



# Understanding bi-project management: engineering complex industrial construction projects

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## Abstract

Engineering large industrial construction projects is usually a complex task involving several co-operating actors. This paper investigates a specific type of such projects, labelled bi-project management. Bi-project management is characterised by two main actors, each of whom manage a part of the project: the owner of the installation (the client organisation) responsible for the engineering of the production process part, and an engineering office responsible for the construction related part. This paper describes and analyses what an engineering office can do to improve control of its part of the project, knowing that its part must be completed in advance; in addition, it is dependent on the client's part and must adapt to any changes the client may make. A framework for analysis and control has been developed, which distinguishes four areas. Two areas (key documents and basic interaction structure) are based on normal project control practices. The two remaining areas have been added to deal with the technological uncertainty and planning structure of the client organisation. The framework helps elucidate the specific nature of bi-project management. Effective bi-project management should not only apply normal project management practices, but also anticipate risks and postpone work to the last possible moment. A main topic for future research is to identify the underlying causes for uncertainty in these types of projects. © 2002 Elsevier Science Ltd and IPMA. All rights reserved.

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## 1. Introduction

Imagine that you, as an engineering office, are involved in building a food processing plant. Your responsibility is to design the construction of the building. Actual building of the plant will start in a few weeks' time and, thus, detailed design is almost completed. Then, the marketing department of the food processing plant signs a few large contracts in the Middle East. The products have to be produced on separate lines for religious purposes. The food processing plant supposes that you, as a well-known engineering office, will be able to handle this disturbance without extra charge and within the tight completion schedule of the whole factory. How should you deal with this situation? How can your knowledge of project management and control help you?

In the process of engineering a petrochemical plant, a similar problem emerges after the definition stage. While the detailed engineering of the construction—performed by the engineering office—is half completed, the people engineering the production process come up with the idea of having two chimneys instead of one, to make their process more efficient. What is the best thing to do, as an engineering office? What kind of planning and replanning is needed, or could you have predicted this kind of disturbance for your part of the project?

These are just two examples engineers reported to us while we studied project management in building or modifying plants for the petrochemical and nutrition industries. We found that the actors involved are faced with enormous challenges concerning the control of projects. Depending on the extent of the industrial construction project (modifying or building), the investments involved range from 2.5 million up to 60 million Euros. Even minor improvements in controlling these projects can have significant effects on the final investment. Industrial construction projects consist of two separate, strongly dependent sub-projects. One

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sub-project is concerned with the parts related to the production process, while the other sub-project is concerned with the construction. This construction sub-project is contracted out by the industrial client organisation to an engineering office. Usually, the process-related part is more complex and uncertain; the construction-related part starts later and has to be finished earlier. This combination of two distinct, but related complex projects of different durations, performed by two parties with a customer-supplier relationship, is specific to what we have labelled *bi-project management*. Relevant and specific questions are: how to co-ordinate the two parts of the project and how to deal with disturbances in one part of the project which influence the other part. So far, this type of project has not been dealt with explicitly in the literature.

### 1.1. *The special nature of bi-project management*

At first glance, bi-project management may be considered to be multi-project management. However, multi-project management deals with one organisation executing several projects simultaneously [1–3]. If we look at this type of project as a whole, it might be understood as a normal, large project. Large projects have been dealt with in textbooks [e.g. 4] and in more detail in Morris and Hough [5]. In general, suggested good practice is to make a proper work breakdown to divide the (large) project in independent sub-projects with clear milestones. In addition, sub-projects can be contracted to others, who are then responsible and accountable for that part of the project. In bi-project management, these practices are not entirely applicable. Firstly, the interdependence between both parts of a project is large. The construction part depends upon the decisions and progress made in the production process part. Secondly, the construction part has to be finished before the production process part. The building part usually takes up a large part of the total completion time and production process-related installations and machines can be placed only after completion of the building. Thirdly, unexpected changes can (and usually will) happen in the production-related part, and they influence the construction part. Construction projects have been dealt with in the literature, as well. Baccarini [6] states that they may be considered the most complex undertaking in any industry. In reviewing current knowledge, Low [7] states that ‘over a sustained period of time, the building industry has continuously strived for better methods of working to achieve time, cost and quality objectives’, a search which, as he states, ‘has led to promising results’. However, little attention has been paid to project-control-related problems in complex, multidisciplinary industrial construction, as dealt with in this article. Moreover, most attention in this field has been on overall project control.

### 1.2. *Motivation and aims of this study*

This article will study bi-project management from the viewpoint of the engineering office as the non-dominant partner. In other words, we will investigate how an engineering office can improve the management of its own part of the project under the specific circumstances we sketched and how it can improve its service to the client. There are several reasons for choosing this point of view. First of all, engineering offices struggle with the dilemma of how to offer their clients a high level of service, while at the same time improving the control of their own sub-project and as a result keeping the costs within budget. Moreover, we gathered from interviews with a large engineering office and a number of their clients that clients expect an engineering office to be able to react to changes in the production-process part, without charging all extra costs or losing too much time. Clients also expect guidance and support from the engineering office, because it has experience with other projects. Excellent communication and guidance can yield a competitive advantage, while communicating only via reports and formal meetings will be judged by clients as being poor service and quality. In order to offer the client the requested service and quality, the engineering offices should be willing and able to function almost as co-maker, assisting in finding ‘the best’ solutions at the lowest cost. The last reason for taking the engineering office’s perspective is that engineering the construction part of a project is a recurrent task for the engineering office (with recurrent problems), while for most client-organisations it is a unique experience.

The central aim of this article is to understand the nature of bi-project management and to present ways to improve the co-ordination between the two parts and thus the control of industrial construction projects. We restrict ourselves to engineering activities and development tasks, excluding the final physical realisation of the production plant.

The paper is organised into five main sections. First, the characteristics and problems of industrial construction projects will be considered in more detail. Second, attention will be drawn to normal control practices, as applied in current practice. Third, a framework is presented to describe and analyse the control in bi-project management, which results in a number of control mechanisms. Fourth, conclusions and management implications will be formulated, while the last section suggests topics for future research.

## 2. **Main characteristics and problems of bi-project management**

In our opinion, four characteristics distinguish bi-project management from other forms of project management.

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