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# The application of business process modelling to organisational analysis of concurrent engineering environments

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## Abstract

Barriers to Concurrent Engineering (CE) or Integrated Product Development (IPD) are organisational in context. Consequently to facilitate CE, significant changes to the design and development of the organisation need to be considered. Both research and practice have demonstrated that companies which invest in improving organisational development issues fair better than those that rely purely on tools and technology alone. The key issues are improving cross-functional integration and developing social mechanisms that facilitate a collaborative environment. The first step in improving an organisation design is of course organisational analysis. Organisational Analysis techniques have been a field of study for many years, resulting in the development of a number of different methodologies ranging from purely mathematical models of analysis to heuristic models using simulation. This paper presents a methodology, which draws upon traditional organisational theory and combines it with the more recent business process re-engineering approaches, for the analysis of organisational issues in a CE environment. The methodology is based on the hierarchical modelling and analysis of the business process. A detailed case study of its application in industry is presented. The paper concludes by summarising the key features of the methodology and issues emerging from its implementation.

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## 1. Introduction

The application of Concurrent Engineering (CE) (or Integrated Product Development (IPD)) is gradually becoming the norm for developing and introducing new products to the market place (Ainscough and Yazdani, 2000). However, the degree to which companies have implemented it and the amount of success varies (Hansen, 1997; Brookes and Backhouse, 1998; Ainscough and Yazdani, 2000; Balbontin et al., 2000). In theory CE is accomplished essentially through two basic thrusts: parallelism or overlapping of different but hitherto sequential activities, and early involvement of all enterprise functions that contribute to a successful product (Bergring and Andersin, 1994). To achieve this, a high degree of ‘integration’ between different business

functions is called for. One of the main barriers to achieving this integration has been the degree to which companies have been able to adapt their organisational structures and organisational processes to suite the demands created by this approach. Removing Organisational barriers have long been cited in literature as the key to successful CE (Karandikar et al., 1992; Lindberg, 1994; Maylor, 1997; Tang et al., 1997). As an example Dougherty (1992) illustrated, via a case study, the negative effects of the two main barriers to CE i.e. functional thinking, which she describes as ‘departmental thought worlds’, and sequential processes, which she describes as ‘organisational product routines’. The main mechanism to achieve integration has been the setting up multifunctional project teams. In fact multifunctional teams are pivotal in the development of New products, and are seen as one of the mechanisms to accelerating product development (Eisenhardt and Behnam, 1995). Dougherty, however, argued that the ‘interpretative’ barriers to successful product development should be overcome by developing an ‘organisational context for col-

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lective action' and 'collaboration mechanisms'. The design of an innovative 'social order' was proposed for new products so that: (1) interactions between departmental thought worlds were based on appreciation and joint development; (2) product definitions were based on collective, first-order customer knowledge; and (3) product norms are based on the specific market. For true collaboration Dougherty argues, liaison roles and project groups alone do not ensure that the dynamics of 'separate thought worlds' will be overcome, a real customer focus may. This she illustrated through a case study where different thought worlds came to a similar understanding of a product in the customer's hands. Interdisciplinary responsibility for focus groups, market research plans, technology audits, and visits with users should enhance collaboration.

Recent examples of successful use of this so-called innovative social order can be found at Toyota, who place great importance on developing the right social mechanisms which enhance integration. Sobek II et al. (1998) reported that Toyota's product development success is based on six management practices. Three of them are primarily social processes: mutual adjustment, close supervision, and integrative leadership from product heads. The other three are forms of standardisation: standard skills, standard work processes, and design standards.

So the process to achieve the kind of structures and mechanisms suggested above is a complex one. It requires of course Organisation Re-design and Development expertise but more importantly, as this paper argues, a well structured approach to Organisational Analysis, which will enable managers to monitor, measure and hence manage the new structures. We need to know that the changes (social mechanisms, changes to organisational processes, and structure) we make are actually delivering the right results. We need a way of measuring the effectiveness of our organisational set up, i.e. a comparison of the desired output versus the actual output.

Research in, or application of Organisational Diagnosis for CE or IPD is lacking (Tang et al., 1997). Methods within Organisation Theory (e.g. Jones, 1995) can be used to investigate and improve the organisational structures and organisational processes. However, extant organisation theories such as those of Thompson (1967), Galbraith (1977) and Mintzberg (1979) allow aggregated analysis and predictions about the organisational performance of engineering teams under given circumstances. Their aggregated view of organisational behaviour prevents them from providing specific prescriptions for organisation design in a CE context (Jin et al., 1995). There is also a lack of focus on the processes, which run through the structures. In CE in order to manage or improve the overlapping of tasks and dynamics of the collaborative effort an explicit understanding of the NPD

process is needed. There is hence a need for a framework in which organisational dynamics of CE and the NPD process can be explicitly analysed.

In this paper we present a methodology for analysing organisational issues in CE within the explicit context of the NPD process, and illustrate through a case study how such a method can contribute towards achieving the kind of 'social order' suggested by Dougherty and practised within world class product development systems such as that in Toyota.

## 2. The research and development process

The research programme was an extension of a European Union (Brite EuRam) funded program called PACE — A Practical Approach to Concurrent Engineering (Walker and Weber, 1997), which involved four companies across Europe. So the research was geared towards satisfying the needs of the collaborating companies, to ensure their continued support for this part of the programme. The research process comprised the following six steps.

### 2.1. Step 1 — industry survey (case studies) and literature review

#### 2.1.1. Industry survey

The aim of the industrial survey was first to establish the key issues affecting the performance of the CNPD/CE process, and secondly to establish the level of importance of organisational issues. This would help enable the definition of requirements for the CE analysis framework. Four companies and one management consultancy across Europe took part in this study. A total of 30 managers, engineers, and functional specialists (such as marketing, quality, purchasing etc.) were involved. The survey was carried out using both structured interviews in the form of questionnaires and semi-structured interviews targeting specific areas of interest. The results of the survey revealed that even within a single company there were many different issues that were individualistic or function related, i.e. not found in the organisation as a whole. However, these 'local' issues when summed up caused serious problems at the business or enterprise level in terms of delayed product launches, reduced profit margins and dissatisfied customers. Only a few issues showed some degree of organisation wide commonality (i.e. those identified by over 50% of the respondents). The issues that emerged (as identified by majority of respondents) in all companies as the cause of many difficulties were as follows.

1. Strength of the functional organisation.
2. Lack of true integration due to inadequate communi-

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