RESEARCH AND DEVELOPMENT OF
PROGRAM MANAGEMENT SUPPORTING SYSTEM

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Abstract

Program management is a concept to deal with huge and complex business activities from social, economical, cultural and environmental points of view and increase their value for client and society. The aim of this study is to establish a framework of program management process and develop a supporting system for program management. In this paper we propose a framework and a proto type supporting system based on case studies and report the result of application to an urban redevelopment using partially implemented software.

1. Introduction

1.1 Background

Recent years in Japan and overseas we have seen huge increase of mega projects with complex nature such as urban development, resort villas, airport construction, construction of high-speed railways or motorway rearrangements. As the economical and social environment has become more global, diversified and complex, traditional project management method is not powerful enough and might neglect critical factors or be too inflexible to respond to changes in situations and the values in society, and then they might cause problems like environmental problems, public protest movements, project's added value decreases, or cost increases. Particularly large, complex, and long-term projects (hereafter we call programs) could be susceptible to these problems. To solve these problems, project managers should broaden their perspectives not only from a technical viewpoint but also from social, economical, cultural, and environmental viewpoints. It is also essential to identify the problems to be solved, the value of business activities, and the problem structure involving latent obstacle factors and stakeholders, and to organize the relevant information. Therefore it is important to develop an integrated concept and methodology for these activities. 'Program management' is an example of such concept and methodology, which is increasingly used in UK, USA and other countries. In our initial survey we found out that there is no or little management theory or management tool for programs in comparison with projects. Therefore we carried out a series of basic survey on actual cases of programs

in UK, USA and Australia and extracted major attributes of programs and their management process. Then we developed a proto-type supporting system for program management which includes Business Environment Analysis and Goal setting, Business Value Analysis, General Process Description, Stakeholders Analysis and Risk Table. We will report the results of this preliminary study. [1]

1.2 Study purpose

The aim of the study is to develop a supporting system for program management. This study will identify essential activities in the program management and establish functions to support these activities. For example, in the program-planning phase, a program could be broken down into executable projects by mobilizing expertise, structuring problems, setting goals, eliciting risks at an early stage. In the program execution phase, the supporting system could help understanding of execution situations and internal/external environmental changes, and flexible feedback about them.
The system will allow complicated business activities to be planned and executed flexibly and efficiently. As the result business values will be increased, business activities will be harmonized with social activities and stress on the environment will be reduced.

2. Case study of program management

Program is a group of projects managed in a coordinated way to obtain benefits not available from managing them individually. The basic theory of program management has been developed and applied mainly in the U.K., U.S.A and Australia. In order to find out the current status of program management theory and application we visited and interviewed a couple of universities and several leading engineering firms and consulting firms in these countries including construction sites.
The results are shown in Table 2.1. We found out that these organizations recognize the importance and future potential of program management but there is no or very little research and development is being done about program management theory and tools. They apply project management techniques to these programs.
The program management has been applied to large-scale, complex projects involving many stakeholders, such as transportation network and airport construction, urban redevelopment, and simultaneous multi-store development, although it is not established as a management technique. As the main reason of the increase of programs they pointed out that diversification and rapid change of social environment and value system, rapid change of clients' needs, increase of size and complexity of projects, increase of clients' responsibility and diversified project formation. We found out that major attributes of program are high uncertainty without defined route to goal, huge and complex, to create added value to society and clients, to include capital investment, to include multiple projects related each other, relatively long term and with various stakeholders. Program management seems to enhance the flexibility and the efficiency of business execution by decomposing complicated business activities into multiple projects and placing them under integrated and coordinated management.

Table 2.1 Outline results of case study

Type	Country	Interviewee	Results	Cases
Univ. A	USA	Prof.	Develop models including organization, process & products Very few study on program management theory	-----
Univ. B	UK	Prof.	Program has two categories: lifecycle type and portfolio type	-----
Univ. C	Aus.	Prof	Program is huge and complex in its nature There are no established method or tools for PGM	------
Eng. Firm D	USA	SE	PGM means long term alliance with clients Management of multiple projects PJT support with knowledge system	Overseas Development
Eng. Firm E	USA	PM, SE	Support system for project basis Training system for program managers	Multi PJT & Mega PJT
Eng. Firm F	USA	PD	Well established training system for project and program managers Key elements of PGM are cost, magnitude, complexity and planning	Freeway network
Eng. Firm G	UK	D, PM	Business value and risks are important Challenging part is initial phases of PGM	Multi PJT & Mega PJT
Eng. Firm H	Aus.	PD	Teams exist specialized in huge projects (urban dev. or airports) Manage these projects with project management tools	Urban Dev. Airport
Consult-ing Firm J	UK	Partner	PGM means complex and multiple projects, multiple stakeholders, limited period and added value for clients in its nature Market is expanding Core parts of PGM (egg. Boundary definition, Clarification of goal, system integration) have R&D potential	Airport, Resort Villages, Chemical plants

Note   SE: Systems engineer, PM: Program manager, PD: Program director, D: Director,
        PGM: Program Management, PJT: Project

At the same time our findings included that recently a few practical examples of program management were seen in new airport and rapid-transit railway construction in Korea. In Japan, there are of course many examples of the similar projects, but program management is not established as a business.

3. Program management process and major elements of program

At first we extracted attributes of programs from detailed study of aforementioned actual cases. Based on it, we identified core processes of program management and major management elements, and with all these factors in view, proposed a framework for program management as a management method. We examined the management process in relation to the aforementioned major attributes of program based on the results of the case study and a literature survey [2] and determined six major elements of program Business environments, Business goal, Business value, Decomposition of program into multiple projects (project portfolio) and their management, Stakeholder and Risk. Figure 3.1 shows the results and can be used as a framework for program management.

Business Process & mgmt elements / Attributes of Program	Major Business Process			Management Elements	
	Conceptual	Planning	Execution	Program	Project
Not to be solved simply as technical matter and needs social, economical and environmental attention	Confirm Business Idea; Analyze Business environment	Analyze Business environment (detail)	Monitor Business Environment	Business Environment	
To be ambiguous and with high uncertainty which needs definition of boundary conditions	Clarify Goal; Produce Concept	<Support Concept Creation>		Business Goal	
To be Huge and Complex	Strategy	Produce Execution Plan		(Strategy)	
To produce added value to social and clients	Value	Business Value (Qualitative, Quantitative) <Evaluate business>	Monitor Business Value	Business Value	QCDSE
To be capital investments	Financial Balance	<Produce business plan>	Monitor Profit & Loss	(Financial Balance)	Financial Balance of individual PJTs
To include multiple projects which are related each other		Decompose to executable projects <Propose alternatives>	Manage Multiple Projects	Project Portfolio (Decompose to multiple projects and integral mgmt)	Management of individual PJTs
To deal with various stakeholders		Identify, analyze and prepare measures for stakehold <Consensus building>	Monitor Stakeholders	Stakeholders (Communication)	Stakeholders
To be relatively long term and with uncertainty	Risk	Identify, analyze and prepare measures for risks	Monitor Risks	Risks	Risks
To be limited period and very few repetitive nature		History Management	History Management	History Management (Cases DB)	Cases DB

Fig. 3.1 Properties of Program, its Major Management Process and Elements

Broadly speaking, program management consists of two phases: first-half program formulation phase and second-half program execution phase. Business activities to be performed in accordance with a program are divided into several associated projects, and performed by controlling projects systematically. Of activities to be performed in accordance with program, those in the first-half program formulation phase are important. Among them, program-planning phase seems to be a particularly important, interesting and challenging process to deal with. In program execution phase, progresses of projects and program as well as changes in business environments are monitored, and program is reviewed, thereby maintaining and improving business values toward an original goal. Based on this framework, we developed a supporting system of program management.
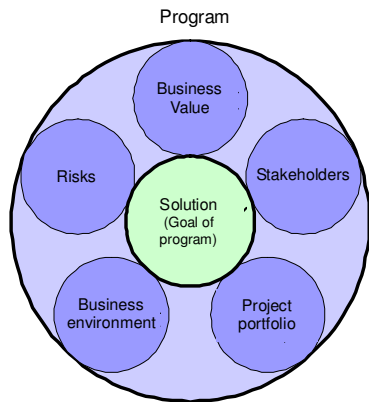

Figure 3.2 Major elements of program

4. Basic concepts of supporting system for program management

This chapter discusses the basic concepts of Program Management Support System (PMSS) and proposes the basic architecture of PMSS, focusing on the planning phase of the program management. We set the following basic concepts of PMSS.

(1) PMSS supports the program-planning phase. As the first step, we set the main objective of PMSS to support a managing team for explicitly and structurally

describing and understanding overviews of target programs by focusing on the aforementioned six key elements, which are the most important factors in program management.

(2) Six key elements include business goal, business value, business environments, project portfolio, risks and stakeholders. We here propose a method for representing and structurally organizing these elements by drawing the following four charts (see Figure 4.1 & Table 4.1).

BV-Chart

TR-Chart

GP-Chart

SH-Chart
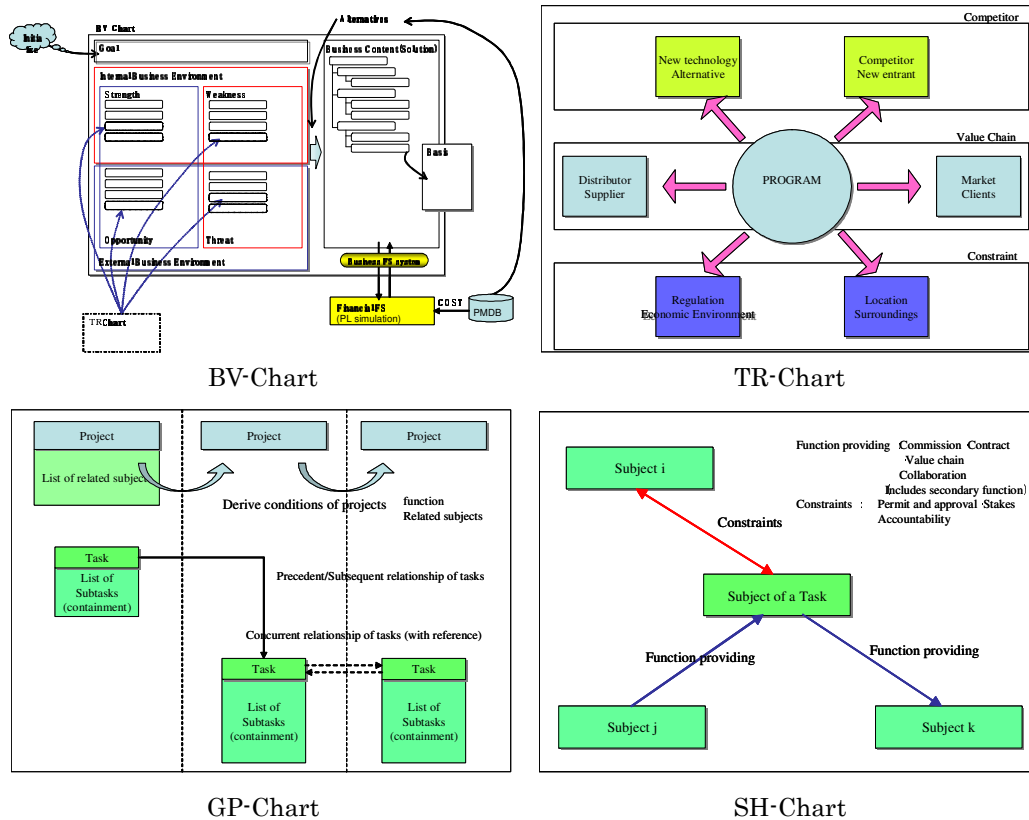
Figure 4.1 Functional Charts for Program Management

- TR Chart: Represents external business environments of a target program and related various stakeholders within a framework of value chain, competitors and constraints. By describing risks with subjects it becomes possible to find out latent stakeholders and risks.

- GP Chart: Represents group of executable projects decomposed from program and tasks indispensable for achieving the mission of the program. Subject, activity, input & output, necessary resources, period, cost and related risks are described with tasks. At the time of description of tasks new projects can be generated. Projects are expressed in the vertical columns.

- SH Chart: Represents relationship among stakeholders. Relationship can be expressed as function providing (collaboration) relations or constraints

(conflicting) relations. Related risks can be also described. This chart can be used for consensus building by sorting out the relationships of stakeholders.

- BV Chart: Represents the mission and goals of the program, criteria for quantitative and qualitative evaluation of the program, funding plan and so on. Business goal is described and analyzed with SWOT method. Further development of this chart is one of our future works

Table 4.1 Relationship between 6 key management elements and 4 charts

	Value	Solution	Business circumstance	Stakeholder	Risk	PPF
	Key program management elements					
TR-C		x	xx	x	x	
GP-C				x	x	xx
SH-C				xx	x	
BV-C	xx	xx	x	x	x	x

xx   The chart mainly represents that element
x   The chart represents that element
PPF   Project portfolio

(3) PMSS supports a managing team to execute the thinking cycle of idea generation, evaluation, finding out problems and generation of alternatives.

(4) Creating flexible plan of a program, PMSS supports to find out explicit and potential risks and to make program plans adaptive to these risks.
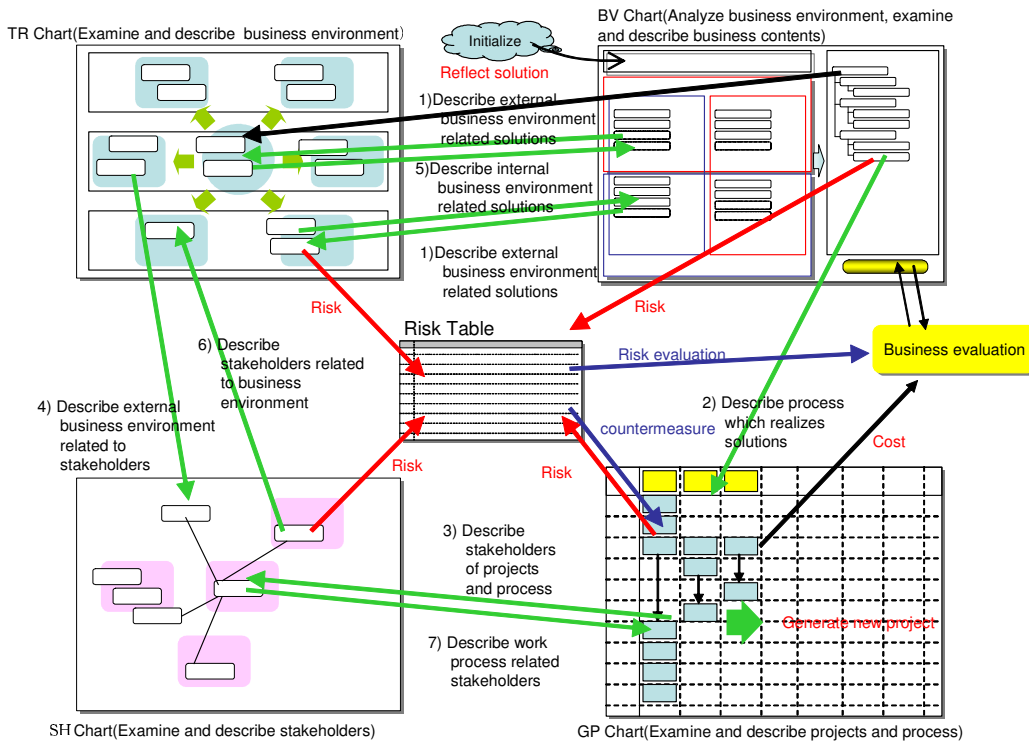
Figure 4.2 Functional Links between 4 Charts

(5) PMSS employs the idea of "Question Provider," which requests a user to add information by asking various questions.

(6) Figure 4.2 shows the relationship between four charts and procedure to use them. Once the initial solution (goal) is envisaged, program-planning phase starts by using

Figure 4.3 Architecture of ideal PMSS

Legend:
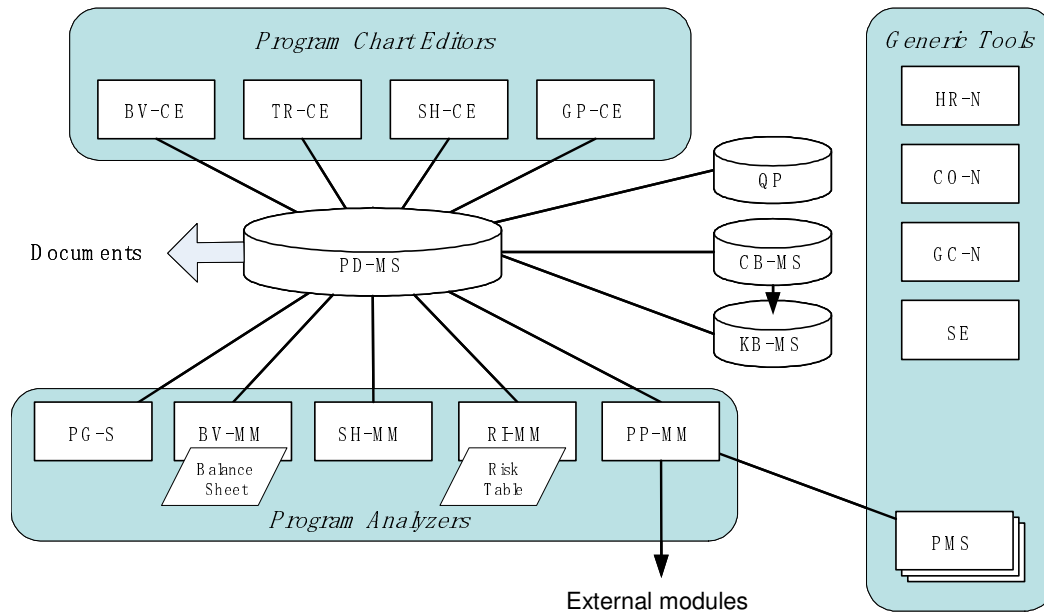
BV-CE: BV Chart Editor
BV-MM: Business Value Management System
CB-MS: Case Base Management System
CO-N: Collaboration Network
GC-N: Global Communication Network
GP-CE: GP Chart Editor
HR-N: Human Resource Network
KB-MS: Knowledge Base Management System
PD-MS: Program Data Management System

PG-S: Program Simulator
PMS: Project Management System
PP-MM: Project Portfolio Management System
QP: Question Provider
RI-MM: Risk Management System
SE: Search Engine
SH-CE: SH Chart Editor
SH-MM: Stakeholder Management System
TR-CE: TR Chart Editor

these four charts. Placing the business goal in the center of TR Chart business environments are examined. Related risks are extracted and conditions are identified to review business contents. In parallel business process is described as a group of projects in GP Chart. It is ideal if we could utilize one from the previously completed program. For project management generic project management software will be used as an external module. From TR and GP Chart related stakeholders are identified and described in SH Chart. At the same time latent stakeholders can be identified within SH Chart and these are reflected to TR and GP Chart as changes of contents. For instance when it becomes necessary that relationship between two subjects should be reinforced in SH Chart new project for this issue is created in GP Chart.

During four charts are described risks are also put together in the risk table. Once countermeasures for risks are identified these risks are reflected in GP chart as tasks. If risks are quantified this is reflected in business value evaluation. Related costs in GP Chart and case DB will be also reflected in the evaluation. Risk tables are not included in this figure.

Figure 4.3 shows the overall architecture of the PMSS when all the expected functions are realized. This architecture consists of data management system (PD-MS), editors of the four charts used for idea processing (Program Chart Editors), management modules that manages each kind of the six key management elements (Program Analyzers), and generic tools, such as search engine, communication support, and collaboration support. In this architecture, the thinking cycle in (3) will be supported as follows:

- Idea generation; supported by the Program Chart Editors that structurally organize the six management elements with the case bases, the knowledge bases, and the generic tools.
- Evaluation; Program Analyzers evaluates the four charts.
- Finding out problems: supported by using the evaluation results (especially, finding out potential risks) with the case bases, the knowledge bases, and the generic tools.
- Generation of alternatives; supported by the Program Chart Editors that structurally organize the six management elements with the case bases, the knowledge bases, and the generic tools.

By applying PMSS to program we aimed to achieve high flexibility in execution process and reduction of backward work, to secure the execution possibility by decomposition and sorting out of problems, to make easy to manage and evaluate and to increase achievability of goal.

We verified that all main activities of the program management described in Chapter 3 are supported by this architecture. Note that this architecture only represents the final image of the PMSS and, therefore, the prototype system to be described in Chapter 5 was implemented a part of the architecture; namely, TR-Chart, GP-Chart, and SH-Chart.

5. Partial implementation of prototype PMSS and test run

5.1 Specification of the Prototype

In the previous chapter, we discussed the issues to be handled for supporting program management process and proposed architecture of the prototype system that mainly supports program-planning process. Based on this architecture, we have developed the following prototype system, which supports to describe and utilize program information based on three charts.

In prototype PMSS, the user describes program information by using GP chart, TR chart, and SH charts. Relationships among these three charts are also stored in this system and the user can review the program from different aspects (e.g., task-oriented, stakeholder-oriented). In this system one of previously completed program cases can be used as a starting point in order to reduce the workload. By using this information, PMSS works as a "Question Provider" that supports to input information that is useful for process planning exhaustively. The user can also add risk information to these charts for evaluating a program from the viewpoint of risk management.

5.2 Implementation of prototype PMSS

Based on this understanding, we implemented the following three functions as prototype PMSS.
- Three chart (GP, TR and SH) generation

- Coordination among three charts
- Program review

Prototype PMSS consists of three windows; namely GP, TR, and SH charts. Prototype PMSS can save and restore program plan for further reuse. In these three charts, the user input information as nodes and links in each chart. The user also input information about the relationships between nodes in different charts. By using these relationships information, the system can identify related information in other charts for program review. For example, when the user selects a task node in GP chart, information node(s) that is (are) referred is highlighted in TR chart and stakeholders node(s) that is (are) related to the task are highlighted. Prototype PMSS can generate risk tables for risk management by collecting all risk information in three charts.

In addition, prototype PMSS supports to search nodes that satisfy the following conditions for program review.
- Search nodes by string:
  Prototype PMSS can search nodes whose name contain given string
- Search nodes by risk level:
  Prototype PMSS can search nodes whose risk level is high. For calculating risk level of each node, prototype PMSS add up all risk level of each risk node.

5.3 Test run of prototype PMSS

In order to verify the effectiveness of the system we carried out test run of prototype PMSS by using two actual cases; i.e., urban redevelopment and factory construction in overseas. Regarding TR Chart it is confirmed that business environment can be described properly. Small problem is that when describing the same phenomenon from different aspects the relation ship is not clearly defined. Regarding GP Chart it is relatively easy to describe projects by focusing the related stakeholders. The problem is that how the description level of the tasks in projects can be coordinated. Regarding SH Chart it is also relatively easy to describe stakeholders if a certain stage is assumed. It will be more effective if the changes of the relationship between stakeholders can be reflected in the other three charts. The problem is that description tends to subjective and more objective viewpoints from outside are necessary.

From these evaluation results, we confirmed our prototype system is effective for describing and reusing information related to the program plan process and is good for a fundamental foundation for implementing a program management support system that deal with whole program management process.

Followings are the issues to be solved for implementing the system.
- Reuse of case information:
  By using this prototype system, we can collect various case data with a lot of related information that are considered in a program management process. This type of information is a good feature for characterizing each program case and is useful for finding similar previous program cases.
- Linkage with other systems:
  There are varieties of systems that are useful for program management. For example, in order to support management in each project, it is desirable to integrate proprietary project management support tool such as MS Project. For evaluating the

program from the economical viewpoint, it is desirable to integrate financial analysis software that can evaluate quantitative value.

6. Conclusion and Future Issues

In this project, the "Program Management Support System" has been developed that can flexibly respond to changes of business environments which become more globalized, rapid changing and complicated.
As the result, the following development goal was achieved.

➢ With the research and survey of program management cases in UK, USA and Australia we have identified major attributes of program, management elements and core processes of program management, and proposed a framework for program management as a management method.

➢ Based on this framework, we proposed an architecture of an ideal Program Management Supporting System (PMSS), which consists of newly developed charts and tables.

➢ Especially focused on program planning phase, we defined the specifications of the prototype system and implemented it as prototype PMSS.

➢ In order to verify effectiveness of PMSS we carried out test run with two actual cases: Urban redevelopment and factory construction in overseas. We confirmed the prototype system has a capability to describe program information properly and is useful for understanding the relationship among them.

Future issues to be dealt with are:

➢ To implement whole PMSS system including Business Value evaluation tool (BV chart) and linking up with the existing general-purpose tools (MS-PROJECT etc.)

➢ To clarify the relationship between program management elements and structuralize these elements

➢ To do research and develop methodology to generate knowledge data base from case data base

➢ To expand PMSS to cover execution phases of program

➢ To expand the application to non construction related projects

Acknowledgements

References

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