case, project team or project owner can see clearly and take the necessary action immediately.



Figure 7: Drawing shows Server Room in red (critical stage) and percentage of work report

The project team or project owner will be notified or track the issue easily as the report is presented clearly in the form of image/picture format, which is not presented in the current practice.

- **Percentage (%) of work progress**

In this part, the project team/project owner can see or monitor the percentage of work progress accordingly. With a simple click on the image, the user is able to see the detailed percentage of work progress. For example, Figure 8 below shows the detailed percentage of work progress on the Fiber Optic Cable at that particular date and time.

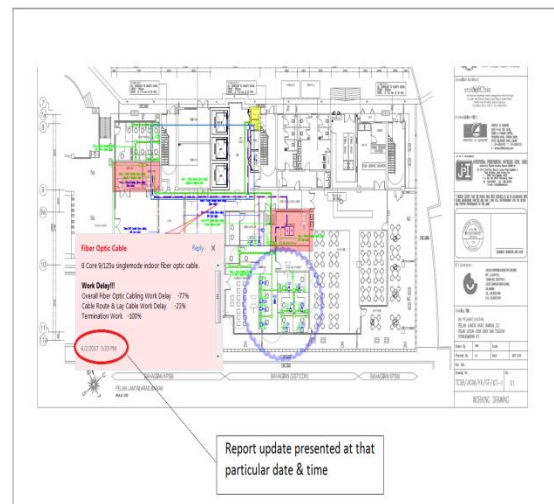


Figure 8: Drawing shows the percentage of Fiber Optic Cable work at that particular date and time

- *Image/Picture reporting on work progress*

The program presents a report on the percentage of work progress and the image/picture of work in progress. From the image presented, the images should tally with the percentage figure presented in the report.

- *Detail Typical Layout Design*

During the technical or coordination meeting in the project, the matters on technical specification design or detail typical layout of the design is required to be presented in the meeting. Meetings with the project owner require a lot of clarification or justification and issues need to be confirmed or referred to from the details of the design.

With the function provided in the new system, all the references from drawing can be accessed instantly. The user can just click on the drawing image for anything that needs to be referred on the detail drawing.

- *Technical Specification Requirement / Technical Specification Compliance*

The project team needs to be clear on the project scope requirement from the start until the end of the project. Otherwise, it will trigger a lot of issues during the completion of the project. In some cases, the need of statement for the compliance of technical specification in the project stated in the project tender is left out in the BoQ project or the work implemented at the project site does not comply accordingly with the technical specification requirement in the project need statement.

The functions available in the VESPA program model would be able to assist the project team to refer immediately to the project scope requirement. The beauty of the system is that it would provide the user with the information required on the spot during the discussion on any matter related to the project. The user can just click on the image and the information will be presented on the drawing.

c) *TDPR (Tabulation Detail Project Reporting)*

The program is specially designed to resolve issues on the contradiction between the claimed amount of work progress between the actual work done at the site and the payment made to the contractor. With the current practice, the method to update the work progress relies on CPM report. The percentage amount of figure of work done at the site reported in the CPM seem to be unreliable.

Therefore, TDPR system generates the report in great detail. TDPR cross-checks the values to prove that the percentage figure report generated at the end of each total column result is the same as the amount figure in CPM and Work Progress Claim. All the data are centralized and interconnected with each other. Furthermore, Microsoft Excel provides unlimited data to be accessed and it uses formulas to generate the systematic calculation in reporting. Figure 9 shows the process work flow between TDPR and CPM.

- *Pilot Study for Project Reporting*

DTS has been implemented as a Project Reporting (part of the new development project solution) system for the purpose of pilot study with the Penang International Airport (PIA), which turned out to be a successful result. This pilot study is to test the reliability of the Project Reporting development and it has indicated that the output results were appropriate and reliable on the actual project. Subsequently,

the data was accurate and detailed. In fact, for the actual Project Work Progress Claim, it was implemented in this system for the Penang International Airport (PIA).

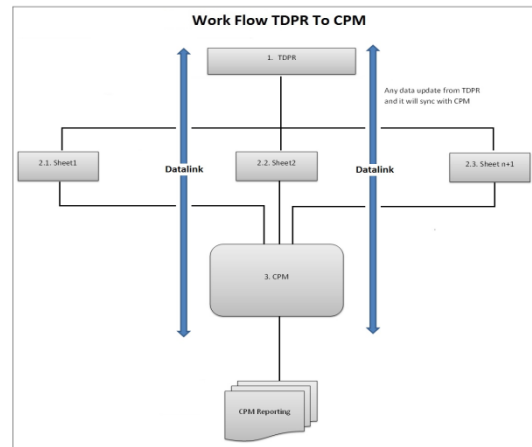


Figure 9: Process work flow between TDPR and CPM

VI. CONCLUSION

This research has successfully achieved its aim to implement a new advanced technology solution that transforms the conventional method of project reporting method to a computerized system. The entire process tool design has addressed the flaws in the conventional process methods. It has proved that the system with unlimited data and the accurate figure will contribute to the systematic calculation of reliable project reporting method. Infrastructure drawing is computerized and it is linked to the whole centralized process. Most importantly, it helps to avoid unforeseen information and hidden cost. Nevertheless, it achieves the objective of eliminating the project delay and save the project from any hidden costs.

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