2004

# Accelerating new product development: the experience of concurrent engineering in Australia

Paul Couchman
*University of Wollongong*

## Publication Details

Couchman, P. (2004). Accelerating new product development: the experience of concurrent engineering in Australia. CIMOC 2004 : Unleashing the Potential of Asian Firms Through Innovation and Knowledge Management. : Proceedings from the Inaugural CIMOC Symposium, Hong Kong (pp. 156-181). Hong Kong: Center for Innovation Management and Organizational Change, University of Hong Kong.

# Accelerating new product development: the experience of concurrent engineering in Australia

**Abstract**
Concurrent engineering (CE) is a distinctive approach to the organisation and management of new product development (NPD) which seeks to achieve cross-functional integration, product life cycle design integration and high levels of project task concurrence in order to reduce development lead times. To address the limited research to date on CE in the Asia-Pacific region, the paper presents findings from a survey of Australian manufacturers (n = 150) and from five in-depth case studies on the application of CE in Australia. The survey found that just over one-half (54%) of the companies surveyed used CE to some extent and that, while adopters had obtained benefits, there was still room for improvement. The case studies revealed differing approaches to the introduction of CE, and identified three main problems with its implementation: confusion about CE, a lack of senior management commitment, and an underestimation of the difficulties associated with the successful introduction of CE. Although CE could be simply dismissed as a passing management fad or fashion, its promotion has had a positive effect by focusing attention on key problems with NPD processes and contributing to the solution of those problems. The paper concludes by arguing for more detailed case studies on NPD and by claiming that the general approach of CE, as a guiding framework for managing NPD rather than a prescriptive methodology, has much to offer many manufacturing firms.

**Keywords**
engineering, concurrent, australia, experience, accelerating, development, product

**Disciplines**
Business | Social and Behavioral Sciences

**Publication Details**
Couchman, P. (2004). Accelerating new product development: the experience of concurrent engineering in Australia. CIMOC 2004 : Unleashing the Potential of Asian Firms Through Innovation and Knowledge Management. : Proceedings from the Inaugural CIMOC Symposium, Hong Kong (pp. 156-181). Hong Kong: Center for Innovation Management and Organizational Change, University of Hong Kong.

# ACCELERATING NEW PRODUCT DEVELOPMENT: THE EXPERIENCE OF CONCURRENT ENGINEERING IN AUSTRALIA

**Paul K. Couchman**
School of Management, Marketing and Employment Relations
University of Wollongong, NSW 2522, Australia
E-mail: paul_couchman@uow.edu.au

**Abstract**

Concurrent engineering (CE) is a distinctive approach to the organisation and management of new product development (NPD) which seeks to achieve cross-functional integration, product life cycle design integration and high levels of project task concurrence in order to reduce development lead times. To address the limited research to date on CE in the Asia-Pacific region, the paper presents findings from a survey of Australian manufacturers (n = 150) and from five in-depth case studies on the application of CE in Australia. The survey found that just over one-half (54%) of the companies surveyed used CE to some extent and that, while adopters had obtained benefits, there was still room for improvement. The case studies revealed differing approaches to the introduction of CE, and identified three main problems with its implementation: confusion about CE, a lack of senior management commitment, and an underestimation of the difficulties associated with the successful introduction of CE. Although CE could be simply dismissed as a passing management fad or fashion, its promotion has had a positive effect by focusing attention on key problems with NPD processes and contributing to the solution of those problems. The

paper concludes by arguing for more detailed case studies on NPD and by claiming that the general approach of CE, as a guiding framework for managing NPD rather than a prescriptive methodology, has much to offer many manufacturing firms.

## Introduction

It is now widely acknowledged that the development and introduction of new products is central to the competitive success of companies in today's turbulent business environment; as Crawford & Di Benedetto (2002: 6) have put it: *"... a successful new product does more good for an organization than anything else that can happen"*. Reflecting and contributing to this acknowledgement, research on new product development has burgeoned since the publication of early studies in the 1960s (e.g. Booz, Allen & Hamilton, 1968; Marquis, 1969; Myers & Marquis, 1969), creating a growing academic literature (for recent reviews see: Henard and Szymanski, 2001; Krishnan & Ulrich, 2001; Ernst, 2002). Many factors, some specific to the product and others relating to the introducing firm's external and internal environments, have been identified as contributing to new product "success" (e.g. Rothwell, 1992; Cooper & Kleinschmidt, 1993), but this paper is concerned with just two of these: the new product development (NPD) process and the reduction of development lead time or time-to-market. The focus on a firm's NPD process (i.e. the organisation and management of the activities through which a new product is conceived, developed and launched into the market) as a determinant of new product success can be traced back to the publications of the US management consultants Booz Allen & Hamilton (1968), but has proved robust across empirical studies (e.g. Brown & Eisenhardt, 1995). The issue of reducing time-to-market is somewhat more recent and derives from the recognition in the managerial literature of time-based competition (e.g. Bower & Hout, 1988; Stalk & Hout, 1990) and which received considerable attention in the business press in the late-1980s (Dumaine, 1989). This notion was applied to NPD (e.g. Gold, 1987; Rosenau, 1988) in an approach that has been called "accelerated product development" (Crawford, 1992).

Concurrent engineering (also known as Simultaneous Engineering, Life Cycle Engineering, and Integrated Product and Process Development) is a concept which emerged in the USA in the late-1980s (Winner et al., 1988), but is based on perspectives within the disciplines of management and engineering that date back at least to the early-20th century (e.g. Ziemke & Spann, 1993; Smith, 1997). Concurrent engineering (CE) has been hailed by its proponents as *"the product development environment of the 1990s"* (Carter & Baker, 1992), and as *"... one of the most significant contemporary trends in new product development"* (Gerwin & Susman, 1996). CE, as a distinctive management approach to the design and development phase of the NPD process, has been defined as:

> " ... a systematic approach to the integrated, concurrent design of products and their related processes, including manufacturing and support. This approach is intended to cause developers, from the outset, to consider all elements of the product life cycle from conception through disposal, including quality, cost, schedule and user requirements." (Winner et al, 1988: v)

CE provides a management philosophy to redress the two major problems often encountered in NPD projects: cross-functional disintegration or "silo-ing", and "relay race" development processes whereby project progress is sequential with "over the wall" hand-overs between functions (Peters, 1992). CE seeks to improve the level of cross-functional integration, ensure the early integration of product life cycle design elements, and increase the level of concurrence in project activities (Couchman, Badham & Zanko, 1999). As an approach, it clearly addresses the two new product success factors of effective NPD processes and reduced time-to-market. Since the early-1990s, various studies have shown that CE has been adopted by many companies across a variety of industries, the application of CE has varied considerably within adopting companies, and the implementation of CE is often

fraught with problems (e.g. Trygg, 1993; Carlsson & Lundqvist, 1995; Poolton & Barclay, 1996; Duffy & Salvendy, 1997).

Despite the optimistic claims of its proponents, there are a number of problems with the concept of CE. While there is general agreement on what CE seeks to achieve, there is considerable disagreement on how the approach should be implemented. Further, there has been some confusion about the concept and a closer examination of the literature on it reveals that CE means different things to different people. In this respect, CE displays all the features of a management fad or fashion (Abrahamson, 1991, 1996; Abrahamson & Fairchild, 1999; Collins, 2000). The confusion about the exact nature of CE largely stems from a lack of rigorous research studies on the application of CE within companies (in contrast to the more common anecdotal "success stories" disseminated in the managerial literature). Such studies did not begin to appear until the mid-1990s (e.g. Haddad, 1996; Gerwin & Susman, 1996), well after the emergence of the concept, and to date there has been very little research on CE in Australia and Asian countries (among the few exceptions are Chin & But, 1993; Yeo & Yeo, 1994; Burns & Szczerbicki, 1997; Zanko et al., 1998). However, the concept persists and has become institutionalised, with a dedicated journal, many conferences, numerous books and other publications, an industry award in the USA, research centres and a number of dedicated societies. The continuing interest has been fuelled by a number of factors, including: claims made by CE proponents of dramatic improvements in NPD performance that can be achieved (e.g. de Graaf, 1996, cites 20 – 90% reductions in time-to-market and 20 – 110% increases in productivity), the publication of influential managerial texts on CE in the late-1980s (e.g. Hartley & Okamoto, 1998; Pallot & Sandoval, 1998; Fleischer & Liker, 1998; Ribbens, 2000), and the formation of practitioner support

communities such as Europe's CE-NET (see http://www.ce-net.org) which have promoted CE and developed the concept further.

So, what are we to make of this "new" approach to NPD? It is clear that we need rigorous systematic research on CE, as we also do for NPD generally, as it is applied in countries in the Asia-Pacific region. Through such studies, we can gain a more reliable understanding of how the concept is interpreted and applied in particular contexts, of the problems encountered during implementation, and of the results that can be achieved. Research is necessary to address the evident shortcomings of the existing literature on CE as an approach to NPD, i.e. what we know about CE is often based on limited case studies, mostly anecdotal, and which have mainly been conducted within the USA and Europe; in much of the literature there is tendency towards universalistic prescription, with little consideration given to important contingencies within the business environment; the concept remains poorly defined, with many interpretations of what constitutes CE in practice. This paper aims to make such a contribution by drawing on empirical data from an Australian survey of manufacturing practices (Morrison et al., 1998) and Australian case studies (Schubert & Couchman, 1998; Couchman, Badham & Zanko, 1999; Badham, Couchman & Zanko, 2000). Accordingly, I develop the paper in the following way. I first discuss the findings from the survey, presenting some comparative data from equivalent studies in other countries (Clegg et al., 2002), and setting the findings against the current context of manufacturing in Australia. To provide more detail on the application of CE within Australian manufacturing firms, I then present a summary overview of the five case studies. Finally, I conclude by addressing the implications for the field of NPD studies of what has been presented by its advocates as a revolutionary new approach to NPD.

## Concurrent Engineering in Australia: Survey Findings

Given its particular structural features, the Australian manufacturing sector would not at first glance appear to be very receptive to a new NPD approach such as CE: the sector is small, consisting of many small firms and a few large ones; it is largely domestically-focused with a relatively low export orientation; there is a structural bias against "high technology" products and processes; there are low levels of R&D in the sector; and there are low and declining levels of product innovation (e.g. Australian Bureau of Statistics, 1998). However, in a context of intensifying globalised competition, and government policies which have reduced support and protection for domestic manufacturing, there is evidence that a significant number of Australian manufacturers are performing well with new products. For example, studies in the 1990s revealed that there had been rapid growth in the export of Elaborately Transformed Manufactures with the faster growing manufacturing firms more likely to have developed products specifically for export markets (Australian Manufacturing Council, 1993), the best practice "leaders" amongst manufacturers tend to derive a higher proportion of their sales from new products (Australian Manufacturing Council, 1994), and there has been a growing recognition of the strategic importance of product innovation (Harrison & Lemonis, 1996). Furthermore, considerable anecdotal evidence suggests that quite a number of Australian manufacturers have introduced new approaches to product innovation such as CE and rapid prototyping. The little survey data available supports this. For example, a 1994 survey of manufacturers revealed that 54% of the companies sampled had adopted CE in the early-1990s, but that perceptions of the value of this process innovation were not very positive (Harrison & Lemonis, 1996). In terms of value obtained, CE was rated lowest among the innovations adopted by the survey companies and its relative

pay-off was seen as below average. However, a later study, based both on case studies and a survey, concluded:

> "...that there is a wide interest in CE across all industries, that the specific approach to CE implementation varies between large and small companies, that benefits to companies that used CE, even in a partial way, are significant, and that there is a great deal of commonality among the specific approaches ..." (Burns & Szczerbicki, 1997: 163)

To explore the experience of CE in more detail, a nationwide survey of manufacturing companies with 150 or more employees (n = 150) was conducted in Australia (Morrison et al., 1998). This addressed the adoption and experiences of twelve "modern manufacturing practices", including CE. The method used was a replication, with slight modifications, of a UK survey (Waterson et al., 1997). In the Australian sample (obtained using standard market research telephone survey probability sampling methods), the median size of the companies was 400 employees, reflecting the structure of the Australian manufacturing sector which is in marked contrast to the larger advanced industrial economies such as the UK and the USA, and the distribution of company size was bimodal with 30% employing less than 250 employees and 26% employing 1,000 or more. The companies in the sample were characterised as follows:

- 65% indicated their level of product innovation was above average;
- 50% indicated their level of manufacturing process innovation was above average;
- 52% indicated their level of investment in R&D was above average;
- 81% indicated the level of competition for their products was high.

The Australian survey showed that 54% (cf. the UK figure of 47%) of the firms surveyed used CE to some extent in their product development operations (see **Figure 1**). Note that of

the twelve manufacturing practices covered, CE was of the lowest incidence at the time of the survey (the top three in Australia were TQM, Empowerment, and Supply Chain Partnership). Compared to the UK, Australian firms had a significantly higher level of adoption of CE, with 27% (versus 23%) indicating that they used this practice a lot or entirely.

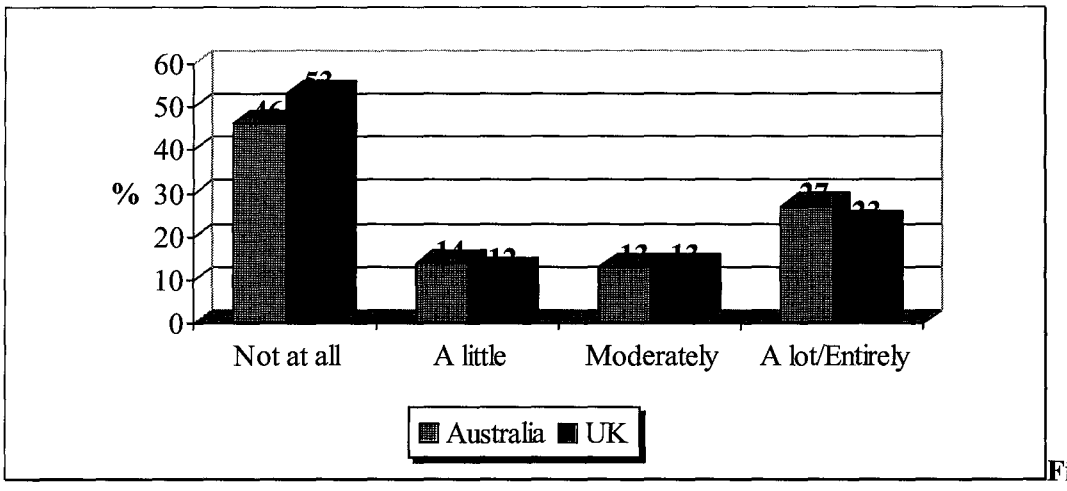


**Figure 1: Use of Concurrent Engineering in Australia and the UK**

In the survey, respondents using CE were asked to indicate the extent to which this practice met three objectives: improvements in quality, cost reduction, and responsiveness to customer demands. As shown in **Figure 2**, the perceived effectiveness of CE in achieving customer responsiveness was considerably higher than that for the other two objectives (as perhaps would be expected), i.e. 56% of users indicated that CE had achieved improved customer responsiveness either a lot or entirely and 86% indicated CE had met this objective to an at least moderate extent. Overall, the perceptions of effectiveness for each of the twelve practices addressed were not very positive with substantial proportions (and in most cases a majority) of the respondents indicating that a practice's contribution to achieving an objective was only moderate or less (**Figure 3**). Note however that CE was rated comparatively favourably in terms of achieving quality and responsiveness objectives and somewhat less so

for cost reduction. Of particular interest here, in a comparative analysis of equivalent survey findings from four countries (i.e. UK, Australia, Japan and Switzerland), an average effectiveness score was calculated for the three improvement objectives (Clegg et al., 2002). For CE, this average score for the four countries was 3.24 (slightly better than "moderate effectiveness" on the five-point scale) and this was not significantly different across the four countries, ranging from 3.19 to 3.32.

Examining the relationships between the level of adoption of CE and the company descriptor variables, it was found that CE uptake was not significantly related to company size (as measured by number of employees), whether the company benchmarked itself either within or outside its sector, the level of product innovation undertaken, and the level of company investment in R&D. These were somewhat surprising findings, not generally consonant with the analysis across the four countries surveyed (Clegg et al., 2002), and could either be a result of the specific nature of the Australian manufacturing sector (eg in terms of its industry structure) or could simply be due to the relatively small sample which did not encompass the large number of small manufacturing firms in Australia. However, the level of CE adoption was significantly related to a company's level of manufacturing process innovation (Kendalls's tau = 0.172, p = 0.014) and – not surprisingly – to the level of competition for the company's products ($\pi$ = 0.153, p = 0.029). Thus, companies which had higher levels of process innovation and which faced higher levels of competition in their product markets were more likely to have adopted CE.

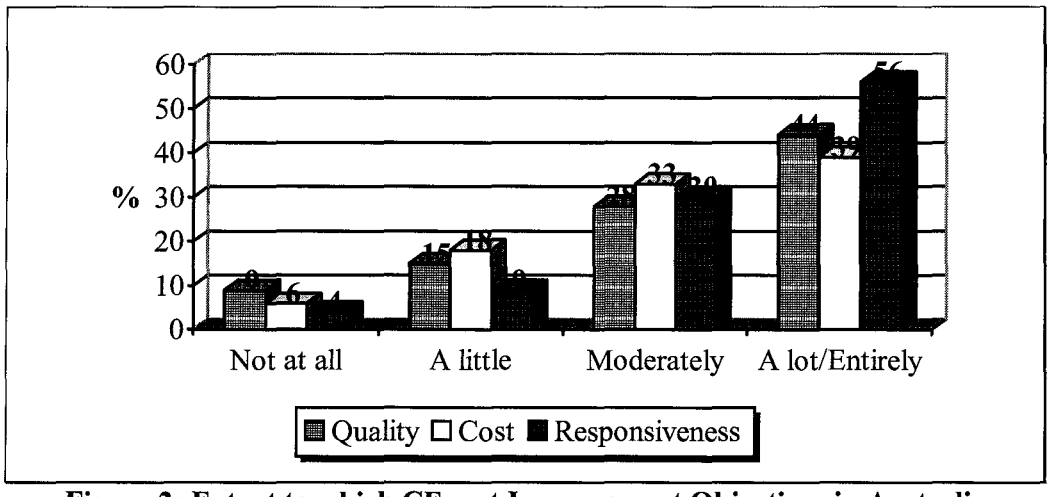


**Figure 2: Extent to which CE met Improvement Objectives in Australia**

When asked about their likely future use of CE, only 2% of current users said they would use it less than at present, 35% indicated the same level, while 63% said they would use it more. This latter finding indicates a fairly positive response to the use of CE, and reinforces the respondents' favourable assessment of the contribution of CE to improvement objectives. So, confirming the findings of Burns & Szczerbicki (1997), it does seem from this survey data that CE is being used as an approach to product innovation among a sizeable proportion of Australian manufacturers, that many of these adopters are obtaining and recognizing the benefits offered, but there is still considerable room for improvement.

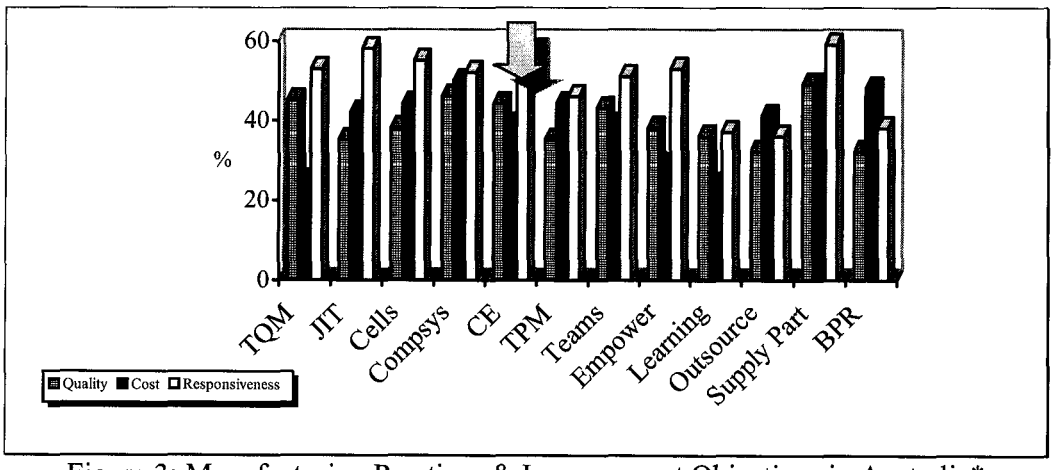


Figure 3: Manufacturing Practices & Improvement Objectives in Australia*

* *(This figure shows the percentage of practice adopters who indicated that a practice had achieved an improvement objective either a lot or entirely)*

## The Case Studies

Surveys can only provide static "snapshots" and "broad brush" insights into product innovation. More detailed case studies are required to provide a more informed understanding of innovation processes and their organizational context. Thus, five in-depth case studies were conducted in order to gain an understanding of new product development processes and of the issues associated with the introduction of concurrent engineering (see **Table 2**). The cases were stand-alone studies, each using a range of data collection methods (i.e. interviews, observation, participant observation and the analysis of secondary data sources), and were not selected according to any sampling or replication logic.

Table 2: The Product Innovation Case Studies

| | **Industry** *(4 digit ANZSIC)* | ***SBU size*** *(no. employees)* | ***Case Study*** | ***Outcome*** |
|---|---|---|---|---|
| A | Iron & Steel | 5,000+ | New steel product (industrial market) | Failure |
| B | Plastic Products | 100 | New plastic product (consumer market) | Partial success |
| C | Electrical Equipment & Appliances | 800 | Introduction of CE (new process for a product sold into consumer markets) | Failure |
| D | Electronic Equipment | 400 | Development & introduction of CE (military systems) | Partial success |
| E | Other Transport Equipment | 1,000 | New aerospace product (component for an OEM customer) | Very Successful |

The cases did cover those areas of the manufacturing sector where CE is most likely to be of particular value, as an examination of the three industries from which the cases were drawn reveals. These three industries, i.e. Metal Products, Petroleum, Coal, Chemical & Associated Products, and Machinery & Equipment, have the following features:

- Between them they accounted for 51% of manufacturing production in 1997-98, and 48% of the people employed in the manufacturing sector;

- Two of them (i.e. Machinery & Equipment, and Petroleum, Coal & Chemicals) had the fastest production growth in the sector over the decade from 1987 to 1997;
- They accounted for 72% of Elaborately Transformed Manufactures in Australia (CE is arguably of greatest relevance to the design and development of ETM products);
- They had three of the highest levels of product innovation over the period from 1991 to 1997;
- Between them they were responsible for 78% of total manufacturing expenditure on R&D in 1996-97.

The case studies threw up some interesting contrasts between different approaches towards the management of product development and the implementation of CE. Firstly, the cases confirmed the diverse nature of what constitutes a "new product" and revealed the company-specific nature of development processes. The organization and management of the development of new products is not only product specific (e.g. in terms of product complexity and degree of novelty to the firm and/or to the market), but is also firm-specific (e.g. in terms of firm size and maturity) and customer-specific (e.g. whether products are designed for consumer markets or under contract to a single customer). Any notion that there could be "one best way" to implement CE, or that CE is universally applicable to all types of new product, is denied by an understanding of this diversity.

Secondly, the cases showed that firms took quite different approaches to the introduction of CE. In case C, for example, the firm's Manufacturing Manager initiated a "CE" project as part of a response to intensified competition. A cross-functional project team was selected and, after brief introductory talk on CE, was assigned to complete what had been a conventional project. Team members were assigned part-time to the project, they were not collocated and were not given any detailed training in the CE approach and methods. The CE

project was widely seen within the company to have been a failure. The project failed in an environment where there was: little support or preparation for cross-functional teamwork, poor integration between the Marketing and R&D functions, a lack of strategic direction from senior management, and a high degree of departmental compartmentalization. In case study D, a project was established (under a broader efficiency program) to develop and introduce a company-specific form of CE. A small cross-functional team (lead by Systems Engineering) was appointed to conduct this project, and this team began its task by systematically identifying the problems associated with the firm's design and development process. Over 200 problems were identified, including high priority issues such as: poor communication among the specialist departments, poor project planning and management, little compliance with company procedures, and a lack of involvement of downstream functions in design and development (invariably leading to a need for later "fix-it" loops during a project). To address these problems, the team formulated a "solution set" (mainly involving organizational, procedural, and management changes) based on CE and Systems Engineering principles but which also built on process improvements in recent successful projects for the firm. Although the project raised the profile of CE within the company, the proposed solution set was never fully implemented (mainly due to a lack of attention in the project to organizational politics and the HRM issues associated with the proposed changes). Interestingly, in the most successful case E (which was considered to have been a "textbook case of CE"), there had been no formal training in, or rigidly-prescribed procedures for, CE. In that case, a CE approach had become widespread within the company over a period of time. It was seen as a necessary response to the pressures of the company's business, strongly supported by senior managers, and brought into the company largely through "a process of osmosis" (CE being widespread within the company's industry).

The case studies also clearly showed that there were three main problems associated with the introduction of CE, problems which usually lead to implementation failures. Firstly, there remains considerable confusion over what CE is in practice. In all five case studies, CE was interpreted in different ways (the only two common themes were that it involved reducing development lead times through maximizing activity overlaps in projects and that cross-functional teamwork was necessary) and there was a high level of uncertainty as to how CE could be introduced in a particular firm. Secondly, senior management commitment to the changes required was widely perceived to be lacking. This lack of commitment was seen, for example, in a lack of strategic direction for and high level review of change initiatives, a reluctance to engage with the difficult issues arising from organizational change, and what often appeared to be only token support (as one case study interviewee put it: *"only lip service was paid to the project"*). This problem was related to a third, a serious underestimation of the difficulties involved in implementing new approaches such as CE. To successfully implement CE involves nothing less than a re-organization of the way that product innovation is carried out within the firm and hence requires a degree of cultural change. Implementation is therefore essentially a political process in which organizational barriers need to be identified and overcome, and this is often difficult because these barriers *".... involve deep-seated and well-entrenched ways of doing things and behaving"* (Maddux & Souder, 1993).

**Discussion and Conclusions**

New product development time reduction has been a major concern (and focus of interest for management researchers) since at least the late-1980s, and the benefits of doing so are now widely recognised. Given the benefits offered, a wide range of approaches have been proposed to speed up the development process (Millson, Raj & Wilemon, 1992). Another

major concern, with a much longer history in new products research, has been the organisation and management of the NPD process and the importance of this to new product success has been reinforced by two recent reviews. Firstly, in a review of empirical studies into new product success factors, Ernst (2002: 31) confirmed the crucial role of process effectiveness factors (e.g. "... the quality of planning before the beginning of the actual development stage is decisive for the success of the NPD project") and organisational factors (e.g. "... an organizational requirement for the success of new product development is the creation of a dedicated project organization which ought to have certain generic characteristics"). Secondly, a meta-analysis of 60 empirical studies that had claimed a significant association between new product performance and various antecedents, including 11 firm process characteristics (Henard & Szymanski, 2001), revealed that of the ten "relatively dominant drivers of new product success", 4 were process characteristics (i.e. marketing task proficiency, pre-development task proficiency, technological proficiency, and new product launch proficiency).

CE is a distinctive approach to the organisation and management of the NPD process that emerged in the USA in the late-1980s. Although its exact origins are somewhat unclear, the approach was first codified in a US consultant's report that had investigated the applicability of CE in the area of military weapons system development (Winner et al., 1988) and later became crystallised through dedicated research centres, consultant practices and conferences. The aims of CE are generally agreed and may be stated as follows: in order to shorten new product development times, reduce development and production costs, achieve a greater customer focus and create high quality products, the approach seeks to achieve (a) design integration – the consideration of all product life cycle issues in the initial stages of product design instead of sequentially during a project, (b) cross-functional integration – the

integration of all relevant functional specialisations in the organisation, most notably through the formation of cross-functional teams, and (c) activity concurrence – maximising the extent of parallel activities and task overlaps in a project while minimising the linear-sequential organisation of tasks in the project's work breakdown structure. Clearly, then, this is an approach that addresses the two major concerns of reducing development times and ensuring an effective NPD process. However, while there is agreement on the aims of the approach, there is disagreement on exactly how these aims should be realised in practice with recommendations for different combinations of organisational and technical measures or "enablers" (e.g. Clausing, 1994; Haddad, 1996; Ranky, 1994). An emergent view is that CE has no single solution or implementation strategy, in other words, as Pawar and Reidel (1994) have put it: *"... any strategy to implement concurrent engineering must choose the right mix of tools and methods, and the appropriate stages for their application".*

Because of the ambiguity or interpretive flexibility of the concept of CE, it could be seen as merely another management fad or fashion (like TQM or BPR):

> "A management fad can be considered an innovative concept or technique that is promoted as the forefront of management progress and then diffuses very rapidly among early adopters eager to gain a competitive advantage. After organizational leaders come to the realization that the concept has fallen short of its expected benefits, the concept is quickly discontinued or drops back to very modest usage." (Ponzi & Koeni, 2002)

Such fads and fashions are the product of "fashion setters", usually made up of a constituency of consultancy firms, management gurus, mass media publications and academics, which promote and disseminate the rational and progressive management technique among "fashion followers" in industry (Abrahamson, 1991; 1996). These fads and

fashions are characterised by a number of features, as well as their transience: they offer the promise of a considerable improvement in performance; they are presented as necessary for survival, new and universally applicable; and they tend to be fairly abstract and ambiguous in their formulation as a solution "package" (Kieser, 1997). All of these features appear to apply to CE, and certainly the interest in this approach – although persisting – is lower now than it was in the mid to late-1990s. But rather than simply dismissing CE, I would argue it is a phenomenon that is worthy of study from within the field of NPD research. Management fashions play an important role in managerial discourse not least because, as Abrahamson (1996) has emphasised, they do shape management understandings and practices.

> "Fashions have symbolic or sign value – flagging up some organizational concerns as being more pressing or worthy of management attention at certain times than others. They also draw attention to, and legitimate the status and expertise of, those who are seen as being able to deal with these pressing problems. According to this logic, the 'fashionization' of ideas has direct and important implications for organizational practice. Indeed the fashionization of ideas is part of organizational practice, reflecting the various strategies enacted to legitimate certain kinds of activity among occupational and professional groups ...." (Swan, Robertson & Bresnen, 2001)

The promotion of CE has indeed focused attention among manufacturers on key problems in the organisation and management of NPD processes, and has contributed to the search for more effective and efficient practices. The discourse among the fashion setters has even achieved a convergence of knowledge from what have usually been disparate domains, i.e. those of organizational design and engineering management.

To complete this paper, I would like to draw two main conclusions from the study presented. The first relates to the academic study of NPD. It is now generally agreed that the body of research in this area is fragmented and beset by methodological shortcomings. As Ernst (2002) noted in his recent review of the empirical literature:

> "The NPD works cited here, with a few exceptions of the more recent works, are methodologically well below the level of empirical work which characterizes other disciplines in the social sciences."

I would argue that one solution to this problem is the production of more detailed case studies on NPD within organisations, rather than the continued proliferation of surveys relying on the responses of single respondents (representing an organisation, a function or a discipline) to questionnaire scale items derived from what are often poorly-operationalised constructs. The latter method of data collection, long dominant in this field of study, raises questions about the validity of the resulting findings (e.g. Ernst & Teichert, 1998). Multi-method case studies, on the other hand, can reveal the actual nature of NPD processes within firms (not just the opinions of single informants), as well as their associated management and organisational issues. They can also provide an understanding of how management fashions, such as CE, are brought into an organisation then translated and applied in particular contexts. In interpreting survey results, we can never be sure as to what exactly respondents are referring to when they answer survey questions on the introduction of new practices such as CE. As the case studies revealed, the term "CE" encompasses a range of applications in practice, each of which was the result, firstly, of particular interpretations by specific groups within the organisation and, secondly, of the intra-organisational politics through which the work practices of different functional specialisations are negotiated. From the ensuing rich descriptions of processes such as these, and of the outcomes, we can gain more sophisticated

understandings of the complex inter-relationships among internal firm factors, external market and business environment factors, and new product performance.

My second conclusion relates to the practical side of NPD. The experience of CE in Australia, as in other countries, indicates that this approach to the management of NPD cannot simply be written off as a "passing fad". In the increasingly competitive environment of manufacturing, with seemingly ever-shortening product life cycles (and hence the need to shorten development lead times), the general approach of CE has much to offer many firms, most notably those producing elaborately transformed manufactures such as cars, aircraft components and electronics products. The successful implementation of CE can lead to major improvements in product development performance, as the CE "success stories" attest. However, it is because CE has the characteristics of a management fashion that its implementation is often so problematic. The interpretive flexibility of the concept leads to confusion within firms over what exactly CE is, and this can lead to implementation problems. So, rather than treating CE as a prescriptive methodology, which can be followed like a recipe book, it is perhaps more useful to see it as a guiding framework which has to be translated into actions appropriate to the context of introduction. CE is not universally applicable across all firms and product types (e.g. Poolton & Barclay, 1996), and neither is there "one best way" to implement CE. The actual means used to realize the aims of CE (typically a mix of technological and organizational "enablers"), and the processes used to introduce these means will be need to be firm specific because "one size does not fit all". Finally, it should be emphasised that introducing CE is neither simple nor straightforward as it most often requires substantial organizational and cultural change. Too often, as our case studies revealed and our survey findings hint at, senior managers seriously underestimate the effort and resources required to successfully introduce this management approach. Further

in-depth research on this problematic area of implementation is required to provide more practical or useable knowledge for firms on: where such success-focused NPD methods are applicable, the conditions necessary for their successful implementation, and the benefits that can be achieved in particular contexts.

## References

Abrahamson, E. 1991. Managerial fads and fashions: The diffusion and rejection of innovations. *Academy of Management Review*, 16: 586 – 612.

Abrahamson, E. 1996. Management fashion. *Academy of Management Review*, 21: 254 – 285.

Abrahamson, E. & Fairchild, G. 1999. Management fashion: Lifecycles, triggers and collective learning processes. *Administrative Science Quarterly*, 44: 708 – 740.

Australian Bureau of Statistics 1998. *Innovation in Manufacturing 1996 – 1997.* Canberra: ABS Cat. No. 8116.0.

Australian Manufacturing Council 1993. *Emerging Exporters - Australia's High Value-Added Manufacturing Exporters.* Melbourne: AMC.

Australian Manufacturing Council 1994. *Leading the Way - A Study of Best Manufacturing Practice (Interim Report).* Melbourne: AMC.

Badham, R., Couchman, P. K. & Zanko, M. 2000. Implementing concurrent engineering. *Human Factors and Ergonomics in Manufacturing*, 10: 237 - 249.

Booz, Allen & Hamilton 1968. *Management of New Products.* New York: Booz, Allen & Hamilton Inc.

Bower, J. L. & Hout, T. M. 1988. Fast-cycle capability for competitive power. *Harvard Business Review*, 66: 110 – 118.

Brown, S. L. & Eisenhardt, K. M. 1995. Product development: Past research, present findings, and future directions. *Academy of Management Review*, 20: 343 - 378.

Burns, T. W. & Szczerbicki, E. 1997. Implementing concurrent engineering: Case studies from Eastern Australia. *Concurrent Engineering: Research and Applications*, 5 (2): 163 – 170.

Carlsson, M. & Lundqvist, M. 1995. Work with and implementation of new concepts for management of product development – experiences of the Swedish Manufacturing Industry. *R&D Management*, 25: 45 – 56.

Carter, D. E. & Baker, B. S. 1992. *Concurrent Engineering: The Product Development Environment for the 1990s.* Reading, MA: Addison Wesley.

Clausing, D. P. 1994. *Total Quality Development: A Step by Step Guide to World Class Concurrent Engineering.* New York: ASME Press.

Chin, K. S. & But, T. W. H. 1993. An Investigation on the Applicability of Concurrent Engineering in Hong Kong Electronic Products Industry. Project Report, Manufacturing Engineering Department, City Polytechnic of Hong Kong.

Clegg, V., Wall, T., Pepper, K., Stride, C., Woods, D., Morrison, D., Cordery, J., Couchman, P., Badham, R., Kuenzler, C., Grote, G., Ide, W., Takahashi, M. & Kogi, K. 2002. An international survey of the use and effectiveness of modern manufacturing practices. *Human Factors and Ergonomics in Manufacturing*, 12: 171 – 191.

Collins, D. 2000. *Management Fads and Buzzwords – Critical-Practical Perspectives.* London: Routledge.

Cooper, R. G. & Kleinschmidt, E. J. 1993. Major new products: What distinguishes the winners in the chemical industry? *Journal of Product Innovation Management*, 10: 90 – 111.

Couchman, P. K., Badham, R. & Zanko, M. 1999. Improving product innovation processes: Moving beyond universalistic prescription to encompass diversity. *Creativity and Innovation Management*, 8: 28 – 36.

Crawford, C. M. 1992. The hidden costs of accelerated product development. *Journal of Product Innovation Management*, 9: 188 – 199.

Crawford, C. M. & Di Benedetto, C. A. 2003. *New Products Management.* Seventh Edition. New York: McGraw-Hill Irwin.

de Graaf, R. 1996. *Assessing Product Development - Visualizing Process and Technology Performance with RACE.* Amsterdam: de Graaf.

Duffy, V. G. & Salvendy, G. 1997. Prediction of effectiveness of concurrent engineering in electronics manufacturing in the U.S. *Human Factors and Ergonomics in Manufacturing*, 7: 351 – 373.

Dumaine, B. 1989. How managers succeed through speed. *Fortune*, 13 February 1989: 54 – 59.

Ernst, H. 2002. Success factors of new product development: A review of the empirical literature. *International Journal of Management Reviews*, 4: 1 – 40.

Ernst, H. & Teichert, T. 1998. The R&D/Marketing interface and single informant bias in NPD research: An illustration of a benchmarking case study. *Technovation*, 18: 721 – 739.

Fleischer, M. & Liker, J. K. 1997. *Concurrent Engineering Effectiveness: Integrating Product Development across Organizations.* Cincinnati, OH: Hauser Gardner.

Gerwin, D. & Susman, G. 1996. Guest Editorial: Special Issue on Concurrent Engineering. *IEEE Transactions on Engineering Management*, 43: 118 - 123.

Gold, B. 1987. Approaches to accelerating product and process development. *Journal of Product Innovation Management*, 4: 81 – 88.

Haddad, C. J. 1996. Operationalizing the concept of concurrent engineering: A case study from the US auto industry. *IEEE Transactions on Engineering Management*, 43: 124 – 132.

Harrison, N. J. & Lemonis, M. 1996. *Australian Manufacturing in the Asia Pacific Region.* Canberra: AusIndustry.

Hartley, J. R. & Okamoto, S. 1998. *Concurrent Engineering: Shortening Lead Times, Raising Quality, and Lowering Costs.* New York: John Wiley.

Henard, D. H. & Szymanski, D. M. 2001. Why some new products are more successful than others. *Journal of Marketing Research*, XXXVIII: 362 – 375.

Keiser, A. 1997. Rhetoric and myth in management fashion. *Organization*, 4: 49 – 74.

Krishnan, V. & Ulrich, K. T. 2001. Product development decisions: A review of the literature. *Management Science*, 47: 1 – 21.

Maddux, G. A. & Souder, W. E. 1993. Overcoming barriers to the implementation of concurrent engineering. In H. R. Parsaei & W. G. Sullivan (Eds.), *Concurrent Engineering: Contemporary Issues and Modern Design Tools.* London: Chapman and Hall.

Marquis, D. G. 1969. The anatomy of successful innovations. *Innovation*, 1: 28 – 37.

Millson, M. R., Raj, S. P., & Wilemon, D. 1992. A survey of major approaches for accelerating new product development. *Journal of Product Innovation Management*, 9: 53 – 69.

Morrison, D., Cordery, J., Couchman, P. K. & Badham, R. 1998. *The Use and Effectiveness of Modern Manufacturing Practices in Australia: Report of A National Survey.* Perth: University of Western Australia.

Myers, S. & Marquis, D. G. 1969. *Successful Industrial Innovations.* National Science Foundation Report NSF 69 – 17. Washington, DC: National Science Foundation.

Pallot, M. & Sandoval, V. 1998. *Concurrent Engineering: Toward the Concurrent Enterprise in the Era of the Internet and Electronic Commerce.* Boston, MA: Kluwer.

Pawar, K. S. & Reidel, C. K. H. 1994. Achieving integration through managing concurrent engineering. *International Journal of Production Economics*, 34: 329 – 345.

Peters, T. 1992. *Liberation Management - Necessary Disorganization for the Nanosecond Nineties*. New York: Pan Books.

Ponzi, L. J. & Koenig, M. 2002. Knowledge management: another management fad? *Information Research*, 8 (1), paper no. 145.

Poolton, J. & Barclay, I. 1996. Concurrent engineering assessment: A proposed framework. *Proceedings of the Institution of Mechanical Engineers*, 210: 321 - 328.

Ranky, P. 1994. *Concurrent/Simultaneous Engineering - Methods, Tools and Case Studies*. Guildford: CIMware Ltd.

Ribbens, J. 2000. *Simultaneous Engineering for New Product Development: Manufacturing Applications*. New York: John Wiley.

Rosenau, M. D. 1988. Faster new product development. *Journal of Product Innovation Management*, 5: 150 – 153.

Rothwell, R. 1992. Successful industrial innovation: critical factors for the 1990s. *R&D Management*, 22: 221 – 239.

Schubert, M. & Couchman, P. K. 1998. Organising for product innovation: Concurrent engineering and human resource management. In P. Vink, E. A. P. Koningsveld, & S. Dhondt (Eds.), *Human Factors in Organizational Design and Management – VI*. Amsterdam: Elsevier.

Smith, R. P. 1997. The historical roots of concurrent engineering fundamentals. *IEEE Transactions on Engineering Management*, 44: 67 - 78.

Stalk, G. & Hout, T. M. 1990. Competing against time. *Research-Technology Management*, 33: 35 – 41.

Swan, J., Robertson, M. & Bresnen, M. 2001. Knowledge management and the colonization of knowledge. *Electronic Journal of Radical Organization Theory*, 7 (2) Special Edition.

Trygg, L. 1993. Concurrent engineering practices in selected Swedish companies: A movement or an activity of the few? *Journal of Product Innovation Management* , 10: 403 - 415.

Winner, R. I., Pennell, J. P., Bertrand, H. E., & Slusarczuk, M. M. G. 1988. *The Role of Concurrent Engineering in Weapons System Acquisition, IDA Report R-338*. Alexandria, VA: Institute for Defense Analyses.

Yeo, K. T. & Yeo, K. K. 1994. Perception and relevance of concurrent engineering in Singapore's manufacturing industry. A paper presented to the IEEE Region 10 (Asia) Ninth Annual International Conference, TENCON, Singapore, 24 – 26 August 1994.

Zanko, M., Couchman, P. K., Badham, R., Schubert, M. & Zainnudin, J. 1998. The role of human resource management in concurrent engineering approaches to product innovation: Australian and Indonesian experiences. *Human Factors and Ergonomics in Manufacturing*, 8: 1 – 15.

Ziemke, M. C. & Spann, M. S. 1993. Concurrent engineering's roots in the World War II Era. In H. R. Parsaei and W. G. Sullivan, W. G. (Eds.) *Concurrent Engineering: Contemporary Issues and Modern Design Tools.* London: Chapman and Hall.