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Readiness Assessment of the construction supply chain for concurrent engineering

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Abstract

There is growing interest in the adoption of concurrent engineering (CE) in the construction industry. While concurrent engineering (CE) is gaining acceptance, some implementation efforts have not realised their full potential for reducing costs, reducing time, and increasing efficiency, effectiveness and performance for product development efforts. This is due in part to insufficient planning to support the implementation. One approach that has been used successfully to improve CE implementation planning is to conduct 'readiness assessment' of an organisation and its supply chain participants prior to the introduction of CE. This helps to investigate the extent to which they are ready to adopt concurrent engineering practices. CE readiness assessment tools and models have been developed and used in other industries such as the manufacturing and software engineering industries. This paper discusses CE and its application to the construction, reviews and compares the existing tools and methods for CE readiness assessment, discusses supply chains generally and construction supply chain specifically, and stresses the need to assess the readiness of the construction supply chain for the adoption of CE. The paper also presents a new readiness assessment model for the construction industry supply chain, and gives examples of its use to assess construction organisations. © 2001 Published by Elsevier Science Ltd.

Keywords: Concurrent engineering; Readiness assessment; Supply chains; Supply chain management; Construction supply chain

1. Introduction

There is a growing awareness of the need for changes within the construction industry, in particular with regard to its current business processes. This is mainly as a result of the following:

1. The potential for dramatically decreasing construction costs through standardisation of construction processes (CIRIA Report, 1999);
2. The increasing demand and sophistication of clients (de Graaf and Sol, 1994);
3. The rising requirements for project functionality through growing competition;
4. The rapid developments in communication and information technologies; and
5. The recommendations in UK Government-initiated reports such as the Latham report (1994) and the Egan report (1998).

Many construction companies are responding to this increasing importance of project development processes by incorporating aspects of concurrent engineering (CE) practices to improve their project development capability (de Graaf and Sol, 1994). Simultaneously, construction companies are also trying to make their supply chain more effective, and more efficient. CE has the potential to make construction projects less fragmented, improve project quality, reduce project duration, and hence reduce total project cost, while creating more satisfied customers.

This paper argues that it is important to establish the readiness of the construction supply chain for the adoption of CE prior to its full implementation. It first discusses concurrent engineering and supply chains before arguing for CE readiness assessment of the construction supply chain.

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2. Concurrent engineering (CE)

Concurrent engineering, sometimes called simultaneous engineering, or parallel engineering has been defined in several ways by different authors. The most popular one is that by Winner et al. (1988), who state that concurrent engineering "is a systematic approach to the integrated, concurrent design of products and their related processes, including manufacture and support. This approach is intended to cause the developers, from the outset, to consider all elements of the product life cycle from conception through disposal, including quality, cost, schedule, and user requirements."

Two particular aspects are worthy of mention in relation to this definition: (a) constructability and (b) supply chain management.

Constructability: i.e. 'is the design appropriate for the requirements of construction?'. This implies:

- All processes must be capable (in statistical process control terms) under expected construction conditions.
- All processes must be available to the organisation when required (note that this does not require that the processes are all within the organisation itself).
- All processes must be economic (in the sense of being within stated cost parameters).

A project that satisfies these requirements is 'viable for construction'. But as the earlier arguments indicate, it is not enough for the organisation to ensure that it 'designs for constructability'. It must do this within the available market window and the budget constraints applying to that window. It is to ensure that this wider requirement is met that the philosophy of concurrent engineering is being adopted in the construction industry.

Supply chain management (SCM): as is implied by consideration of constructability, the benefits of CE will not be experienced unless all of the suppliers and subcontractors in the supply chain are 'best in class', with respect to their capabilities in engineering, consruction, and service provision, and demonstrate these capabilities in their management of their part of the supply chain. For example, in the automotive domain it is said (usually *sotto voce*) that of the percentage of defects to be found in an automobile, over 30% arise from Tiers 1 and 2 suppliers, and not from the company whose badge is on the car. This will inevitably become higher, as original equipment manufacturers (OEMs) move away from direct production themselves. Some other automotive statistics regarding CE and SCM are given below:

> Being six months late in bringing a new product to the market can result in a loss of 30% of profit for a product with a lifetime of 5 years, whereas increasing the development budget by 50% to get it out in time will cause a loss of profit of only 4%. (Reinertsen, 1983; Crawford, 1992).

> An automotive manufacturer in Europe lost US$ 1.8 billion in profit alone (before regaining its market share) by being one year behind its competitors in introducing a new model to the market. (Holberton, 1991).

> An automotive manufacturer in Europe (a different one) estimates that one day's delay in the design of a new model will result in a loss of sales revenue of US$150,000 for a replacement vehicle, and over US$1.5 million for a vehicle penetrating a new market. (Anon, 1993).

The need to improve the performance of the construction supply chain participants merely to remain competitive can be achieved during the design process by considering all aspects of the project's phases concurrently. Incorporating requirements from the construction, operation and maintenance phases at an early stage of a project would undoubtedly lead to an overall improvement in project performance. The essential constituents of 'Concurrent Construction' are as follows (Love and Gunasekaran, 1997):

- The identification of associated downstream aspects of design and construction processes.
- The reduction or elimination of non-value-adding activities.
- The development and empowerment of multi-disciplinary teams.

3. CE readiness assessment

3.1. Introduction

While concurrent engineering (CE) is gaining acceptance, some implementation efforts have not realised their full potential for reducing costs, reducing time, and increasing efficiency, effectiveness and performance for product development efforts. This is due in part to insufficient planning to support the implementation (Khalfan and Anumba, 2000). One approach that has been successfully used to improve CE implementation planning is to conduct readiness assessment of an organisation prior to the introduction of CE. This will help to investigate the extent to which the organisation is ready to adopt concurrent engineering (Componation and Byrd, 1996), and to identify the critical risks involved in its implementation within the company and its supply chain. CE readiness assessment has been successfully used for the planning of CE implementation in several industry sectors, notably manufacturing and software engineering, as described below.

3.2. Readiness assessment tools and models

There are several tools and models which are being used for readiness assessment of organisations for