# ROLLING OUT NEW PRODUCTS ACROSS INTERNATIONAL MARKETS

# CAUSES OF DELAYS

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I hereby declare that this thesis is the result of my own independent investigation and it does not include material from a prior thesis or published work. Also, this thesis is not accepted for any degree and it not being concurrently submitted in candidature for any degree elsewhere.

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George M. Chryssochoidis

# Summary

The problem of delays in product rollout becomes more unwieldy for new products that are being launched across many countries. This concern rises when firms operate in rapid technological change and high internationalisation business environments.

This study aims to form an empirically based body of knowledge about rollout of new products across international markets, build strong theory and provide insights for better practice. The study focuses on both static and dynamic aspects of the management of new product rollout across international markets. The investigation considers an extensive set of variables describing the company's external and internal environment, as well as the company's action across borders. It attempts more precisely to identify:

- whether timeliness in new product rollout relates to new product success;
- whether companies roll out new products across their international markets simultaneously or sequentially; and
- the factors that lead to delay in rollout schedules and their interaction.

A six-phase research methodology was designed and implemented. These phases were: (1) a review of literature across several streams of research; (2) a pilot telephone interview study; (3) exploratory interviews in 6 companies and a preliminary cross-case analysis; (4) the refinement of methodological and theoretical framework issues; (5) an additional series of research interviews in 24 more companies; and (6) a second cross-case analysis. These were followed by the formulation of a model and the estimation of the magnitude of direct, indirect and total effects of each factor upon rollout timeliness. The main findings were:

- Timely rolled-out projects were far more successful than delayed rolled-out projects.
- Sequential new product rollouts were more frequent than simultaneous ones. Delays were consistently featured in the cases of sequential new product rollouts.
- The main factors that lead to delay in rollout schedules were: insufficiency of marketing and technological resources, poor internal communications between the HQ and the country markets, lack of synergies in product handling by the sales force in both the HQ and the country markets, lack of synergies in customer familiarity with the product, lack of proficiency in the new product development process and a deficient product.

A description of the project and more details follow.

# Chapter 1

# An overview

## 1.1 Introduction

This chapter provides an overview of the present research. It first discusses the area under investigation and the status of the relevant theory. The problem under investigation and the research objectives are then described, together with a summary of the structure of the thesis.

## 1.2 Rolling out new products across international markets

The environment in which organisations operate is becoming increasingly dynamic and international. And it is to be expected that, 'the more change there is in the firm's environment, the greater the need to develop the product mix constantly, so as it matches the environment' (Hart, 1987, p.1). Consequently, it is likely that organisations will have constantly to seek the appropriate development and rollout of new products for international markets. Many researchers have devoted their attention to the study of new product development (Montoya-Weiss and Calantone, 1994; Brown and Eisenhardt, 1995) or diffusion of new products (Mahajan and Peterson, 1985; Sultan *et al.*, 1990) in a domestic market context. Although it is still important to examine new product activities in domestic markets it is critical to investigate new product rollout in a multi-country context. There is strong evidence that competition is becoming more international or global in an increasing number of sectors (Porter, 1986; Kobrin, 1991) and it is crucial to penetrate overseas countries in quick succession with new products to pre-empt competition. Oackley (1996) showed that there is a significant association between greater new product commercial successes and more ambitious and speedier overseas launches.

The timely completion of the new product rollouts across international markets is becoming in this respect a fundamental source of competitive advantage for an organisation. Researchers have surprisingly neglected the timeliness in the new product rollout activity across either domestic or international contexts leading to an incomplete understanding of the design and implementation of product policy (see Craig and Hart, 1992; Douglas and Craig, 1992). Some previous attention has been paid to new product development in multinational enterprises (Ronkainen, 1983) or modelling the international new product diffusion but little effort has gone into understanding the causes of delays/timeliness of the overall rollout exercise. This may be due to some people's estimation that new product development and product commercialisation are a single process. However, these two activities are not

necessarily the same and have different aims. It is reasonable to say that the purpose of the new product development process is to create or build a new product (Hart, 1996). Conversely, the purpose of the product commercialisation process is to make the product available for sale across the company's target markets (Mascarenhas, 1992a; 1992b). At the same time, the diffusion of an innovation is defined as the process by which that innovation is communicated through certain channels over time among the members of a social system (Rogers, 1983). These are different issues and have to be considered as such. The issue of timeliness in rolling out a new product has, however, received scant attention, and discussion is still in its infancy. As such much remains to be done. This thesis intends to contribute to the knowledge of timeliness in new product rollout and to stimulate others to undertake additional research in this under investigated crucial area.

## 1.3 Present status of theory

Douglas and Craig (1992) identified the subject of the present study as an area requiring urgent attention:

> ***In the case of product decisions, more in-depth examination of new product development in a global context - issues such as whether and when to develop products for global rather than national markets, as well as when and how to transfer products and brands from one country to another, and to develop appropriate positioning strategies, need further study. Examination of factors influencing the composition of the international product portfolio, and the nature of product lines in each country, for example, similarity of target segments and product markets, the nature of competition and existence of potential economies of scope, is another area which merits greater attention (p.308).***

In the past several works have focused on issues such as the product's international life cycle (Vernon, 1966), multinational product planning (Keegan, 1969), the country-of-origin image (Samiee, 1994), product transfers across countries (Davidson and Harrigan, 1977; Hill and Still, 1984), the customisation of marketing (Walters and Toyne, 1989; Szymanski *et al.*, 1993; Cavusgil and Zou, 1994), as well as the characteristics of export performers (Bilkey, 1978; Madsen, 1987; Miesenbock, 1988; Aaby and Slater, 1989; Chetty and Hamilton, 1993).

Also, writers acknowledge that companies need to rapidly make their products available for sale in several countries to keep in line with the rapid pace of change in the business environment (Olson *et al*, 1995; Oakley, 1996). Nonetheless, research efforts seem to have stopped short of examining the theoretical and practical

dimensions of new product rollout. It is of concern that there is a considerable lack of understanding of the variables that might be relevant to the issue of timeliness in new product rollout. The importance of delays and the causes of these delays also remain unknown.

## 1.4 This study

This study constitutes an extensive empirical investigation of decision making in the rollout of new products across international markets with particular reference to delays in the rollout schedule. The study

- obtains from senior managers an evaluation of the various factors that lead to delays.
- It formulates a causal model and determines the indirect, direct and total effects of each factor upon the others and rollout timeliness.
- It results in normative recommendations on the subject of new product rollout across international markets.

It is important to investigate if there are delays in new product rollout in cross-border activities. If they exist, it is also important to examine how they influence new product success, the factors that lead to delay and the similarity of these factors across organisations and technology settings. Variations in internal and external elements and the circumstances in which organisations operate may permit the development of in-depth knowledge on this subject. The study provides new empirical work into how manufacturing companies roll out their new products across several country markets and relevant issues.

## 1.5 Problem statement

The ultimate problem under study in this empirical investigation is how to improve the performance of new product rollout across international markets. The assumption made is that a theory of timely cross-border new product rollout will enable improved product decisions to be made and will improve the success rate of the new product launches across international markets. The general problem under study is

> How can manufacturing companies active in international markets achieve the timely rollout of new products?

## 1.6 Research objectives

The overall objective of this research is to gain an understanding of the nature of causes of delays when rolling out new products across international markets, the interaction between these causes, and the effects upon new product success. Subsidiary objectives are:

- to determine if timely rolled-out new products are more successful than delayed rolled-out new products;
- to acquire information with respect to the time schedules adopted by companies in rolling out new products across international[1] markets, and whether both simultaneous and sequential rollouts are used by companies;
- to study if there is a link between product technology and sequential rollout and sequential rollout and rollout delays;
- to obtain a picture of the length of these delays;
- to understand the causes of these delays; and
- to explore the interaction between these causes of delays.

## 1.7 Research questions

The main research questions (RQs) are as follows:

**RQ1 Is rollout timeliness related to new product success?**

**RQ2 Do firms roll out their new products across international markets simultaneously or sequentially ?**

This question looks more precisely at two different aspects:

(RQ2a) Is there a link between the nature of product technology and sequential rollout?

(RQ2b) Is there a link between sequential rollout and delays?

**RQ3 What factors lead to rollout delay?**

**RQ4 What is the interaction between these factors and their direct and indirect effects upon rollout delay?**

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[1] This research focuses on the European operations of international firms only and omits detailed investigation of operations in other countries.

## 1.8 Dimensions of this study and structure of the thesis

Given the absence of previous empirical research on the timeliness of new product rollout across international markets, this research is exploratory in nature. A six-phase research methodology was designed and implemented. It consisted of: (1) a review of literature across several streams of research in both the domestic and international business fields; (2) a pilot telephone interview study; (3) exploratory interviews in 6 companies and a preliminary cross-case analysis; (4) the refinement of methodological and theoretical framework issues; (5) an additional series of interviews in 24 more companies; and (6) a second cross-case analysis. These are followed by the construction of a model and the estimation of the magnitude of direct, indirect and total effects of each factor upon rollout timeliness. The decomposition of effects provides important insights into these factors that lead to delays in the rollout of new products across international markets. The sampled population in this investigation belongs to the manufacturing sector. The author sought organisations of different sizes and different nationalities of ownership, in the wider electronics industry. The organisation of this thesis is as follows:

- Chapter 1 overviews the project and clarifies the research questions and objectives.
- Chapter 2 discusses the importance of the product variable and rollout timeliness. This is followed by a review of pertinent literature and the development of an initial conceptual framework.
- Chapter 3 explains the methodology of the present study.
- Chapter 4 presents the cross-case analysis of the investigated cases.
- Chapter 5 answers the research questions and expands on the formulation of a model that explains the interaction between the factors leading to rollout delays. This is followed by the measurement of the inter-relationships among these factors and their effects upon rollout delays.
- Chapter 6 concludes with a discussion of the key contributions made by this study, limitations of the present project and areas for future research.

# Chapter 2

# The importance of timely new product rollout/literature review

## 2.1 Introduction

Discussion first focuses on the importance of the product variable for organisational survival and the current shift of attention to time as the source of competitive advantage. Advantages of timely new product rollout are presented alongside the repercussions of delays in rollout schedules (section 2.2). This is followed by a literature review and consideration of the insights previous research provides to the present project (section 2.3). The chapter concludes with the construction of a conceptual framework based upon these insights.

## 2.2 The product variable and timeliness

### 2.2.1 The significance of the product variable

The product is the *raison d'être* of the company, its *sine qua non*[1]. All business activity revolves around the product. While many factors contribute towards the outcome of organisational activities, the right product at the right place and the right time plays a decisive role in long-run company success. All marketing strategy and tactics revolve around the product because it is the basic tool with which organisations bargain for revenue (Buskirk, 1966, p. 227). As Borden (1963) postulates:

> ***Generally, no single functional area, has so much bearing on the sales and profit opportunities present and future, as that of having products that meet the desires of consumer groups and yield margins that permit a satisfactory profit. (p. 252)***

Products stimulate growth in the firm and constitute responses to competition and changing environments. Products also reflect the creativity of management and organisational innovativeness (Hisrich and Peters, 1991, pp. 7-8).

Much of the literature in economics up to 1930 omits discussion of the product variable. Under the assumption of demand and supply homogeneity, the basis for competition is the price. This assumption -- partially valid in the 18th and 19th centuries by virtue of companies' orientation towards mass-produced products -- became non-sustainable by the beginning of the 20th century. Concurrent revolutions in production, communications and transportation, and industry structure have changed the basis of competition. In the early 1930s, Chamberlin (1933) asserted that managers combined advantageous prices, advertising and product aspects for the sale of their products. Chamberlin's assertion had a tremendous impact in the sense

[1] This section has benefited from Avlonitis (1980)

that the assumption of homogeneous products was abandoned. Nonetheless, the admission of the importance of product as a variable came only in the early 1950s when aspects like product quality were recognised to affect product differentiation (Brems, 1951, p.12).

It is this product differentiation and the development of the concept of differential advantage (Clark, 1954, pp. 326-8) that constitute a fundamental platform of much of today's competition. Chamberlin considers that buyer preferences for one product variety over another lead to non-entry into an exchange (Chamberlin, 1957, p. 56). This creates an imbalance between sellers in so far as their activities and individual products must match customer preferences. These buyer preferences reflect a variation in needs and wants, and they allow competitors to pursue a policy of differential advantage in general and product differentiation in particular. Sellers need to adjust the product and the elements surrounding its sales according to the requirements of each market segment. However, the sellers have to readjust their approach and offering constantly to sustain differential advantage because of constant changes in these buyer preferences.

In the 1950s and 1960s, it was easy for managers to experience growth of sales in markets because of an environment of economic stability, affluence and increased customer consumption. International competition and the rate of technological change were still mild, national growth curves were moving upwards every year, and national markets were well protected against competition from other nations. But in the 1970s, the rules changed. The marketing environment deteriorated sharply. The oil crises, long periods of recession, decreased income, rocketing change in technology, the formation of economic trade blocs and the globalisation of competition changed marketing practice for good.

The transition from steady growth to unstable economic conditions during the early 1970s brought substantial changes in the industrial systems and with them increased attention on the product variable. It was then that the product started to become a primary weapon and a marketing variable of fundamental importance for organisational survival (Wentz *et al.*, 1973). Since then, rapidly changing economic conditions established firmly the role of the product variable at a prominent position. Product innovations by competitors have, for instance, become pivotal in disrupting market equilibrium (Littler, 1994, pp. 293-300). Advances in business strategy have also highlighted the contestability of markets due to the non-exclusivity of sustainable advantage and the rapid imitation of innovative products by competitors at a fraction of

cost (Ghemawat, 1979, p. 27). In parallel, failure costs increased. Research on the outcomes of R & D programmes in a variety of industrial sectors suggested a 'success' rate between 12 and 20 per cent (Mansfield *et al.*, 1972), with only one in seven products actually launched achieving commercial success (Booz *et al.*, 1982).

The emergence of the 'borderless world' forced companies to reconsider and elaborate their strategies (Bartlett and Ghoshal, 1987, pp. 7-8). It also created a new set of challenges for organisations, in which global management of products and the cohesion between strategic and product decisions became instrumental for survival (Ohmae, 1991). This is because corporate and business strategy decisions are reflected and embedded in product decisions. For instance, Ansoff's (1958), Drucker's (1963) and Abell's (1980) work, on the appropriate ways to identify which business an organisation is in, is largely based on the type and scope of its products and markets. Within the framework of a broader business strategy, setting of pertinent business objectives would provide adequate guidance for concrete product operations and plans.

### 2.2.2 Time as a source of competitive advantage

Profit seeking or maximisation of profit seemed once to be the single business objective. Such a normative objective was the doctrine of traditional economists. Yet, even prominent economists such as Papandreou (1952), Williamson (1963), Baumol (1965), and Grabowski and Mueller (1972) have argued that several economic objectives are necessary for the survival of an organisation, including high levels of sales growth, market share and profit. Achievement of these objectives was understood to indicate a well-performing organisation. However, such accomplishments may have become increasingly difficult to achieve in the recent years. This has happened for several reasons, including the substantial changes in the wider business environment. Ansoff (1990) shows that economic and environmental turbulence has substantially risen over recent years. Doyle (1994) mentions ten major changes that continue to affect marketing and strategy. These are: fashionisation; the creation of micromarkets; rising customer expectations; requirements for improved service and products; product commoditisation; erosion of brands; increase in constraints imposed by government; politics and society; rapid technology change; increasing competitive rivalry; and globalisation.

The influence of these changes upon company action is important and will intensify more in the years to come (Doyle, 1994). For instance, technological

advancements are no longer isolated within individual countries, but transcend national boundaries and change the competitive scene across the globe. Events like European integration facilitate the rapid diffusion of technology through the abolition of national borders and the simultaneous change in national legislation and regulations across several countries. Multinational players (e.g., buyers, suppliers, research and development bodies and competitors) become transnational in search of economies of scale and scope. Much focus is on building products that are 'global' while meeting 'local' needs (Bartlett and Ghoshal, 1987). However, time and cultural differences, difficulties in communication, distance, a variation in technological standards and intense competitive rivalry create problems. These result in new challenges for organisations.

New dimensions also appear to gain momentum in the competitive game. Organisations seem to shift emphasis to time as a means to acquire and sustain competitive advantage. Indeed, time is coined as the current source of competitive advantage (Stalk and Hout, 1990). Stalk (1988) notes:

> ***Like competition itself, competitive advantage is a constantly moving target. For any company in any industry, the key is not to get stuck with a single simple notion of its source of advantage. The best competitors, the most successful ones, know how to keep moving and always stay on the cutting edge.***
>
> ***Today, <u>time</u> is on the cutting edge. The way leading companies manage time - in production, <u>in new product development and introduction</u>, in sales and distribution - represent the most powerful new sources of competitive advantage.***

Stalk also notes that, while time is a basic business variable, management seldom monitored its consumption explicitly - almost never with the same precision it accorded to sales and costs. Yet, time is a more critical competitive yardstick than traditional financial measurements. It is already nearly forty years since Jay W. Forrester (1958), the person who created the system dynamics approach, established a model of time's impact on an organisation's performance. He tracked the effects of time delays and decision rates within a simple business system consisting of a factory, a warehouse, a distributor and retailers, and showed the adverse effects of lengthy operations. The cycle period from the finished product to the retailer was sufficient as long as demand was stable and forecasts were accurate. When unexpected changes occurred, they resulted in lengthy delays that distorted the flow of production, procurement, sales and consequently finances. Distortions that reverberate throughout the system not only

produce instability within the organisation, but can also undermine the organisation's position in the eyes of its customers.

Stalk continues:

> ***These distortions plague business today. To escape them, companies have a choice: They can produce to forecast or they can reduce the time delays in the flow of information and product through the system. The traditional solution is to produce to forecast. The new approach is to reduce time consumption.***

Stalk explicitly recognises the need for a reduction in the time spent on new product development and product introduction to markets. This indicates that an organisation that can develop and roll out new products faster and on schedule enjoys an advantage over its competitors. It also means that product rollout patterns may have changed for good. More and more companies develop products and product innovations targeting markets in several countries, and they co-ordinate their launch on a global basis. Ford's new Escort is an example. This is the company's second global car after the Mondeo. Several companies opt for a simultaneous launch across markets world-wide, as in the case of Miscosoft's new operating platform, 'Windows 95', launched on August 24th, 1995. Fast and timely rollout becomes an integral part of organisational adaptation and alignment with these evolving environmental conditions, and is pivotal for organisational survival.

### 2.2.3 Timeliness in rolling out new products across international markets

The notion of timeliness of rollout across international markets may comprise decisions regarding the order of entry across country markets (which country first, which second?) and against competition (pioneer or follower?). Nonetheless, what underlines and cuts across both aspects is how long it will take to market the product across all target country markets.

Firstly, this time period concerns a choice between simultaneous versus sequential new product rollout. Simultaneous means that the company makes the product available across all its target markets at the same time. Sequential means that the company makes its product available first in some markets and later in others. Secondly, this time period concerns the timeliness versus delay in such availability. Timely (on schedule) availability of the new product means that the company rolled-out its new product as planned, calculated and expected. Delay in the schedule means that the company did not roll out its new product as planned, calculated and

expected. It is likely that the longer the delay, the worse the outcome, because the new product will not be available for sale across several countries.

Such definition of timeliness is similar to that used by Cooper and Kleinschmidt (1994) in their study of timeliness in new product development. It is also similar to the one used by Olson *et al.* (1995) in their discussion of timeliness in new product commercialisation. Authors in both contributions perceive timeliness as the time required to complete the activity relative to its scheduled/anticipated time frame (see for instance, Olson *et al.*, 1995, p. 56). Timeliness of new product rollout across international markets therefore revolves around two factors:

- the company decision on the simultaneous versus sequential rollout of its new product across countries and the timing schedule; and
- delays in the rollout schedule.

The time schedules for new product rollouts across all company European target markets, and the causes of delays in the rollout schedule, are the focus of the present empirical study.

The emphasis on avoidance of delays in new product rollout across countries is crucial, yet it is often underestimated by many companies. It is easier for managers to obtain the crude measures of overall company performance than to isolate the softer, very complex and daunting effects of delays in rolling out new products across countries. However, the advantages associated with timely new product rollout across international markets are substantial. Among these advantages are the following:

- Enhancement of competitive advantage. A delayed introduction of technology (e.g., VCRs, compact discs) not previously available in the market increases the issues at stake. Increasing lead-time in individual country markets also helps a pioneer to establish a stronger brand name (Schmalensee, 1982) and to move customers' ideal points closer to the pioneer's mix of product attributes (Carpenter and Nakamoto, 1989). Research into consumer products suggests that consumer information processing is strongly influenced by what the consumer already knows about a product category. Consumers reduce the cognitive demands of processing new information by relying on previous learning (Fiske and Taylor, 1984). Thus, consumers use their knowledge of a pioneering brand as a measure against which to judge late brands in the category (Carpenter and Nakamoto,

1989; 1994), or may fail to integrate information about late brands into their existing knowledge structure at all (Kardes and Kalyanaram, 1992). Increasing lead-time in individual countries also helps the pioneer to further broaden its product line (Robinson and Fornell, 1985).

- Quick response to rapidly changing markets and technologies, and ever shortening product lifetimes. Increasing obsolescence and intensified competition mean shorter windows of opportunity if products are not rapidly available for sale. One report reveals that product lifetimes are becoming as short as two years in some industries (Patterson, 1990).
- Increase in profitability. There is evidence that it is better to develop a product on time but well over budget than to develop it on budget and late. A report suggested that, under a very specific set of circumstances, a six-month delay will reduce a high-tech product's profitability by one-third (Dumaine, 1989). Vesey (1991) adds that decreasing the development time by six months improves profits by 11.9 per cent (p.14).
- Reduction in 'time to market'. In the case of products marketed to several countries, 'time to market' includes not only product development time, but also time to 'commercialise' the product (Olson *et al.*, 1995) across countries (Mascarenhas, 1992a; 1992b). Consequently, rapid development is likely to be worth little, if the length of product introduction time across countries is longer than planned, calculated and expected.

Delays in rollout can also have a series of severe repercussions for the company. This happens because the expense of a newly developed product with no sales in its multiple international target markets goes beyond longer break-even times and reduction in product lifetime profits. No method of financial accounting or business monitoring can adequately report business costs. Some of them are:

- A burden on the company's resources, such as funds, facilities and management attention, that may be disproportionate to the product's future contribution to sales and profits. This may also happen at the expense of other products. Technical innovativeness cannot also be tested and psychological disappointment of personnel may reduce organisational effectiveness and efficiency in the short and long run.

- Non-revitalisation of the product portfolio across countries with new products. This is likely to result in decreased international sales, excess capacity and truncated company ability to sell. It is not only important to introduce new products across countries on time in order to compete head-on-head or to pre-empt competition in these countries, it is also important to stick to the schedule in doing so.
- Poor technological and social connotations for companies respected by marketing channels and the public across the world for innovativeness against competition and keeping pace with technology advances (Clark and Fujimoto, 1991). This can seriously affect corporate image.
- Early elimination of the new product. Technology has been the main agent in the birth, growth, decline and death of innumerable products in the past. The rapid diffusion of technology across countries, the abolition of trade barriers (e.g., European Union), the acculturation of executives with customer preferences across nations, advances in telecommunications and the multiplication of competitors rapidly render products outdated, outmoded and less efficient: in other words, obsolete. Products with delays in their availability across countries are quickly outlived and become prime candidates for elimination before the company recovers the costs of their development.

Rollout of new products across countries and identification of causes of delays therefore, seems to take a prominent position in managerial decision making regarding the achievement of competitive advantage and organisational survival. Prompt rather than belated amendment can cut costs, free up resources, improve margins, and assist organisations in achieving and maintaining competitive advantage. Several insights from previous research can assist investigation of the issue. These are presented next.

## 2.3 Literature review

### 2.3.1 Introduction

This section reviews the literature concerning:

- the diffusion of innovations, a stream largely relevant to research in consumer behaviour;
- business strategy;
- product portfolio management, new product development and product elimination;
- international business; and
- research in international marketing.

### 2.3.2 Innovations and their diffusion across markets

The diffusion of an innovation is defined as the process by which that innovation 'is communicated through certain channels over time among the members of a social system' (Rogers, 1983). As such, the diffusion process consists of four key elements: innovation, communication channels, time and the social system (Mahajan *et al.*, 1990). Diffusion theory mainly focuses upon the communication channels - that is, media, verbal and non-verbal interpersonal communication - by which information about an innovation is transmitted to or within the social system. Modelling of diffusion is a relatively advanced area of research, with published work spanning several decades. Diffusion studies generally analyse the development of first purchases of a new product or service by a population over a period, the rate of diffusion, the cumulative number of adopters during that period, the total number of potential adopters in a population and the rate at which adoption occurs (see Mahajan *et al.*, 1990; 1993 for a literature review and directions for further research and Mahajan *et al.*, 1995, for a discussion of empirical generalisations and managerial uses of diffusion research). Various functional forms for the rate of adoption lead to models that imply different diffusion processes. Methodologies seem to follow a prespecification of an analytical model and its fitting to data for a varying number of applications.

Researchers look at the diffusion of innovation from different perspectives. Several researchers have evaluated the applicability of the theory to consumer behaviour. A recent meta-analysis of 15 major articles on the subject (Sultan *et al.*, 1990) found that 213 sets of parameters were used in the estimations. Innovations examined included agricultural products, durable goods, industrial products,

franchises in fast food restaurants and hotels, medical innovations and financial investments. Most diffusion applications were based on US and European data. The meta-analysis showed that diffusion of an innovation depends more upon such factors as word-of-mouth than upon the innate innovativeness of consumers. The estimated coefficients of innovation were fairly stable under a wide variety of conditions, although models fitted to data from European countries have higher coefficients than US models. The coefficient of innovation reflects the chance of adoption of an innovation by an individual. In contrast, the coefficient of imitation varied widely with (1) the type of innovation examined; (2) the estimation procedure employed, and (3) the use of other marketing-mix variables by the company.

Marketing management researchers focused on the implications of the diffusion theory for:

- targeting new product prospects; and
- developing marketing strategies aimed at potential adopters.

Research in the area has largely developed by examining the major assumptions underlying the basic Bass (1969) model. Thus, research has examined what happens to the diffusion of an innovation under the following conditions:

- the market potential of the new product changes;
- the diffusion of an innovation depends upon other innovations;
- the nature of an innovation changes over time;
- the geographic boundaries of the social system change during the diffusion process;
- the diffusion process is not binary (potential adopters adopt or do not adopt);
- the diffusion of an innovation is influenced by marketing strategies;
- the product and market characteristics influence diffusion patterns;
- there are supply restrictions;
- there is more than one adoption by adoption unit.

Questions have been raised in recent years about the forecasting accuracy of diffusion models, asserting that the analytical elegance of most studies surpasses the empirical validation of their derived results (see Gatignon and Robertson, 1985; Robertson and Gatignon, 1986 and Mahajan *et al.*, 1990; 1993; 1995). Research on

diffusion of innovations (henceforth DR) contributes relatively little to the present study. This is due to several issues:

- DR focuses mainly on domestic markets. Extension of the models in international markets is truly limited in number and scope. The few models applied to international markets take into account consumer-only variables like cosmopolitanism (Gatignon *et al.*, 1989) or consumer involvement, learning and culture (Wills *et al.*, 1991; Amine, 1993; Samli *et al.*, 1993). DR in effect understands that adoption of products across countries is fundamentally affected by communication between consumers. For instance, Mahajan *et al.* (1995) conclude that: 'an important concept of diffusion theory relevant to predicting the global diffusion is the nature of communication about the innovation between two countries. The ability of change agents or adopters of an innovation in one country, called the lead market, to communicate with the potential adopters in the second country, referred to as the foreign market, ....., influences the rate of adoption among its potential adopters' (p. 381). Severe questions were raised about the applicability of the premises of the Bass model in international settings (Mahajan *et al.*, 1990, p. 21).
- DR does not consider all the firm-originated decisions and the time objectives regarding the geographic spread and time length of launch. DR also does not consider if the launch of an innovation is a (re)action to competition. Gatignon and Robertson clearly mention on these points that DR 'almost totally ignores firm intentions for marketing the innovation. Even the research on new product diffusion conducted by marketing and consumer behaviour researchers ignores the intentions of supplier firms' (Gatignon and Robertson, 1985; Robertson and Gatignon, 1986, p. 6). DR seems to assume in this respect that rollout is simultaneous across the world.
- DR does not consider any firm factors that facilitate or delay the launch of an innovation across borders (e.g., lack of resources, deficient communication with subsidiaries, few synergies with other products, inappropriate distribution, mistakes in the product development or product inferiority factors).
- Last, but not least, DR applies to first product sales. The same internal organisational circumstances and market dynamics may not apply to product replacements.

Despite the number of its limitations, however, research on the diffusion of innovations provides insights that are relevant to this study. These are:

- An increase in market potential in some markets (the first assumption in the Bass model) may trigger a shortage of available quantities of products and other resources. These may be due, for instance, to insufficiency of manufacturing capacity to satisfy the requirements of additional countries; or lack of resources, including marketing and technical staff time and funds, to serve these markets.
- The rollout of a product relates to other products (the second assumption in the Bass model). Synergies between this product and other existing products are likely to facilitate the timely rollout across countries. Lack of synergies on technological or marketing grounds (such as product concept, distribution channels, sales force education and maintenance requirements) are very likely to cause delays in rolling out a new product.
- Delays should happen if the nature of innovation changes over time (the third assumption in the Bass model). Product adaptations for individual markets require time and resources. The possession of the necessary resources will lead to enhanced technologies and marketing effort, which, in turn, will lead to more rapid diffusion because they will meet the customer needs sooner and better (Mansfield, 1982; Robertson and Gatignon, 1986, pp. 5-6). Insufficient quantity and inadequate quality resources (that is, the required resources exceed the current organisational capabilities), are likely to cause delays in rolling out the new product.

These are insights to be considered in the present investigation.

### 2.3.3 Organisational strategy

'Strategy' is defined in several distinct ways (see Hax and Majluf, 1988; Kerin *et al.*, 1990 for a discussion). Perspectives range from idiosyncratic strategies that vary for every single business setting (Andrews, 1971) to contingent strategies (Chandler, 1962; Learned *et al.*, 1965; Mintzberg, 1978; Hambrick, 1980; Ginsberg, 1988) and generic strategies applicable to every business setting (Porter, 1980; 1985). These varying perspectives have a profound effect upon marketing and product portfolio strategy across borders. The deployment of a new product across multiple country markets reflects strategic decisions regarding product portfolios and constitutes the

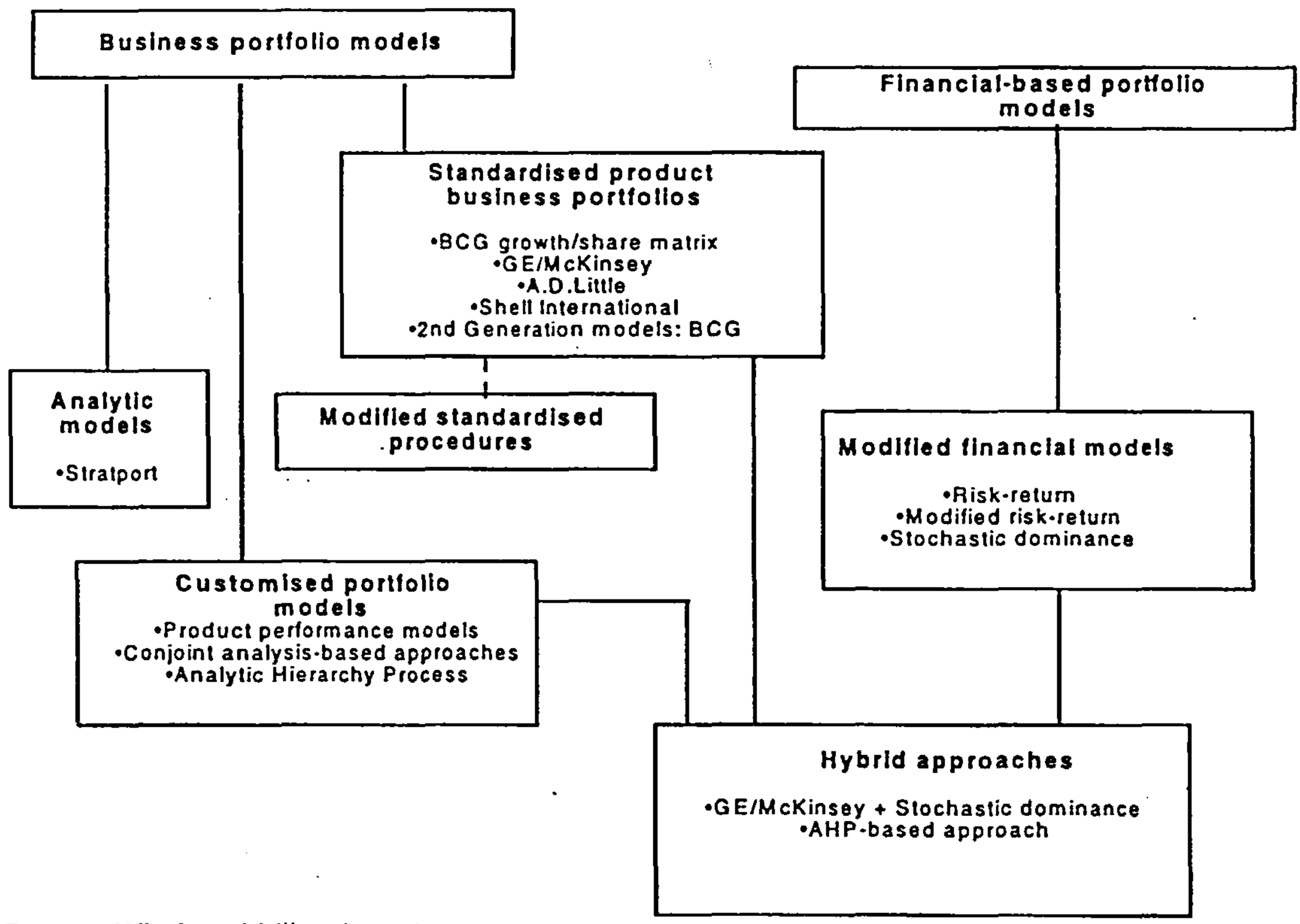
implementation of such decisions (Douglas and Craig, 1989). It therefore becomes important to look more closely at product portfolios, which we will consider next.

### 2.3.4 Product management

#### 2.3.4.1 Management of product portfolios

During the 20th century, firms generally developed from offering a single line to offering multiple lines and products. Organisations learned that they could not succeed without good management of their products. This 'involves an understanding of, and sensitivity to, consumer needs to identify good ideas for new products and services, knowledge about competitors, an appraisal of opportunities [and] a commitment to the process of developing new products' (Hisrich and Peters, 1991, p. v) and further is concerned with 'eliminating these products that do not serve the company goals any more' (Avlonitis, 1980; Hart 1987).

Substantial literature on this subject has accumulated over the years (Cooper, 1979; Booz *et al.*, 1982; Johne, 1984; Johne and Snelson, 1989; Craig and Hart, 1992; Hart and Baker, 1994). Many researchers concentrated upon the composition of product portfolios (see Varadarajan, 1990; Mahajan and Wind, 1992; Wind and Lilien, 1993). Figure 2.1 shows a classification of product portfolio models. Models are grouped on an either financial or business base.




Source: Wind and Lilien (1993)

**Figure 2.1 Classification of product portfolio models**

Other researchers concentrated on aspects such as the position of the product variable within the framework of the broader dynamics of competition (Gatignon *et al.*, 1989; Heil and Robertson, 1991; Bowman and Gatignon, 1995). Linking the above indicate the need to identify the position of a new product within the wider company product portfolio. The most important products for the company are likely to be the products that account for a substantial amount of company sales (Mahajan *et al.*, 1993). Because these products are important, they are more likely to reflect the main business focus of the company and the current strategic directions of a firm.
The rollout of these products is therefore more likely to attract managerial attention for accurate estimation of the anticipated rollout time, and should constitute a basis for the sampling rationale of the present project.

#### 2.3.4.2 (Re)action against competition and the rollout of new products

Chen *et al.*, (1992) and Heil and Walters (1993) argued that any company's incentive to act or react - probably through the launch of a new product - relates to at least four different elements:

- competitive impact and its pervasiveness;
- attack intensity (the extent to which the competitive action has affected the company's markets for the specific product);
- the type of action; and
- implementation requirements (the degree of effort that the initiating firm requires to execute an action).

These are explained in turn.

**Competitive impact**

It is likely that the greater the competitive impact suffered by a company under attack (the 'victim'), the greater the 'victim's' intention to (re)act. This is because the 'victim' company is more likely to become aware of, and motivated to respond to, an action that has great competitive impact upon its long-term survival. The pervasiveness of such competitive impact is also important. Competitors attempting to achieve their objectives in a manner that:

- is inconsistent with the rules of competitive conduct in an industry; or
- is overly self-serving; or

- threatens social and political norms; or
- benefits one party at the expense of another,

are sending signals of high hostility to other firms (Heil and Walters, 1993). These signals tend to stimulate the feeling of pervasiveness and trigger strong reactions (Scherer and Ross, 1990; Kahneman *et al.*, 1986a; 1986b). Although competitors may initially be uncertain of the implications of such a move, its very pervasiveness will tend to impel the 'victims' to react (Chen *et al.*, 1992). This may create a snowball effect (Farrell and Saloner, 1985) which is likely to give a strong impetus to any company in the sector to (re)act, even unnecessarily (Chen *et al.*, 1992). By the same logic, a hostile competitive action with pervasive implications for the 'victim' company will tend to provoke speedy counteractions and a fast and timely rollout of new products. This is because a delay in the availability of the new product for sale may cancel out all potential benefits for the company from developing the product in the first instance. In contrast, when a competitor undertakes a market activity:

- in a conventional manner;
- that is not overly self-serving; or
- that is consistent with social and political norms; or
- that is unselfish,

signals of low hostility are derived by the affected firms. Perception of the importance of competitive impact is weaker because the normal pattern of competitive behaviour is not disturbed (Nicholson, 1978; Kahneman *et al.*, 1986a; 1986b). By the same logic, a less hostile competitive action with non-pervasive implications will tend not to create a speedy counteraction and a rapid timely rollout.

**Intensity of the attack**

Attack intensity reflects the degree to which the company under attack (the 'victim') perceives itself to be threatened by competitors' action across its markets (Chen *et al.*, 1992). This captures the direct threat of a competitive action to the company under attack. While competitive impact reflects the pervasiveness of the move, attack intensity focuses more on the depth and width of the effect upon the 'victim's' markets. A competitive move does not have the same overall impact on every market of the 'victims' it threatens. The degree of threat depends upon the number and the importance of the affected market(s) for the affected companies. The more the

markets, the greater the threat. This impact also depends upon the internationalisation of the attacking firms. The more international the attacking firm and the higher the intensity of the attack, the higher the overall force and the potential impact of that attack.

**Type of action and implementation requirement**

Nonetheless, firms are not always prepared to act or counteract. They need time not only to understand and analyse changes in competitive rivalry, but also to decide how to respond (Chen *et al.*, 1992). A company's response relates to the type of action concerned and the implementation requirements for that action. For instance, in some sectors, most new products introduced by competition are replacements of older ones. This influences the importance of technology changes incorporated in every new product generation, because the product life cycle is short and new products incorporate in most instances only few technological changes (Samiee and Roth, 1992). In other cases, the situation may be different and introducing a new product may demand the incorporation of important technological changes.

The rollout of such a new product may require major investment in assets (Galbraith and Kazanjian, 1986), major reorientation of the organisation (Thompson, 1967), major change in the definition of the business (Abell, 1980), reconfiguration of the organisational structure (Galbraith and Kazanjian, 1986) and radical changes in management practice (Dutton and Duncan, 1987). Such new products may be fewer, but their rollout is more likely to face obstacles in execution because of the difficulty in reorienting and structurally reforming the company (Chen *et al.*, 1992). Something similar was argued by Teece (1977) when he claimed that international transfer of technology may be deterred by substantial difficulties and costs.

Concluding, this research stream provides an important insight into the present investigation. This insight is that 'victim' companies will have different incentives to react and their response behaviour is shaped by the attack intensity and pervasiveness of competitive moves having an impact upon them. The degree of threat to the company's key markets across multiple countries is likely to be a key issue. Major implementation requirements due to substantial technological changes will delay the rollout of the new products.

#### 2.3.4.3 Adding new products: new product development[2]

Research in the area is diverse and large. Even though new product development (NPD) is crucial to organisational survival and a major core competence, it is nevertheless challenging to group the various contributions into coherent research streams. Literature is fragmented and varied. Within a wider innovation literature, there are two broad areas of inquiry that complement one another (Adler, 1989).

The first area of inquiry is economics oriented. It offers understanding of innovation across countries and industries, the evolution of technologies, and intrasector differences in the propensity of firms to innovate (e.g., Nelson and Winter, 1977; David, 1985; Dosi, 1988; Urabe *et al.*, 1988). Within this area, product development remains rather neglected. At best, this work describes the evolution of idiosyncratic innovation routines within organisations (Nelson and Winter, 1977).

The second area of inquiry is the NPD literature, explaining how firms develop new products. Research contributions in this second area have multiplied in parallel with the increasing importance of proficient NPD for organisations (Dumaine, 1991; Business Week, 1992; Schender, 1992). In the NPD literature, the primary focus has been to acquire a rich understanding of the actual process of developing new products and the reasons for 'success'. This research area indicates that organisational structures, managerial practices and product/project characteristics lead to an improved NPD process and greater new product success. Literature in the NPD area can be organised (Brown and Eisenhardt, 1995) into three major research streams, namely: (1) rational plan, (2) communication web, and (3) disciplined problem solving. These streams have followed diverse routes of development, but their findings are complementary. The three research streams are now presented.

**NPD as rational plan**

This rational plan perspective emphasises that successful NPD is the result of the combination of several elements. Put in simple terms, the basic rationale underlying this stream of research is that a product well planned and implemented and appropriately supported will be a success (Brown and Eisenhardt, 1995). Typically, methodologies rely heavily on single informants quantifying subjective judgements surrounding long lists of success and failure factors. Researchers also use a variety of indicators to measure success (profits, sales, market share, etc.). There have been several attempts to integrate research in this area. A recent meta-analytical

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[2] This section has benefited from Brown and Eisenhardt (1995).

review (Montoya-Weiss and Calantone, 1994) examined 47 studies. They grouped the factors responsible for success in NPD into four sets: strategic, market environment, development process and organisational factors (see Table 2.1).

**Table 2.1 List of factors affecting new product success**

**1. Strategic factors**
- Product advantage
- Marketing synergy
- Technological synergy
- Strategy
- Company resources

**2. Market environment factors**
- Market potential
- Market competitiveness
- Environment (no risk, certainty, favourable regulatory environment)

**3. Development process factors**
- Protocol (firm's knowledge and understanding of target market, customer needs, product concept, product specifications)
- Proficiency of predevelopment activities (initial screening, market and technical assessment, market study and analysis)
- Proficiency of market development activities (proficiency of market research, customer tests, service, advertising, distribution, launch)
- Proficiency of technological activities (proficiency of product development, in-house testing, technology skills)
- Top management support, control, skills
- Speed to market (speed of development process or launch effort)
- Costs (overruns, expenditure control)
- Financial/business analysis (proficiency of ongoing financial and business analysis during the NPD process)

**4. Organisational factors**
- Internal/external relations
- Organisational factors

Source: Montoya-Weiss and Calantone (1994)

Strategic factors include product advantage, synergies in marketing and technology and company resources. Market environment factors include the competitive nature of the market and its potential. Development process factors reflect the proficiency of the company in the execution of the NPD process. Organisational factors complement the above by including strong internal and external relations and internal company co-ordination.

Studies in this stream remain largely exploratory. As Brown and Eisenhardt (1995) suggest, the exploratory state of current theory still causes several problems regarding the coherence of the developed theory. The basic finding, that a product

that is well planned and implemented and appropriately supported will be a success, does not seem to judiciously advance theory. The same is true of claims that products targeted at a large growing market are more successful. Such a finding could not be considered surprising (Brown and Eisenhardt, 1995).

Historically, the study by Myers and Marquis (1969) was among the earliest. They investigated the development of 567 successful products and processes in over 100 firms and 5 industries. Later studies added failures to the mix (e.g., Rothwell, 1972; Rubestein *et al.*, 1976). The SAPPHO study (e.g., Rothwell, 1972; Rothwell *et al.*, 1974) looked at 43 success and failure pairs among chemical and instruments' firms in the UK.

Similar studies in Finland (Kulvik, 1977), Hungary (Szakasits, 1974) and West Germany (Gerstenfeld, 1976) largely confirmed the findings of the previous studies. Later research sharpened the emergent emphasis on product advantages, market attractiveness and internal organisation. Particularly important were two studies by Cooper (1979; 1983a; 1983b; 1984; 1985a; 1985b; 1988; 1992 and Cooper and Kleinschmidt, 1987; 1991). The first examined 102 successful and 93 failed products within 103 industrial firms in Canada (Cooper, 1979). The second study examined 203 products in 125 manufacturing firms, including 123 successes and 80 failures (Cooper and Kleinschmidt, 1987). More recently, the same authors conducted a third study of product development in the North American and European chemical industries. The authors replicated some of their earlier findings. They suggest that successful product development occurs when (see, for instance Cooper, 1994 and Cooper and Kleinschmidt, 1993a; 1993b; 1995a; 1995b):

- The product delivers unique benefits and superior value to the customer. It is developed by a cross-functional team, it is sharply defined early in its process and it receives time and resources.
- The process of product development is proficiently executed, multistage, strongly market oriented and focused upon the customer. This process also includes up-front preparation, namely screening, market studies and technical feasibility.

The findings of the Stanford Innovation Project in the electronics industry also emphasised product advantage, market attractiveness and internal organisation. Seventy product success/failure pairs were initially surveyed and, from these, 21 case studies were subsequently conducted (Maidique and Zirger, 1984; 1985). A third study expanded the first two by examining 86 success/failure product pairs

(Zirger and Maidique, 1990). The authors' conclusions largely confirm Cooper's (1979) and Cooper and Kleinschmidt's (1987) studies. For example, the authors wrote: 'Products are more likely to be successful if they are planned and implemented well' (Zirger and Maidique, 1990, p. 879). More recently, other authors confirmed the importance of predevelopment planning (Dwyer and Mellor, 1991), the focus on marketing and R & D involvement (Hise *et al.*, 1990; Gupta *et al.*, 1986; 1991).

Of much interest to the present study is also a recent trend towards studying the acceleration of product development (e.g., Gupta and Wilemon, 1990; Cordero, 1991; Mabert *et al.*, 1992; Millson *et al.*, 1992), timeliness in NPD (Cooper and Kleinschmidt, 1994) or speedier overseas launches (Oackley, 1996). For example, Gupta and Wilemon (1990) polled the factors that accelerated the development processes. These factors included more resources, internal organisation, early cross-functional teamwork, customer and supplier involvement in the process and visible top management support.

Cooper and Kleinschmidt (1994) found that the top three time savers during the NPD process are the organisation of the project, a solid up-front preparation and a strong market orientation of the NPD effort. Interestingly, these authors identified that timeliness in NPD shows only a small positive correlation with financial performance of a new product project; its impact is not nearly as strong as one might have expected. Timeliness in NPD emerged as an independent or stand-alone performance dimension in the factor analysis they conducted. More precisely, they identified a two-factor solution where factor 1 was a *financial performance factor* (comprising profitability, success/failure, market share, and impact on firm; loadings >.65); whereas factor 2 was the *time-related factor* (p. 392). Further their correlation matrix revealed only a handful of significant correlations between the measures of time and the various financial performance measures and certainly 'far less than the direct or almost one-to-one links the 'hype' seems to imply' (p. 393). They also noted that a correlation of .42 found between timeliness and profitability explained only 16 per cent of the variation in this possible causal relationship.

Oackley (1996) examined the association between commercial successes and international commercialisation of the new products. He found that there is a significant association between greater commercial successes and more ambitious and speedier overseas launches. He suggested that firms should commercialise their new products in foreign countries as boldly and as quickly as possible.

The distinction between 'new' products and product replacements is also important (Saunders and Jobber, 1988; 1994). These authors suggested that managers manage product replacements and 'new' products differently. The authors:

- identified that there are 5 different types of product replacement, namely inconspicuous or conspicuous substitution, tangible or intangible repositioning and a facelift;
- detected that the number and type of marketing and technological changes vary in accordance with the above types (a facelift replacement, for instance, has undergone only changes in its appearance and consumer promotion, whereas an intangible repositioning has undergone a change in price, target market and advertising);
- argued that launch-phase strategy is distinguished into a rapid or slow penetration and a rapid or low skim; and
- found that replacing the older products can be done on a national, segmental or regional basis.

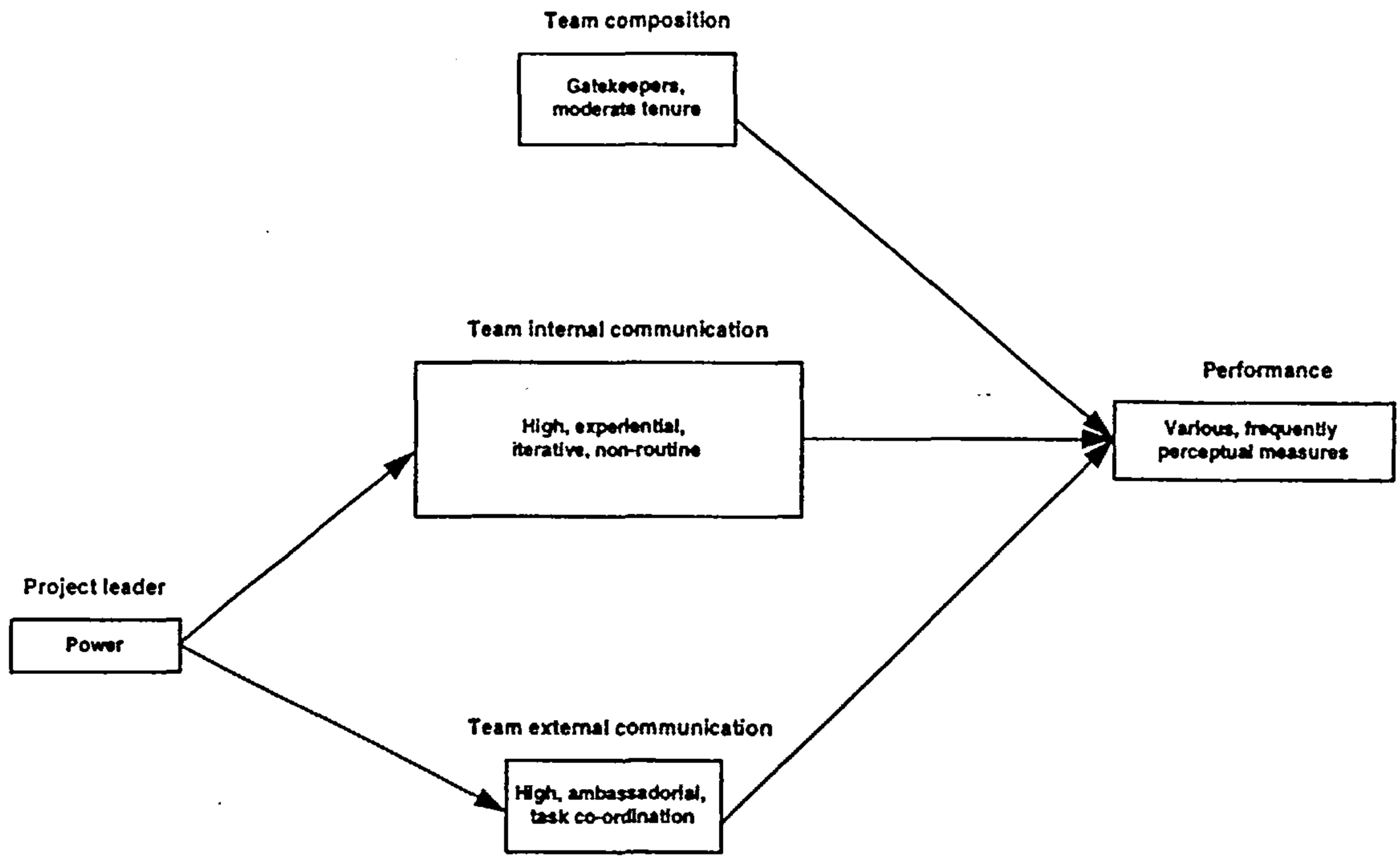
**NPD as a communication web**

This second stream narrowly focuses only on communication. The underlying premise is that communication among project team members and with outsiders stimulates the performance of development teams. Thus, the more the members connect to each other and with key outsiders, the greater the likelihood of successful development. Methodologically, studies have used multiple informants and sophisticated research designs. These methodologies yielded quality insights, an issue that is of interest to the present investigation too.

Two theoretical themes emerge in the literature. One, an information-processing view, emphasises that frequent and appropriately structured task communication (both external and internal) leads to more comprehensive and varied information flow to team members and, thus, to higher-performing development processes. The second, a resource dependence view, emphasises that increased resources (e.g., budget, personnel, equipment) available to the team lead to higher-performing development processes.

Some of the earliest empirical research along these lines focused on the flow of information in R & D groups (e.g., Allen, 1971; 1977; Katz and Tushman, 1981). The results of these early studies highlighted the importance of external communication, mainly between key product development individuals and people

outside their specialities. This external communication brought information into the organisation that was then disseminated to fellow team members (Katz and Tushman, 1981).




Source: Brown and Eisenhardt (1995)

**Figure 2.2 NPD as a communication web**

The content of that external communication was examined by Ancona and Caldwell (1990; 1992a; 1992b). They measured success by subjective team and management ratings of performance. The authors found that team members communicated more with outsiders who had similar functional backgrounds. They also found that, when the team comprised more functions, there was greater external communication by the team as a whole and greater performance (Ancona and Caldwell, 1992a). This external communication strategy was comprehensive. Teams combined 'ambassador' and 'task-co-ordination' activities that helped them to secure resources, gain information and so enhance success. 'Ambassador' (that is, political) activities involved lobbying for support and resources, buffering the team from outside pressure and engaging in impression management. 'Task co-ordination' involved the co-ordination of technical or design issues.

Finally, researchers focused on how communication affects the performance of teams over time. For example, Katz (1982) explored in a large US organisation the relationships among the degree of external communication, the mean tenure of a team and performance. He found that group performance increased with mean

tenure of the group, but that this relationship reversed and performance dropped off after five years. The decline in performance was significantly correlated with a decline in external communication.

There also has been interest in the internal communication among team members. Keller (1986) found that internal group cohesion helped performance. Similarly, Ancona and Caldwell (1992a) found that teams with thorough internal communication had superior performance. They defined goals better, developed workable plans and prioritised work. Dougherty (1990) showed though, that the various functional departments were isolated in their own 'sphere' of knowledge and way of understanding. Not surprisingly, individuals from different departments interpreted the same information in different ways. What distinguished successful projects was not the absence or presence of these barriers, but rather how they were overcome. Failed products received sequential attention by functional groups, each function dominating a particular phase of the project. Successful products were developed by cross-functional personnel that convened in a highly interactive, iterative fashion. This increased information content (Dougherty, 1990) and participation (Dougherty, 1992).

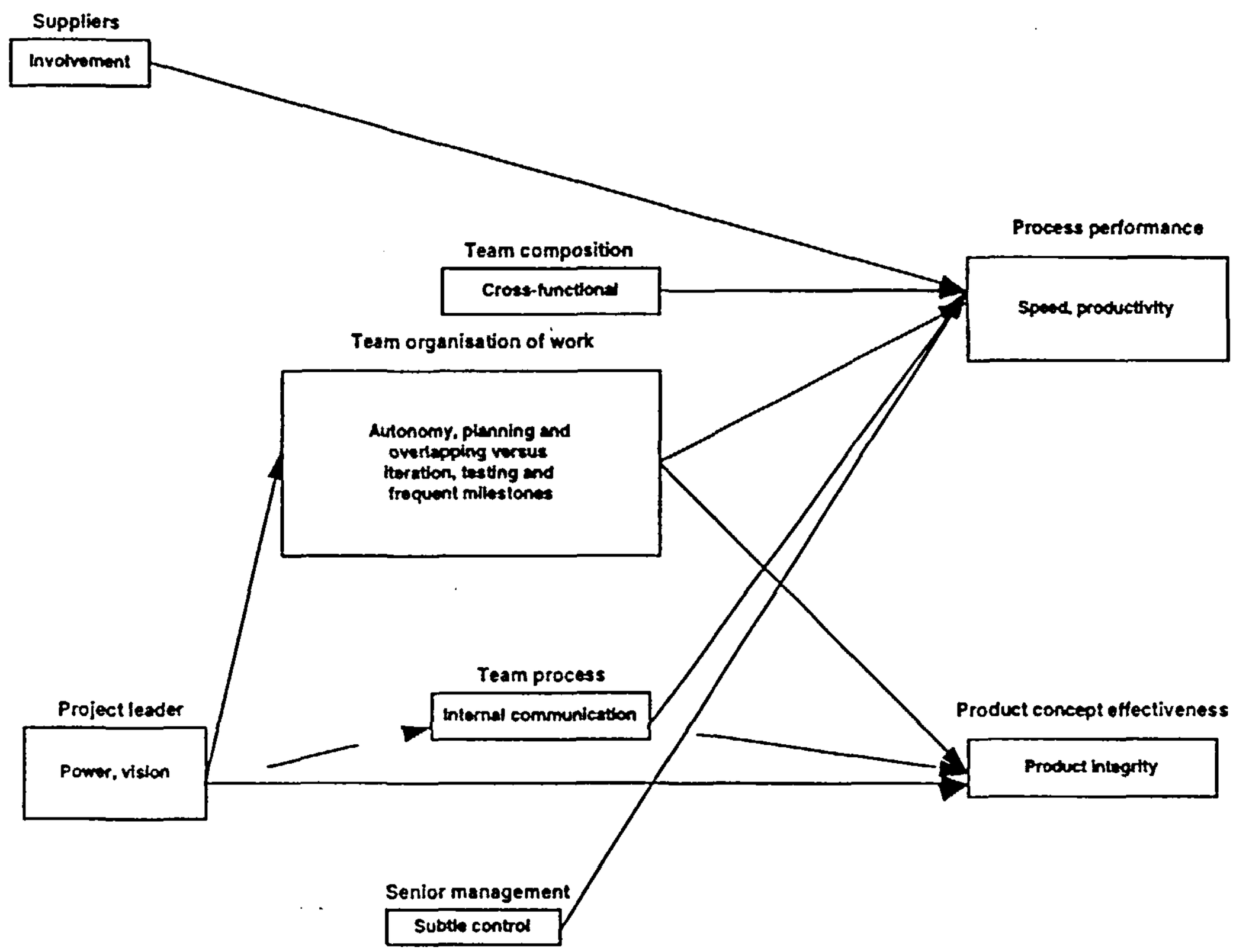
More recently, some researchers explored the link between the product development process and organisational structure. Olson *et al.* (1995) interviewed managers from different functions for 45 NPD projects. They found that the less experience cross-functional teams have with a new product, the greater:

- the amount of difficulty they encounter;
- the interdependency among the various functional areas;
- the flow of information and resources; and
- the reliance on less formal co-ordination structures.

In contrast, the more experience the functional participants have with a new product, the more mechanistic and formal the development process. Olson *et al.* (1995) also examined the time required for commercialisation. They found that projects with good 'fit' between newness and formality were likely to be completed within -or faster than - their anticipated time frame. 'Fit' was defined as the balance between the newness of the project and formality. The greater the extent of project newness, the lesser the need for formality to achieve successful NPD and timely product launch.

**NPD as a disciplined problem solving**

The disciplined problem-solving stream (Brown and Eisenhardt, 1995) evolved from case-based research (Imai *et al.*, 1985; Quinn, 1985; Takeuchi and Nonaka, 1986).[3] Methodologies are more complex and sophisticated than the single-informant ones that underlie much of the rational model research. The perspective extends the information-processing view of the communication web research by emphasising both information and problem-solving practices. Successful product development results from balancing a relatively autonomous project team and a disciplined heavyweight leader,[4] strong top management and overarching product visions (Brown and Eisenhardt, 1995). The result is a fast and productive development process.




Source: Brown and Eisenhardt (1995)

**Figure 2.3: Disciplined problem-solving model of NPD**

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3 See Imai *et al.* (1985). They studied seven successful product development projects, including Fuji-Xerox's FX-3500 copier, Honda's City box-car and Canon's Sure Shot camera.

4 'Heavyweight' team leaders co-ordinate the activities of a product development team and work with senior management to create an overarching product concept (part of the 'product integrity' concept - see below). Senior management can exercise subtle control through these 'heavyweight' team leaders, who manage their teams in the context of a product vision.

Later research concentrated upon two sectors with different speeds of technological change: automotives of medium and computers of rapid technology change. Clark *et al.* (1987), Clark and Fujimoto (1991) and Hayes *et al.* (1988) studied 29 cases of major car development projects across three American, eight Japanese and nine European companies. They reported that extensive supplier networks coupled with overlapping product development phases, communication, cross-functional groups, heavyweight team leaders and 'product integrity'[5] improved performance. They measured three dimensions of product development process performance: total product quality, lead time and productivity. Heavyweight team leaders are able to gain resources, command respect, break down traditional functional allegiances and build a strong product vision (Clark *et al.*, 1987; Clark and Fujimoto, 1991; and Hayes *et al.*, 1988). Hayes *et al.* (1988) also emphasised predevelopment activities and described how resolving conflicts early is an important factor in speeding up the development process.

At the same time, Womack *et al.* (1990) examined lean versus mass production in the auto industry. Their conclusions replicate those of Clark *et al.* (1987), Clark and Fujimoto (1991) and Hayes *et al.* (1988).

Two major studies were carried out in the electronics industry. Iansiti (1992; 1993) examined all the major products developed by the 12 chief competitors in the mainframe computer industry (from Japan, the USA and Europe) during the 1980s (27 in-depth studies). The author focused on the development of technologies associated with the packaging and interconnect system of the mainframe processor. The primary result is that a high system focus predicted both the lead-time and productivity of product development teams. Similar to product integrity, system focus implied concern for how technology choices for a given component fit with the product as a whole. System focus also involved early planning for the integration of new technology.

Another study in the computer industry, by Eisenhardt and Tabrizi (1995), considered 72 products in 36 Japanese, European and US firms in the personal, workstation, mainframe and peripherals segments of the electronics industry. They contrasted a compression model of fast NPD with an experiential approach. They found that product teams who engaged in more experiential or improvisational product design through frequent iterations, more testing, frequent milestones, and powerful leadership developed products more quickly. In contrast, attempts simply to

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5 'Product integrity' (Clark and Fujimoto, 1991) is a broad concept. It implies a clear vision of the product's intended image and performance, and its fit with corporate image, competences and customers.

compress the product development cycle by computer-aided design, rewards for schedule attainment, supplier involvement, overlapping development stages or extensive planning not only did not accelerate pace, but in fact often slowed it.

In summary, the rational plan model offers a wide-ranging list of new product success factors. The communication web stream seems to focus on a single, yet fundamental dimension within the wider product development area. Although the findings do not form a fully coherent picture, they substantiate the probable existence of highly influential insights for the present research project. This is so despite their bias towards product development for domestic markets. It is likely that some of the new product success factors and communication issues strongly affect the time to roll out a new product across international markets. These studies suffer, though, from a major shortcoming: the product rollout is seen as part of the product development process, whereas in fact the purpose of each activity is different. The aim of the NPD process seems to be the building of a new product. The aim of the product launch seems to be its availability for sale across the company's markets. Saunders and Jobber (1988; 1994) clearly demonstrate that launch strategies are a different area from NPD.

It is likely that the development and roll-out of products across international markets are also affected by other elements. These may include market heterogeneity, sufficiency of company resources to adapt products, and co-ordination between the development team and overseas subsidiaries/agents. These issues are not present in current NPD literature. Despite these deficiencies, however, the broader NPD literature does offer insights of substantial importance to the present study. It seems that factors affecting delays in product development may also be responsible for delays in rollout. For instance, it is likely that a product developed without customer opinion from several countries will not satisfy the needs of those countries. Sending the product back to the drawing board will automatically cause delays in rollout. In-depth case study methodologies may help to uncover some of the complexities of product rollout processes, and this is another element to take into account in the present investigation.

Furthermore, the disciplined problem-solving stream of research widens the focus of the 'communication web" on the amount and variety of information exchange, by adding a third dimension to the NPD literature: that is, on-time product development involves specific problem-solving practices. It is likely that there are different problem-solving models for sectors of medium (e.g., automotives) versus

rapid (e.g., computers) technological change sectors. On the other hand, it is still too early to conclude that the problem-solving practices in NPD may be equally applicable to rollout. Problem-solving procedures are a refined conceptual area and need separate consideration in a later investigation. This is because we are not yet certain about the effects of delays in rollout of new products upon new product success. We also do not know the actual causes of such delays yet. Problem-solving procedures are therefore omitted from the present investigation.

#### 2.3.4.4 Eliminating products from the product portfolio

The product elimination literature is in parts wide ranging and general, and in other instances narrowly focused and detailed (Avlonitis, 1980; Hart, 1987). Only a handful of empirical studies have been carried out. Cooper (1975), Avlonitis (1980) and Hart (1988; 1990) are among the most important ones. Table 2.2 presents the majority of studies on product elimination published so far. These studies suggest that elimination may occur both before and after the launch of the new product (Cooper, 1975; Avlonitis, 1980).

As candidates for elimination, products undergo a four-stage process. In the first stage, managers recognise the existence of such products using specific poor performance criteria (Rothe, 1970; Baccour, 1971; Avlonitis, 1980; Hise *et al.*, 1984). In the second stage, managers attempt to revitalise these products (Eckles, 1971; Hise and McGinnis, 1975; Avlonitis, 1980). In the third stage, managers evaluate the actual weakness of the products (Worthing 1971; Banville and Pletcher, 1974; Avlonitis, 1980). In the fourth stage, managers identify the phasing-out strategy (Rothe, 1970; Avlonitis, 1980; Salerno, 1983). The formality of the elimination process has also been examined (Avlonitis, 1985) alongside the influence of several contextual elements (Avlonitis, 1980; Salerno, 1983; Kent, 1984; Hart, 1988; 1989). It is noticeable, however, that the elements transcending the extant literature on product elimination are:

- the descriptive versus prescriptive nature of studies;
- the phases- versus non-phases-based elimination decision making; and
- the internal and external influences upon the elimination decision.

This has created some serious problems. Key ones are the following:

**Table 2.2 Empirical versus prescriptive and phase versus non-phase based studies**

| | Phase reported | | | | Phase | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | approach | Sample | Sector |
| **Empirical research** | | | | | | | |
| Avlonitis (1980) | * | * | * | * | yes | 20 + 94 firms | British engineering |
| Baccour (1971) | * | n.a. | * | * | yes | 11 firms | n.a. |
| Banville and Pletcher (1974) | - | - | - | - | no | 24 firms | small home appliances |
| Cooper (1975) | - | - | - | - | no | 114 products | Canadian manufacturers |
| Eckles (1971) | * | * | * | * | yes | n.a. | veterinary, electrical |
| Evans (1977) | * | - | - | - | no | 62 salesmen | one SME electronics |
| Gauthier (1985) | * | - | * | * | yes | 17 interviews | French manufacturers |
| Hart (1987) | * | * | * | * | yes | 33 + 166 firms | British manufacturers |
| Hise and McGinnis (1975) | * | * | - | - | yes | 96 firms | sample of 500 largest US |
| Hise *et al.* (1984) | n.a. | n.a. | n.a. | n.a. | n.a. | 299 firms | Large US manufacturers |
| Kent (1984) | * | * | * | * | yes | 12 interviews | Scottish food processing |
| Rothe (1970) | * | n.a. | * | * | yes | | n.a. |
| Salerno (1983) | * | * | * | * | yes | 64 firms | French manufacturing |
| Tavlaridis (1989) | | | | | yes | 19 firms | Greek manufacturers |
| Worthing (1971) | -/* | - | -/* | - | no | 1 firm | n.a. |
| **Prescriptive studies** | | | | | | | |
| Alexander (1964) | * | * | * | * | yes | not applicable | not applicable |
| BCG (1972) | * | - | - | - | n.a. | not applicable | not applicable |
| Berenson (1963) | - | - | * | - | yes | not applicable | not applicable |
| Browne and Kemp (1976) | * | - | * | - | yes | not applicable | not applicable |
| Clayton (1966) | * | - | - | - | yes | not applicable | not applicable |
| Drucker (1963) | * | - | - | -/* | n.a. | not applicable | not applicable |
| Fluitman (1973) | * | - | - | - | n.a. | not applicable | not applicable |
| Hallaq (1976) | * | - | - | - | n.a. | not applicable | not applicable |
| Hamelman and Mazze (1972) | * | * | * | - | yes | not applicable | not applicable |
| Houfek (1952) | * | - | - | - | yes | not applicable | not applicable |
| Kotler (1965) | * | - | * | * | yes | not applicable | not applicable |
| Kotler (1974) | * | - | - | - | n.a. | not applicable | not applicable |
| Kratchman *et al.* (1975) | * | - | - | - | yes | not applicable | not applicable |
| McSureley and Wileman (1973) | * | * | * | * | yes | not applicable | not applicable |
| Michael (1971) | - | - | - | * | n.a. | not applicable | not applicable |
| Sonnecken and Hurst (1960) | * | * | * | - | yes | not applicable | not applicable |
| Wind and Claycamp (1976) | * | - | - | - | n.a. | not applicable | not applicable |
| Winkler (1972) | - | - | - | * | yes | not applicable | not applicable |

Note: Unit of analysis is the single research project and not the various publications derived from it.

- The gap between prescriptive stances and empirical studies is sufficiently wide to impose problems of incomparability of findings and incomprehension of management practice.

- There is only anecdotal understanding of the relationship between product elimination and product replacement issues. There is also no empirical evidence on elimination decisions of products marketed in international markets.
- The examination of product elimination for new products targeting international countries is complementary, yet different from new product rollout. It is complementary because elimination may occur before or during the rollout of a new product across its international markets. It is also complementary because there may be a link between product cannibalisation or optimal timing of product replacement and rollout. Here, though, attention is focused on the time it takes to commercialise the new product across countries and the causes of delays in doing so. It is likely that a poor performer becomes a candidate for elimination, but current knowledge does not permit one to conclude that delay in rollout correlates with poor new product performance in the first instance.

### 2.3.5 International business literature

The literature on international business spans almost 200 years but specific research traditions are isolated and there is limited interaction between them. Older contributions relevant to this project go back to international trade theories. More recent contributions have their roots in theories of organisational structure in multinational enterprises and international marketing.

#### 2.3.5.1 International trade theories: the international product life cycle concept

Several decades ago, Heckscher (1919) and Ohlin (1933) extended the Ricardian trade model (Ricardo, 1817) and suggested that nations' trade success comes from product-related cost advantages. Later, Linder (1961) found that trade commodities are similar between countries with similar income levels and demand patterns. The reciprocity of product demand and supply was also used by Alfred Marshal in his theory of foreign trade (1879). Buckley and Casson (1976) also assumed within the framework of internalisation theory that the cross-border elimination of external intermediaries includes international product management operations.

In the mean time, Vernon (1966) and Wells (1968; 1969) introduced the international product life cycle (IPLC) theory. They argued that US firms technologically innovate and sell their products first in the domestic US market. This is because early home demand for advanced goods helps US firms to pioneer new products. These firms would export during the early phases of industry development and then establish foreign production as foreign demand grew. This happens

because firm-specific advantages constitute a comparative advantage that is fully realisable for the companies only by moving production from one country to another. Eventually, foreign firms would enter the industry as technology diffused, and both foreign firms and the foreign subsidiaries of US companies would export to the United States. The concept of the IPLC was highly influential. Lutz and Green (1983) and Onkvisit and Shaw (1983) empirically confirmed that the theory has some explanatory relevance for specific cases.

Other studies, however, questioned this relevance. Mullor-Sebastian (1983) found that industrial groups of products behave in a manner predicted by the IPLC theory on world markets, but not the individual products in these groups. It seems that the IPLC theory is rather limited in explaining the early post-war foreign manufacturing investment of US companies possessing specific functional utility (e.g., washers) (Onkvisit and Shaw, 1983). The IPLC theory does, however, provide an important insight into the present project. This insight is that the rollout may take place in either simultaneous or sequential manner across countries. A simultaneous rollout is when the product is made available in all countries at the same time. A sequential rollout is when the product is made sequentially available in one country after another. This is an insight to consider in the present investigation.

#### 2.3.5.2 Internationalisation strategies

The internationalisation of the firm has long been an important issue in international business research and has received regular press coverage, as a series of recent overviews suggest (Young, 1990; Buckley and Ghauri, 1993). Internationalisation strategies are a broad concept and can be defined as the part of a company's strategies that takes place across national boundaries. These were first associated with describing a company's outward action during the first phase of its internationalisation (Johanson and Wiederscheim-Paul, 1975). Even though such a crossing of national boundaries in the process of a firm's growth may be argued to be a meaningless threshold (Buckley, 1990), development through internationalisation still has significant differences and unique features as compared with development in usually narrower domestic environments (Buckley and Ghauri, 1993).

From a research point of view, there has been a substantial focus on the 'process' content of a firm's internationalisation. Within this stream, evolution in 'stages' has historically attracted substantial attention. The 'stages' theory argues that firms proceed in a sequential fashion along some organisation continuum in the development of their international activities (Johanson and Wiedersheim-Paul, 1975;

Bilkey and Tesar, 1977; Johanson and Vahlne, 1977; 1990; Cavusgil, 1980; Reid, 1981; Wortzel and Wortzel, 1981; Moon and Lee, 1990). This has been historically associated with a change in the state of a company's involvement across national boundaries (Johanson and Wiedersheim-Paul, 1975; Johanson and Vahlne, 1977; 1990). The 'stages' theory has been challenged both theoretically (Reid, 1984) and empirically (Young and Hood, 1976; Buckley *et al.*, 1979; Turnbull and Valla, 1986; Turnbull, 1987). Among the criticisms was that determination of stages and operationalisation in multiproduct, multidivisional firms are difficult (Turnbull, 1987). An evaluation of the theory was recently made in an attempt to delineate its boundaries (Rao and Naidu, 1992; Andersen, 1993).

Nonetheless, this research stream confirms the interest of the present investigation in simultaneous versus sequential rollout. Furthermore, it introduces the notion of resource sufficiency into the discussion of simultaneous versus sequential rollout of new products across international markets. Firms may be more or less developed in their internationalisation. Greater company involvement in some country markets is likely to be associated with greater resources devoted by the company to these markets. Such resources are likely in turn to facilitate rapid and timely new product rollout in these countries. This is another insight for the present study.

#### 2.3.5.3 International strategies

'Content' elements of international strategies have also been examined. The mode of entry into foreign markets has long attracted attention, and various paradigms have been proposed. Thus, according to Dunning's *eclectic* explanation (Dunning, 1980; 1988), mode of entry depends on ownership-, internalisation- and location-specific advantages. Moreover, the *transaction cost* explanation (Caves, 1982; Hennart, 1982; Anderson and Gatignon, 1986; Gatignon and Anderson, 1988) considers the choice of entry mode on a continuum as different alternatives of vertical integration.

At the corporate level, the fountainhead of most ideas is Perlmutter's notion of the geocentric firm (Perlmutter, 1969). More recently, Bartlett (1986) and Bartlett and Ghoshal (1986) outlined how the management of operations on a global basis is critical to exploiting the resources of national subsidiaries by the larger corporation. Prahalad (1975), Barlett (1985) and Ghoshal (1987) also explained the multitude of potential strategies for doing so. These strategies range from global integration to national adaptation.

There are also several proposed strategies at the business level (see Sullivan and Bauerschmidt (1991) and Doz and Prahalad (1991)). These strategies vary and depend upon several criteria. Among them are:

- Mobility barriers (Hout *et al.*, 1982; Caves and Ghemawat, 1992; Karakaya, 1993). Yeoh (1994) clearly indicated that approvals and patents to be a major barrier for launch of new chemical entities across countries.
- Market imperfections and economic disequilibria that permit multimarket sourcing and production shifting (Kogut, 1985a; 1985b).
- The nature of sector, namely global versus multidomestic (Prescott, 1983; Cvar, 1984; Porter, 1986; Roth *et al.*, 1991). An important criterion in the assigning of sectors into one group or another is the standardisation of technology across countries (Porter, 1986). Kobrin (1991) extended the above. He created a list of several sectors and showed their degree of internationalisation.
- The flexibility of the company and its ability to transfer its acquired capabilities across borders (Kogut, 1989). This includes how managers manage efficiency, effectiveness and learning in organisations (Sullivan and Bauerschmidt, 1991).
- The nature of investment, company integration and attention to local government requirements (Morrison and Roth, 1992, pp. 400-1).
- The industry globalisation drivers, organisation structure, management processes and nationality (Johansson and Yip, 1994).

Morrison and Roth (1992) eventually found that these business strategies form four clusters. The first cluster comprises firms pursuing domestic strategy; the second cluster comprises exporting firms; a third cluster consists of firms pursuing an international product innovation strategy; the fourth cluster comprises firms that pursue a quasi-global manufacturing and marketing strategy.

The above suggest three additional key elements for the sampling and the discussion of the present project:

- The first is the high internationalisation of some sectors. Time to roll out new products across multiple countries is likely to be very important in environments of intense internationalisation.
- The second is technological heterogeneity between sectors and activities. Gatignon and Robertson (1986) clearly support this point when they mention: 'the speed of diffusion can be enhanced by a reasonable standardisation of a

technology or retarded if competing standards prevail..... This factor is particularly important for high technology products, especially those dependent on software and auxiliary components (p. 4)'. Substantial product technological customisation is therefore a fundamental dimension for companies when they develop and rollout their new products.

- The third is the existence of approvals as a barrier to entry.

#### 2.3.5.4 Elements of organisational structure in multinational enterprises

Several researchers have examined the nature of structure and co-ordination mechanisms within multinational enterprises (MNEs). Historically, researchers first focused their attention upon the more evident elements of structure, namely departmentalisation in companies. Later on, researchers moved their focus towards describing structure through 'softer' and less apparent elements, like the nature of administrative mechanisms.

Early research by Stopford and Wells (1972) and Franko (1976) identified structure in terms of world-wide product divisions, world-wide functional divisions, geographic area divisions, international division and a matrix system. Egelhoff (1988) found that MNEs with world-wide product division structures tend to have high levels of foreign product diversity. MNEs with area division structures tend to have a greater percentage of foreign sales. MNEs with matrix structures tend to have relatively high levels of both foreign product diversity and foreign sales. Porter (1986) classified activities of MNEs in terms of 'configuration/co-ordination', and Takeutchi and Porter (1986) applied the concepts in the marketing area. 'Configuration' is distinguished into activity performed in a single country and activity performed in multiple countries (Porter, 1986). Roth (1992) extended the above when he found that configuration practices by MNEs are grouped into the following different clusters:

- concentrated hub (firms locate only their marketing and sales activities in many countries);
- local innovators (firms have their activities geographically dispersed);
- transnational innovators (firms co-ordinate their marketing and sales regionally and their R & D, manufacturing and finance globally);
- regional federation (a federation of regionally co-ordinated activities); and
- primary global (activities are either performed in a single location or dispersed and co-ordinated globally).

Each one of these clusters comprises companies that have configured their activities in a different way.

On the other hand, 'co-ordination' refers to the myriad of options regarding how management of operations takes place. This area has attracted multiple contributions. Martinez and Jarillo (1989) reviewed the literature in the area and grouped the administrative mechanisms used by MNEs in co-ordinating their international operations into two groups. The first group comprised the 'harder', more structural and formal mechanisms, namely:

- the grouping of organisational units (departmentalisation);
- the centralisation or decentralisation of decision making;
- the formalisation of procedures (written policies, job descriptions, etc.);
- the extent of planning (functional plans, scheduling, etc.); and
- the output and behaviour control (reports, direct supervision, etc.).

The second group comprised the 'softer', more informal and subtle mechanisms, namely:

- the lateral cross-departmental relations (temporary teams, task forces, committees, etc.);
- the informal communication (management trips, meetings, personal contacts between managers, etc.); and
- the socialisation between managers (a common organisational culture, shared vision, etc.).

Martinez and Jarillo (1989) also found a pattern of evolution: as time has passed, researchers have concentrated more on subtler and more informal mechanisms, abandoning their older unidimensional focus on 'harder' structural issues. Examples of this trend are Roth (1992) and Sullivan (1992).

Barlett and Ghoshal (1987; 1989), however, clarified that there are different distinguishable organisational models for different sectors and company types. They have constructed in this respect, a 'transnational organisation model' for transnational enterprises similar to that which Hedlund (1986) discussed. Ghoshal and Nohria (1993) complemented the above by introducing the notion of 'fit' between individual sector or country situations and the administrative mechanisms. Their findings imply that companies must identify the most appropriate organisational

model and use administrative mechanisms that 'fit' their business environment and individual markets. They found that such a 'fit' results in high performance. In support of this, the same authors found that the greater the technological dynamism, competition and local subsidiary resources, the greater the formalisation and integration, and the less the centralisation of international company activities (Ghoshal and Nohria, 1989). This means that, in volatile competitive environments, firms should opt for greater integration and more formal mechanisms.

Other researchers have looked at the impact of the culture and origin of parent companies on the use of administrative mechanisms. Rosenzweig and Singh (1991) argued that formal mechanisms of control are employed when there is cultural distance between MNEs' HQ and their subsidiaries. Kriger and Solomon (1992) found that American MNEs grant less autonomy than Japanese-parented MNEs to their subsidiaries.

Relationships between HQ and subsidiaries are of substantial importance for the present study. Previous research indicates that management of product activities may be performed in one, more than one or all countries where the company is present (configuration issues). The co-ordination of these activities is through specific mechanisms. MNEs seem to use 'softer' administrative mechanisms nowadays. An important question is whether extensive use of these 'softer' co-ordination mechanisms is necessary for timely rollout across countries. Limited use of them may well lead to delays in rollout schedule and they should therefore be included in the discussion of the present project.

#### 2.3.5.5 Order-of-entry

Numerous conceptual and empirical studies also advanced the notion that first movers achieve long-term competitive advantages. These studies purport to demonstrate the presence of a systematic direct relationship between order of entry for products (Spital, 1983; Lilien and Yoon, 1990), brands (Whitten, 1979; Urban *et al.*, 1986), businesses (Robinson and Fornell, 1985; Lambkin, 1988; Parry and Bass, 1990) and market share. Kerin *et al.* (1992) soon highlighted, however, the complexity of the phenomenon and suggested that there are other factors that moderate the order of entry-market share. Szymanski *et al.* (1995) extended the work of Kerin *et al.* (1992). They proposed that there are at least 11 market strategy and 5 marketplace factors that play this moderating role. Market strategy factors include customisation of the product; development time for the new product and synergies in facilities, customers and marketing activities. Marketplace factors

include the speed of technological change and the consumer versus industrial nature of markets.

Such first-mover effects were also examined within the context of wider international markets. Mascarenhas (1992a; 1992b) examined the intermarket and intramarket orders of entry and their performance consequences for an industrial product (the semi-submersible rig used in oil-drilling industry and launched in 73 markets). He found that almost a quarter of a century elapsed before this industrial product was introduced to two-thirds of candidate markets, even though it catered for similar needs internationally. He argued that simultaneous entry into multiple markets occurs in the mature stage of the product life cycle and the smaller markets are served later when the uncertainty regarding the product future is reduced. His findings can be summarised in the following statements:

- Market entry occurs sooner in large developed and highly centralised markets.
- First entrants are MNEs and later entrants are small local firms. Surviving first entrants maintain the highest long-term market share, followed by early followers and later entrants.

The study by Mascarenhas (1992a; 1992b) is a remarkable effort to identify the market share implications of some aspects of new product rollout across international markets. In doing so, it is essentially the only study which comes close to the focus of the present investigation and confirms the importance of the investigated subject.

The study has a number of notable features. It explicitly mentions the notion of simultaneous versus sequential entry that implicitly appeared first in the IPLC theory. It also looks at the individual project level, concentrates on a single sector and examines the product launch in a multitude of company markets. Third, it implicitly introduces the concept of key and secondary markets. Secondary markets are the less important markets for the company. These are important insights for the sampling rationale of the present investigation.

Mascarenhas (1992a; 1992b) focuses, however, on two different aspects of the rollout of a new product across international markets. He looks at the macro order of market entry, namely which country first and which second. He then looks at the micro order of market entry, namely pioneer or follower. The study also suffers in at least two areas:

- The first concerns the adoption of market share as the performance indicator. This is probably due to the conceptual roots of the study in the order-of-entry literature which extensively uses market share as the preferred indicator of performance. The appropriateness of market share has long been questioned as a performance indicator (Thomas and Gardner, 1985; Jacobson, 1988).
- The second concerns the narrow conceptual framework of the study. By having its conceptual roots in the order-of-entry literature, the study neglects substantial insights from other research streams. The explanatory power of the study suffers accordingly. It is notable that more recent discussions of the order-of-entry literature have identified a much wider range of factors affecting performance (Szymanski *et al.*, 1995).

Despite such shortcomings, Mascarenhas' work provides important elements to consider in the present investigation.

### 2.3.6 Research in international marketing

Contributions in international marketing are also relevant to our focus here. Initial focus was on the standardisation of advertising (Elinder, 1964; Fatt, 1964). Later, the discussion broadened to include other elements of the international marketing programme (Buzzell, 1968; Keegan, 1969; Aylmer, 1970). Recently, Douglas and Craig (1989) developed a model of international expansion (see Figure 2.4).

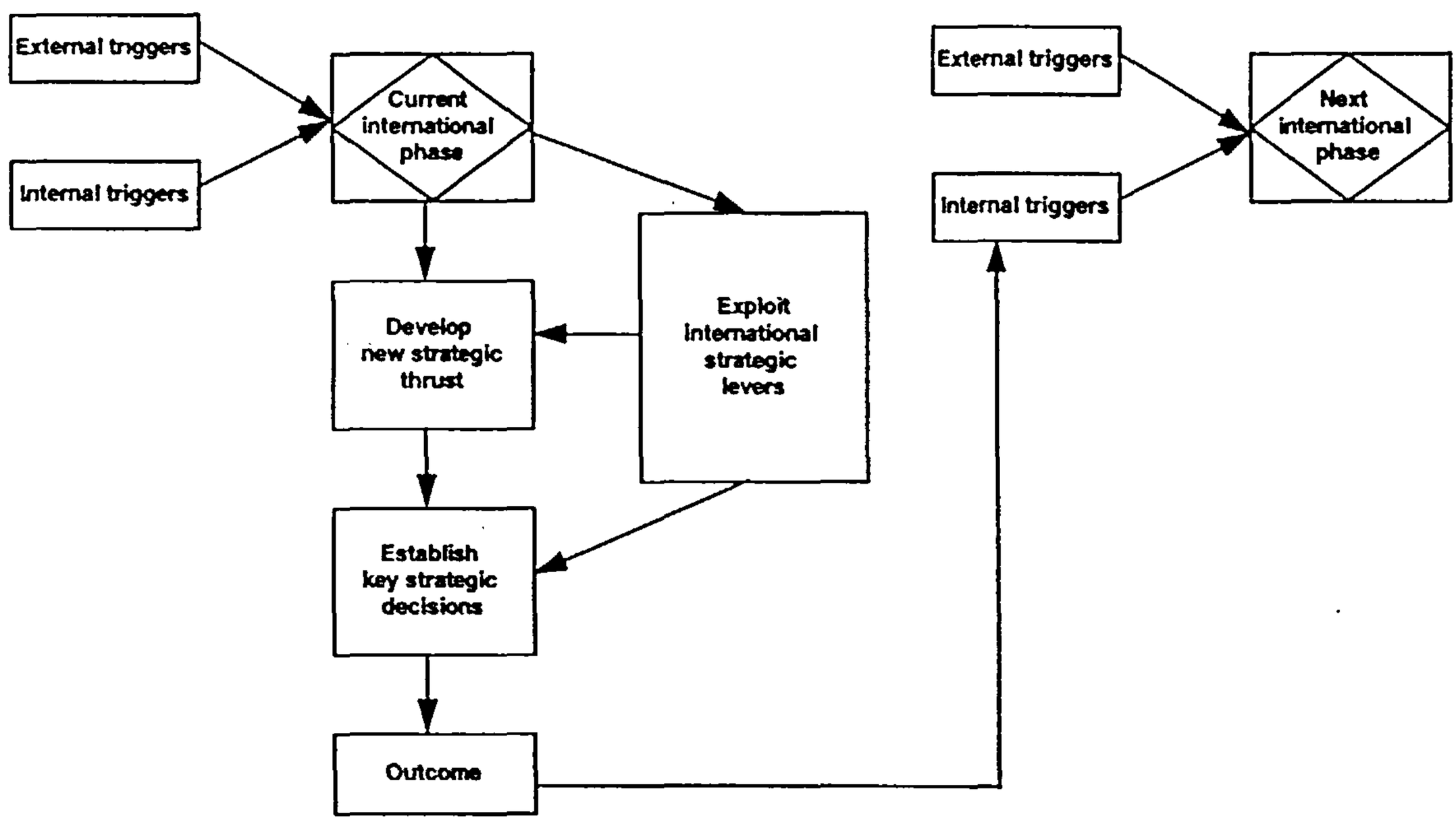


**Figure 2.4 Douglas and Craig's (1989) evolutionary process**

They conceived the international marketing strategy as an evolutionary process in which not only product policy but all organisational and marketing strategy elements vary at each successive phase. There are four successive phases: *pre-international; initial entry; local market expansion;* and *global rationalisation.* Douglas and Craig argued that there are influencing elements that interact with each other. Triggers drive companies to consider further expansion into international markets. Levers for this increasing international expansion are skills, proprietary assets and synergies. These foster strategic thrust, which leads in turn to decisions of strategic importance. Such decisions are development and adaptation of products for international markets, improvement of efficiency in operations and development of global product strategies. Success drives the companies to continue into the next expansion phase. Table 2.3 exhibits in more detail the assumed triggers, key decisions and international levers for each expansion phase.

**Table 2.3 Douglas and Craig's (1989) influencing elements**

| Phase | Triggers | Strategic Decisions | Levers |
|---|---|---|---|
| **Initial foreign market entry** | Saturation of domestic market<br>Customers move overseas<br>Risk diversification<br>Sourcing opportunities overseas<br>Foreign competition enters home market<br>Effort to be abreast of technology change<br>Government incentives to export<br>Telecommunications advances | Choice of markets<br>Timing of entry<br>How operations will be conducted | Through products, skills and marketing practices the firm is leveraging its core competencies and extending scale economies |
| **Local market expansion** | Local market growth<br>Meeting local competition<br>Local management initiative/motivation<br>Desire to use assets effectively<br>Natural market boundaries | Development of product lines which will permit growth in different segments within each country<br>Product adaptations<br>Increase economies of scope | Build strategy based upon existing structure for scope economies<br>Leverage proprietary assets (brands, expertise) for achieving expansion of product lines and share |
| **Global rationalisation** | Effort to avoid duplication of effort<br>Transfer of experience/ideas<br>Emergence of global customers<br>Emergence of global competition<br>Development of global marketing infrastructure | Improve efficiency<br>Develop global strategy | Exploit synergies<br>Improve co-ordination and integration of all operations |

The findings of other studies that relate to the present project follow.

Early research attention focused upon market elements, particularly market diversification. Ayal and Zif (1978) indicated 12 potential market diversification strategies and the factors affecting their selection. These factors (Ayal and Zif, 1979)

were: sales-response function, growth rate, sales stability in each market, competitive lead-time, spill over effects, product adaptation, communication adaptation, distribution scale economies, control requirements and extent of constraints. Their findings imply that market diversification produces superior profitability and profit stability. However, this diversification needs to be extensive (Olugosa, 1993; Kim *et al.,* 1989).

Kim *et al.*, (1989) introduced the notion of relatedness to market diversification. They found that diversification in related segments is generally associated with favourable profitability, but inconclusively associated with profit stability. Unrelated diversification will be positively correlated with profit performance when firms become well diversified internationally.

At the same time, Levitt (1983) argued the existence of segments with similar characteristics across countries. This is due to the reduction of old-established differences in national preferences by mass culture, economic and cultural interdependencies across countries and expansion of world-wide communications. These permit the applicability of a standardised action internationally. There has been a vigorous debate surrounding the validity of this argument. In fact, much discussion has taken place over the opportunities of, and barriers to, such standardisation. This discussion gives the impression that fragmentation rather than homogenisation may more appropriately describe international consumers (Kreutzer, 1988; Jain, 1989; Samiee and Roth; 1992) and international marketing strategies.

Later, attention focused upon product elements (see Table 2.4 for a list of these studies and other details). It seems that firms with more innovative products tend to be of Japanese rather than European origin and pursue a world-wide product standardisation strategy (Kotabe, 1990). Firms from newly industrialising countries have not reached high levels of innovativeness, but are rapidly improving upon this (Ting, 1982). Samiee and Roth (1992) and Szymanski *et al.* (1993) found that a broad product line, high-quality new products, quality service and competing in high-growth segments are elements associated with superior financial performance.

Davidson and Harrigan (1977) and Hill and Still (1984) suggested that firms initially introduce home-conceived products overseas. Hill and Upknown (1992) argued that these products usually undergo adaptation if they are consumer goods. There are indications, though, that MNE product adoption strategies are not consistent for all regions (Still and Hill, 1985). Fewer adaptations are required for products targeting the Americas, Africa and less developed Asian countries. More adaptations are required for products targeting developed Asian countries (James

# Table 2.4: Empirical research in international marketing: product aspects

| | Davidson and Harrigan (1977) | Davidson and Haspeslagh (1982) | Douglas and Rhee (1989) | Hill and Still (1984) | Hill and James (1991) | Hill and UpKwon (1992) | Gatignon et al. (1989) | Ghoshall and Bartlett (1988) | James and Hill (1993) |
|---|---|---|---|---|---|---|---|---|---|
| Level of investigation | Product | New products | PIMS defined business | Product | Product lines | Product lines | Innovation | Innovation | Product lines |
| Sample | Large MNEs | Large MNEs | PIMS based | Directory of American companies operating abroad | Directory of American companies operating abroad | Directory of American companies operating abroad | Euromonitor data | Large MNEs | Directory of American companies operating abroad |
| Sample size and nationality | n.a. US | 57 US | 437 US and European | 19 US and UK | 15 US | 28 US | 6 Europe - 14 countries | 75 Us, Japan, Europe | 15 US |
| Other sampling details | | | Two geographical subsamples (US vs Europe) | | | MNEs with 6+ foreign subsidiaries | | Multiphase/multi-methodology | MNEs with 7+ foreign subsidiaries |
| Method of investigation | Secondary data and interviews | n.a. | Secondary data | Mail questionnaire | Mail questionnaire | Mail questionnaire | Secondary data | Interviews and mail questionnaire | Mail questionnaire |
| Analysis | Frequencies | Qualitative and frequencies | Quantitative | Qualitative and frequencies | Frequencies | Quantitative | Quantitative | Qualitative and quantitative | Quantitative |
| Aspects | *I* | *Z, I* | *A, B, C, D* | *M, N* | *K, L, O* | *O* | *S, W* | *V* | *P* |

| | Kirpalani and McIntosh (1980) | Kotabe (1990) | Leroy (1976) | Manu (1992) | Ronkainen (1983) | Samiee and Roth (1992) | Hill and Still (1985) | Szymanski et al. (1993) | Ting (1992) |
|---|---|---|---|---|---|---|---|---|---|
| Level of investigation | Business | Product | Product | Innovation | Product | Products | Product | PIMS defined business | Product category |
| Sample | SMEs | International Directory of Corporate Affiliations | Large MNEs | PIMS (SPI4) based | Mainly Fortune 500 | America's Corp. Families and Dir of Corp. Affiliations | Directory of American Companies operating abroad | PIMS (SPI4) based | n.a. |
| Sample size and nationality | 34 US, Canada | n.a. Japan, Europe | 5 US, Canada | 473 US, Europe | 4 US | 147 US | 50 US | 1556 US, Canada, UK, and Western Europe | n.a. Far East |
| Other sampling details | | | | Two subsamples | | Firms in 'global' industries | | Companies serving only one national country | |
| Method of investigation | Interviews | Mail questionnaire | Interviews | Secondary data | Interviews, document analysis, observation | Mail questionnaire | Survey | Secondary data | Secondary data and primary sources |
| Analysis | Quantitative | Quantitative | Qualitative | Quantitative | Qualitative | Quantitative | Frequencies | Quantitative | Qualitative |
| Aspects | *D, E, F, G, H, J* | *R, U* | *Q* | *T* | *Y* | *J* | *P, J* | *J* | *R* |

Guide to investigated issues and aspects:

| Product and line aspects | | Product transfers | | Creation and diffusion of innovations | | N.p.d. | | Launch | |
|---|---|---|---|---|---|---|---|---|---|
| *Relative product quality* | A | *Subsidiary line origins* | K | *Degree of innovativeness* | R | *Process* | Y | *Order of market entry* | Z |
| *Relative amount of new products* | B | *Trasnfer initiation* | L | *Propensity to innovate* | S | | | *Speed of initial launch* | Z |
| *Product age* | C | *Obstacles* | M | *Innovation orientation* | T | | | | |
| *Relative line breath/width* | D | | | | | | | | |
| *Product line complementariness* | E | *Adaptations* | N | *Intra- and inter-company creation and diffusion* | V | | | | |
| *Sophistication* | F | *Subsidiary mix and mix localisation* | O | *Effects of market growth, nationality, standardisation and trade across the Triad* | U | | | | |
| *Value added of features* | G | | | | | | | | |
| *Position on PLC* | H | *Geographic variations* | P | | | | | | |
| *Frequency of launching products abroad* | I | *Production location patterns* | Q | *Simultaneity of diffusion* | W | | | | |
| *Standardised or tailor-made* | J | | | | | | | | |

and Hill, 1993). Product adaptation can then take place on either a 'modules' or a 'core product + attachments' base (Walters and Toyne, 1989).

When time passes and local subsidiaries increase in size, they alter the content of their product lines. Local subsidiaries replace the products developed for the HQ's home base with products conceived and developed locally (Hill and James, 1991). They may, however, adopt products from other subsidiaries. This happens when there is strong integration and dense intra- and inter-unit communication. Strong integration and communication facilitate creation, adoption as well as diffusion of innovations within the broader corporation (Ghoshal and Bartlett, 1988). This means that new products developed either in the HQ or in other subsidiaries can be rapidly adopted by third units if there is strong interaction in the corporation. There is some evidence that product development by MNEs is subject to the same rules and premises presented earlier under the NPD literature (Ronkainen, 1983).

In summary, studies in international marketing are also of substantial value to the present project. A key element is the extent of changes in the technology and marketing mix. Another is the relatedness between segments and the uniformity of technology and marketing changes across countries. Critical in this respect may be not the actual extent of product and marketing changes *per se*, but whether the organisation has adequate and sufficient resources, skills and proficiency to carry out these changes. Major changes in technology, distribution channel or salespersons' education may be more difficult to accomplish than changes in advertising or promotion.

## 2.4 Conclusions: the emergent theoretical framework

The above review shows that there is an inadequate literature and a paucity of contributions on the subject under investigation. Despite these limitations, however, previous research provides some insights into both the issue of new product rollout across international markets and the potential causes of delays in its schedule. This happens for reasons of cross-fertilisation between fields. When such insights are seen holistically, they form a more coherent whole than the sum of the constituent parts. The constructs included in the emergent conceptual framework, the items relevant to each construct and their conceptual roots are summarised in Table 2.5. Their linkages are depicted in Figure 2.5.

**External and internal environmental factors**

It seems that both external and internal environment factors will affect the company's product/market and rollout decisions. External environmental factors include the speed of technological obsolescence, the marketing and technological heterogeneity across countries and the pervasiveness and attacking intensity of competitive action. Internal environmental factors include the way the company develops its new product, the configuration of its international operations and the intensity of co-ordination between the HQ and subsidiaries/agents across countries.

Some of these factors are rooted in the wider organisational and business management research and they are assumed to apply at the much narrower product commercialisation area. For instance, Stopford and Wells (1972), Franko (1976), Miller and Dröge (1986) and other researchers' findings on organisational structure and administrative mechanisms are also likely to be pertinent at the narrower areas of product/market, NPD process or product rollout decisions. Similarly, the pervasiveness and attacking intensity of competitive action factors rooted in Chen *et al.* (1992) and Heil and Walters (1993) work are also expected to apply to product/market and rollout decisions.

Other factors such as the technological and market heterogeneity, rooted in the international marketing literature (i.e., Jain, 1989; Samiee and Roth, 1992; Wills *et al.*, 1991), have traditionally been close to the area under investigation and they are understood to have a major and direct influence upon product/market and rollout decisions.

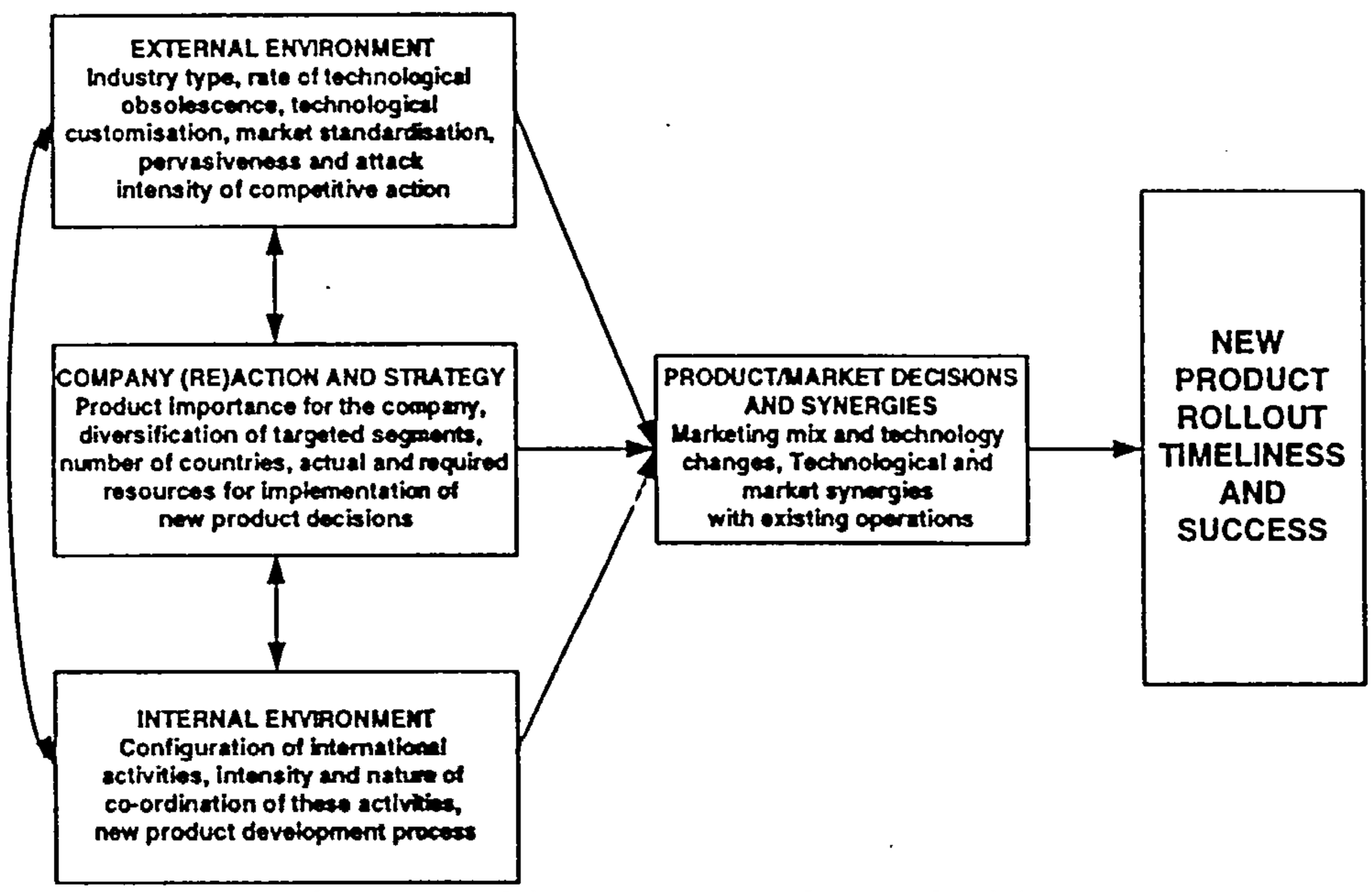


**Figure 2.5 The emergent theoretical framework**

## Table 2.5 Constructs included in the theoretical framework, items relevant to each construct and conceptual roots

### External environment

| Constructs and items tapping each construct | Conceptual roots |
|---|---|
| **Legal and regulatory environment and approvals:** Extent of local government regulations; Problems in acquiring government/technical approvals. | Ghoshal and Nohria (1989; 1993), Samiee and Roth (1992), Yeoh (1994) |
| **Technological heterogeneity:** Standardised product technology and specifications. | |
| **Complexity of customisation of product technology:** Substantial complexity of hardware and software adaptation. | Samiee and Roth (1992) |
| **Rate of technological obsolescence:** Speed of technology change within the industry; Product and production technology obsolescence rate; Rate of product modification instigated by main competitors. | Samiee and Roth (1992)<br>Samiee and Roth (1992) |
| **Market homogeneity:** Customer needs/preferences are standardised Europewide; Product awareness and information exists Europewide; Competitors market a standardised product Europewide; Standardised purchasing practices exist Europewide. | Kirpalani and MacIntoch (1980), Levit (1983), Kreutzer (1988), Gatignon *et al.*, (1989), Jain (1989), Wills *et al.*, (1991), Samiee and Roth (1992), James and Hill (1993), Yeoh (1994) |
| **Pervasiveness and attack intensity of competitive action:** Firm was threatened by competitive action; Competitive action was very hostile towards the company; This action was resulting in sales at firm's own expense; Firm was threatened in all its key European markets. | Chen *et al.*, (1992), Heil and Walters (1993), Bowman and Gatignon (1995) |

### Internal environment

| | |
|---|---|
| **Nature and intensity of co-ordination of company activities across markets:**<br>Assessment of performance: Cost and profit centres for performance assessment; Comprehensive management information systems; Quality control procedures; Standard cost procedures for performance assessment.<br>Formalisation: Formal performance appraisals; A written marketing strategy; Written manuals of procedures and fixed rules; Master marketing plans and schedules.<br>Centralisation: Who decides (HQs or subsidiaries) regarding : technology/specifications for new product; Time to launch in their markets; Product appearance/features; Segments to serve in each country; Promotion and advertising; Pricing.<br>Integration: Direct contact; meetings and interaction between Head Office and subsidiaries /agents and between staff in different European subsidiaries/agents; Transfers of managers between Head Office-subsidiaries/agents and between subsidiaries/agents; Interdepartmental permanent committees set up to allow Head Office and subsidiaries/ agents' staff to engage in joint decision making; Interdepartmental temporary task forces set up to facilitate Head Office and subsidiaries/ agents staff collaboration on specific issues; Liaison personnel; Project managers with responsibilities over total operations across Head Office and subsidiaries/agents; A matrix system where Head Office personnel within specialisations is fully integrated with personnel in subsidiaries/agents; A set of shared goals; values; and beliefs shaping behaviour of subsidiaries/agents' staff across European countries. | Stopford and Wells (1972), Franko (1976), Bartlett (1986), Miller and Dröge (1986), Porter (1986), Porter and Takeutchi (1986), Bartlett and Ghoshal (1987a; 1987b), Ghoshal (1987), Egelhoff (1988), Lemak and Bracker (1988), Ghoshal and Bartlett (1988), Martinez and Jarillo (1989; 1991), Jarillo and Martinez (1990), Rosenzweig and Singh (1991), Kriger and Solomon (1992), Roth (1992), Sullivan (1992), Ghoshal and Nohria (1993), Ghoshal *et al.*, (1994) |
| **New product development process:**<br>Integration: Integration between technical; marketing and manufacturing functions; Integration between these functions when located in different countries; Technical and marketing personnel contribution of accurate; on time and high quality input; Subsidiaries/agents provided continuous feedback; Final customers were strongly involved and provided feedback<br>Proficiency of execution of the NPD process: Predevelopment project planning; Tests of prototypes by customers/trial sales; Co-ordination of distribution channels and logistics; Co-ordination of advertising and promotion; Technical development and sorting out of unexpected 'bugs'; Technical testing of the product.<br>Protocol/ early known targets: The intended users; target countries and their needs and preferences; The product concept and product positioning; The final product specifications and technical requirements; The product final features and characteristics | Ancona and Caldwell (1992), Calantone and Cooper (1979), Cooper (1979), Ronkainen (1983), Maidique and Zirger (1984; 1985), Clark *et al.*, (1987), Cooper and Kleinschmidt (1987; 1993; 1993), Hayes *et al.*, (1988), Zirger and Maidique (1990), Clark and Fujimoto (1991), Iansiti (1992; 1993), Brown and Eisenhardt (1995), Eisenhardt and Tabrizi (1995) |

## Table 2.5 Constructs included in the theoretical framework, items relevant to each construct and conceptual roots (continued)

### Company (re)action and strategy

| Constructs and items tapping each construct | Conceptual roots |
|---|---|
| **Diversification of target segments:**<br>Number of *key* European markets for this type of product; In how many of these *key* markets the product was launched; The number of *secondary* European markets for this type of product; In how many of these *secondary* markets the product was launched; European countries which are *key* markets for the company. | Ayal and Zif (1978; 1979), Kim *et al.*, (1989), Olugosa (1993) |
| **Availability of resources for implementation of marketing and engineering decisions for the new product:**<br>Marketing resources: Marketing personnel/funds to adapt advertising/promotion; Personnel to train sales staff and technicians; After-sales service personnel and equipment; Distribution channels<br>Engineering resources: R & D personnel / funds to adapt product; Hardware and software adapted for European country markets. | Johanson and Vahine (1977; 1990), Jain (1989); Chen *et al.*, (1992), Hell and Walters (1993); Cooper (1994) |

### Product/market characteristics and synergies

| | |
|---|---|
| **Extent of marketing mix and technology changes and synergies with existing operations:**<br>Hardware and software platform / architecture; Product appearance / features; Brand names; Product positioning; Distribution channels; Logistics and delivery systems; Advertising spending; Promotion to trade and final customers; Market research, advertising, promotion, production, sales force and service, hardware and software development technical capabilities and resources; Product handling/'feeling' has changed for customer; Change in the way user is informed about product functions; Change in the way user interacts with and controls operation of product. | Davidson and Harrigan (1977), Ting (1982), Still and Hill (1985), Robertson and Gatignon (1986), Saunders and Jobber (1988; 1994), Ghoshal and Nohria (1989; 1993), Jain (1989), Walters and Toyne (1989), Kotabe (1990), Zirger and Maidique (1990), Hill and James (1991), Hill and James (1991), Hill and Upknown (1992), Samiee and Roth (1992), Hell and Walters (1993), Szymanski *et al.*, (1993), Cooper and Kliesnchmidt (1993), Olugosa (1993), Cavusgil and Zou (1994), Dhebar (1995), Ali *et al.*, (1995) |
| **Product superiority:** Unique attributes and clearly visible benefits to the customer; Superior quality; performance; value for money; Attributes also perceived as useful by the customers; Intended image consistent with corporate image. | Cooper (1979), Clark and Fujimoto (1991), Cooper (1994), Brown and Eisenhardt (1995), Montoya-Weiss and Calantone (1994) |

### Timeliness of new product rollout

| | |
|---|---|
| **Scheduled/anticipated and actual time across European markets:**<br>Length of planned and actual time for rolling out this product across key and all European markets.<br>Adherence of new product to rollout schedule. | Vernon (1966), Mascarenhas (1992a; 1992b); Cooper and Kleinschmidt (1994); Olson *et al.*, (1995) |

### Success of the new product rollout across multiple country markets

| | |
|---|---|
| Achievement of targets: Sales (value); Customer acceptance; Return on Investment; Product development budget costs; Technical performance of product; Development of the new product ; Product roll out across the key European markets; Product roll out across all (key+secondary) European markets. | Griffin and Page (1993), Montoya-Weiss and Calantone (1994) |

**Company (re)action and strategy factors**

Factors such as target market segments, the desired technological and marketing customisation, the level of required investment and the company engineering and marketing resources available, which are rooted back to Ayal and Zif (1978; 1979), Cooper (1994), Johanson and Vahlne (1977; 1990), Chen *et al.* (1992), Hail and Walters' (1993) research are likely to be pertinent to the nature of marketing and technology incorporated in the new product as well as product rollout decisions.

**Product/market decisions and synergies**

These product/market decisions include the extent of technological and marketing changes for the new product as well as the synergies of the new product with existing operations (sales force, distribution channels, target markets). There is a multitude of research on these issues as it is indicatively reported in Davidson and Harrigan (1977), Still and Hill (1985), Zirger and Maidique (1990), Samiee and Roth (1992), Cooper and Kleinschmidt (1993), Cavusgil and Zou (1994), Montoya-Weiss and Calantone (1994). These give an indication of the likely new product rollout strategies across countries and a potential linkage with the simultaneous versus sequential manner of rolling out new products and rollout timeliness. New product rollout will in turn affect the success of the new product.

Insights for the methodology and the sampling rationale include the following:

**Rollout**

- This study should make a distinction between rolling out into 'key' versus secondary (in terms of importance of sales for the company) country markets (Mascarenhas, 1992a; 1992b).
- It should examine the sequential versus simultaneous manner of new product rollout in many candidate markets (IPLC theory; Mascarenhas, 1992a; 1992b).

**Projects**

- Following traditional NPD literature and Mascarenhas (1992a; 1992b) the study should concentrate on individual project level.
- It also focus upon projects deemed important for the company in terms of sales (Mahajan *et al.*, 1993). It is likely that managers will pay substantial

attention to scheduling and estimating accurately the anticipated rollout time for such projects.

**Sophisticated research approach**

- The study should pursue a multiphase, in-depth case study approach.

**Sample**

- The study should use sample in sectors with high internationalisation (Prescott, 1983; Cvar, 1984; Porter, 1986; Kobrin, 1991; Roth *et al.*, 1991) and different speeds of technology change (Porter, 1986; Ghoshal and Nohria, 1989; 1993; Samiee and Roth, 1992).
- It should consider customisation versus standardisation of product technology (Still and Hill, 1985; Porter, 1986; Ghoshal and Nohria, 1989; 1993; Samiee and Roth, 1992; James and Hill, 1993).

Insights for the research questions include the following:

- This study should investigate if timeliness of new product rollout is related to new product success.
- It should examine if firms roll out their new products across international markets simultaneously or sequentially. It should also examine the link between the nature of product technology and sequential rollout and sequential rollout and delays.
- It should explore the factors that lead to rollout delay.
- It should also look into the interaction between these factors and their direct and indirect effects upon rollout delay.

The methodology with more specific details of the research procedures used are presented next, in Chapter 3.

# Chapter 3

# Methodology

## 3.1. Introduction

The importance of the timeliness of new product rollout, the insights supplied by previous literature on the subject and the emergent theoretical framework were explained in the previous chapter. This chapter describes in more detail the methodology of the present study. Discussion focuses, in particular on the nature of the dependent variable (section 3.2), the context of the study (section 3.3), the justification for selecting the case method (section 3.4), the research phases (section 3.5), sample selection (section 3.6), data collection, formulation of hypotheses and measurement issues (section 3.7), and the method of carrying out the cross-case analysis (section 3.8). The nature of the dependent variable is first explained.

## 3.2 The dependent variable

Delay (conversely, on-time), as a noun, is defined as 'the time during which something is delayed' (Oxford dictionary). There is in this definition an intrinsic comparative element of

- a time difference between two periods used as yardsticks (i.e., reference); and
- initial expectations and final result.

Let us focus initially on the first issue (i.e., the reference periods). There are at least six different perspectives to use in comparing rollout time periods. The character of these perspectives is different. Some look internally into the company, others contrast what happens internally with what happens outside the company. Their aims are also different. Some aim to judge timeliness, others to identify company efficiency, while others still may indicate company business philosophy.

Perspectives that look internally within the company involve comparisons between the usual time taken for the company to roll out its new products, the scheduled/anticipated time and the actual time taken to roll out a specific new product. Distinctly, the perspectives that contrast what happens internally with what happens outside the company involve, in turn, the same comparisons against competition. Figure 3.1 shows how these perspectives relate to each other.

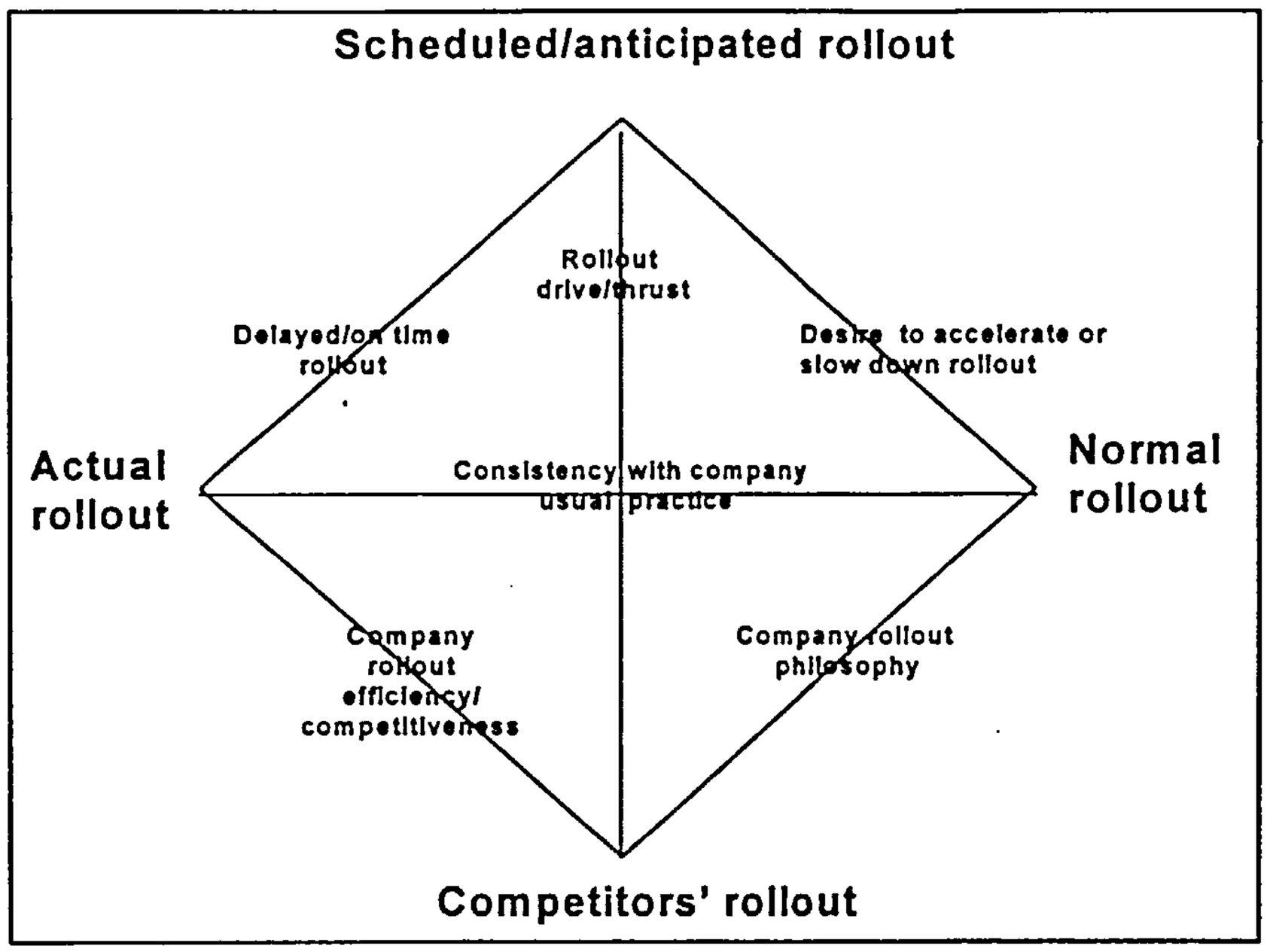


**Figure 3.1 The rollout diamond**

At the four corners of the diamond are the company's *scheduled/anticipated rollout* time period, the *actual rollout* time period (how long it actually took), the *normal rollout* time period (i.e., the usual company practice) and the *competitors' rollout* period (for similar products).

- Comparing the *scheduled/anticipated against the actual* rollout time shows whether managers achieved their initial expectations or plans regarding the necessary period to make the new product available for sale across its target markets.
- Comparing the *scheduled/anticipated against the normal* rollout time shows the desire of the company to accelerate or slow down the length of the rollout period for a specific new product against what is the usual company rollout period. A desire to diminish the scheduled time period may well depend upon the launch of products by rivals, the acceleration of technological change and rapid product obsolescence.
- Comparing the *actual against normal* rollout time shows whether the rollout period was eventually consistent with usual company practice despite managerial desire to accelerate the rollout.

- Comparing the *actual product rollout time against rivals'* rollout periods indicates if the company is efficient and competitive in terms of time.
- Comparing the *normal rollout time* (i.e., the usual company rollout periods) *against competition* also seems to be an indicator of the overall company philosophy towards the marketplace. It is possible that some firms will opt for longer or shorter rollout periods than their rivals.
- Comparing the *scheduled/anticipated against rivals'* rollout periods may well show differences in the ability of the company to innovate and renew its product lines. These differences may also show a variation of business philosophy in line with the arguments of Miles and Snow (1978).

Table 3.1 summarises the discussion on the aims of the six comparative perspectives.

**Table 3.1 Aims of comparative perspectives**

| *dt* in rollout periods | | Aim |
|---|---|---|
| Scheduled/anticipated ↔ Actual rollout | = | Identifies rollout delay or timeliness |
| Scheduled/anticipated ↔ Normal rollout | = | Shows desire to accelerate or slow down rollout period |
| Actual ↔ Normal rollout | = | Shows if the actual rollout time was . consistent with usual company practice |
| Actual ↔ Competitors' rollout | = | Indicates company efficiency and competitiveness |
| Normal ↔ Competitor's rollout | = | Describes company philosophy |
| Scheduled/anticipated ↔ Competitors' rollout | = | Indicates drive and thrust |

The dependent variable in this study is the *timeliness in new product rolling out across European markets.*

Extending the definitions by Cooper and Kleinschmidt (1994) and Olson *et al.* (1995) regarding timeliness in NPD and launch, a rollout is timely when it is completed within- or faster than- its planned (scheduled/anticipated) time frame. A rollout delay occurs when the rollout is completed later than its planned time frame.

This time frame in new product rollout is dependent upon managers' perceptions regarding the period aimed at, or needed, to make the new product available for sale in target segments across the company's target country markets. Such managerial perceptions may well vary, with individuals overestimating or underestimating time periods systematically. Such perceptions may be influenced

by personal attitudes, previous work experience, lack of experience in decision making and planning, or simple misunderstanding of the actual strengths and weaknesses of the organisation. Despite potential variations in the causes and the cognitive processes by which individuals identify, plan the schedule of, and estimate the anticipated time to roll out products across country markets, it is reasonable to infer that the difference between the scheduled/anticipated time considered to be necessary to roll out during the planning stage and the time taken to roll out a new product during the implementation stage is due to elements which have not evolved in accordance with expectations at the initial identification stage. A delay shows serious managerial misjudgement and may have substantial implications for company activities. Such misjudgement is assumed of course not to be deliberate and intentional. Understanding the causes of delays is therefore, of fundamental importance to managers.

It is important to reiterate at this point that the focus of the present study is on delays in the rollout phenomenon, not the reasons for late product development of a new product or the most appropriate timing of the order of such entry within or across country markets. Timeliness in international new product rollout is not the same as a timely order-of-entry into a domestic (Kerin *et al.*, 1992; Szymanski *et al.*, 1995) or a foreign (Mascarenhas, 1992a; 1992b) market; a timely NPD process (Cooper and Kleinschmidt, 1994; Olson *et al.*, 1995) or a speedier new product crossing of the national borders (Oackley, 1996). The purpose of each activity is different:

- The aim of a timely NPD process seems to be the building of a new product within an anticipated time frame. It is assumed here that there is no time gap between the completion of the NPD process and the launch of the new product in the first country.
- The aim of the timely order-of-entry may be to pioneer product availability for sale within markets (micro order of market entry) or across countries (macro order of market entry).
- The aim of timeliness in new product's international rollout is the availability of the new product for sale across the company's country markets within the anticipated time frame, irrespective of which country the company enters first and whether the company is entering each country as a pioneer, early follower or

late follower. It is assumed that the company has already decided to make its new product available internationally (Oackley, 1996). This is also independent of rollout strategies. Saunders and Jobber identified that there is a link between the launch and deletion strategies of older products (1994). They found, for instance, that rapid rollout strategies are accompanied by rapid deletion of older products and low price launches are accompanied by lower priced deletions.

## 3.3 The context of this research

### Unit of analysis

The individual project is the unit of analysis in this study. There are notable limitations associated with investigations of new product performance and rollout timeliness at higher levels (e.g., firm level). Considerable variations in the effect of individual factors upon timeliness and new product success often exist across various new product ventures and product groups of the same firm. It is unrealistic to expect that the same elements will be responsible for delays in all product cases. Consequently, investigation of the rollout timeliness at aggregate level (i.e., the level of the overall firm or a level higher than the individual project) will result in amalgamated findings and misleading interpretation. Therefore the position taken in this research is that the individual project must be selected as the unit of study, to obtain a more precise measurement of the factors affecting the timeliness relationship and potential effects upon new product success. This stance is in line with the majority of research in NPD (see Montoya-Weiss and Calantone, 1994) and Mascarenhas's (1992a; 1992b) work.

### Key and secondary markets

A distinction is made between *key* and *secondary* markets. A key market is a European country that is important for the company in terms of sales for the specific product. A secondary market is a European country that is less important for the company in terms of sales for the specific product. A company may not roll out a new product to less important target country markets (Mascarenhas, 1992a; 1992b). Sales are also understood to take place in a regular and frequent manner.

### Europe

This study was restricted to a European context for four reasons:

- It was considered to be practically impossible to collect accurate data for rollout times in individual countries in more than one continent.
- Many organisations organise their operations on a region-by-region basis. This means that European head offices may not be fully aware of company operations in other continents (e.g., Asia or South America).
- European integration implies that tariff constraints and import restrictions that exist in international trade between other countries are not studied here. However, the sheer number of individual countries, their geographical dispersion and their heterogeneity do permit the researcher to consider Europe as an adequate and suitable focus area for study. The number of European countries (22) is equivalent to the number of countries in the American continent (23 countries) or South East Asia (22 countries).
- Financial and time constraints made it difficult to carry out interviews outside the UK. Nonetheless, the UK is particularly suitable since it hosts the majority of European offices of companies operating in the studied sectors.

## 3.4 Case research

### Rationale

Under the circumstances, namely the lack of any previous conceptual framework, this study had to aim to build theory instead of confirming or refuting existing knowledge. This essentially qualitative study aims 'to describe, decode, translate and otherwise come to terms with the meanings, not the frequency, of certain more or less natural occurring phenomena in the social world' (van Maanen, 1979) and to 'lead to more grounded concepts closer to reality and therefore of greater practical value generated directly from experience acquired in the course of social research' (Glaser and Straus, 1967). It therefore aims to contribute to the theory both of rollout of new products across international markets and of factors related to delays in scheduled/anticipated time.

Case research methodology was followed. Bonoma (1985) has argued in his discussion about the use of case research methodologies in marketing that:

> ***'there are identifiable sets of research situations where the qualitative, in-depth approaches are desirable, even if accompanied by some risks to data integrity. In particular, they are useful when a phenomenon is broad and complex, where the existing body of knowledge is insufficient to permit the posing of causal questions,***

*and when a phenomenon cannot be studied outside the context in which it naturally occurs'. (p. 207)*

Rollout across multiple countries is a broad and complex phenomenon that occurs within a real-life context and needs to be approached as such. Moreover, the existing body of knowledge is insufficient to provide appropriate quality causal links. Rollout of new products across multiple countries is also a phenomenon which cannot be studied outside its company and industry context. Case research methodology permits perception of the complex relationships involved in such a real-life phenomenon. Case research is indeed capable of providing a 'deep understanding' (Geertz, 1973) and a 'fuller contextual sense of the phenomena under study' (Milles, 1979).

At the annual conference of the British Academy of Management in 1993, which was devoted to research methodologies in management, Professor A. Pettigrew stated that the study of processes in a contextualist manner had to meet six requirements (Pettigrew, 1993): embeddedness: the importance of multiple levels of analysis; temporal interconnectedness (past, present and future time); the role of context and action; the search for a holistic explanation; locating and explaining processes and outcomes; and involvement and distance in the research process. This research project and its analysis meet all of these criteria. Although the unit of analysis is the project level, it is still necessary to investigate potential influences on rollout schedule and implementation by extracting data relating to several levels of analysis (i.e., the firm, its product lines and the project itself). Second, rollout is influenced by company past action and present outcome. The actual aims of the project and its analysis also meet the next requirements, namely the search for a holistic explanation and locating and explaining processes and outcomes. Last, but not least, the researcher needed to come close to the data, while keeping a 'safe' distance to maintain a desirable level of objectivity.

The exploratory question 'why does the delay in rollout of new products across countries take place' also concerns a contemporary phenomenon, and it is an occurrence where the investigator has little control over events. Both these considerations are conditions for the use of cases in social research (Yin, 1984). Moreover, case research permits the use of multiple sources of data to obtain a better picture and to improve the quality of interpretation. Harrigan (1983) agrees on this point in her discussion of appropriate methodologies for business

research, arguing that 'fine-grained studies' access to multiple viewpoints provide meticulous attention to detail and relevance to business practice' (pp. 398-9).

**Limitations**

It is acknowledged, however, that there are potential problems associated with the use of case research methodology, including the possibility of a lack of rigour in the research. Kerlinger (1973) has commented that too many times in the past case study investigators were unsystematic and allowed equivocal evidence or biased views to influence the direction of their findings and conclusions. The general lack of accumulated experience on how to test investigators' abilities to conduct case research, and the plethora of discoveries and potential relationships, also commonly cause the investigator to deviate from the research axis. Much attention was given to these potential problems during this study.

Case studies also risk low data integrity and may provide little basis for generalisation. It can be argued, of course, that the risk of low data integrity is traded for the currency and contextual richness. In Yin's (1984) terms, the goal here is to understand and generalise to theoretical propositions and not to theoretical universes. The design of this study has vigorously attempted to address problems of validity and reliability:

- Construct validity is increased when establishing correct operational measures for the concepts being studied.
- External validity is increased when establishing the domain to which the findings of the study can be generalised.
- Internal validity is increased when establishing a causal relationship whereby certain conditions are shown to lead to other conditions.
- Reliability is increased when demonstrating that, if procedures followed during the design and implementation of a study are repeated, they will lead to the same results.

To improve the rigour of the research, this study followed the structured approach proposed by Eisenhardt (1989) and Miles and Huberman (1984) on data analysis. This procedure comprises:

- accurate definition of the research question with some a priori constructs;

- specification of the population on theoretical grounds instead of randomly;
- use of multiple data collection methods combining both qualitative and quantitative measures;
- overlap of the data collection and analysis;
- a within-case and cross-case analysis using divergent techniques;
- use of iterative tabulation of evidence for each construct and search for 'why' behind relationships;
- application of the theoretical (cases that vary against key variables) and literal (cases with the same critical variables) replication logic for confirmation, extension and sharpening of theory based on cross-case analysis;
- comparison with previous literature whenever possible; and
- completion of the research process when data show that improvement is marginal.

This research also followed a multiple-phase development to enhance the robustness of the process.

The use of case research is contrary, however, to the largely quantitative positivist methodologies repeatedly presented in marketing research. This is a significant political problem because as

> ***'the major thrust of most published marketing research is toward deductive, numerate, and causality directed research, the researcher may have a greater challenge in demonstrating the benefits and necessity of qualitative methods for the problem studied' (Bonoma, 1985, p. 206).***

Yet, the pre-eminence of quantitative, positivist studies has opened the discipline to the charge of 'new marketing myopia' (Brownlie *et al.*, 1994). A notable and important feature of theoretical contributions in management and international marketing is their dependence on a limited number of cases. Argyris (1952), Chandler (1962) and Johanson and Wiedersheim-Paul (1975) are prominent examples. Desphande (1983) claims:

> ***'Marketing scholars have too long ignored the meta-theoretical implications of reliance on a single paradigm. This paradigm has been identified as that of logical positivism. In its exclusion of a more qualitative paradigm, marketing theory has developed certain inherent methodological biases. These biases come from developing new***

*theoretical contributions while using methodologies more appropriate to theory testing than to theory generation' (p. 108).*

Nowhere does a focus upon deductive methodology present more of a problem than in research into the rollout of new products across international markets. The preceding review of the literature shows that contributions to the understanding of the subject can be gained from various fields. Studying rollout requires an interdisciplinary approach, without prejudging which of the theoretical contributions of these fields, if any, will be applicable.

There also remains a severe need for preliminary 'theory-building' to advance knowledge on the subject under investigation, before moving towards study types of causal disconfirmation (see also Bonoma, 1985). Under these circumstances, it is still allowable at this stage of theory development to accept the dangers of generalising from the facts of a limited number of cases.

At the same time, we may still use hypothesis-testing, the terminology of positivism (Yin, 1984) and quantitative analysis techniques at both the initial and the later stages of the research process (McClintock *et al.*, 1979; Jauch *et al.*, 1980). This implies a more flexible phenomenological philosophy. The list of variables that might be relevant is so broad that some structure is needed. This results in the generation of an initial conceptual framework whose relative applicability is to be discovered by later analysis. The subsequent development of hypotheses becomes the basis for replication, extension, refinement and tentative confirmation of the earlier findings.[1] Theoretical propositions form the platform for quantitative confirmatory research at a future date when representativeness of conclusions will be clarified. This thesis generates such propositions that can be tested in future studies.

## 3.5 The research phases

This study followed a multistage development for reasons relating to its exploratory character, and qualitative methodology requirements, and the limited guidance available in extant literature. The different phases are as follows:

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[1] Worsley *et al.*, (1970) have adopted an extreme stance on this matter. They argued on the representativeness of cases that 'it is of the same kind that enabled Sir Ronald Ross to announce the "cause" of malaria when he found the malaria parasite in the salivary gland of a single female Anopheles mosquito in 1897' (p. 112).

- *Phase 1.* An exhaustive literature review of the major marketing, international business and engineering management journals, which has rapidly confirmed the paucity of contributions to the subject. Despite this, the literature review provided elements likely to be relevant to the subject in question and helped shape the initial theoretical framework to guide the later stages of the research.
- *Phase 2.* A pilot telephone interview involving six different companies operating in highly international sectors where new product rollout was expected to be important.
- *Phase 3.* A series of interviews with six companies resulting in refinement of the problem under investigation and a preliminary cross-case analysis.
- *Phase 4.* Construction of a semi-structured interview guide, formulation of hypotheses and construction of a questionnaire.
- *Phase 5.* An additional series of interviews in 24 more companies.
- *Phase 6.* A second cross-case analysis for all 30 (6 + 24) cases.

## 3.6 Sampling rationale

This study is based on companies operating in different high internationalisation sectors which are subject to rapid technology change. Although the study is specific to those companies, the design allows for expanding the findings into a more formal theory of international new product rollout for companies operating in sectors with similar characteristics. A pilot study looked at 6 cases. Sampling for the main body of the study was implemented in two phases and was restricted to 30 companies due to time constraints, the nature of activity and the marginal contribution of additional cases (see figure 3.2).

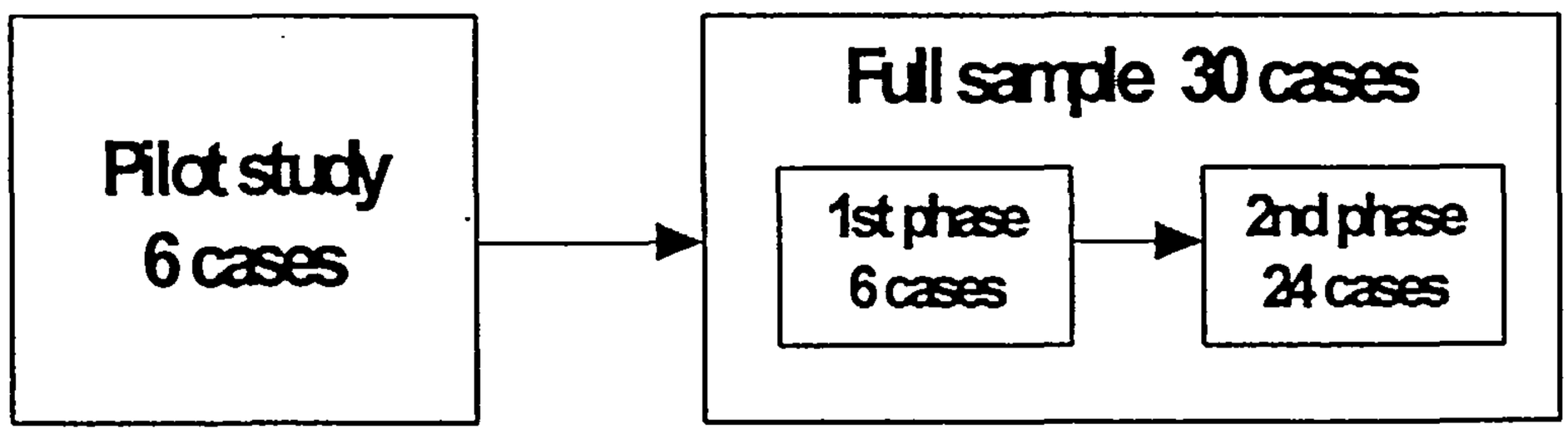


**Figure 3.2 The pilot and the full sample study**

As Selltiz *et al.* (1976) argue, such a 'purposive sampling is appropriate when the goal is to obtain good insights and critical appraisals because of the special experience of the sample cases' (p.536). This is characterised by 'the use of

judgement and a deliberate effort to obtain representative samples by including presumably typical cases' (Kerlinger, 1973, p.129).

The use of multiple cases is important because it permits replication, extension, refinement and tentative confirmation of the initial findings. This is advisable and strongly supported in the literature (Harrigan, 1983; McGee and Thomas, 1989, p.41). Analysis and contrasting of multiple cases reveals particularities and illustrates conditions for transferability of the conclusions of this study to other business settings. More details follow.

### 3.6.1 Pilot study: 6 cases

A pilot study was conducted. The names of the companies were obtained from the Datamonitor directory. Six companies covering five sectors were selected in a random manner and were approached by telephone. The selection of the specific sectors was based on previous evidence that these specific sectors have a high proportion of international activities (Prescott, 1983; Cvar, 1984; Porter, 1986; Roth *et al.* 1991). Table 3.2 shows the spread of firms in the UK and Europe in these sectors.

**Table 3.2 Sectors in the pilot study**

| Sector Dun & Bradstreet International (Europe) 1994 (SIC US 1987) | Firms in Europe | Firms in UK |
|---|---|---|
| Surgical and medical instruments, dental equipment and supplies, X-ray apparatus and cubes, electro-medical equipment | 116 | 24 |
| Mining machinery | 43 | 19 |
| Telephone/telegraph apparatus<br>Radio & TV communications equipment | 127<br>121 | 69<br>24 |
| Oil-field machinery | 23 | 11 |
| Construction machinery (inc. earth moving) | 154 | 21 |

The name of the marketing manager of the interviewed company was obtained. During the telephone interview, two key questions were posed. The first concerned the major problems they faced in managing their product lines across international markets. The second concerned the importance of timeliness in product launches. Short notes were taken by hand.

**Findings**

One company (oil-field machinery and supplies) considered as a problem the time to develop products. With development periods for 'new' products spanning over 30

years, the company introduces new product lines every 10 years on average. The UK HQ were facing substantial problems of co-operation with their US-based HQ for the international management of their product lines. Another company (construction equipment) mentioned that it experienced a serious new product failure. New product development takes 5-6 years. The company has also developed only two new products (line additions) in the last 20 years. The third company (a mining machinery firm) mentioned that geological characteristics are different for every mine and each country has different safety standards, thus requiring substantial product customisation. Delays in new product availability were common. The fourth company (a surgical equipment manufacturer) was in the process of concentrating around some core products (through shrinkage of specialised lines). It was currently experiencing short product development phases of 1-2 years at maximum, yet the competition managed to introduce new products quicker than the company in some of its country- markets. The fifth company (a dental equipment firm), supplying both machinery and consumer goods, mentioned that it was diversifying its product lines and relaunching existing products. Sales of older products had collapsed and the company needed the rapid introduction of new products into its international markets and multiplication of the versions launched at each new round. New product types were launched every 8-9 months.

The findings confirmed the managerial importance of the new product rollout timeliness issue, the appropriateness of insights from previous literature, and prompted the researcher to decide the following for the main study:

**Sectors**

- Concentrate upon highly international sectors of rapid technology change. In other highly international sectors of slower technology change (e.g., earth-moving equipment), NPD seemed infrequent and product lines narrow, resulting in limited occurrence of new product introductions to international markets.

**Cases**

Select projects:

- with both standardisable and customisable technology across countries.
- targeting both niche and mass/volume markets.
- of different novelty to the company ('truly' new products, product modifications, etc.).

**Procedure**

- Carry out in-depth face-to-face interviews, given the apparent complexity of the investigated issues. A mail survey was expected to undermine the robustness of the research design.
- Implement the sampling rationale for the full sample in two phases for reasons of a sequential step-by-step procedure, need to re-inforce the emergent theoretical framework and qualitative methodology.
- Select an equal number of timely versus delayed cases for greater comparability.

The method of selection of sectors and cases is explained next. The implementation of the procedure follows.

### 3.6.2 Full sample: 30 cases

#### 3.6.2.1 The method of selection of sectors and cases

The findings of the pilot study guided the investigation for the selection of the full sample. Taken together, the products investigated are in the wider electronics industry. An examination of Kobrin's (1991) list permitted the establishment of highly international sectors including telecommunications (Kobrin's international integration index of 0.404), electronics and computers (0.385), photographic equipment (0.324) and measuring instruments (0.286), where technological change is rapid and product launches are likely to be frequent. Eventually, 40 per cent of the investigated products had a product/production obsolescence period of 1-2.5 years, and an additional 40 per cent had an obsolescence period of 2.5-5 years. The Datamonitor directory was used to establish the number of companies active in each sub-sector in the UK. The Kompass directory was used for supplementary information. This was followed by the following process:

- Identification of technology and likely product candidates through an in-depth investigation of multiple sources. The entire six-year period (1990-1995) of publications of *BYTE* magazine were first examined. *BYTE* covers the major yearly exhibitions in these sectors (e.g., CeBIT), reports technology evolution and presents multiple new products in several technological areas. This was further supplemented by additional professional publications, and the search of

databases such as F&S for product announcements in the industry. Particular attention was given to technology and products that appeared in 1994 and 1995.

- Identification of companies that have launched products in the last three years in the technological areas of interest.
- Contact of these companies and mailing of the research project description alongside an invitation to participate in it (see Appendix 1).
- Pre-screen with the appropriate respondent over the telephone of the number and type of company product launches in Europe in the last three years in the product technology areas of interest and selection of a major product (in terms of sales). The product should have been launched in three or more European markets. An overall response rate of 50 per cent was achieved during these telephone calls. The rest mostly declined because marketing and sales to Europe were controlled from HQ located in other countries.

#### 3.6.2.2 Cases

Table 3.3 shows the list of focal cases and participating companies. The focal cases can be more precisely split into three areas.

**Data and image acquisition technologies**

One high- and ultra-high-speed camera, two medium-speed industrial and professional cameras, two hand stand still 35 mm cameras, one security identification and lamination system and three instruments for data acquisition and testing.

**Data and image output technologies**

PC printers (4 cases), screen and audio (4 cases). Printers are two laser, one solid ink colour and one matrix bar-code. Screen and audio comprise two TV sets, one PC monitor and one sound mixing system.

**Communication technologies**

Telecommunications (7 cases) and computer local area network products (6 cases). Cases in telecommunications consist of two private branch exchange systems (PBXs), one GSM telephone, three modems and one PC-telephony integration platform. Local area network cases involve two Ethernet print servers, one Ethernet 10/100 adapter card, one Ethernet multiplexer and one RS232 adapter. These 30

**Table 3.3 Product technologies and selected companies**

| Area of technology | | Number of cases | Nature of product technology | Product use | Software controlled | Company name(s) |
|---|---|---|---|---|---|---|
| Data/ image acquisition technologies | Photographic equipment | 1 | High- and ultra-high-speed camera | Ballistic testing | yes | Hadland Photonics |
| | | 1 | Medium-speed industrial camera | Control of production lines | no | Hitachi |
| | | 1 | Medium-speed professional camera | Filming | no | Sony |
| | | 2 | Hand stand still 35 mm cameras | General use | no | Hanimex, Halina |
| | | 1 | Security identification and lamination system | Security control | yes | Laminex |
| | Measuring instruments | 1 | Climatic data recording instrument | Weather data acquisition | yes | Delta-T Instruments |
| | | 1 | Dynamometer | Vibration data acquisition/ testing | yes | Instron |
| | | 1 | Electric data recording/ testing instrument | Component testing | no | Voltech |
| Data/ image output technologies | Printing | 2 | Laser (B&W) medium/high-speed printers | Office printing | yes | OKI, Brother |
| | | 1 | Solid ink colour printer | Portable colour printing | yes | Citizen |
| | | 1 | Matrix (B&W) bar-code printer | Bar-code printing | yes | TEC |
| | Screen | 2 | TV sets | General use | no | Toshiba, Panasonic |
| | | 1 | PC monitor | General/ office use | yes | Taxan |
| | Audio | 1 | Sound mixing system | Theatre use | no | Soundcraft |
| Communication technologies | Local area networks (LAN) | 2 | Ethernet print servers | Computer networks | yes | Emulex, 3Com |
| | | 1 | Ethernet 10/100 adapter card | Computer networks | yes | Allied Telesyn |
| | | 1 | Ethernet port switch | Computer networks | yes | LanArt |
| | | 1 | Ethernet multiplexer | Computer networks | yes | Cray Coms |
| | | 1 | RS232 adapter (signal converter) | Computer networks | no | Amplicon Liveline |
| | Telephony | 2 | PBX systems | Switch telecommunication system | yes | Mitel, Nortel |
| | | 1 | GSM mobile telephone | General use | no | Orbitel |
| | PC-telephony interface | 1 | Modem (ISDN) | Data/ image transfer | yes | Racal Datacom |
| | | 2 | Modems (analogue) | Data/ image transfer | yes | US Robotics, Motorol |
| | | 1 | PC-telephony integration platform | Data/ voice routing | yes | Rhetorex |
| | Total | 30 | | | | |

cases represent 24 different product technologies; 22 of the cases are software dependent and almost all use electronic components.

### 3.6.2.3 Customisation of product technology and type of target markets

Cases were classified in terms of product technology customisation from country to country (see Table 3.4). They were assigned to three groups. The first group comprised products using similar technology that does not need customisation from country to country (i.e., the mobile GSM telephone, the Ethernet products, the sound mixing system, the hand stand still 35 mm cameras, the ISDN modem).

**Table 3.4 Sample cases: customisation of product technology and type of target markets**

| | Type of target markets | |
|---|---|---|
| **Customisation of product technology** | **Mass/volume markets Total: 19** | **Niche segment/client-based sales Total: 11** |
| **Substantial (several standards) Total: 6** | Analogue modems (2) | PBXs (2), dynamometer (1), PC-telephony integration platform (1) |
| **Some Total: 7** | TV sets (2), PC monitor (1), printers (2 B&W laser, 1 barcode printer, 1 colour solid ink) | |
| **Limited Total: 17** | Hand still 35 mm cameras (2), GSM mobile telephone (1), Ethernet LAN (5), RS232 adapter (1), ISDN modem (1) | Security identification and lamination system (1), high- and ultra-high-speed camera (1), medium-speed industrial and professional cameras (2), electric testing instrument (1), climatic data acquisition instrument (1), sound mixing system (1) |

The second group of products comprised products requiring customisation (i.e., technology and specifications) from country to country, where such customisation is not difficult (i.e., the TV sets, the PC monitor, the laser and matrix printers). The third group comprised products requiring extensive and complex customisation from country to country. Examples include a software driven dynamometer (a vibration data acquisition and testing instrument) or some telecommunication products (analogue modems, PBXs) which also undergo laborious approvals from country to country.

The 30 cases targeted 19 mass/volume markets (63 per cent of cases) and 11 niche segments (37 per cent of cases); 15 cases in the sample faced delays in rollout (50 per cent of the sample), while 15 cases were on time (50 per cent of the sample).

#### 3.6.2.4 Diversity and convergence of product technologies

The apparent diversity of investigated product technologies, which might lead to criticisms of sample inconsistency, incoherence and inappropriateness, is misleading. The sample cases share several common elements to give sample coherence and consistency, yet they exhibit sufficient variance to permit the fruitful influence of technological and contextual disparity. Substantial convergence or merging of technologies is evident. For instance, most cases (i.e., printers, PC monitors, network cases, PC-telephone integration, modems and several instruments) use Microsoft Windows based software that makes them interconnectable and technologically compatible.[1] Second, there is a cross-utilisation of technologies in the investigated products. For instance:

- TV sets and PC monitors use similar tube technologies.
- Printers execute the reverse function of data/image acquisition products. Instead of image being transformed into data, it is data that are transformed into image.
- Digital data transfer technology is similar.
- Modems, local area network products, PC-telephone integration and telecommunication products are currently merging into a single pool of interrelated LAN/WAN (local area network/wide area network) applications.

On the other hand, product technologies of the investigated cases vary, something that facilitates generalisation of findings by highlighting the demands and conditions where rollout timeliness may be easier or more difficult to achieve. It is this balance between sample coherence, consistency and diversity which permits better quality comparisons in studies which follow the multiple case replication logic and in the early stages of theory development (Yin, 1983, p.48-52).

#### 3.6.2.5 Project novelty

Almost half (47 per cent) of the cases concerned modifications of existing company products (type nos 6 and 7 in Table 3.5).

The second place was shared between:

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[1] It is regular practice to combine technologies (i.e. PC monitors, network technologies, GSM mobile telephony, modems and printers) and sell them to either business or consumers in a single computer package.

- Products that are totally new to the world, for which there was an existing market (16.7 per cent).
- Products that are new to the company, which offered new features versus competitive products (13.3 per cent).
- Product line extensions (13.3 per cent).

This shows a greater number of projects in 'existing' areas of product activity (60 per cent of cases; types 5, 6 and 7) than projects in 'novel' product activities for the company (40 per cent of cases; types 1-4).

**Table 3.5 Sample cases: project novelty**

| Type of project | Number of cases | % of total cases | Cum. % |
|---|---|---|---|
| **'Novel' areas of product activity** | | | |
| 1. Product totally new to the world, which created an entirely new market | 1 | 3.3 | 3.3 |
| 2. Product totally new to the world, but for which there was an existing market | 5 | 16.7 | 20.0 |
| 3. Product totally new to the company, which offered new features versus competitive products in an existing market | 4 | 13.3 | 33.3 |
| 4. Product new to the company, which competed against fairly similar products on the market | 2 | 6.7 | 40.0 |
| **'Existing' areas of product activity** | | | |
| 5. New item in an existing product line for the company, which was sold into an existing market | 4 | 13.3 | 53.3 |
| 6. A significant modification of an existing company product | 13 | 43.3 | 96.7 |
| 7. A fairly minor modification of an existing company product | 1 | 3.3 | 100.0 |

The existence of 'new' products of different novelty is important. It is necessary to have a spread of new product types as opposed to only one type. Internal company and external environment circumstances are likely to affect differently the novel product activities compared to the existing ones.

### 3.6.2.6 Origin of parent companies

The sample comprises North American, UK and Asian companies. Among the 30 cases, 11 companies are of North American origin, 9 are of UK origin (7 UK and 2 UK/USA) while 10 are of Asian origin (9 Japanese and 1 Hong Kong). Table 3.6 shows the origin of parent companies of the sample cases. The focus of this research is not to seek out a bias regarding timeliness of new product rollout across multiple countries and firms' country-of-origin. The composition of the sample is the

result of the nationality of the majority of companies active in the investigated sectors. For instance, almost all printer manufacturers are of Japanese and almost all manufacturers of local area network products are of North American origin.

**Table 3.6 Sample cases: origin of parent companies**

| Origin | Number of cases | Total |
|---|---|---|
| **North American** | | 11 |
| USA | 8 | |
| USA/Canada | 2 | |
| USA/Australia | 1 | |
| **UK** | | 9 |
| UK | 7 | |
| UK/USA | 2 | |
| **Asian** | | 10 |
| Asian (Japan) | 9 | |
| Asian (Hong Kong) | 1 | |

Most of the companies were manufacturing multiple product lines, thus appearing in more than one product group. However, the selected product was the one of more interest on theoretical grounds to the present study. No more than one subsidiary belonging to the same corporation was contacted for additional interviews. The researcher considered that cases drawn from subsidiaries of the same corporation might contaminate research results.

### 3.6.2.7 Multiple sources of data

Multiple methods of data collection were used in accordance with the insights of previous literature (Ghoshal and Bartlett, 1988) and the premises of robust research methodologies (Miles and Huberman, 1984; Eisenhardt, 1989). The first method consisted of a semi-structured, protocol-based interviewing. This method was selected as the most suitable to obtain detail without abandoning a more rigorous systematic process (Yin, 1984, pp. 64-6).

Data were collected from both principal and additional informants in the sample companies. The principal informants were marketing managers or divisional/ product range directors responsible for European (or, failing that, international) operations. They were directly overviewing product planning, development, and commercialisation. Informants' titles reflected a great variety of job functions. Table 3.7 shows some indicative titles of principal informants.

In addition, additional interviews were carried out with engineering or manufacturing directors located in the UK for one-third of the companies. Their names were requested during the actual interview with the principal informant.

**Table 3.7 Indicative titles of principal informants**

| Company | Informant's title |
|---|---|
| Sony | Divisional Director |
| Nortel | European Marketing Manager |
| Emulex Europe | Director, European Sales Operations |
| Motorola, Info Systems Group | Marketing Director |
| Toshiba (UK) Limited | Group Product Manager |
| Brother International Europe | General Manager - European Development and Technical Services |
| Rhetorex Europe Limited | General Manager |
| Hanimex (Europe) Limited | Manager, European Operations |

It was difficult to carry out additional interviews for all companies for reasons of diverse location of the NPD or manufacturing sites (USA, Japan or South East Asia). It is noticeable, however, that the qualitative and quantitative analysis of the responses of this sub-population confirms the compatibility of their responses with the information provided by the principal interviewees.

The second method of data collection was through a questionnaire completed by all principal and the additional interviewees. The above two methods of data collection (i.e., protocol-based interviewing and completion of a questionnaire) were further supplemented with information from a third source. This comprised the web site of each participating company and professional publications in the field of computing (the *BYTE* magazine) for the entire 1990-5 period (six years). The *BYTE* publications gave extensive information on the evolution of technologies and the products of most sample companies.

## 3.7 Full sample: data collection

### 3.7.1 First phase of data collection

The sampling rationale for the full sample was implemented in two phases. The 6 cases that supplied information in the first phase of data collection for the full sample were Nortel, Panasonic, Halina, Hanimex, Delta-T and Instron.

Six cases were seen to be sufficient for the refinement of research propositions and the better understanding of core and key antecedent factors that lead to timeliness in new product rollout. These six cases were in both mass/volume

markets (3 cases) and niche segment markets (3 cases). Half (50 per cent) of the product technologies were standardised and half (50 per cent) were customised (see Table 3.8).

Four cases were in the area of data/image acquisition technologies. They include two cases in photographic equipment (cameras) and two cases in measuring instruments (one climatic data logger and one dynamometer). The fifth case was in data/image output technologies (television set) and the sixth case was in telecommunication technologies (private branch exchange).

**Table 3.8 First six cases: sectors and companies**

| | Product | Company | Delays in rollout | Origin | Customisation of product technology |
|---|---|---|---|---|---|
| **Niche markets** | | | | | |
| Telecommunication technologies | Private branch exchange | Nortel | no | North American | yes |
| Data/image acquisition technologies | Climatic data logger | Delta-T | yes | UK | no |
| | Dynamometer | Instron | yes | UK/USA | yes |
| **Mass/volume markets** | | | | | |
| Data/image acquisition technologies | Cameras | Halina | yes | Asian | no |
| | Cameras | Hanimex | no | North American | no |
| Image output technologies | TV sets | Panasonic | no | Asian | some |

The companies selected have not only exhibited product diversity, but also varied in size, turnover and nationality. Data collection in this first phase:

- first, reinforced the appropriateness of elements drawn from previous literature.
- second, permitted the identification of core and key antecedent factors that influence timeliness of new product rollout.
- third, refined research questions and propositions.

The core and key antecedent factors that influence timeliness of new product rollout are presented next. Research questions and propositions follow.

### 3.7.2 Identification of core and key antecedent factors

**Core factors**

The factors that influence timeliness of new product rollout (see Table 3.9) relate to company sufficiency in marketing and technology for the specific new product, synergies in product handling and use, proficient execution of the NPD process and

**Table 3.9 List of core factors that influence timeliness of new product rollout**

| Product specific factors |
|---|
| 1. Sufficiency in marketing resources. |
| 2. Sufficiency in technological resources. |
| 3. Synergies in product handling by sales force and product use by customers. |
| 4. Superior product. |
| **NPD process factors** |
| 5. Quality integration during the NPD process: integration between functions and sites; input by subsidiaries/agents and customers. |
| 6. Proficiency of execution of the NPD process: technical and marketing activities. |
| 7. Known targets: knowledge by the firm of intended technical and marketing targets at the start of the NPD process; early product definition. |
| **Organisational factors** |
| 8. Internal communication between European HQ and European subsidiaries/ agents and between subsidiaries themselves: Direct informal contact between European HQ and subsidiaries/agents; formal contact through establishment of permanent committees and temporary task forces involving both HQ and subsidiaries/agents' staff; shared goals, values and beliefs in both HQ and subsidiaries/agents. |

**Table 3.10 List of antecedent factors**

| Antecedents | Direction of their effects | | | |
|---|---|---|---|---|
| | Sufficiency in Marketing | Sufficiency in Technology | Synergies in product handling and use | Internal communi-cation |
| 1. Firm size | yes | yes | | |
| 2. Extent of customisation of product technology | yes | yes | | |
| 3. Complexity of customisation of product technology/ approvals | yes | yes | yes | |
| 4. Speed of technology change | yes | yes | yes | |
| 5. Extent of competitive threat | yes | yes | | |
| 6. Strategic intention for the specific new product | yes | yes | | |
| 7. European market share and sales | | | | yes |

communication intensity between European HQ and European subsidiaries/agents. Their existence leads to timely rollout; lack of them results in delays in rollout schedule. These factors also influence each other.

**Antecedent factors**

The antecedent factors influence the core set of factors in the following manner (see Table 3.10):

- The size of the firm, the extent of customisation of product technology, the extent of competitive threat and the strategic intention for the specific new product were seen to influence sufficiency in marketing and technology.
- The complexity of customisation of product technology, the difficulty of acquiring approvals and the speed of technology change were identified as influencing sufficiency in marketing, sufficiency in technology as well as synergies in product handling and use.
- The product European market share and the value of European product sales were seen to influence the intensity of internal communication between European HQ and its European subsidiaries/agents.

The qualitative evidence does not provide clear indications regarding any additional influences from the antecedent upon the core factors.

### 3.7.3 Propositions

A set of propositions was established and refined during the first phase of data collection for the full sample of the present study. They concern the core factors that influence timely new product rollout (Table 3.9). They are expressed as hypotheses:

**Research question 1: Is rollout timeliness related to new product success?**

**Hypothesis H1a: New product success of timely and delayed rollout cases does differ.**

**Research question 2: Do firms roll out their new products across international markets simultaneously or sequentially?**

This question looks at two different aspects:

**(RQ2a): Is there a link between the nature of product technology and sequential rollout?**

**(RQ2b): Is there a link between sequential rollout and delays?**

**Hypothesis H2a:** **There is a relationship between the nature of product technology and sequential rollout.**

**Hypothesis H2b:** **There is a relationship between sequential rollout and delays.**

**Research question 3: What factors lead to rollout delay?**

**Hypothesis H3a:** **There is a relationship between sufficiency in marketing and timeliness in new product rollout.**

**Hypothesis H3b:** **There is a relationship between sufficiency in technology and timeliness in new product rollout.**

**Hypothesis H3c:** **There is a relationship between synergies in product handling by the sales force, use by the customers and timeliness in new product rollout.**

**Hypothesis H3d:** **There is a relationship between product superiority and timeliness in new product rollout.**

**Hypothesis H3e:** **There is a relationship between integration during the new product development process and timeliness in new product rollout.**

**Hypothesis H3f:** **There is a relationship between proficiency of the new product development process and timeliness in new product rollout.**

**Hypothesis H3g:** **There is a relationship between knowledge of intended targets at the start of the new product development process and timeliness in new product rollout.**

**Hypothesis H3h:** **There is a relationship between intensive internal communication between the European HQ and subsidiaries/agents, and between subsidiaries/agents themselves and timeliness in new product rollout.**

The above factors were seen to interact with each other. The fourth research question concerns this interaction and the direct and indirect effects upon rollout delay:

**Research question 4: What is the interaction between these factors and their direct and indirect effects upon rollout delay?**

No specific hypotheses were established for this research question.

**Table 3.11: Summary of hypotheses**

| | Hypothesised Effect | Dependent variable |
|---|---|---|
| **RESEARCH QUESTION 1** | | |
| H1a:Timely rollout | yes | New product success |
| **RESEARCH QUESTION 2** | | |
| H2a:Nature of technology | yes | Sequential rollout |
| H2b:Sequential rollout | yes | Rollout timeliness |
| **RESEARCH QUESTION 3** | | |
| H3a:Sufficiency in marketing | yes | Rollout timeliness |
| H3b:Sufficiency in technology | yes | Rollout timeliness |
| H3c:Synergies in product handling and use | yes | Rollout timeliness |
| H3d:Superiority of product | yes | Rollout timeliness |
| H3e:Integration during the development process | yes | Rollout timeliness |
| H3f: Proficient development process | yes | Rollout timeliness |
| H3g:Early knowledge of intended targets | yes | Rollout timeliness |
| H3h:Intensive communication | yes | Rollout timeliness |
| **RESEARCH QUESTION 4** | | |
| H4a: Interaction between factors | | Rollout timeliness |

### 3.7.4 Second phase of data collection

The first phase of data collection for the full sample:

- first, reinforced the appropriateness of elements drawn from previous literature.
- second, permitted the identification of core and key antecedent factors that influence timeliness of new product rollout.
- third, refined research questions and propositions.

This first phase also set the guidelines for the second and final phase of data collection for the full sample. It refined further the elements to discuss in the interviews and the questions to include in the questionnaire. The interview aimed to explore in depth the practice of international product rollout within the firms, verify the factors leading to timely/delays in rollout and expose their interactions. The questionnaire aimed to measure and test the relationships. In doing so, completion of the questionnaire complemented the data from the interviews. The 24 companies whose European HQ are located in the UK and have provided input in the second and final data collection phase are: Mitel, Toshiba, Hitachi, Motorola, Cray Computers, US Robotics, Taxan, OKI, Brother International, TEC, Citizen, LanArt, Allied Telesyn, Rhetorex, Orbitel, 3COM, Racal Datacom, Emulex, Hadland Photonics, Voltech, Amplicon Liveline, Laminex, Soundcraft and Sony.

More details regarding the data collection through the interviews are provided next. Details regarding the questionnaire, which was used to measure and test relationships follow.

### 3.7.5 First method of data collection: case protocol

**Questions**

An initial case-protocol (interview guide) was amended after the end of the first phase of data collection. The case protocol, as it was used during the second and final data collection phase, comprised open questions relating to:

- the company and its products;
- the success of the project under consideration;
- the timeliness of NPD and rollout;
- the country and segment market and technological heterogeneity;
- the availability of marketing and technological resources;
- the development process of the new products, new product characteristics;
- the co-ordination of relationships with European subsidiaries/agents including centralisation and formalisation of decision making for marketing and product decisions, as well as performance control and communication practice;
- the internal organisational structure both across Europe and internationally;
- the European unit and its position within the broader corporation;

and others. This case protocol is presented in Appendix 2.

**Interview practice**

Each targeted firm was contacted by phone to obtain the name of the marketing manager responsible for European operations for specific product areas prior to sending the description of the project and a covering letter asking for an appointment. Follow-up telephone calls and a discussion over the telephone ensured that the respondents had received the documentation and met the criteria for inclusion and interview. An estimated 20,000 miles were covered in travelling for interviews and data collection.

Interviews spanned over several hours over one or two consecutive appointments. Every meeting was planned. Specific goals for every meeting were also set according to information and depth of clarification required. The use of

tape recording was minimised in order to avoid intimidation of respondents, but detailed records were kept during the discussion.

At the beginning of the interview, the investigator asked the respondent to put aside 30 minutes towards the end of the interview for completion of a questionnaire. It was explained that completion of such a questionnaire would provide a common and coherent base of background information on the projects under investigation for statistical analysis at a later stage.

The interviews started with a broad discussion about the problems faced by the marketing manager of the company and the responsibilities of the interviewed people for development of new products and rollout. Some 30 minutes prior to the expected end of the interview or after all the issues had been properly explored, the investigator supplied the interviewee with the questionnaire and asked them to complete it. In all but two cases, the questionnaire was completed in front of the researcher. Respondents were requested to complete the questionnaire with respect to the individual project discussed during the interview.

The interviews were then concluded with a short discussion of current findings. Such a discussion of findings with a substantial number of senior managers soon improved the robustness of the theory under construction and the way to communicate the findings of this project (the 'story'). Qualitative draft case reports were written immediately after the interviews (see Appendices 3 and 4 for some examples). All interviews were carried out by the researcher without the assistance of any other person.

Telephone and mail follow up was used to establish a longer-term relationship if further contact was needed. Interviewees appeared to view the investigator in the most of the cases, as a person with whom to exchange experience and as a provider of potentially important information about best practice. The obligation of the investigator to restrict information to academic purposes was used as a means of establishing trust. This was further enhanced by a friendly manner and the exchange developed during the interviews. It was noticeable that the interaction with the respondents moved in all cases into discussion of confidential company matters regarding company reorganisation, strategy reorientation, redistribution of marketing responsibilities, and change in internal company communication methods. In return for participation, respondents were promised a copy of an interim and a final report on the aggregate data.

An estimated period of ten months was finally spent on data collection. Several times, the interviewer reviewed recorded notes, data and case drafts. Research findings were also presented at five major academic conferences during the evolution of this research for comments and feedback.

### 3.7.6 Second method of data collection: measurement

Insights from relevant research, together with qualitative evidence from the first phase of data collection, helped to develop the measurement of the core and antecedent factors. These measures were included in the questionnaire that formed the second means of data collection. Completion of the questionnaire aimed to measure and test relationships. The questionnaire was used in its final form in 24 of the 30 cases. Most of the important elements have remained unchanged though, something that has permitted adequate completion of the quantitative analysis. Measures for each construct and their conceptual roots are presented below.

#### 3.7.6.1. Measurement of rollout timeliness and new product success

**Rollout timeliness**

Mascarenhas (1992a; 1992b) found that market entry occurs sooner in larger markets, the companies serving their smaller markets at a later date. In line with his findings and qualitative evidence, rollout timeliness was measured for both 'key' and 'all' (key + secondary) markets. There were differences between rollout time to 'key' versus rollout time to 'all' (key + secondary) markets.

New product rollout time was defined as starting 'when the product was launched in the first European country'. The end date was considered to be 'the date that launch was completed (i.e., the product was available for sale) in the target European countries'. This applied to both 'key' and 'all' (key + secondary) country markets.

New product rollout timeliness was measured in two ways. One was a measure of time in months. Respondents were requested to indicate the planned (i.e., scheduled/anticipated) time period and actual time spent on rollout of the investigated products. The phrasing of the questions is shown in Table 3.12.

This first measure sought to identify:

- the approximate number of months companies aim to, and eventually, take to roll out their new products across multiple countries;

- the approximate number of months respondents consider to be a delay.

**Table 3.12 Planned and actual time to roll out the new product**

Please show the approximate time to roll out the new product in months:

| | |
|---|---|
| 1. How long was the period you planned for rolling out this product | |
| - across its *key* European target markets? | _____ |
| - across *all* its European target markets (both key and secondary)? | _____ |
| 2. How much time did it actually take to roll out the product | |
| - across its *key* European target markets? | _____ |
| - across *all* its European target markets (both key and secondary)? | _____ |

The time difference is then taken to give a relative measure, circumventing several potential problems of comparability of absolute time periods. A question on whether the timing or completion of the rollout across Europe was affected by seasonal trends, special events (such as European exhibitions), publishing of catalogues was also asked.

The second was a relative perceptual measure (scale ranged from -5 for 'very long' to +5 for 'very fast') for rollout across "key" and "all" (key + secondary) markets, as presented in Table 3.13:

**Table 3.13: Questions on new product rollout timeliness**

| *Do you consider the time spent on:* | VERY LONG | | | | | | | | | | VERY FAST |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Product rollout across its *key* European target markets | -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 |
| 2. Rollout across *all* (key + secondary) European target markets | -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 |

This second measure aimed to identify the degree to which the project adhered to the 'time schedule' and it was 'time-efficient'. Qualitative evidence suggested that this measure was clearly understood by respondents and captured 'sticking to schedule', the importance of it and time efficiency.

A low negative score (-5) indicates 'far behind schedule', 0 indicates 'stayed on schedule' and a high score (+5) indicates 'ahead of schedule'. Respondents pointed out that they consider the scheduled/anticipated time as the yardstick against which they compare time importance and efficiency or inefficiency. Respondents indicated that they assigned a zero score for projects done in a time-efficient manner, (that is, 'as fast as it was expected to be done'), positive scores for

projects done in a more time- efficient manner, (that is, 'faster than it was expected to be done'), and negative scores for projects done in a time- inefficient manner, (that is, 'longer than it was expected to be done').

**New product success**

Griffin and Page (1993) report the findings of a multidisciplinary research project regarding the most commonly used measures for assessment of new product performance. In that project a core of 'success/failure' (S/F) measures used by both academic researchers and industry were established and grouped as follows:

- four customer acceptance measures;
- four measures of financial performance;
- five product-level measures; and
- one firm-based measure.

For the purposes of the present investigation at project level, seven core S/F measures were drawn from the above as follows:

- Customer acceptance: 'revenue (sales value) goals' and 'customer acceptance' (two measures);
- Financial performance: 'return on investment' and 'break-even point from start of project' (two measures); and
- Product-level measures: 'cost of developing the new product'; 'technical performance of product', and 'speed to market' (three measures).

'Break-even point from start of project' was measured with one question asking the number of months to break-even. Scales for the other success measures ranged from -5 for 'much below target' to +5 for 'much above target', in line with Cooper and Kleinschmidt's (1993a) suggestions. A negative value indicates that the new product has underperformed along the particular dimension. A zero value indicates that the new product has met the intended targets. A positive value indicates that the new product has exceeded its targets (see Table 3.14).

The NPD literature associates 'speed to market' with the timeliness of the NPD process (Cooper and Kleinschmidt, 1994). The same premise is adopted here. New product development time was defined as being from the managers' 'first meeting to consider the feasibility of developing the specific product to the date at

which product stabilisation (i.e., no more changes are made to the product) is reached'.

**Table 3.14 Questions on success of the new product**

Please show us the degree of success *for this specific new product:*

| *Have you met your targets concerning:* | MUCH BELOW TARGET | | | | | | | | | | MUCH ABOVE TARGET |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Sales (value) | -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 |
| 2. Customer acceptance | -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 |
| 3. Return on investment | -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 |
| 4. Product development budget costs | -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 |
| 5. Technical performance of product | -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 |

and

| What is the approximate break-even time for this new product (months)? |
|---|

NPD timeliness was also measured in two ways. One was a measure of time in months. Respondents were requested to indicate the planned (i.e., scheduled/anticipated) and the actual time spent on NPD of the studied products (Table 3.15).

**Table 3.15 Planned and actual time to develop the new product**

Please show the approximate time to develop the new product in months:

| | |
|---|---|
| 1. How long was the period you planned for developing this product ? | _____ |
| 2. How much time did it actually take to develop the product? | _____ |

The time difference is then taken to give a relative measure, circumventing several potential problems of comparability of absolute time periods. The second was the relative perceptual measure (scale -5 to +5). The question asked is in Table 3.16.

**Table 3.16 Question on NPD timeliness**

| *Do you consider the time spent on:* | VERY LONG | | | | | | | | | | VERY FAST |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Development of the new product | -5 | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 |

The rationale for the above two measures is similar to that explained earlier in this section regarding timeliness of the new product rollout.

### 3.7.6.2 Measurement of core factors

#### 3.7.6.2.1 Sufficiency of resources

The construct was measured with the questions which are shown in Table 3.17. Based on qualitative evidence and relevant literature, seven items were used to tap sufficiency of marketing and technology resources. These resources comprise the number and quality of people assigned to the project (Gupta and Wilemon, 1990), the level of spending (Cooper, 1983), and other internal skills and capabilities (Johne and Snelson, 1988; Cooper and Kleinschmidt, 1993a; 1993b). The absolute amount of people, funding, skills or capabilities, while reflecting the company endowment for the new product, is not a satisfactory indicator on its own. There is a need to examine whether these resources were eventually put to use effectively and efficiently and whether other circumstances had adverse effects (Dougherty, 1992; Parry and Song, 1993; Langley and Truax, 1994). The effect of the above is reflected in the final result: whether the company had sufficient availability of adequate quality elements (e.g., distribution channels).

**Table 3.17: Questions on sufficiency of resources**

| Did the company have sufficient availability of adequate quality | NOT AT ALL | | | | VERY MUCH SO |
|---|---|---|---|---|---|
| (a) Marketing personnel or funds to adapt product advertising and promotion for your European country markets | 1 | 2 | 3 | 4 | 5 |
| (b) Personnel to train sales staff and technical personnel across your European country markets | 1 | 2 | 3 | 4 | 5 |
| (c) Personnel and equipment for the after-sales service of this product in your European country markets | 1 | 2 | 3 | 4 | 5 |
| (d) Distribution channels in your European country markets | 1 | 2 | 3 | 4 | 5 |
| (e) Technical personnel or R & D funds to develop product versions for particular European country markets | 1 | 2 | 3 | 4 | 5 |
| (f) Hardware adapted for your European country markets | 1 | 2 | 3 | 4 | 5 |
| (g) Software adapted for your European country markets | 1 | 2 | 3 | 4 | 5 |

Questions (a) to (d) indicate the sufficient availability of adequate marketing resources. Questions (e) to (g) indicate the sufficient availability of adequate technological resources and actual product. The above correspond precisely to what Montoya-Weiss and Calantone (1994) call in their meta-analysis 'strategic factors' (i.e., marketing, technology synergies and resources). It must be stressed that measurement on a 1 to 5 scale is consistent with previous research.

#### 3.7.6.2.2 Synergies in product handling and use

Qualitative evidence suggested that two types of synergy are of particular importance. These are synergies in product handling by the sales force and product-user complementarity. Questions are shown in Table 3.18.

**Table 3.18 Questions on synergies in product handling and use**

| | | | | | |
|---|---|---|---|---|---|
| *For this new product:* | MUCH LOWER | | | | MUCH HIGHER |
| (a) What level of training did the sales force need to handle the new product? | 1 | 2 | 3 | 4 | 5 |
| *This new product has greatly benefited from its closeness to the company's existing:* | NOT AT ALL | | | | VERY MUCH SO |
| (b) Sales force and service capabilities and resources | 1 | 2 | 3 | 4 | 5 |
| *Show your agreement when you compare this specific new product against previous or other products:* | | | | | |
| (c) The handling or 'feeling' has changed for the customer | 1 | 2 | 3 | 4 | 5 |
| (d) The way in which the user is kept informed by the product and its function has changed | 1 | 2 | 3 | 4 | 5 |
| (e) The way in which the user interacts with and controls the operation of the product has changed | 1 | 2 | 3 | 4 | 5 |

Questions (a) and (b) measured the synergies of the existing sales force to handle the new product. Question (a) was drawn from Cavusgil and Zou (1995), who measured the construct of product complexity. These authors indicated that high product complexity results in a greater need to train sales staff across countries. Question (b) was drawn from extant literature on new product performance (Cooper, 1983; de Brentani, 1991; Cooper and Kleinschmidt, 1993). Questions (c) to (e) measured product-user complementarity of the new product compared against previous or other products. Product-user complementarity is defined as no disruption in the way the user handles and interacts with a particular new product (Dhebar, 1995, p. 139). Dhebar (1995) identified three facets in such product-user complementarity that are reflected in the questions used in this study: the new product's 'touch and feel' (e.g., the taste of a beverage, the handling of a camera); the way in which the user is kept informed about the state and performance of the product; and the way in which the user interacts with and controls the operation of the product (pp. 139-40).

#### 3.7.6.2.3 Superior product

The construct was measured with questions drawn from Cooper (1994) and Clark and Fujimoto (1991). Questions are shown in Table 3.19.

**Table 3.19 Questions on superiority of product**

| *This new product offered:* | NOT AT ALL | | | | VERY MUCH SO |
|---|---|---|---|---|---|
| (a) Unique attributes and clearly visible benefits to the customer | 1 | 2 | 3 | 4 | 5 |
| (b) Superior quality, performance and value for money for the customer | 1 | 2 | 3 | 4 | 5 |
| (c) Attributes that were also perceived as useful by the customer | 1 | 2 | 3 | 4 | 5 |
| (d) An intended image consistent with the firm's corporate image | 1 | 2 | 3 | 4 | 5 |

Unique attributes (question (a)) indicate that certain product characteristics are not available from competitive products. The visibility of the benefits indicates that these unique product characteristics are very obvious to the customer. Superior product quality, performance and value for money (question (b)) indicates a positive impact for the customer, since the purchase and use of the product is understood to provide substantial benefits. Attributes perceived to be useful by the customers (question (c)) also indicate that the importance of product characteristics and benefits is clearly communicated to the customer. Product image is among the non-product advantages that strengthen the perceived superiority of a new product (Cooper, 1994). Consistency between product and corporate image (question (d)) can increase the superiority of the product perceived by the customer. Discrepancy between the product and corporate image may not persuade the customer of the truthfulness of the product offering (Clark and Fujimoto, 1991).

The above correspond precisely to what Montoya-Weiss and Calantone (1994) identify in their meta-analysis as the 'product advantage' factor.

#### 3.7.6.2.4 Quality integration during the NPD process

The construct was measured with questions drawn from Clark and Fujimoto (1980), Gupta and Wilemon (1991), Cooper (1994) and Brown and Eisenhardt (1995), in line with qualitative evidence from the case studies. Questions are shown in Table 3.20.

Questions focused on two facets of integration: internal company integration and integration between the company and its markets. Questions (a) and (b) indicate internal company integration. They bear upon the relations

between different functions and between functions when they are located in different countries. Question (c) focuses upon the accuracy, quality and timely inputs of the marketing and engineering functions to the NPD process.

**Table 3.20: Questions on quality of integration during the NPD process**

| *During the development process of this new product:* | NOT AT ALL | | | | VERY MUCH SO |
|---|---|---|---|---|---|
| (a) The integration between the technical, the marketing and the manufacturing functions was high | 1 | 2 | 3 | 4 | 5 |
| (b) The integration between these functions when located in different countries was also high | 1 | 2 | 3 | 4 | 5 |
| (c) Technical and marketing personnel contributed accurate, on time and high-quality input | 1 | 2 | 3 | 4 | 5 |
| (d) Subsidiaries and/or agents provided continuous feedback | 1 | 2 | 3 | 4 | 5 |
| (e) Final customers were strongly involved and provided feedback | 1 | 2 | 3 | 4 | 5 |

Question (d) reflects the integration between the company and its European subsidiaries/agents. Reasons for inclusion of this question were as follows:

- Respondents considered the integration between the senior marketing and engineering staff which is usually dispersed across continents to be a separate issue from the integration between European HQ and subsidiaries/agents for product and marketing decisions.
- In several cases, the European subsidiaries/agents had accounting, legal and operational independence from the European HQ. Subsidiaries/ agents were also frequently the immediate buyers of the new products.

Question (e) concerns the involvement of final customers and feedback during the NPD process.

All the above correspond to what Montoya-Weiss and Calantone (1994) identify in their meta-analysis as the 'internal/external relations' and 'organisational' factors.

**3.7.6.2.5 Proficiency of execution of the NPD process**

The construct was measured with questions drawn from Cooper (1994). Questions are shown in Table 3.21.

Questions (a) and (b) show the up-front company proficiency in marketing and business matters. These correspond precisely to what Montoya-Weiss and Calantone (1994) identify in their meta-analysis as 'proficiency in market pre-

development activities'. Questions (c) to (e) show the proficient execution of pre-launch and customer testing activities. These correspond precisely to what Montoya-Weiss and Calantone (1994) identify in their meta-analysis as 'proficiency in market development activities'.

**Table 3.21 Questions on proficiency of execution of the NPD process**

| *The following were proficiently executed:* | NOT AT ALL | | | | VERY MUCH SO |
|---|---|---|---|---|---|
| (a) Predevelopment project planning Europewide | 1 | 2 | 3 | 4 | 5 |
| (b) Preliminary market assessment and market research Europewide | 1 | 2 | 3 | 4 | 5 |
| (c) Tests of prototypes by customers/trial market sales Europewide | 1 | 2 | 3 | 4 | 5 |
| (d) Co-ordination of distribution channels and logistics Europewide | 1 | 2 | 3 | 4 | 5 |
| (e) Co-ordination of advertising and promotion Europewide | 1 | 2 | 3 | 4 | 5 |
| (f) Preliminary technical assessment and setting of technical targets | 1 | 2 | 3 | 4 | 5 |
| (g) Technical development and sorting out of unexpected 'bugs' | 1 | 2 | 3 | 4 | 5 |
| (h) Technical testing of the product | 1 | 2 | 3 | 4 | 5 |

Questions (f) to (h) show the company preparation on engineering grounds as well as the actual technical development and testing of the product. These correspond precisely to what Montoya-Weiss and Calantone (1994) identify in their meta-analysis as 'proficiency in technology development activities'.

### 3.7.6.2.6 Targets known at the start of the NPD process

The construct was measured with indicators drawn from Cooper (1994). Targets include both technology and marketing elements. Technical targets concern the final technical requirements and product specifications. Marketing targets concern target countries, intended users, precise understanding of preferences, concise product positioning and a clear product concept. Questions are shown in Table 3.22.

**Table 3.22 Questions on early definition of market and technical targets**

| *The firm knew at the start of the product development process:* | NOT AT ALL | | | | VERY MUCH SO |
|---|---|---|---|---|---|
| (a) The intended users, target countries and their needs/ preferences | 1 | 2 | 3 | 4 | 5 |
| (b) The product concept and product positioning in the market | 1 | 2 | 3 | 4 | 5 |
| (c) The final product specifications and technical requirements | 1 | 2 | 3 | 4 | 5 |
| (d) The product final features and characteristics | 1 | 2 | 3 | 4 | 5 |

These correspond precisely to what Montoya-Weiss and Calantone (1994) identify in their meta-analysis as the 'protocol during the NPD process' factor.

#### 3.7.6.2.7 Intensity of co-ordination between European HQ and subsidiaries/ agents and between subsidiaries/agents themselves

The construct was measured with indicators adopted from Lawrence and Lorsch (1967), Galbraith (1973), Edström and Galbraith (1977), Miller and Dröge (1986), Martinez and Jarillo (1989; 1991), and Roth *et al.,* (1991). Martinez and Jarillo (1989), in their review of research on co-ordination mechanisms in multinational corporations, classified these mechanisms into two groups.

The first group consists of structural and formal mechanisms, including *formal structure*, *centralisation* and *formalisation* of decision making, *planning* and *performance control.* The second group consists of more informal and subtle mechanisms including *lateral relations*, *informal communication* and *organisational culture.*

As Martinez and Jarillo (1989) argued, lateral relations cut across the formal structure and include direct contact among managers of different departments that share a problem, temporary or permanent task forces, teams, committees, integrating roles and integrative departments (Lawrence and Lorsch, 1967; Galbraith, 1973; Galbraith and Kazanjian, 1986). Internal communication supplements the formality of structures (Simon, 1976) by creating a network (Kotter, 1982) of informal and personal contacts among managers across different units of the company: corporate meetings and conferences, management trips, personal visits, transfers of managers, etc.

The development of an organisational culture through this process of socialisation of individuals improves internal communication, the way of doing things, the decision-making style, and the objectives and values of the company (Pfeffer, 1982). Thus a veritable 'system of ideology' (Mintzberg, 1983) is 'internalised' (Simon, 1976) by executives throughout the organisation, something that generates identification and loyalty (Selznick, 1957). Questions are shown in Table 3.23.

Questions (a) to (e) indicate the extent of lateral or cross-departmental relations and cross-subsidiary/agent relations. Questions (f) to (i) indicate the extent of informal communication and personal contact among managers in both the European HQ and European subsidiaries/ agents. Question (j) indicates the

socialisation between managers and the establishment of a common organisational culture through the existence of shared values, beliefs and goals.

**Table 3.23 Questions on intensity of co-ordination**

*With respect to the typical relationships between European Head Office and European subsidiaries/ agents for marketing and product decisions in markets where you rolled out the new product.*

| *To what extent were the following co-ordination mechanisms used?* | NOT ALL | AT | | VERY | MUCH SO |
|---|---|---|---|---|---|
| (a) Interdepartmental permanent committees set up to allow Head Office and subsidiaries/agents' staff to engage in joint decisionmaking | 1 | 2 | 3 | 4 | 5 |
| (b) Interdepartmental temporary task forces set up to facilitate collaboration between Head Office and subsidiaries/agents' staff on specific issues | 1 | 2 | 3 | 4 | 5 |
| (c) Liaison personnel | 1 | 2 | 3 | 4 | 5 |
| (d) Project managers with responsibilities over total operations across Head Office and subsidiaries/agents | 1 | 2 | 3 | 4 | 5 |
| (e) A matrix system where Head Office personnel within specialisations are fully integrated with personnel in subsidiaries/agents | 1 | 2 | 3 | 4 | 5 |
| (f) Direct contact, meetings and interaction between Head Office and subsidiaries/agents' staff on most decisions | 1 | 2 | 3 | 4 | 5 |
| (g) Direct contact, meetings and interaction between staff in different European subsidiaries/agents | 1 | 2 | 3 | 4 | 5 |
| (h) Transfers of managers between Head Office and subsidiaries/ agents | 1 | 2 | 3 | 4 | 5 |
| (i) Transfers of managers between subsidiaries/agents | 1 | 2 | 3 | 4 | 5 |
| (j) A set of shared goals, values and beliefs shaping behaviour of subsidiaries/agents' staff across European countries | 1 | 2 | 3 | 4 | 5 |

### 3.7.6.3 Measurement of antecedent factors

#### 3.7.6.3.1 Firm size

Firm size was measured with the questions shown in Table 3.24.

**Table 3.24 Questions on firm size**

| |
|---|
| (a) What is the approximate number of full-time employees in your business unit (across Europe)? |
| (b) What is the approximate European sales turnover of your business unit (average last 3 years)? |

#### 3.7.6.3.2 Extent of customisation of product technology for the European market

The focus and definition of product technology was restricted in this study. It was decided to minimise the confusion which would occur from the investigation of multiple technologies employed in the sampled products. Manufacturers of printers employ, for instance, microprocessor technology for their functioning, ink technology for their toner, plastic technology for their covers, metal technology for their parts,

data transfer technology for connectability with other devices, photographic technology for copying, and so on.

Thus, 'technology' was defined here as the set of those closely related technological advances and technical specifications that act as a coherent whole and give the product its main and distinctive character. These are, for example PAL/SECAM technology for TV sets, GSM technology for mobile telephones, ISDN or analogue signal transmission technology for modems, and so on.

Only a handful of technologies in each product were thus examined, their selection being made in co-operation with the respondents. The researcher considered the respondents to be in a prime position to supply quality judgement on the main product technologies. The extent of customisation of product technology for the European market was measured with the questions shown in Table 3.25.

**Table 3.25 Questions on extent of customisation of product technology for the European market**

| *For this new product, the following apply:* | NOT AT ALL | | | | VERY MUCH SO |
|---|---|---|---|---|---|
| (a) Standardised product technology and specifications exist in Europe | 1 | 2 | 3 | 4 | 5 |
| (b) Extent of local government regulations in Europe is high | 1 | 2 | 3 | 4 | 5 |

These questions are drawn from Samiee and Roth's (1992) market standardisation construct and Ghoshal and Nohria's (1989; 1993) discussion of the multinational and transnational environment. The initial Samiee and Roth (1992) measure comprised five items that were partly irrelevant to the needs of the present study: standardisation of customer needs/preferences; product awareness and information across countries; standardised product technology and specifications; standardised competing products; and standardised purchasing practice.

On the other hand, Ghoshal and Nohria (1989;1993) indicated that the local context can vary in a number of ways, one of which is technology. Interviews and the subsequent qualitative analysis have also shown that respondents cognitively linked customisation of product technology with local regulations in different European countries. These regulations included government approvals and certifications for compliance to safety, electromagnetic interference, radio interference and other technical standards.

#### 3.7.6.3.3 Complexity of customisation of product technology/ approvals

This construct was measured through the indicators shown in Table 3.26. Technologies were cross-tabulated separately following discussion and advice from the interviewees. Scores were assigned by the investigator for the complexity of a handful of technologies in each product and the complexity of approvals in each company case, and these scores were averaged. The measure of the acquisition of the necessary certifications was incorporated because it was considered to be directly relevant to the complexity of customisation of product technology (see also Yeoh, 1994).

**Table 3.26 Indicators on complexity of customisation of product technology for the European market/approvals**

| *For this new product, the following apply:* | NOT AT ALL | | | | VERY MUCH SO |
|---|---|---|---|---|---|
| (a) The company has experienced substantial problems in acquiring government or other technical approvals | 1 | 2 | 3 | 4 | 5 |
| (b) Complexity of adaptation of product hardware to the requirements of different European country markets is substantial | 1 | 2 | 3 | 4 | 5 |
| (c) Complexity of adaptation of product software to the requirements of different European country markets is substantial | 1 | 2 | 3 | 4 | 5 |

#### 3.7.6.3.4 Speed of technology change

The construct was measured with three separate questions drawn from Samiee and Roth (1992) who understand that technological change affects the product, production processes and the rate of product modifications instigated by competitors (Table 3.27).

**Table 3.27 Questions on speed of technology change**

| | | | | | |
|---|---|---|---|---|---|
| (a) Speed of technology change within the industry | no change well established | slow | mode-rate | rapid | very rapid and in major ways |
| (b) Product and production technology obsolescence rate | > 10 yrs | 5-10 yrs | 2.5-5 yrs | 1-2.5 yrs | < 1 year |
| (c) Rate of product modification instigated by main competitors | seasonally | periodically <1yr interval | annually | periodi-cally>1yr interval | irregularly no pattern |

#### 3.7.6.3.5 The extent of competitive threat

The construct was measured with questions drawn from Chen *et al.*, (1992) and Heil and Walters (1993) (see Table 3.28).

**Table 3.28 Questions on competitive threat**

| *For this new product, the following apply:* | NOT AT ALL | | | | VERY MUCH SO |
|---|---|---|---|---|---|
| (a) You were threatened by competitive action | 1 | 2 | 3 | 4 | 5 |
| (b) This action was very hostile towards your company | 1 | 2 | 3 | 4 | 5 |
| (c) This action resulted in sales at your own expense | 1 | 2 | 3 | 4 | 5 |
| (d) You were threatened in all your key European markets | 1 | 2 | 3 | 4 | 5 |

The questions reflect the pervasiveness, depth and width of threat of competitive action for the company. Competitive action has neither the same pervasiveness upon every competitor it threatens, nor the same overall impact in all the markets. The degree of threat an action poses to a given company will depend, therefore, on both the importance to that company of the affected market(s) and the number of these markets. If this competitive action simultaneously threatens a company (question (a)), is pervasive (question (b)), and it is intense across the company's key European markets (questions (c) and (d)), the overall force of the competitive threat is raised for the company (see section 2.3.4.2).

#### 3.7.6.3.6 The strategic intention for the specific new product

The construct was measured with questions drawn from Chen *et al.*, (1992) and Heil and Walters (1993). Questions are shown in Table 3.29. Important new products for the company are likely to have high sales potential (question (a)), long-term prospects (question (b)) and long-lasting effects against competitors (question (c)).

**Table 3.29 Questions on strategic intention for the specific new product**

| *For this new product, the following apply:* | NOT AT ALL | | | | VERY MUCH SO |
|---|---|---|---|---|---|
| (a) Your product had high potential to capture sales from competition | 1 | 2 | 3 | 4 | 5 |
| (b) Your product was a short-term or interim move against competition | 1 | 2 | 3 | 4 | 5 |
| (c) Your product was targeted to have long-lasting strategic effects against competition | 1 | 2 | 3 | 4 | 5 |

#### 3.7.6.3.7 European product market share and value of European product sales

Market share was calculated from the two questions which are shown in Table 3.30. These questions also provided the value of sales of this new product to European countries.

**Table 3.30 Questions on European product market share**

| | |
|---|---|
| (a) | How much is the approximate yearly value of the European market for this product? |
| (b) | How much are the approximate yearly sales of this new product to European countries? |

#### 3.7.6.4 Definition of product 'newness'

Seven categories of new product types were defined, based on a modified version of Booz *et al.*'s (1982) scheme and Cooper and Kleinschmidt (1993):

- product that is totally new to the world, which creates an entirely new market (true innovations);
- product that is totally new to the world, but for which there was an existing market;
- product that is totally new to the company, but which offered new features versus competitive products in an existing market;
- a product line that is new to the company, but which competed against fairly similar products on the market;
- a new item in an existing product line for the company, which was sold into an existing market;
- a significant modification of an existing company product; and
- a fairly minor modification of an existing company product.

#### 3.7.6.5 Number of target European markets for the new product and where the new product was rolled-out

Information was obtained for both the key and secondary target European country markets for the specific product under investigation, and the number of countries where the company rolled-out the product. The questions are in Table 3.31. Additional information about the nature of target segments in each key country market was obtained during the interview.

**Table 3.31 Questions on European country markets**

| | |
|---|---|
| (a) | What is the number of your *key* European markets for this type of product? |
| (b) | In how many of these *key* markets have you launched the product? |
| (c) | What is the number of *secondary* European markets for this type of product? |
| (d) | In how many of these *secondary* markets have you launched the product? |
| (e) | Which European countries are *key* markets for your company? |

## 3.8 Cross-case analysis

The data collection and individual case analysis had a certain degree of overlap in both the first and second phase of data collection. This is in accordance with the premises for theory building and rigour in research (Miles and Huberman, 1984; Eisenhardt, 1989). The aim was to synthesise the knowledge gained up to each point, to integrate and refine conceptual linkages from the evidence. Analysis followed a systematic process in stages.

1. Classification and structuring of information. The sequence was as follows:
   (a) Compare the scheduled/anticipated time to roll out the new products.
   (b) Compare the time it eventually took to roll out the new products across Europe and the causes of delays in each case.
   (c) Establish a cross-case list of scheduled/anticipated versus actual rollout time and cross-tabulate causes of delays.
2. Identification of interrelationships.
   (a) Regroup the causes of delays into logical and coherent sets.
   (b) Establish a cross-case list of relationships between the independent variables (i.e., the core and antecedent factors).
   (c) Conceive the context of interrelationships and cross-tabulate the relationships between the independent and dependent variables.
3. Contrast the interrelationships between settings (between companies in the same sector and between sectors).
4. Conclusion at both individual and cross-case levels.
5. Construction of a conceptual framework and contrasting the findings with extant literature.

Through a continuous process of induction and combination, the identification and categorisation of interrelationships became gradually apparent. Arguments were formed. A consistent and cohesive match between these arguments and qualitative evidence progressively emerged. These eventually formed a more comprehensive and detailed conceptual framework (Figure 3.3).

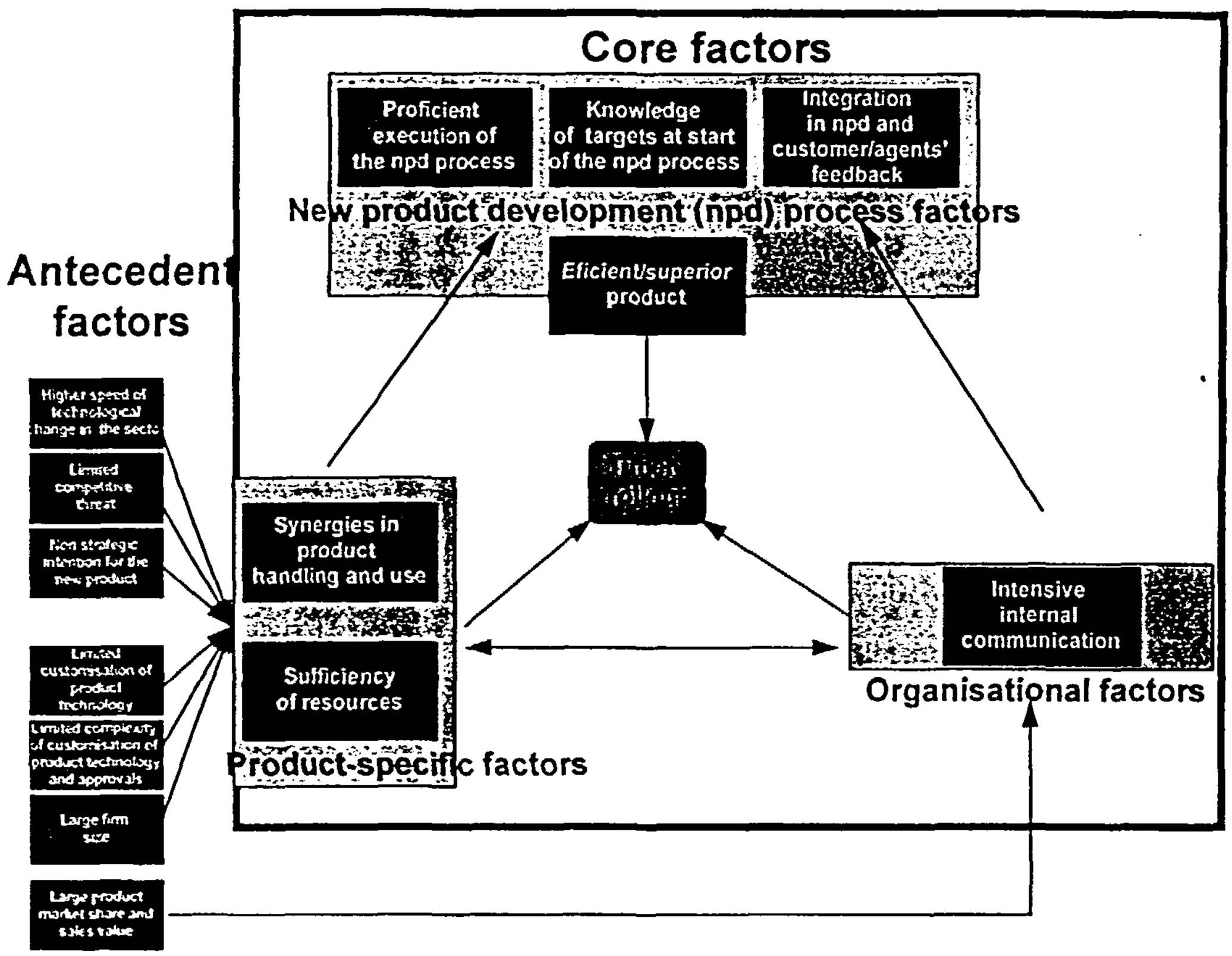


**Figure 3.3 Timeliness in new product rollout: the interrelationships between the core factors and the direction of effects from the antecedent factors**

The diagram shows the interrelationships between the core factors and the effects from the antecedent factors. The qualitative evidence does not provide clear indications for any other additional effects from the antecedent upon the core factors. These interrelationships are explained in more detail here below:

**Interrelationships between the core factors and the effects from the antecedent factors**

A group of countries constitute a technologically heterogeneous market when products need to adapt to different technical specifications and technological

standards. This is the tangible side of the matter. The 'softer' and intangible side of the matter is the acquisition of government and other approvals. This can be painstaking and laborious. Specific applications in the area of analogue and digital communications in Europe are good examples of technologically complex markets and laborious government approvals. The 10BASE-T, which is the current de facto standard in Ethernet, and the PCL5e emulation technology in laser printers show the technological standardisation in other sectors. Customisation of product technology imposes a challenge on the sufficiency of engineering resources available to the company.

Marketing and engineering resources are employed by the company in formulating and implementing actions for the new product rollout across its technologically homogeneous or heterogeneous markets. Marketing and engineering resources are broadly defined as the people, funds, expertise, skills, assets and all other related elements, both tangible and intangible, employed by the organisation in formulating and implementing the development and rollout of a new product. Various such resources of a substantially different nature are required to co-exist. They include distribution channels, marketing personnel and funds for adequate product promotion, personnel for training of sales staff and technicians, personnel and equipment for after sales, skills, expertise, knowledge, connections and others. They also include R & D personnel and funds to provide a technically adequate product for different markets, and sufficient and adequate quality of hardware as well as software.

Together these form a 'bundle'. However, this bundle of resources serves each individual new product heterogeneously and dissimilarly. Each new product is idiosyncratic in this sense, since it requires different organisational assets, resources and practices for its development and rollout. What becomes important is the balance and compatibility between what is required for the specific new product and what is already available in sufficient quantity and adequate quality within the company. Such balance and compatibility between the required and existing bundle is also neither static nor guaranteed. Internal organisational circumstances may change during the development and rollout of the new product, and alter such compatibility. A highly knowledgeable marketing manager may, for instance, quit the company before the rollout of the new product. When these marketing and technological resources meet the technological and other requirements of the different target markets, then the organisation has the capacity

to 'leverage' resources for the new product. This leverage of resources has a multiple effect.

It first helps the extent of communication within the company because there is a better understanding between HQ and subsidiaries/agents. The quality of resources assists the quality of interaction between people, leads to better communication, and facilitates outcomes. This eventually results in a better co-ordination between European HQ and subsidiaries/agents.

Secondly, it affects positively the proficiency of the NPD process. It improves the integration between functions in different sites and countries and the quality of input provided by them. Widely spread company resources participate actively and offer timely, accurate and professional input into the NPD process, thus contributing directly and indirectly to early product definition, accurate identification of technical specifications, final product features and exact market requirements. Integration between functions therefore leads to timely and accurate inputs, which consequently lead to early product definition. The above will also improve the chances of developing superior product. Each component on its own determines the overall proficiency of the NPD process, as well as interactively, its outcome. These effects will not happen, however, if there is insufficient and inadequate communication between the European HQ and their subsidiaries/agents across European countries. The intensive use of informal 'soft' co-ordination mechanisms permits the rapid transfer of market knowledge from the various European markets back to the NPD team and the European HQ. The effects of this communication supplement and complement the effects of resource leverage. The final result is an effective and efficient transfer of quality resources, skills and knowledge which facilitates NPD. Communication effectiveness and resource transfer become thus enabling factors that influence the chances of securing product superiority.

Third, resources affect the ability of the sales force to handle the new product. This is because compatibility between what is required for the new product and what is already available in sufficient quantity and adequate quality may strongly bear upon the ability of the sales force to handle the new product. The sales force has to be considered separately from distribution channels. Sales staff may not have the experience, expertise, skills and abilities to handle the new product. This may happen independently of the suitability of the distribution channels regarding the target segments of the new product. Sales personnel are also at the forefront of the company's operations, close to customers and among

the few major ways of educating customers. They are of primary importance in improving 'product-user complementarity', that is, the familiarity of the user with the functioning of and way of using the new product.

Resources bear on the ability of the sales force to handle the new product for reasons of the rapid, efficient and effective training of sales staff when necessary. Sales people employed by the company subsidiaries or independent agents across countries develop technological and marketing knowledge, stronger links with the customers and an in-depth engineering and selling expertise for current and new products. However, the 'leverage' of resources will be undermined if there is no 'product-user complementarity'. Such complementarity becomes a company resource in the sense that its existence is a tangible asset for the organisation. It increases the likelihood that users will perceive the new product as superior. If customers understand how the product functions, product features become more clearly visible, superior attributes are more easily perceived and performance is better understood. The non-existence of complementarity raises insurmountable obstacles, erodes the capacity of the organisation to 'leverage' resources, and it is a liability for the organisation.

All the above - namely, resources, communication, synergies in product handling and product superiority - influence rollout timeliness directly. They are 'agents' of primary importance for the rapid and timely rollout of the new product. The company cannot roll out the new product easily if one or more of these 'agents' of primary importance is not in place. Insufficient resources, lack of adapted product, inapt distribution intermediaries or poorly informed customers will make it difficult for the organisation to roll out the new product and support it across its target countries. Deficient communication will increase such problems.

A non-proficient execution of the development process coupled with limited internal communication is likely to result in products that do not meet the requirements of European HQ or individual country managers for their respective markets. Due to defective communication, the company will also not realise from the start of the NPD process what products are technically appropriate, superior to the competition and acceptable to customers, sales personnel and independent distributors in some countries. Furthermore, sales staff will not become aware of the new company product, and will not know in advance about its features and availability date, which will prevent them from improving future customer familiarity with the product.

An immediate effect is for the company to opt for a sequential instead of simultaneous new product rollout. Managers will go this way in order to balance business requirements and stretching of their resources against speed of country coverage. In doing so, they want to minimise the risk of product rollout failure and bad reputation. A subsequent effect may be a delay in the rollout of the new product, which makes new product success more difficult to achieve.

We see, therefore that each one of these agents of primary importance, individually and together, reinforces, fosters and dictates the company's ability to serve its target segments across multiple countries. Rapid and timely rollout will take place when the whole NPD process is executed in a proficient manner, company communication is intensive, the product is superior, sales staff and users are familiar with the handling of the product, and resources are adequate. Delayed rollout will take place when the NPD process is executed in a non-proficient manner, company communication is defective, the product is inferior, sales staff and users are unfamiliar with the handling of the product, and resources are inadequate.

## 3.9 Summary

A pilot study was initially carried out. This was followed by the identification of pertinent factors to the issues under investigation through six exploratory case studies. A cross-case analysis established coherent groups of core factors and key antecedents which were largely confirmed later from data collected in 24 more companies. The initial conceptual framework was amended, and hypotheses were refined. Data collection took place with two complementary methods. The first method used a semi-structured case protocol which permitted the investigator to explore relevant issues in depth without abandoning a more rigorous research process. The second method used a detailed questionnaire whose aim was to measure and test the relationships. Additional data were also requested from secondary sources. Data were subsequently analysed through both qualitative and quantitative techniques. These allowed a richer explanation and permitted testing for internal consistency and explained variance of the individual factors.

Details of data analysis are discussed in Chapter 4.

# Chapter 4

# Data analysis

## 4.1 Introduction

In the preceding chapter, the methodology of this study was presented. This chapter reports the cross-case analysis of the 30 investigated cases. Discussion commences with descriptive data regarding timely and delayed cases, including development and rollout periods, project novelty, number of European countries where the new products were rolled-out, sales value and market shares, as well as the origin of parent companies. The frequency of causes of delays, grouped by importance, is shown followed by a summary of the qualitative findings. The quantitative analyses are presented next. The chapter concludes with the effects of the antecedent upon the core factors and a summary of key findings.

## 4.2 Timely versus delayed cases

### 4.2.1 Rollout periods

New product rollout time was defined as starting when the product was launched in the first European country. The end date was considered to be the date that launch was completed in the European target countries. The 30 sample companies *planned* to roll out the new products:

- across the *key* European target markets within 4.5 months on average;
- across *all* (key + secondary) their European target markets within 7.0 months on average.

The range of *planned* rollout periods is 1-34 months for the *key* and 1-45 months for *all* European target markets.

The *actual* time taken was:

- 6.8 months on average, for new product rollout across the *key* and
- 10.1 months across *all* European target markets.

Table 4.1 shows the *planned* and the *actual* rollout time for the sample cases. A *timely* rollout is defined in this study to occur when it is completed within- or faster than- its planned (scheduled/anticipated) time frame. A rollout delay occurs when the rollout is completed later than its planned time frame. Following the above definitions,

the sample projects have been classified as either timely or delayed rollout cases. Fifteen are labelled timely and fifteen delayed rollout cases (see Table 4.1).

**Table 4.1 New product rollout time (months)**

| Product | Rollout time Key markets | | Rollout time All markets | | Rollout delay+ | |
|---|---|---|---|---|---|---|
| | Plan | Actual | Plan | Actual | Key | All |
| | | | | | months | months |
| **Timely rollout cases** | | | | | | |
| Laser (B&W) high-speed printer | 2 | same | 2 | same | 0 | 0 |
| Solid ink colour printer | 4 | same | 4 | same | 0 | 0 |
| Hand stand still 35 mm camera | 1 | same | 1 | same | 0 | 0 |
| Medium-speed industrial camera | 2 | same | 2 | same | 0 | 0 |
| Ethernet port switch | 3 | same | 3 | same | 0 | 0 |
| PBX | 34 | same | 45 | same | 0 | 0 |
| Laser (B&W) medium-speed printer | 1 | same | 1 | same | 0 | 0 |
| TV set | 3 | same | 3 | same | 0 | 0 |
| Medium-speed professional camera | 12 | same | 12 | same | 0 | 0 |
| Sound mixing system | 1 | same | 1 | same | 0 | 0 |
| PC monitor | 3 | same | 6 | same | 0 | 0 |
| Ethernet 10/100 adapter card | 1 | same | 1 | same | 0 | 0 |
| Matrix (B&W) bar-code printer | 1 | same | 1 | same | 0 | 0 |
| TV set | 1 | same | 1 | same | 0 | 0 |
| Analogue modem | 3 | same | 3 | same | 0 | 0 |
| **Average:** | **4.8** | **same** | **5.7** | **same** | **0** | **0** |
| **Delayed rollout cases** | | | | | | |
| RS 232 adapter | 3 | 12** | 3 | 12** | 9 | 9 |
| Ethernet multiplexer | 4 | 6** | 12 | 14** | 2 | 2 |
| Climatic data recording instrument | 3 | 4 | 6 | 9 | 1 | 3 |
| Ethernet print server | 1 | 2 | 3 | 4 | 1 | 1 |
| High- and ultra-high speed camera | 2 | 3 | 4 | 6 | 1 | 2 |
| Hand stand still 35 mm camera | 2 | 6 | 6 | 18 | 4 | 12 |
| Dynamometer | 3 | 9 | 3* | 9* | 6 | 6 |
| Security identification and lamination system | 18 | 36** | 36 | 48** | 18 | 12 |
| PBX | 3 | 8 | 6 | 12 | 5 | 6 |
| Analogue modem | 4 | 7 | 7 | 14 | 3 | 7 |
| Mobile GSM telephone | 1 | 5 | 3 | 7 | 4 | 4 |
| ISDN modem | 4 | 6 | 4 | 6 | 2 | 2 |
| PC-telephony integration platform | 6 | 14** | 14 | 24** | 8 | 10 |
| Ethernet print server | 3 | 9** | 6 | 12** | 6 | 6 |
| Electric data recording/testing instrument | 6 | 6 | 12 | 24 | 0 | 12 |
| **Average:** | **4.2** | **8.8** | **8.3** | **14.6** | **4.6** | **6.3** |
| **Average (timely+delayed rollout cases):** | **4.5** | **6.8** | **7.0** | **10.1** | **4.6** | **6.3** |

* The company does not have any secondary markets - score is assigned for comparative purposes.

** Rollout delays were still increasing in these four cases and rollout was indefinitely postponed in the fifth one (Security identification and lamination system). Scores are assigned for comparative purposes.

\+ Rollout delay in *key* markets and rollout delay in *all* (key + secondary) markets.

The rollout delays are calculated separately from delays that may have occurred during the development of the new product. More details regarding NPD delays are provided later (section 4.2.6).

**Rollout time: timely versus delayed cases**

The *planned* rollout period across *key* European target markets was almost the same for both timely and delayed cases (4.8 against 4.2 months on average). However, time periods were longer in delayed than in timely cases with respect to:

- the *planned* rollout period across *all* European target markets (8.3 against 5.7 months on average);
- the *actual* rollout period across *key* European target markets (8.8 against 4.8 months on average).

T-tests show that these differences are not statistically significant.

The *actual* rollout time across *all* European target markets was also longer in delayed than in timely cases (14.6 against 5.7 months on average). T-tests show that this difference is statistically significant ($p < .05$).

The rollout delay (*planned* - *actual* rollout time) is 4.6 months on average, for rollout across *key* target and 6.3 months on average, for rollout across *all* European target markets (Table 4.2).

**Table 4.2 Planned and actual rollout time: timely versus delayed cases (months)**

| Time | Timely cases | | Delayed cases | | Signif. |
|---|---|---|---|---|---|
| | Means | Std dev. | Means | Std dev. | |
| Planned, *key* markets | 4.8 | 8.5 | 4.2 | 4.0 | no |
| Actual, *key* markets | 4.8 | 8.5 | 8.8 | 8.1 | no |
| Rollout delay, *key* markets | 0 | | 4.6 | | |
| Planned, *all* markets | 5.7 | 11.2 | 8.3 | 8.4 | no |
| Actual, *all* markets | 5.7 | 11.2 | 14.6 | 11.0 | .05 |
| Rollout delay, *all* markets | 0 | | 6.3 | | |

These correspond to 109 per cent (4.6/4.2) of planned rollout time across key markets and 75 per cent (6.3/8.3) of planned rollout time across all European target markets.

**Eliminating the outliers**

The above calculations are influenced though, by the existence of one timely (Nortel) and one delayed case (Laminex) that act as statistical outliers. Each reported rollout period for these two cases is distant over 2 standard deviations from the respective averages of all other cases (*z-scores* range from 2.084 to 4.557). Table 4.3 shows

the means and standard deviations for both timely and delayed cases when these two statistical outliers are eliminated.

The *planned* rollout period across *key* European target markets remained almost the same for both timely and delayed cases (2.7 against 3.2 months on average). T-tests show that this difference is still not statistically significant. Time periods were longer in delayed than in timely cases with respect to:

- the *planned* rollout period across *all* European target markets (6.3 against 2.9 months on average);
- the *actual* rollout period across *key* European target markets (6.9 months against 2.7 months on average); and
- the *actual* rollout period across *all* European target markets (12.2 months against 2.9 months on average).

T-tests show that these differences are statistically significant ($p \leq .01$).

**Table 4.3 Planned and actual rollout time: timely versus delayed cases when the two statistical outliers are eliminated from the calculations (months)**

| Time | Timely cases | | Delayed cases | | Signif. |
|---|---|---|---|---|---|
| | Means | Std dev. | Means | Std dev. | |
| Planned, *key* markets | 2.7 | 2.8 | 3.2 | 1.5 | no |
| Actual, *key* markets | 2.7 | 2.8 | 6.9 | 3.2 | .001 |
| Rollout delay, *key* markets | 0 | | 3.7 | | |
| Planned, *all* markets | 2.9 | 2.9 | 6.3 | 3.7 | .01 |
| Actual, *all* markets | 2.9 | 2.9 | 12.2 | 6.2 | .000 |
| Rollout delay, *all* markets | 0 | | 5.9 | | |

These figures indicate that managers in both timely and delayed rollout cases planned to make their new products available in their key European target markets at similar periods. However, managers in the delayed cases decided to postpone the rollout of their products to secondary markets until a later date. The delay in the rollout of the new product to its key target markets consequently impacts upon the actual time taken to roll out the new product to its secondary markets.

These actual delays were also reflected in the perceptual timeliness of the new product rollout measure (scale ranged from -5 for 'very long' to +5 for 'very fast'). Correlations between the actual and perceptual rollout timeliness measures were also very strong (average .71, $p \leq .001$). The perceptual timeliness measure aimed to identify the degree to which the project adhered to the time schedule, where a low negative score (-5) indicates 'far behind schedule', 0 indicates 'stayed on

schedule' and a high score (+5) indicates 'ahead of schedule'. Respondents indicated that they assigned a zero score for projects done in a time- efficient manner, (that is, 'as fast as it was expected to be done'), positive scores for projects done in a more time- efficient manner, (that is, 'faster than it was expected to be done'), and negative scores for projects done in a time- inefficient manner, (that is, 'longer than it was expected to be done'). Table 4.4 shows the means and standard deviations of the perceptual timeliness measure for both timely and delayed cases. Differences are strongly significant ($p \leq .000$).

**Table 4.4 Perceptual timeliness measure: timely versus delayed cases (scale -5 to +5)**

| | Timely cases | | Delayed cases | | Signif. |
|---|---|---|---|---|---|
| | Means | Std dev. | Means | Std dev. | |
| Rollout time, key markets | 1.1 | 2.2 | -2.2 | 2.0 | .000 |
| Rollout time, all markets | 0.8 | 2.5 | -2.9 | 1.8 | .000 |

The assigned scores indicate that the timely cases were rolled-out in a time-efficient manner (scores 1.1 and 0.8, on average) and that the delayed cases were rolled-out in a time-inefficient manner (scores -2.2 and -2.9, on average). The difference in scores (scores 1.1 and 0.8 instead of the expected 0 score) for the timely cases may be attributed to cognitive biases of managers, in the sense that managers appear to inflate the timely rollout achievements in the perceptual measure.

### 4.2.2 Project novelty

The sample comprise 15 timely and 15 delayed roll out cases. The majority (80 per cent) of the 15 timely cases concern product line additions or modifications of existing products (product types 5, 6 and 7 in Table 4.5). In contrast, the majority (60 per cent) of the 15 delayed cases are 'new' products to the company or 'new' products to the world (product types 1, 2, 3, and 4 in Table 4.5).

A dummy variable was subsequently created. Each case belonging to the group of products in 'novel' product activities (product types 1, 2, 3, and 4) was assigned the value of 1. Each case belonging to the group of products in 'existing' product activities (product types 5, 6 and 7) was assigned the value of 2. T-tests show that the differences between timely and delayed cases regarding the product novelty are statistically significant ($p < .05$).

This shows that products which constitute 'novel' product activities for the company are more likely to face rollout delays than products in 'existing' product areas.

**Table 4.5 Project novelty: timely versus delayed cases**

| Type of project | Number of timely cases | Number of delayed cases |
|---|---|---|
| **'Novel' areas of product activity** | | |
| 1. Product totally new to the world, which created an entirely new market | | 1 |
| 2. Product totally new to the world, but for which there was an existing market | 2 | 3 |
| 3. Product totally new to the company, which offered new features versus competitive products in an existing market | 1 | 3 |
| 4. Product new to the company, which competed against fairly similar products on the market | | 2 |
| **Sub-total:** | **3 (20%)** | **9 (60%)** |
| **'Existing' areas of product activity** | | |
| 5. New item in an existing product line for the company, which was sold into an existing market | 3 | 1 |
| 6. A significant modification of an existing company product | 8 | 5 |
| 7. A fairly minor modification of an existing company product | 1 | |
| **Sub-total:** | **12 (80%)** | **6 (40%)** |

### 4.2.3 Number of European country markets

The timely rolled-out products have been made available for sale in all their European target country markets (4.93 key and 12.4 secondary countries) (see Table 4.6). The 15 delayed rolled-out products have been made available for sale in fewer than their target markets (3.66 out of 5.0 key and 4.4 out of 10.66 secondary countries). Key countries comprise in almost all cases the UK, Germany and France followed by Italy, Holland, Scandinavia and Spain.

**Table 4.6 Intended and actual number of target key and secondary country markets: timely versus delayed rollout cases (average)**

| | Timely rollout cases | | Delayed rollout cases | |
|---|---|---|---|---|
| | Intended number of target countries | Actual number of target countries | Intended number of target countries | Actual number of target countries |
| Key | 4.93 | 4.93 | 5.00 | 3.66 |
| Secondary | 12.66 | 12.40 | 10.66 | 4.40 |

The above indicate that delayed products roll out to fewer target country markets than timely products. The delayed rolled-out products target both niche segments (7 out of the 15 delayed cases) and mass consumer/volume markets (8 out of the 15 delayed cases). The sample contains however, a lower proportion of products targeting niche segments (11 out of the 30 cases) than products targeting mass/volume markets (19 out of the 30 cases). This shows a greater propensity of products targeting niche segments to face delays in rollout.

### 4.2.4 Product European market share and value of European product sales

Fifty-five per cent of the investigated cases ($n = 20$) concern products which occupied up to 10 per cent of the European market, 30 per cent between 30 and 49 per cent of the market, and 15 per cent over 50 per cent of the European market in value terms. T-tests show weak significant differences ($p \approx .10$) with respect to market share occupied by timely (average 30 per cent) versus delayed (average 12 per cent) cases. This may have happened for the following reasons:

- Targeting, or the prospect of, a lower market share may have not put pressure on firms to achieve timely new product rollout; or
- The delay in the rollout of the new product results in a weaker market position and a smaller market share for the new product compared to timely rolled-out ones.

It is still possible however, that the timeliness of the new product rollout is independent of targeting, or the prospect of, a higher market share.

Value of sales varied from less than £300,000 (30 per cent of cases), to £500,000-£2 million (30 per cent of cases) and over £8 million (40 per cent of cases) and the value of the European market for 35 per cent of the investigated cases was less than £8 million, for 30 per cent it was £10-200 million and for 35 per cent it was over £200 million. T-tests show no significant differences between timely and delayed cases with respect to either the actual product sales or the yearly value of the European market. The above indicate that rollout delays happen independently of the value of the new product sales or the value of the target market of the new product.

### 4.2.5 Origin of parent companies

There is a disproportionate representation of Japanese companies in 'timely' projects (see Table 4.7).

**Table 4.7 Origin of parent companies: timely versus delayed rollout cases**

| Origin | Number of timely cases | Number of delayed cases |
|---|---|---|
| **North American** | | |
| USA | 3 | 5 |
| USA/Canada | 1 | 1 |
| USA/Australia | 1 | - |
| **UK** | | |
| UK | - | 7 |
| UK/USA | 1 | 1 |
| **Asian** | | |
| Asian (Japan) | 9 | - |
| Asian (Hong Kong) | - | 1 |
| **Total:** | 15 | 15 |

All nine Japanese companies rolled-out their products on time, in contrast with western (USA and UK) companies, whose majority (14 out of 19 cases) faced delays. The focus of this research was not to seek out a bias regarding rollout timeliness and firms' country-of-origin. Also, the sample size is too small to permit any generalisations about timeliness of multiple country rollouts and firms' country-of-origin, although future research might attempt to explore and confirm the existence of a nationality bias in the context of successful, timely international market rollout and the implications for international product management. The presence of Japanese companies in the timely rollout cases may have also happened for the following reasons:

- The area of product technology may have created certain demands and conditions where new product rollout timeliness was easier to achieve. For instance, almost all printer manufacturers rolled-out on-time. All printer manufacturers were of Japanese origin;
- Firm- and point-in-time-specific circumstances; or
- The character of the necessary marketing action or the nature of competition may have placed different pressures on firms to achieve timely new product rollout.

In the present study, the analysis concentrates on rollout timeliness irrespective of firms' country-of-origin. A striking feature is however, that *all* seven British companies faced delays in rollout.

### 4.2.6 NPD time

NPD time was defined as being from the managers' first meeting to consider the feasibility of developing the specific product to the date at which product stabilisation (i.e., no more changes are made to the product) is reached. The average *planned* NPD time of the 30 sample cases was 14.4. months (the range is 3-36 months). The average *actual* NPD time was 21.2 months (the range is 4-60 months) (Table 4.8).

**Table 4.8 NPD time, delays in NPD and rollout delays (months)**

| Product | Company name | NPD Time | | NPD Delay | NPD Case labelled | Rollout delay* |
|---|---|---|---|---|---|---|
| | | Plan | Actual | | | |
| Laser (B&W) high-speed printer | Brother | 18 | 16 | -2 | Timely | 0 |
| Solid ink colour printer | Citizen | 24 | 24 | 0 | Timely | 0 |
| Hand stand still 35 mm camera | Hanimex | 12 | 12 | 0 | Timely | 0 |
| Medium-speed industrial camera | Hitachi | 12 | 18 | 6 | Delayed | 0 |
| Ethernet port switch | LanArt | 12 | 12 | 0 | Timely | 0 |
| PBX | Nortel | 36 | 60 | 24 | Delayed | 0 |
| Laser (B&W) medium-speed printer | OKI | 15 | 18 | 3 | Delayed | 0 |
| TV set | Panasonic | 12 | 12 | 0 | Timely | 0 |
| Medium-speed professional camera | Sony | 24 | 36 | 12 | Delayed | 0 |
| Sound mixing system | Soundcraft | 9 | 12 | 3 | Delayed | 0 |
| PC monitor | Taxan | 9 | 12 | 3 | Delayed | 0 |
| Ethernet 10/100 adapter card | Telesyn | 3 | 5 | 2 | Delayed | 0 |
| Matrix (B&W) bar-code printer | TEC | 18 | 24 | 6 | Delayed | 0 |
| TV set | Toshiba | 12 | 12.5 | 0.5 | Delayed | 0 |
| Analogue modem | US Robotics | 4 | 4 | 0 | Timely | 0 |
| | | | | | | |
| RS 232 adapter | Amplicon | 4 | 5 | 1 | Delayed | 9 |
| Ethernet multiplexer | Cray Comms | 24 | 36 | 12 | Delayed | 2 |
| Climatic data recording instrument | Delta-T | 18 | 36 | 18 | Delayed | 3 |
| Ethernet print server | Emulex | 8 | 10 | 2 | Delayed | 1 |
| High- and ultra-high speed camera | Hadland | 9 | 15 | 6 | Delayed | 2 |
| Hand stand still 35 mm camera | Halina | 12 | 24 | 12 | Delayed | 12 |
| Dynamometer | Instron | 12 | 24 | 12 | Delayed | 6 |
| Security identification and lamination system | Laminex | 12 | 24 | 12 | Delayed | 12 |
| PBX | Mitel | 12 | 24 | 12 | Delayed | 6 |
| Analogue modem | Motorola | 4 | 4 | 0 | Timely | 7 |
| Mobile GSM telephone | Orbitel | 12 | 14 | 2 | Delayed | 4 |
| ISDN Modem | Racal | 18 | 20 | 2 | Delayed | 2 |
| PC-telephony integration platform | Rhetorex | 24 | 60 | 36 | Delayed | 10 |
| Ethernet print server | 3COM | 18 | 28 | 10 | Delayed | 6 |
| Electric data recording/testing instrument | Voltech | 24 | 36 | 12 | Delayed | 12 |
| **Average:** | | 14.4 | 21.2 | 6.8 | | |

* Figures correspond to rollout delays in *all* (key + secondary) target European countries.

A *timely* NPD is defined in this study to occur when it is completed within- or faster than- its planned (scheduled/anticipated) time frame. A delay in NPD occurs when the NPD is completed later than its planned time frame. Following the above definitions, seven cases are labelled timely and twenty three delayed NPD cases (see Table 4.8). The average delay in NPD is 6.8 months.

**NPD time: timely versus delayed rollout cases**

The *planned* NPD time is the same for both timely and delayed rollout cases (14.6 against 14.0 months on average). Both timely and delayed rolled-out cases faced delays during their NPD period (planned-actual NPD time), irrespective of the timeliness of their future rollout (Table 4.9).

The frequency of delays in NPD is higher, however, in delayed than in timely rollout cases. Fourteen out of the 15 delayed rollout cases have faced delays in their development. In comparison, only 9 out of the 15 timely rollout cases faced delays in their development.

**Table 4.9 Planned and actual NPD time: timely versus delayed rollout cases (months)**

| NPD time | Timely rollout cases | | Delayed rollout cases | | Signif. |
|---|---|---|---|---|---|
| | Means | Std dev. | Means | Std dev. | |
| Planned NPD time | 14.6 | 8.4 | 14.0 | 6.7 | no |
| Actual NPD time | 18.5 | 13.9 | 24.0 | 14.3 | no |
| Delays in NPD | 3.9 | 6.5 | 10.0 | 9.0 | .05 |

The *actual* NPD time is longer in delayed than in timely rollout cases (24.0 against 18.5 months on average) (Table 4.9). This results in a longer NPD delay in delayed (14.0-24.0= 10.0 months) than in timely rollout cases (14.6-18.5= 3.9 months) on average. T-tests show that this difference is statistically significant ($p < .05$). These NPD delays correspond to 26.7 (timely rollouts) against 71.4 per cent (delayed rollouts) of planned NPD time. This means that delayed rollout cases experienced almost three times as much overrun NPD time than timely rollout cases.

The data from Tables 4.2 and 4.9 show that the 15 delayed rollout cases faced:

- a NPD delay of 6.1 months on average (3.9- 10.0= -6.1 months); and
- a rollout delay of 4.6 months, for rollout in *key* European target markets and 6.3 months on average, for rollout in *all* European target markets.

The 15 delayed rollout cases appear therefore, to be 10.7 months late (-6.1 + -4.6=

-10.7) in their *key*, and 12.4 months late (-6.1 + -6.3= -12.4) in *all* their European target markets. For reasons which will be explored later, NPD delays also have serious repercussions on the completion of sequential international market launch.

The NPD delays were also reflected in the perceptual NPD timeliness measure (scale ranged from -5 for 'very long' to +5 for 'very fast'). Correlations between the actual and perceptual NPD timeliness measures were also very strong (.60, $p \leq .001$). The perceptual NPD timeliness measure aimed to identify the degree to which the project adhered to the NPD time schedule, where a low negative score (-5) indicates 'far behind schedule', 0 indicates 'stayed on schedule' and a high score (+5) indicates 'ahead of schedule'. Table 4.10 shows the differences between timely and delayed rollout cases regarding the perceptual NPD timeliness measure. Differences are significant ($p \leq .05$).

**Table 4.10 Perceptual NPD timeliness measure: timely versus delayed rollout cases (scale -5 to +5)**

| | Timely rollout cases | | Delayed rollout cases | | Signif. |
|---|---|---|---|---|---|
| | Means | Std dev. | Means | Std dev. | |
| Timeliness in NPD | -0.6 | 1.4 | -2.0 | 1.69 | .05 |

Next section gives more details on the causes of delays in new product rollout.

### 4.2.7 Causes of rollout delays and their frequency

Causes of delays in the cases that encountered rollout delay ($n = 15$) were grouped into several sets of closely related elements. Three different answers ('not a problem', 'minor' and 'MAJOR') have been assigned to each set of elements after careful consideration and cross-checking across cases and technologies:

- 'Not a problem' ('No') means that the firm did not face problems in the specific area under investigation or this is not applicable (i.e., no need to customise the product technologically to different country markets).
- 'minor' means that the problem existed, but it was not serious.
- 'MAJOR' means that the problem existed and was a major obstacle.

Table 4.11 shows the frequency of experienced problems of minor and MAJOR importance by type of cause. In 40 per cent of delayed cases, there were problems in 2-4 areas. In 40 per cent of the delayed cases, there were problems in 5-8 areas. In three cases, problems were experienced in 9 of the 13 areas.

**Table 4.11 Delayed rollout cases: frequency of minor and MAJOR causes of rollout delays (*n = 15*)**

| Cause | Minor causes of rollout delays | | MAJOR causes of rollout delays | | Minor + MAJOR causes of rollout delay |
|---|---|---|---|---|---|
| | Occurrences in delayed rollout cases | Frequency (%) | Occurrences in delayed rollout cases | Frequency (%) | Cumulative frequency (%) |
| ***Insufficient availability of adequate quality of:*** | | | | | |
| (a) marketing/ customer support, personnel and related | 0 | 0 | 11 | 74 | 74 |
| (b) distribution channels | 1 | 7 | 8 | 54 | 61 |
| (c) engineers, technical resources, personnel and related | 4 | 27 | 4 | 27 | 54 |
| (d) hardware or software | 2 | 14 | 7 | 47 | 61 |
| ***Lack of synergies in product handling by*** | | | | | |
| (a) sales force | 1 | 7 | 6 | 40 | 47 |
| (b) user; user unfamiliar | 1 | 7 | 3 | 20 | 27 |
| ***Problems during development of the new product:*** | | | | | |
| (a) Non-proficient new product development process | 1 | 7 | 6 | 40 | 47 |
| (b) Internal communication between European HQs and new product development teams | 1 | 7 | 3 | 20 | 27 |
| ***Internal co-ordination and communication:*** | | | | | |
| (a) Internal communication between European HQs and subsidiary/agents and between subsidiaries/agents themselves | 3 | 20 | 5 | 34 | 54 |
| ***Other elements:*** | | | | | |
| (a) Extensive customisation of product technology | 3 | 20 | 1 | 7 | 27 |
| (b) Complexity of customisation of product technology | 1 | 7 | 2 | 14 | 21 |
| (c) Approvals | 1 | 7 | 2 | 14 | 21 |
| (d) Low European product market share or value of European product sales | 5 | 33 | 2 | 14 | 47 |

**Frequency of minor and MAJOR causes together**

Problems existed in the following areas.

**In 74 per cent of delayed cases:**

- Inadequate marketing personnel and resources.

**In 61 per cent of delayed cases:**

- Inadequate distribution channels.
- Inadequate hardware or software.

**In 54 per cent of delayed cases:**

- Inadequate engineering and technical personnel and resources.
- Lack of internal communication between European HQ and agents/subsidiaries and between subsidiaries/agents themselves.

**In 47 per cent of delayed cases:**

- Lack of synergies in product handling by the European subsidiaries/agents' sales staff.
- Non-proficient NPD process.
- Low European product market share and value of European product sales.

**In <47 per cent of delayed cases:**

- Lack of synergies in product handling by user (27 per cent).
- Communication between European HQ and NPD teams (27 per cent).
- Extensive customisation of product technology (27 per cent).
- Complexity of customisation of product technology (21 per cent).
- Government or other approvals (21 per cent).

**Frequency of MAJOR causes only**

In terms of MAJOR causes, the picture is different. Marketing insufficiency (marketing incapabilities, insufficient expertise, personnel and resources) is the single most frequently experienced cause of delayed rollouts **(74 per cent)** followed far behind by other causes.

## Table 4.12 Causes of rollout delays: problem areas

| Company | Sufficient availability of adequate quality | | | | Synergies in product handling | | New product development | | Internal communication | Customisation of product technology | | Approval | Importance of product |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Engineering/ technical personnel/ resources | Marketing personnel/ resources | Hardware/ software | distri-bution channels | by sales force across Europe | by end user | Communication European HQs and n.p.d. teams | Proficient new product development | Eur.HQs and agents/ subsidiaries and between | Extent of | Complexity of | Complex or other problems | European market share or sales |
| **Timely rollout cases** | | | | | | | | | | | | | |
| Brother | no | no | no | no | no | no | no* | no | no | no | no | no | no |
| Citizen | no | no | no | no | no | no | no* | no | no | no | no | no | no |
| Hanimex | no | no | no | no | no | no | no* | no | no | no | no | no | no |
| Hitachi | no | no | no | no | no | no | no* | no | no | no | no | no | no |
| LanArt | no | no | no | no | no | no | no* | no | no | no | no | no | no |
| Nortel | no | no | no | no | no | no | no* | no | no | minor | no | no | no |
| OKI | no | no | no | no | no | no | no* | no | no | no | no | no | no |
| Panasonic | no | no | no | no | no | no | no* | no | no | minor | no | no | no |
| Sony | no | no | no | no | no | no | no* | no | no | no | no | no | no |
| Soundcraft | no | no | no | no | no | no | no | no | no | no | no | no | no |
| Taxan | no | no | no | no | no | no | no* | no | no | minor | no | no | no |
| Telesyn | no | no | no | no | no | no | no* | no | no | no | no | no | no |
| TEC | no | no | no | no | no | no | no* | no | no | no | no | no | no |
| Toshiba | no | no | no | no | no | no | no* | no | no | minor | no | no | no |
| US Robotics | no | no | no | no | no | no | no* | no | no | minor | no | no | no |
| **Delayed rollout cases** | | | | | | | | | | | | | |
| Amplicon | no | MAJOR | no | MAJOR | no | no | no | no | MAJOR | no | no | no | MAJOR |
| Cray | MAJOR | no | MAJOR | no | no | no | no* | no | no | no | no | no | no |
| Delta-T | minor | MAJOR | no | no | no | no | no | no | minor | no | no | no | no |
| Emulex | no | no | MAJOR | no | no | no | MAJOR* | MAJOR | no | no | no | no | minor |
| Hadland | minor | MAJOR | no | MAJOR | MAJOR | MAJOR | no | no | minor | no | no | no | no |
| Halina | minor | MAJOR | MAJOR | no | no | no | no* | no | MAJOR | no | no | no | no |
| Instron | MAJOR | no | minor | no | MAJOR | MAJOR | no* | MAJOR | no | MAJOR | MAJOR | no | no |
| Laminex | MAJOR | MAJOR | minor | MAJOR | MAJOR | no | MAJOR | MAJOR | MAJOR | no | no | no | MAJOR |
| Mitel | no | MAJOR | no | MAJOR | MAJOR | no | MAJOR* | minor | MAJOR | minor | no | MAJOR | minor |
| Motorola | no | no | MAJOR | minor | no | no | no | no | no | minor | minor | minor | no |
| Orbitel | minor | MAJOR | MAJOR | MAJOR | no | no | no | no | no | no | no | no | minor |
| Racal | no | MAJOR | no | MAJOR | no | no | no | no | MAJOR | no | no | no | minor |
| Rhetorex | no | MAJOR | MAJOR | no | minor | minor | no* | MAJOR | no | minor | MAJOR | MAJOR | minor |
| 3COM | MAJOR | MAJOR | MAJOR | MAJOR | MAJOR | MAJOR | no* | MAJOR | no | no | no | no | no |
| Voltech | no | MAJOR | no | MAJOR | MAJOR | no | minor | MAJOR | minor | no | no | no | no |

* If new product development is located in another continent

**In 54 per cent of delayed cases:**

- Inadequate distribution channels.

**In 47 per cent of delayed cases:**

- Inadequate hardware or software.

**In ≤40 per cent of delayed cases:**

- Lack of synergies in product handling by the European subsidiaries/agents' sales staff (40 per cent).
- Non-proficient NPD process (40 per cent).
- Lack of internal company communication between European HQ and agents/subsidiaries and between subsidiaries themselves (34 per cent).
- Inadequate engineering and technical personnel and resources (27 per cent).
- Lack of communication between European HQ and NPD teams (20 per cent).
- Lack of synergies in product handling by user (20 per cent).

Almost none of the timely cases faced any problems in the above mentioned areas. Table 4.12 gives the details for each investigated case. Detailed case descriptions for four timely (Brother, OKI, Allied Telesyn, Hitachi) and four delayed (Mitel, Rhetorex, Instron and Laminex) cases are also available in appendices 3 and 4. The particular cases are either 'extreme' or 'typical' cases (Yin, 1984), and they intend to communicate a range of different circumstances to the reader. Circumstances of extreme heterogeneity in technological standards across countries and high complexity of the approvals' procedures are shown for instance, in the Mitel and Rhetorex cases. The Brother, OKI and Allied Telesyn are examples of intensive organisational communication. Moreover, the Mitel and Laminex serve as cases of the lack of synergies in product handling by the sales force.

## 4.3 Factor analyses

The quantitative analysis of the questionnaire items followed the premises of psychometric literature (Nunnally, 1978). After an initial data screening, exploratory factor analysis (EFA) was performed for the establishment of factors and construct identification. EFA is a set of multivariate statistical methods for describing the relationships among the item scores in a correlation matrix by assigning them to a

few relatively independent but conceptually meaningful composite variables called factors (Yaremko *et al.*, 1982). The steps involved are (1) the preparation of the correlation matrix; (2) the extraction of initial factors; and sometimes (3) various rotation procedures aimed at obtaining the simplest interpretable factors.

EFA is particularly useful for the situation where links between the observed and latent variables (a latent variable is a variable that represents an abstract theoretical construct) are uncertain. The analysis proceeds in an exploratory mode to establish if factors exist and that the items (i.e., observed variables) which tap these factors can be identified (Hair *et al.*,1995, p.366-8). The EFAs carried out in this study are listed in Table 4.13.

**Table 4.13 Table of EFAs in this study**

| Section | CORE FACTORS | Section | ANTECEDENT FACTORS |
|---|---|---|---|
| 4.3.1 | New product success | 4.3.9 | Firm size |
| 4.3.2 | Sufficiency in marketing | 4.3.10 | Extent of customisation of product technology for the European market |
| 4.3.2 | Sufficiency in technology | | |
| 4.3.3 | Synergies in product handling and use | | |
| 4.3.4 | Superior product | 4.3.11 | Complexity of customisation of product technology for the European market/ approvals |
| 4.3.5 | Quality integration during the NPD process | | |
| 4.3.6 | Proficiency of execution of the NPD process | 4.3.12 | Extent of competitive threat |
| 4.3.7 | Targets known at the start of the NPD process | 4.3.13 | Strategic intention for the specific new product |
| 4.3.8 | Internal communication between European HQ and subsidiaries/agents and between subsidiaries/agents themselves | | |

The factor items were then subjected to reliability tests. 'Reliability' is defined as 'the degree to which measures are free from error and therefore yield consistent results' (Peter, 1979, p. 6). These are important for the establishment of construct validity. There are several reliability coefficients (see Churchill and Peter, 1984), but Cronbach's coefficient alpha, which is a generalised measure of the internal consistency of a multi-item scale, is considered among the most robust and widely used (Peterson, 1994). While a Cronbach's alpha score of $\geq 0.5$ denotes acceptable, a score of $\geq 0.7$ signifies good scale reliability (Nunnally, 1978). The individual EFAs and reliability tests are now presented.

### 4.3.1 New product success

The suitability of factor analysis for the variables to be considered here (sales, customer acceptance, return on investment, product development budget costs, technical performance of the new product)[1] and the timeliness measures for both NPD and rollout was first determined by the *measure of sampling adequacy* (MSA) (Hair *et al.*,1995, p. 374). The MSA quantifies the degree of intercorrelations among the variables and the appropriateness of factor analysis. Low MSA values indicate low intercorrelations between variables and unsuitability of the factor analysis. The MSA index ranges from zero to one, reaching one when each variable is perfectly predicted without error by the other variables. A score of below .60 is 'miserable' and below .50 unacceptable (Hair *et al.*, 1995, p.374).

The MSA gave acceptable scores of .61-.80 for all but one new product success variables. The MSA score regarding the 'product development budget costs' variable (scaled from 'much below target' to 'much above target') was 'miserable' (.53). This low MSA score indicates likely unsuitability of the measurement of the particular variable in the present study. Two thirds of the sample products were developed outside Europe. This may have resulted in the respondents not being fully aware of all budget details regarding the development of the new products. For precautionary reasons, this particular new product success variable was excluded from subsequent analysis. The actual NPD timeliness measure was used (correlated at .60 with the perceptual NPD timeliness measure, $p < .001$).

The EFA produced a two factor solution (orthogonal factors) explaining 78.6 per cent of total variance (see Table 4.14). The first factor explained 55.9 per cent of total variance ($e = 2.79$). Factor loadings ranged from .69 to .92 and reliability was very good (Cronbach's $\alpha = .83$).

**Table 4.14 Factor analysis: new product success**

| Items | Orthogonal factor solution: factor loadings | |
|---|---|---|
| | Factor 1 *'Financial performance'* | Factor 2 *'Timely NPD'* |
| **Sales** | **.92** | .08 |
| **Customer acceptance** | **.70** | -.45 |
| **Return on investment** | **.87** | .26 |
| **Technical performance of product** | **.69** | -.47 |
| **NPD timeliness** | | **.78** |
| **Eigenvalue** | **2.79** | **1.13** |
| **Factor explained variance (%)** | **55.9** | **22.7** |
| **Total explained variance (%)** | **78.6** | |
| **Cronbach's alpha score** | **.83** | |

[1] The 'break-even point from start of project' variable was omitted because of missing values.

The first factor had four highly loading items. These are sales, customer acceptance, return on investment and technical performance. The second factor consisted of one highly loading (.78) single item; timely NPD. Factor 1 is clearly a financial performance factor; whereas factor 2 is a timely NPD-related factor. The other measures load weakly on the NPD time dimension. Note that the above replicate Cooper and Kleinschmidt's (1994) factor structure of timeliness in NPD.

## CORE FACTORS (CF)

### 4.3.2 Sufficiency of resources

**Sufficiency in marketing**

The four (4) items comprised the following (see section 3.7.6.2.1):

- 'Marketing personnel/ funds to adapt advertising and promotion' (A1).
- 'Personnel to train sales staff and technicians' (A2).
- 'After-sales service personnel and equipment' (A3).
- 'Distribution channels' (A4).

One factor emerged explaining 86 per cent (eigenvalue= 3.43) of total variance. Reliability is high (Cronbach's $\alpha$ = .94). The easily interpretable factor concerns firm sufficiency in marketing elements and resources. The factor (coded CF1) was named 'Sufficiency in marketing' (see Table 4.15). The MSA values were adequate for both the EFA presented here and the ones which follow.

**Sufficiency in technology**

The three (3) items comprised the following (see section 3.7.6.2.1):

- 'R & D personnel / funds to adapt product' (A5).
- 'Hardware adapted for European country markets' (A6).
- 'Software adapted for European country markets'(A7).

One factor emerged explaining 86.7 per cent (eigenvalue= 2.60) of total variance. Reliability is high (Cronbach's $\alpha$ = .92). The easily interpretable factor concerns firm sufficiency in engineering and technical elements and resources. The factor (coded CF2) was named 'Sufficiency in technology' (see Table 4.15).

### 4.3.3 Synergies in product handling and use

Items were as follows (see section 3.7.6.2.2):

- 'Synergies in sales force regarding the new product' (A8).
- 'Training sales force needed to handle the new product' (A9).
- 'Product handling / 'feeling' has changed for customer' (A10),
- 'Way user is informed about product functions has changed' (A11)
- 'Way user interacts and controls operation of product has changed' (A12).

Synergies concerned product complexity to be handled by the sales force and the product-user complementarity. An EFA revealed the existence of one factor (eigenvalue = 2.86) explaining 57 per cent of total variance. One item (A9) had a low factor loading (-.47). A subsequent EFA after the elimination of A9 explained a higher variance 68 per cent (*e* = 2.71), with high factor loadings (min .71 and max .89) and high reliability (Cronbach's $\alpha$ = .84). The easily interpretable factor (coded CF3) was named 'Synergies in product handling and use' (see Table 4.15). The factor indicates the existence of synergies regarding the offering of the product to the marketplace. It reflects the complexity of product handling by the existing company sales force alongside the ease and familiarity of product use by the customers.

### 4.3.4 Superior product

Four items (see section 3.7.6.2.3) were subjected to EFA:

The new product offered:

- 'Unique attributes and clearly visible benefits to the customer' (A13).
- 'Superior quality, performance, value for money' (A14).
- 'Attributes also perceived as useful by the customers' (A15).
- 'Intended image consistent with corporate image' (A16).

One single factor (eigenvalue = 2.70) was produced explaining 67.6 per cent of total variance with high factor loadings (min .68 and max .91) and high reliability (Cronbach's $\alpha$ = .83). The easily interpretable factor (coded CF4) was named 'Superior product' (see Table 4.15).

### 4.3.5 Quality integration during the NPD process

Five items (see section 3.7.6.2.4) were subjected to EFA:

- 'Integration between technical, marketing and manufacturing functions was high' (B1).

- 'Integration between these functions when located in different countries was also high' (B2).
- 'Technical and marketing personnel contributed accurate, on time and high quality input' (B3).
- 'Subsidiaries/agents provided continuous feedback' (B4)
- 'Final customers were strongly involved and provided feedback' (B5).

One single factor (eigenvalue = 3.07) emerged explaining 61.6 per cent of total variance with high factor loadings (min .68 and max .90) and high reliability (Cronbach's $\alpha$ = .83). The easily interpretable factor (coded CF5) was named 'Quality integration during the NPD process' (see Table 4.16).

### 4.3.6 Proficiency of execution of the NPD process

Eight items (see section 3.7.6.2.5) were subjected to EFA:

- 'Predevelopment project planning' (B6).
- 'Preliminary market assessment and market research' (B7)
- 'Tests of prototypes by customers/trial sales' (B8).
- 'Co-ordination of distribution channels and logistics' (B9).
- 'Co-ordination of advertising and promotion' (B10).
- 'Preliminary technical assessment and setting of technical targets' (B11).
- 'Technical development and sorting out unexpected "'bugs"' (B12).
- 'Technical testing of the product' (B13)

One single factor was produced with high loadings and high percentage of explained variance. However, two of the items (B7 and B11) were eliminated from further consideration on statistical grounds. B7 reflects proficiency in predevelopment market activities. B11 reflects proficiency in technology development activities. The remaining six items were considered sufficient for further analysis. The single factor solution remained intact in a subsequent EFA. The single factor (eigenvalue = 4.18) explained 69.7 per cent of total variance with high factor loadings (min .73 and max .88) and high reliability (Cronbach's $\alpha$ = .91). The easily interpretable factor (coded CF6) was named 'Proficiency of execution of the NPD process' (see Table 4.16).

### 4.3.7 Targets known at the start of the NPD process

Four items (see section 3.7.6.2.6) were subjected to EFA:

- 'The intended users, target countries and their needs and preferences' (B14).
- 'The product concept and product positioning' (B15).
- 'The final product specifications and technical requirements' (B16).
- 'The product final features and characteristics' (B17)

One single factor (eigenvalue = 2.62) was produced explaining 65.6 per cent of total variance with high factor loadings (min .78 and max .84) and high reliability (Cronbach's $\alpha$ = .82). The easily interpretable factor (coded CF7) regarding early product definition was named 'Targets known at the start of the NPD process' (see Table 4.16).

### 4.3.8 Intensity of co-ordination between European HQ and European subsidiaries/agents and between subsidiaries/agents themselves

Substantive qualitative examination of the case data has shown that:

- transfers of managers were not practised by any of the investigated companies; and
- liaison personnel and project managers were considered by respondents to be encompassed in broader systems, such as matrix systems (item C5).

The above items were eliminated from inclusion in the factor analysis, leaving the following items:

- 'Direct contact, meetings and interaction between European HQ and subsidiaries/agents' (C1).
- 'Direct contact, meeting and interaction between European subsidiaries/agents' (C2).
- 'Interdepartmental permanent committees between European HQ and subsidiaries/agents' (C3).
- 'Interdepartmental temporary task forces between European HQ and subsidiaries/agents' (C4).
- 'The use of a matrix system' (C5).
- 'A set of shared goals, values, and beliefs shaping behaviour' (C6).

EFA on these produced one single factor (eigenvalue = 3.86) explaining 64.4 per cent of total variance, high factor loadings (min .64 and max .89) and high reliability (Cronbach's $\alpha$ = .88). The easily interpretable factor (coded CF8) was named 'Internal communication between European HQ and European subsidiaries/agents and between subsidiaries/agents themselves' (see Table 4.17). In Ghoshal and Nohria's (1989; 1993) terminology, it reflects the notion of 'normative integration' within international company operations.

## Table 4.15 List of core factors (CF) and their items

| Code | Factor name | Items (summary of question) | | Factor loading | e** | Variance | α*** |
|---|---|---|---|---|---|---|---|
| | | | **Sufficiency of adequate quality of** | | | | |
| **CF1** | **Sufficiency in marketing** | A1 | Marketing personnel/funds to adapt adv/promotion | .91 | 3.43 | 86.0 | .94 |
| | | A2 | Personnel to train sales staff and technicians | .94 | | | |
| | | A3 | After-sales service personnel and equipment | .92 | | | |
| | | A4 | Distribution channels | .92 | | | |
| | | | **Sufficiency of adequate quality of** | | | | |
| **CF2** | **Sufficiency in technology** | A5 | R & D personnel / funds to adapt product | .89 | 2.60 | 86.7 | .92 |
| | | A6 | Hardware adapted for European country markets | .95 | | | |
| | | A7 | Software adapted for European country markets | .94 | | | |
| **CF3** | **Synergies in product handling and use** | A8 | Sales force | .71 | 2.71 | 68.0 | .84 |
| | | A10R* | Product handling/'feeling' has changed for customer | .89 | | | |
| | | A11R* | Way user is informed about product functions has changed | .88 | | | |
| | | A12R* | Way user interacts with and controls operation of product has changed | .77 | | | |
| | | | **The new product offered** | | | | |
| **CF4** | **Superior product** | A13 | Unique atributes and clearly visible benefits to the customer | .81 | 2.70 | 67.6 | .83 |
| | | A14 | Superior quality, performance, value for money | .85 | | | |
| | | A15 | Attributes also perceived as useful by the customers | .91 | | | |
| | | A16 | Intended image consistent with corporate image | .68 | | | |

*R = scoring was reversed; **e = eigenvalue; ***α = Cronbach's α

## Table 4.16 List of core factors (CF) and their items

| Code | Factor name | Items (summary of question) | | Factor loading | e** | Variance | α*** |
|---|---|---|---|---|---|---|---|
| CF5 | **Quality integration during the new product development process** | B1 | Integration between technical, marketing and manufacturing functions was high | .71 | 3.07 | 61.6 | .83 |
| | | B2 | Integration between these functions when located in different countries was also high | .80 | | | |
| | | B3 | Technical and marketing personnel contributed accurate, on time and high quality input | .79 | | | |
| | | B4 | Subsidiaries/agents provided continuous feedback | .90 | | | |
| | | B5 | Final customers were strongly involved and provided feedback | .68 | | | |
| CF6 | **Proficiency of execution of the new product development process** | | **The following were proficiently executed** | | 4.18 | 69.7 | .91 |
| | | B6 | Predevelopment project planning | .87 | | | |
| | | B8 | Tests of prototypes by customers/trial sales | .88 | | | |
| | | B9 | Co-ordination of distribution channels and logistics | .86 | | | |
| | | B10 | Co-ordination of advertising and promotion | .78 | | | |
| | | B12 | Technical development and sorting out unexpected 'bugs' | .73 | | | |
| | | B13 | Technical testing of the product | .85 | | | |
| CF7 | **Targets known at the start of the new product development process** | | **The firm knew at the start** | | 2.62 | 65.6 | .82 |
| | | B14 | The intended users, target countries and their needs and preferences | .80 | | | |
| | | B15 | The product concept and product positioning | .78 | | | |
| | | B16 | The final product specifications and technical requirements | .80 | | | |
| | | B17 | The product final features and characteristics | .84 | | | |

*R = scoring was reversed; **$e$ = eigenvalue; ***$\alpha$ = Cronbach's $\alpha$

**Table 4.17 List of core factors (CF) and their items**

| Code | Factor name | Items (summary of question) | | Factor loading | $\theta$** | Variance | $\alpha$*** |
|---|---|---|---|---|---|---|---|
| | | | **Extensive use of** | | | | |
| **CF8** | **Internal communication between European HQ and subsidiaries/agents and between subsidiaries/agents themselves** | C1 | Direct contact, meetings and interaction between European HQ and subsidiaries/agents | .78 | 3.86 | 64.4 | .88 |
| | | C2 | Direct contact, meetings and interaction between European subsidiaries/agents | .89 | | | |
| | | C3 | Interdepartmental permanent committees between European HQ and subsidiaries/agents | .83 | | | |
| | | C4 | Interdepartmental temporary task forces between European HQ and subsidiaries/agents | .85 | | | |
| | | C5 | The use of a matrix system | .64 | | | |
| | | C6 | A set of shared goals, values and beliefs shaping behaviour | .78 | | | |

*R = scoring was reversed; **$\theta$ = eigenvalue; ***$\alpha$ = Cronbach's $\alpha$

### 4.3.9 Firm size

This was measured through the approximate number of full-time employees and sales turnover (average last 3 years) of the business unit across Europe. Figures were log10 transformed for minimisation of skewness, and subsequently factor analysed. One single factor emerged explaining 86.7 per cent of total variance (eigenvalue = 1.73). The factor exhibited high factor loadings and high reliability (Cronbach's $\alpha$ = .81). The easily interpretable factor (coded AF1) was named 'Firm size' (see Table 4.18).

### 4.3.10 Extent of customisation of product technology for the European market

The items which were drawn from Samiee and Roth (1992) and Ghoshal and Nohria (1989,1993) were combined into a single measure (see also section 3.7.6.3.2). This was subjected to an EFA which produced one single factor (eigenvalue = 1.40) explaining 70 per cent of total variance and high loadings (> .78). Cronbach's $\alpha$ (= .57) indicated acceptable but marginal reliability, however (see Table 4.18). The factor (coded AF2) was named 'Extent of customisation of product technology for the European market'.

### 4.3.11 Complexity of customisation of product technology for the European market/approvals

Scores were assigned by the investigator following discussion and responses from the interviewees (scaling: Not at all = 1, Very much so = 5) to the following items (see also section 3.7.6.3.3):

- 'Problems in acquiring government/ technical approvals' (X3)'.
- 'Substantial complexity of hardware adaptation' (X4)'.
- 'Substantial complexity of software adaptation' (X5)'.

An EFA was carried out on all three items. One single factor emerged that explained 70 per cent of total variance (eigenvalue = 2.10). Reliability also attained high levels (Cronbach's $\alpha$=.79). The factor (coded AF3) was named 'Complexity of customisation of product technology for the European market/approvals' (see Table 4.18).

### 4.3.12 Extent of competitive threat

Items comprised the following (see also section 3.7.6.3.4):

**Table 4.18 List of antecedent factors (AF) and their items**

| Code | Factor name | Items (summary of question) | | Factor loading | *e*** | Variance | α*** |
|---|---|---|---|---|---|---|---|
| **AF1** | **Firm size** | Log10<br>Log10 | Number of full-time employees in business unit (Europe)<br>Sales turnover in business unit (Europe,3 years) | .86<br>.86 | 1.73 | 86.7 | .81 |
| **AF2** | **Extent of customisation of product technology for the European market** | X1<br>X2R* | Standardised product technology/ specifications<br>Extent of local government regulations high | .83<br>.83 | 1.40 | 70.1 | .57 |
| **AF3** | **Complexity of customisation of product technology for the European market/approvals** | X3 (APPR)<br>X4 (CMHW)<br>X5 (CMSW) | Problems in acquiring government/technical approvals<br>Substantial complexity of hardware adaptation<br>Substantial complexity of software adaptation | .78<br>.91<br>.81 | 2.10 | 70.0 | .79 |
| **AF4** | **Extent of competitive threat** | X6<br>X7<br>X8<br>X9 | Firm was threatened by competitive action<br>Competitive action was very hostile towards the company<br>This action was resulting in sales at firm's own expense<br>Firm was threatened in all its key European markets | .97<br>.95<br>.93<br>.91 | 3.58 | 89.7 | .96 |
| **AF5** | **Strategic intention for the specific new product** | X10<br>X11R*<br>X12 | Product had high potential to capture sales from competition<br>Product short-term/interim move against competition<br>Product targeted to have long-lasting strategic effects | .86<br>.77<br>.93 | 2.23 | 74.3 | .82 |

*R = scoring was reversed; ***e* = eigenvalue; ***α = Cronbach's α

- 'Firm was threatened by competitive action' (X6).
- 'This competitive action was very hostile towards the company' (X7).
- 'This action was resulting in sales at firm's own expense' (X8).
- 'Firm was threatened in all its key European markets' (X9).

An EFA produced a single factor which explained 89 per cent of total variance, showed strong factor loadings and exhibited exceedingly high reliability (Cronbach's $\alpha$ = .96). The factor (coded AF4) was named 'Extent of competitive threat' (see Table 4.18).

### 4.3.13 Strategic intention for the specific new product

Items comprised the following (see also section 3.7.6.3.7):

- 'Product had high potential to capture sales from competition' (X10).
- 'Product short-term/interim move against competition' (reversed) (X11).
- 'Product targeted to have long-lasting strategic effects' (X12).

An EFA produced a single factor which explained 74 per cent of total variance, exhibited strong factor loadings and showed high reliability (Cronbach's $\alpha$ = .82). The factor (coded AF5) was named 'Strategic intention for the specific new product' (see Table 4.18).

The effects of all the above antecedent factors upon the core factors are discussed next.

## 4.4 Effects of antecedent factors upon the core factors

### 4.4.1 Introduction

As mentioned in the theoretical framework (sections 3.7.2 and 3.8), some antecedent factors (AFs) were identified to influence the core factors (CFs) in the framework. Factor analysis on a series of items and reliability tests (see section 4.3) established a series of highly reliable and easily interpretable factors. The scores provided by the respondents on the items loading high on each AF were averaged to create scales specific to each factor. Hair *et al.* (1995) argue that when the average or summated scale is valid (that is, the items correctly define the factor) and reliable (i.e., the alpha coefficient is high), then this scale is the best alternative for representation of the factor (p. 9 and pp. 390-1).

A short discussion of the effects of the AFs upon the CFs follows.

### 4.4.2 Firm size (AF1)

Figures show that there is a strong positive correlation (.40, $p < 0.1$) between firm size and sufficiency in marketing (see Table 4.19). This means that bigger firms have an advantage. They are able to shift marketing resources, capabilities, skills and expertise) from one product to another. Recall that the factor CF1 (sufficiency in marketing) concerns sufficient availability of adequate quality of:

- marketing personnel and funds to adapt advertising and promotion;
- personnel to train sales staff and technicians;
- after-sales service personnel and equipment; and
- distribution channels.

So, bigger firms can more easily reach a critical mass. This results in a rapid sufficiency of adequate quality of marketing resources to support the rollout of a new product. In contrast, smaller companies are at a disadvantage. Lacking capabilities, skills, expertise and resources, these companies cannot easily support the rollout of their new products across international markets.

In contrast, firm size does not have a statistically significant effect upon sufficiency in technology. This means that sufficiency in technology resources, capabilities, skills and expertise depends upon other things than the actual size of the company. More likely, such sufficiency is project dependent. Recall that factor CF2 (sufficiency in technology) concerns sufficient availability of adequate quality of:

- R & D personnel and funds to adapt product;
- Hardware adapted for different European countries; and
- Software adapted for different European countries.

However, the marginal statistical significance of the correlation (.29; $p <.15$) shows a tendency of bigger firms to have some advantages in this area too.

### 4.4.3 Extent of customisation of product technology for the European market (AF2)

There is a strong negative correlation between the extent of customisation of product technology for the European market and both

**Table 4.19 Product-moment correlation coefficients between antecedent and core factors (identified relationships only)**

| | Factor code | CF1 Sufficiency in marketing | CF2 Sufficiency in technology | CF3 Synergies in product handling and use | CF8 Internal communication between European HQs and subsidiaries/agents and between subsidiaries/agents themselves |
|---|---|---|---|---|---|
| Firm size | AF1 | .40* | .29+ | - | - |
| Extent of customisation of product technology for the European market | AF2 | n.s. | -.44* | -.39* | - |
| Complexity of customisation of product technology for the European market/approvals | AF3 | n.s. | n.s. | -.37* | - |
| Speed of technology change | | | | | |
| (a) Rate of product modification instigated by main competitors++ | | .29* | n.s. | n.s. | - |
| (b) Speed of technology change++ | | n.s. | n.s. | n.s. | - |
| (c) Product and production obsolescence rate++ | | n.s. | n.s. | n.s. | - |
| Extent of competitive threat | AF4 | n.s. | n.s. | - | - |
| Strategic intention for the specific new product | AF5 | n.s. | n.s. | - | - |
| Product European market share | | - | - | - | .36+ |
| Value of European product sales | | - | - | - | n.s. |

*$p \leq 0.10$, ** $p \leq 0.01$, *** $p \leq 0.001$
+ $p < .15$
++ Kendall-Tau b correlation coefficients
- = relationship not identified

- 'Product and production obsolescence rate'.

An EFA which was carried out yielded no meaningful factor. For this reason, all the above three items were retained independently and used separately in the analysis. The Kendall's Tau b non-parametric correlation test for ordinal variables was employed. Only one relationship was found to be statistically significant (see Table 4.19). There is a positive relationship between rate of product modification (5 = seasonal; 4 = periodically <1 yr interval; 3 = annually; 2 = periodically >1 yr interval; 1 = irregularly - no pattern) and sufficiency in marketing. The frequent product launches seem to increase the likely number of replacement product generations and the similarity of new products. These impact positively upon company sufficiency in marketing resources, capabilities, skills and expertise. There were no significant correlations between speed of technological change and

- sufficiency in technology (CF2); and
- synergies in product handling and use (CF3).

This may be due to the fact that engineering capabilities in competing companies exist in both rapidly and less rapidly changing environments. Technological change may also not bear upon the interface between the user and the product. For instance, companies may keep the same product-user interface despite major changes in product technology.

**4.4.6 The extent of competitive threat (AF4) and the strategic intention for the specific new product (AF5)**

There is no statistically significant link (see Table 4.19) between AF4, AF5 and

- sufficiency in marketing (CF1); and
- sufficiency in technology (CF2).

The reasons for this picture have their roots in the complexity of wider competitive dynamics for each of the sampled cases which evolved over several generations of replacement or new products. It is therefore less easy to capture statistically how the competitive threat and the strategic intention for the specific new product affect sufficiency in marketing and technology. Current data do not permit the development

of a full and accurate picture of these effects. Such a discussion would require a different set of data, and a longitudinal research project tracing the long-term evolution of competition and product portfolios.

### 4.4.7 Product's European market share and value of European product sales

The high product market share in Europe and the high value of product sales to the European market were identified to influence the internal communication between European HQ and subsidiaries/agents. The supposed link was that the higher the product market share or product sales to Europe, the higher the importance attributed by the corporation to the European market. This was seen to have a positive impact upon the communication effort to keep abreast with developments in the local European markets. Only the correlation between market share and intensity of communication (CF8) is marginally significant (.36, $p < .15$) (Table 4.19).

## 4.5 Conclusion: summary of the chapter

This chapter reported the cross-case analysis of the investigated cases in the main study. Before proceeding further, it is necessary to mention that the potential elimination of the two statistical outliers would have only marginal importance; thus, the analysis incorporated all 30 cases, unless otherwise stated. Descriptive information with respect to timely and delayed cases was first provided. There are several differences between timely and delayed cases, as follows:

- The project novelty for the company. Delayed cases are in 'novel' product areas for the companies. Timely cases are in product areas where companies are already active. These are usually product line extensions or replacements of older products.
- The number of target markets where the company rolls out the new product. Delayed products are made available to only a few of their target country markets. Timely products are made available to almost all their target country markets.
- Type of target markets. Delayed cases target small niche segments. Timely cases target mass consumer/volume markets.

- Market share. Delayed products have generally lower market share. The actual yearly value of the European market for that product or value of product sales level do not seem to relate to rollout timeliness.
- The origin of parent companies. UK or North American companies may be more prone to delay in the rollout of their new products. Japanese companies may be more prone to timeliness in the rollout of their new products.
- Delays in development occurs in both timely and delayed rolled-out new products. Nonetheless, timely rolled-out cases show a less frequent and shorter NPD delay than delayed rolled-out cases.

Discussion continued with the summarised presentation of qualitative information on the causes of delays for each case. The importance and frequency of delays across-cases was also presented. There are several causes of delays. Insufficiency of adequate quality of marketing resources is both the most frequent and the most important cause. Insufficiency of adequate quality of engineering resources and technology and lack of internal communication come second. Problems in the NPD process follow closely. Problems in customisation of product technology/approvals and lack of synergies in product handling and use supplement the above. A series of factor analyses and reliability tests followed. Several items reflecting the above were subjected to EFA. High factor loadings, good to excellent reliabilities in all but one case, and easily interpretable factors have confirmed the appropriateness of items used in this study. Table 4.20 summarises the results of the EFAs and reliability tests.

Some antecedents were identified as influencing the factors that lead to rollout timeliness. Section 4.4 examined the statistical significance of the relationships. Table 4.21 shows whether the hypothesised effects where statistically confirmed. It was found that bigger firms have an advantage in reaching a critical mass in marketing for the rollout of the new product. Larger companies are likely to be better equipped to orchestrate the gathering of the necessary skills, expertise, market connections, people and funds to support a new product. Smaller companies may be more likely to have greater difficulties in doing so. Their problems may even increase if companies target markets with a wide variation of requirements.

However, bigger firms do not always have an advantage in reaching a critical mass in technology for the new product. Such sufficiency is positively affected by the standardisation of product technology. Standardised product technology assists

organisations to achieve more easily a critical mass in engineering resources, skills, capabilities and expertise for the new product. Customisation of product technology makes it more difficult for companies to achieve a critical mass in technology for the new product.

**Table 4.20 Summary of results from the EFAs and reliability tests**

| Factor name(s) | Explained variance (%) | Cronbach's α |
|---|---|---|
| **New product success** | 78 | |
| (a) Financial performance | 55.9 | .83 |
| (b) Timely NPD | 22.7 | n.a. |
| **Core factors influencing rollout timeliness** | | |
| (a) Sufficiency in marketing | 86 | .94 |
| (b) Sufficiency in technology | 86 | .92 |
| (c) Synergies in product handling and use | 68 | .84 |
| (d) Superior product | 67 | .83 |
| (e) Quality integration during the NPD process | 61 | .83 |
| (f) Proficient execution of the NPD process | 70 | .91 |
| (g) Targets known at the start of the NPD process | 65 | .82 |
| (h) Internal communication between European HQ and subsidiaries/agents and between subsidiaries/agents themselves | 64 | .88 |
| **Antecedent factors** | | |
| (a) Firm size | 87 | .81 |
| (b) Extent of customisation of product technology for the European market | 70 | .57 |
| (c) Complexity of customisation of product technology for the European market/approvals | 70 | .79 |
| (d) Extent of competitive threat | 89 | .96 |
| (e) Strategic intention for the specific new product | 74 | .82 |

**Table 4.21 List of antecedents and the statistical significance of their effects**

| Antecedents | Factor code | Direction of their effects CF1 | CF2 | CF3 | CF8 |
|---|---|---|---|---|---|
| (a) Firm size | AF1 | **yes** | marginal | | |
| (b) Extent of customisation of product technology for the European market | AF2 | n.s. | **yes** | **yes** | |
| (c) Complexity of customisation of product technology for the European market/ approvals | AF3 | n.s. | n.s. | **yes** | |
| (d) Speed of technology change | | partial | n.s. | n.s | |
| (e) Extent of competitive threat | AF4 | inconclusive | inconclusive | | |
| (f) Strategic intention for the specific new product | AF5 | inconclusive | inconclusive | | |
| (g) European market share | | | | | marginal |
| (h) European sales value | | | | | n.s. |

Within this wider framework, complexity of technological customisation does not seem to have a statistically significant effect upon either marketing or technological sufficiency. This may be due to the small number of cases that experienced

substantial complexity in customising their products. In contrast, such complexity bears strongly and negatively upon synergies in product handling by the sales force and product-user familiarity. It seems that it is difficult for sales staff to learn about:

- country-specific hardware and software and
- complex government approval procedures. Such approvals usually require an in-depth knowledge of both technical and administrative matters.

These may be due to lack of expertise or lack of time. The sales force may dilute their efforts in selling a wide range of products, they may not wish to devote substantial time in learning the functioning of complex hardware and software, and they may not have the depth of knowledge required for supporting complex high technology products. Customers also experience difficulties in learning how to handle and interact with products that need complicated adaptation from country to country. Both customers and sales staff appear better able to handle and use uncomplicated, technologically non-customisable new products.

The speed of technology change is positively associated with company sufficiency in marketing. Companies in sectors of frequent product modifications create a marketing infrastructure that facilitates fast and timely rollout of younger generations of new products. Rapid change of technology does not however, mean sufficiency in engineering resources is easier or more difficult to achieve. Such sufficiency seems to be project-specific.

The study did not find any statistically significant effects of competitive threat and the strategic intention for the new product upon sufficiency in marketing and technology. This is likely due to the difficulty of capturing the complexity of competitive dynamics when the research focus is on the single new product project.

This study also found that there is a statistically marginal, yet positive link between market share and internal communication between European HQ and European subsidiaries/agents. There is greater managerial attention upon products that account for high market share across Europe, which, in turn, promotes internal company communication.

Further analysis concentrates on the core factors (CF1, ..., CF8) of the theoretical framework, rollout timeliness and the interactions between these core factors. Answers to the four research questions, alongside confirmation or rejection of the hypotheses of the present investigation, are presented in Chapter 5.

# Chapter 5

# Findings and discussion

## 5.1 Research question 1: Is rollout timeliness related to new product success?

### 5.1.1 Introduction

Hypothesis 1 stated that

***New product success of timely and delayed rollout cases does differ.***

The EFA regarding new product success (section 4.3.1) has revealed a two-factor solution. The first factor comprised sales, return on investment, customer acceptance and technical performance of product and was named *'financial performance'*. The second factor comprised NPD timeliness and was named *'timely NPD'*.

### 5.1.2 Rollout timeliness and new product success

For the first new product success factor (factor 1), the item values of the items loading high on the factor were averaged. Table 5.1 shows the difference in means and the standard deviations for the factors 1 and 2 between timely and delayed rolled-out cases. T-tests show these differences in means to be significant.

**Table 5.1 New product success factors 1 and 2: means and standard deviations for timely versus delayed rollout cases**

| Factor name | Timely cases | | Delayed cases | | T-tests |
|---|---|---|---|---|---|
| | Mean | Std.dev. | Mean | Std.dev. | signif. |
| Factor 1 | 1.95 | 1.67 | -.86 | 1.80 | .000 |
| Factor 2 | -3.83 | 6.58 | -9.93 | 9.07 | .05 |

The above indicate that timely rolled-out new products are far more successful than delayed rolled-out new products. A rapid and timely rollout becomes, therefore, a fundamental element for the overall successful NPD effort.

### 5.1.3 Relationships between rollout timeliness and success dimensions

The analysis proceeded with an examination of the individual relationships between rollout timeliness and the different success dimensions (sales, return on investment, technical performance, etc.). Table 5.2 shows the correlation coefficients between the various success dimensions and rollout timeliness.

**Table 5.2 Relationships between the new product success dimensions and rollout timeliness: correlation coefficients**

| Dimensions | Code | S1 | S2 | S3 | S4 | S5 | S6 |
|---|---|---|---|---|---|---|---|
| Sales | S1 | 1.00 | | | | | |
| Customer acceptance | S2 | .50** | 1.00 | | | | |
| Return on investment | S3 | .85*** | .46** | 1.00 | | | |
| Technical performance | S4 | .57*** | .53*** | .35* | 1.00 | | |
| Timeliness in NPD | S5 | .36* | n.s. | .44** | n.s. | 1.00 | |
| Timeliness in rollout (across *all* markets) | S6 | .66*** | n.s. | .57*** | n.s. | .45** | 1.00 |

+ $p \leq .10$, * $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

The text below explains these relationships:

- There is a strong and positive relationship between timely rollout and sales (.66, $p < .001$) and between timely rollout and return on investment (.57, $p < .001$). These indicate a crucial relationship between rapid and timely product availability and sales and return on investment. The considerably high correlations at a strong level of statistical significance show how destructive delays are in new product rollouts across international markets. Surprisingly, there is a small difference in correlations between timely rollout and sales, and rollout and return on investment. One might have expected a greater difference, suggesting a smaller effect upon profitability. Apparently, missed sales for products with rapid obsolescence and short product life cycles (and probable declining prices in the late stages of the products' life cycle) have a direct and immediate impact upon profitability. This is also captured from an extremely high (.85, $p \leq .001$) correlation between sales for the investigated products and return on investment.
- The relationships between timely rollout and technical performance and customer acceptance are not statistically significant. These are important issues. A remarkable technical product performance may not accelerate availability of the new product across countries. The same happens regarding customer acceptance. This indicates that organisational and other company or product related elements play a more fundamental role than technical performance and customer acceptance in timeliness of new product rollout.
- The relationship between timely NPD and technical performance is also not statistically significant. This replicates Cooper and Kleinschmidt (1994) who also found a non significant relationship between NPD timeliness and the technical success rating. Cooper and Kleinschmidt (1994) argued that how the project was

organised proved to be the strongest determinant of time efficiency and staying on schedule. At the same time, the relationship between timely NPD and customer acceptance is also not statistically significant. Potential customer acceptance may not help the NPD team to overcome a series of technical and organisational challenges that may bear upon the timely completion of the NPD process.

- The relationship between timeliness in NPD and rollout is positive and strong (.45, $p \leq .01$).
- There is a stronger correlation at higher significance levels between timeliness of rollout and sales (i.e., .66, $p \leq .001$) and return on investment (.57, $p \leq .001$) than timeliness in NPD and sales (.36, $p \leq .05$) and return on investment (.44, $p \leq .05$). This has been confirmed by multiple regression where sales or return on investment are regressed upon timeliness in rollout and timeliness in NPD (the two independent variables). Timeliness in rollout has scored higher standardised beta coefficients and statistical significance levels. This means that the impact of delays in rollout is likely to be greater than the impact of delays in NPD despite a strong and positive correlation between the two timeliness measures. These demonstrate that rapid rollout may probably overcome the negative impact of delays during the NPD phase.

### 5.1.4 Conclusion

Hypothesis 1 is accepted. This hides, however, certain interesting elements:

- Timeliness in new product rollout is strongly and positively correlated to both sales and return on investment. In fact, timely rollout has a stronger effect upon sales and return on investment than a timely developed new product. This means that the impact of delays in rollout is greater than the impact of delays in NPD despite a strong and positive correlation between them. It is reminded to the reader that sales are captured through a perceptual measure. The measure used does not differentiate between sales concluded prior to the actual product availability, sales at the time of product availability or sales at a later stage. Return on investment is also captured through a perceptual measure.
- The actual time it takes to make the new product available for sale across countries (in months) does not seem to be linked to a remarkable product technical performance or customer acceptance contrary to conventional managerial wisdom. A remarkable technical performance or higher customer

acceptance come second to the actual product availability for sale and potential new product uniqueness among competing products.

## 5.2 Research question 2: Do firms roll out their new products across international markets simultaneously or sequentially?

### 5.2.1 Introduction

This question looks at two different aspects:

- Is there a link between the nature of product technology and sequential rollout? (Research question 2a).

  Hypothesis 2a states that

  ***There is a relationship between the nature of product technology and sequential rollout.***

- Is there a link between sequential rollout and delays? (Research question 2b).

  Hypothesis 2b states that

  ***There is a relationship between sequential rollout and delays.***

Managers interviewed generally implied that simultaneous rollout meant a rollout that was completed within 1 to 2 months from the date of availability in the first European country. In accordance with this, the cases were assigned into two groups. The first group comprised 8 cases (27 per cent of the sample) of planned completion of the new product rollout in 1-2 months across all target markets. The cases in the first group were defined and labelled as 'simultaneous rollout'. The second group comprised 22 cases (73 per cent of the sample) of planned completion of the new product rollout in periods of over 2 months across all target markets. The cases in the second group were defined and labelled as 'sequential rollout' (see Table 5.3).

### 5.2.2 The nature of product technology and sequential rollout

New products in some product technologies are more prone to sequential rollout. All 3 cases in measurement instruments and all 7 cases in telecommunications were planned to roll out sequentially (Table 5.4). These also have a higher incidence of delays. Eight out of these 10 cases eventually faced rollout delays.

This happens because the technological component becomes an additional problem area for the companies. Table 5.5 and 5.6 show the problem areas for the

**Table 5.3 New product rollout time (months)**
**(Simultaneous planned time=Sm; sequential planned time= Sq)**

| Product | Rollout time Key markets | | Rollout time All markets | | Rollout Labelled | | Rollout delay+ | |
|---|---|---|---|---|---|---|---|---|
| | Plan | Actual | Plan | Actual | Sm | Sq | Key | All |
| | | | | | | | months | months |
| **Timely rollout cases** | | | | | | | | |
| Laser (B&W) high-speed printer | 2 | same | 2 | same | Sm | | 0 | 0 |
| Solid ink colour printer | 4 | same | 4 | same | | Sq | 0 | 0 |
| Hand stand still 35 mm camera | 1 | same | 1 | same | Sm | | 0 | 0 |
| Medium-speed industrial camera | 2 | same | 2 | same | Sm | | 0 | 0 |
| Ethernet port switch | 3 | same | 3 | same | | Sq | 0 | 0 |
| PBX | 34 | same | 45 | same | | Sq | 0 | 0 |
| Laser (B&W) medium-speed printer | 1 | same | 1 | same | Sm | | 0 | 0 |
| TV set | 3 | same | 3 | same | | Sq | 0 | 0 |
| Medium-speed professional camera | 12 | same | 12 | same | | Sq | 0 | 0 |
| Sound mixing system | 1 | same | 1 | same | Sm | | 0 | 0 |
| PC monitor | 3 | same | 6 | same | | Sq | 0 | 0 |
| Ethernet 10/100 adapter card | 1 | same | 1 | same | Sm | | 0 | 0 |
| Matrix (B&W) bar-code printer | 1 | same | 1 | same | Sm | | 0 | 0 |
| TV set | 1 | same | 1 | same | Sm | | 0 | 0 |
| Analogue modem | 3 | same | 3 | same | | Sq | 0 | 0 |
| **Delayed rollout cases** | | | | | | | | |
| RS 232 adapter | 3 | 12** | 3 | 12** | | Sq | 9 | 9 |
| Ethernet multiplexer | 4 | 6** | 12 | 14** | | Sq | 2 | 2 |
| Climatic data recording instrument | 3 | 4 | 6 | 9 | | Sq | 1 | 3 |
| Ethernet print server | 1 | 2 | 3 | 4 | | Sq | 1 | 1 |
| High- and ultra-high speed camera | 2 | 3 | 4 | 6 | | Sq | 1 | 2 |
| Hand stand still 35 mm camera | 2 | 6 | 6 | 18 | | Sq | 4 | 12 |
| Dynamometer | 3 | 9 | 3* | 9* | | Sq | 6 | 6 |
| Security identification and lamination system | 18 | 36** | 36 | 48** | | Sq | 18 | 12 |
| PBX | 3 | 8 | 6 | 12 | | Sq | 5 | 6 |
| Analogue modem | 4 | 7 | 7 | 14 | | Sq | 3 | 7 |
| Mobile GSM telephone | 1 | 5 | 3 | 7 | | Sq | 4 | 4 |
| ISDN modem | 4 | 6 | 4 | 6 | | Sq | 2 | 2 |
| PC-telephony integration platform | 6 | 14** | 14 | 24** | | Sq | 8 | 10 |
| Ethernet print server | 3 | 9** | 6 | 12** | | Sq | 6 | 6 |
| Electric data recording/testing instrument | 6 | 6 | 12 | 24 | | Sq | 0 | 12 |
| **Average:** | **4.5** | **6.8** | **7.0** | **10.1** | | | **4.6** | **6.3** |

* The company does not have any secondary markets - score is assigned for comparative purposes.

** Rollout delays were still increasing in these four cases and rollout was indefinitely postponed in the fifth one (Security identification and lamination system). Scores are assigned for comparative purposes.

\+ Rollout delay in *key* markets and rollout delay in *all* (key + secondary) markets.

**Table 5.4 Product technologies, sequential rollout and delays: number of cases**

| Area of technology | Total cases | Simultaneous rollout | Sequential rollout | Timely cases | Delayed cases |
|---|---|---|---|---|---|
| Photographic equipment | 6 | 2 | 4 | 3 | 3 |
| Measuring instruments | 3 | - | 3 | - | 3 |
| Telecommunications | 7 | - | 7 | 2 | 5 |
| Others | 14 | 6 | 8 | 10 | 4 |
| **Total all cases** | **30** | **8** | **22** | **15** | **15** |

## Table 5.5 Timely rollout cases: extent of customisation of product technology and problem areas

| Company | Sufficient availability of adequate quality | | | | Synergies in product handling | | New product development | | Internal communication | Customisation of product technology | | Approval | Importance of product |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Engineering/ technical personnel/ resources | Marketing personnel/ resources | Hardware/ software | distri-bution channels | by sales force across Europe | by end user | Communication European HQs and n.p.d. teams | Proficient new product development | Eur.HQs and agents/ subsidiaries and between | Extent of | Complexity of | Complex or other problems | European market share or sales |
| **Cases of substantial customisation of product technology** | | | | | | | | | | | | | |
| Nortel | no | no | no | no | no | no | no* | no | no | minor | no | no | no |
| US Robotics | no | no | no | no | no | no | no* | no | no | minor | no | no | no |
| **Cases of some customisation of product technology** | | | | | | | | | | | | | |
| Brother | no | no | no | no | no | no | no* | no | no | no | no | no | no |
| Citizen | no | no | no | no | no | no | no* | no | no | no | no | no | no |
| OKI | no | no | no | no | no | no | no* | no | no | no | no | no | no |
| Panasonic | no | no | no | no | no | no | no* | no | no | minor | no | no | no |
| Taxan | no | no | no | no | no | no | no* | no | no | minor | no | no | no |
| TEC | no | no | no | no | no | no | no* | no | no | no | no | no | no |
| Toshiba | no | no | no | no | no | no | no* | no | no | minor | no | no | no |
| **Cases of limited customisation of product technology** | | | | | | | | | | | | | |
| Hanimex | no | no | no | no | no | no | no* | no | no | no | no | no | no |
| Hitachi | no | no | no | no | no | no | no* | no | no | no | no | no | no |
| LanArt | no | no | no | no | no | no | no* | no | no | no | no | no | no |
| Sony | no | no | no | no | no | no | no* | no | no | no | no | no | no |
| Soundcraft | no | no | no | no | no | no | no | no | no | no | no | no | no |
| Telesyn | no | no | no | no | no | no | no* | no | no | no | no | no | no |

* If new product development is located in another continent

## Table 5.6 Delayed rollout cases: extent of customisation of product technology and problem areas

| Company | Sufficient availability of adequate quality | | | | Synergies in product handling | | New product development | | Internal communication | Customisation of product technology | | Approval | Importance of product |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Engineering/ technical personnel/ resources | Marketing personnel/ resources | Hardware/ software | distribution channels | by sales force across Europe | by end user | Communication European HQs and n.p.d. teams | Proficient new product development | Eur.HQs and agents/ subsidiaries and between | Extent of | Complexity of | Complex or other problems | European market share or sales |
| **Cases of substantial customisation of product technology** | | | | | | | | | | | | | |
| Instron | MAJOR | no | minor | no | MAJOR | MAJOR | no* | MAJOR | no | MAJOR | MAJOR | no | no |
| Mitel | no | MAJOR | no | MAJOR | MAJOR | no | MAJOR* | minor | MAJOR | minor | no | MAJOR | minor |
| Motorola | no | no | MAJOR | minor | no | no | no | no | no | minor | minor | minor | no |
| Rhetorex | no | MAJOR | MAJOR | no | minor | minor | no* | MAJOR | no | minor | MAJOR | MAJOR | minor |
| **Cases of some customisation of product technology** | | | | | | | | | | | | | |
| No case | | | | | | | | | | | | | |
| **Cases of limited customisation of product technology** | | | | | | | | | | | | | |
| Amplicon | no | MAJOR | no | MAJOR | no | no | no | no | MAJOR | no | no | no | MAJOR |
| Cray | MAJOR | no | MAJOR | no | no | no | no* | no | no | no | no | no | no |
| Delta-T | minor | MAJOR | no | no | no | no | no | no | minor | no | no | no | no |
| Emulex | no | no | MAJOR | no | no | no | MAJOR* | MAJOR | no | no | no | no | minor |
| Hadland | minor | MAJOR | no | MAJOR | MAJOR | MAJOR | no | no | minor | no | no | no | no |
| Halina | minor | MAJOR | MAJOR | no | no | no | no* | no | MAJOR | no | no | no | no |
| Laminex | MAJOR | MAJOR | minor | MAJOR | MAJOR | no | MAJOR | MAJOR | MAJOR | no | no | no | MAJOR |
| Orbitel | minor | MAJOR | MAJOR | MAJOR | no | no | no | no | no | no | no | no | minor |
| Racal | no | MAJOR | no | MAJOR | no | no | no | no | MAJOR | no | no | no | minor |
| 3COM | MAJOR | MAJOR | MAJOR | MAJOR | MAJOR | MAJOR | no* | MAJOR | no | no | no | no | no |
| Voltech | no | MAJOR | no | MAJOR | MAJOR | no | minor | MAJOR | minor | no | no | no | no |

* if new product development is located in another continent

cases of substantial versus limited customisation of product technology. It is noticeable that cases of:

- substantial customisation of product technology face problems in both technology and non-technology areas.
- limited product customisation (= standardised technology) mostly face problems in non-technology related areas.

The computer-telephone integration market is a case in point of substantial product technology customisation. This market, which is part of the wider telecommunications industry, was, until a few years ago, a nascent industry. Currently, it experiences a phenomenal and explosive growth which is strongly linked to the emergence of powerful PC microprocessor and robust operating systems (i.e., OS/2, Windows NT). Its applications comprise voice messaging, inbound and outbound call processing, information services, and database access via telephone. Manufacturers need to customise the technology embodied in their products for individual countries due, mainly, to cross-country differences in telecommunication protocols. The U.S., European and other international digital networks are technically very different, with some countries supporting digital technology, while other employ 'hybrid' analogue-digital protocols or various analogue telecommunication protocols. Public and private investments made in telecommunication infrastructure are so varied that it is virtually impossible to standardise the telecommunication products across countries. The above become even more complex to achieve nowadays because of the new much stricter European Union requirements for electromagnetic interference. The case study of Rhetorex Europe Ltd. (see a full case description in the appendix) clearly shows the company's difficulties in both non-technology and technology areas and how these have resulted in a sequential planned rollout time.

### 5.2.3 Sequential rollout and delays

Delays were consistently featured in the cases of sequential new product rollout (15 out of the 22 cases). In marked contrast, all the simultaneously planned launches were timely. The observation of a high occurrence of delays in sequential as opposed to simultaneous country market launches is surprising. Bearing in mind that the researcher had requested the principal informant to select a recent rollout project, but had not specified the mode of rollout (sequential or simultaneous), the observed

distribution of timely and delayed cases among the two modes of rollout is instructive. The result challenges conventional arguments for risk reduction in sequential launches (Mascarenhas, 1992a; 1992b). Managers have tended to view simultaneous multi-country launches as a difficult and high risk strategy, and have traded off speedy market penetration for risk reduction by opting for a sequential rollout. This may have had for sequential rollout cases in this study an opposite result since it entails:

- a delay in the anticipated time frame for new product commercialisation across countries. Managers seem to have underestimated the difficulties and most of them did not eventually achieve their targets; and
- a substantial risk of new product failure. Such a failure contradicts the managerial target of reduction of risk.

### 5.2.4 Conclusion

Both hypotheses 2a and 2b are accepted. Specific product technologies are prone to sequential rollout and subsequent delays. This likely relates to the extent and complexity of customisation of product technology. All products planned to roll out sequentially have eventually faced delays.

## 5.3 Research question 3: What factors lead to rollout delay?

### 5.3.1 Introduction

The eight hypotheses related to this question state in summary that

***There is a relationship between***

- ***sufficiency in marketing ($H_{3a}$);***
- ***sufficiency in technology ($H_{3b}$);***
- ***synergies in product handling and use ($H_{3c}$);***
- ***product superiority ($H_{3d}$);***
- ***integration during the new product development process ($H_{3e}$);***
- ***proficiency of the new product development process ($H_{3f}$);***
- ***knowledge of intended targets at the start of the new product development process ($H_{3g}$);***
- ***intensive internal communication between the European HQ and subsidiaries/agents, and between subsidiaries/agents themselves ($H_{3h}$)***

***and timeliness in new product rollout.***

### 5.3.2 Factors that lead to rollout delay

The framework of the present study comprised eight core factors that lead to rollout delays. Factor analysis on a series of indicators and reliability tests (section 4.3) established a series of highly reliable and easily interpretable factors. For each factor, item values were averaged. Table 5.7 shows the difference in factor means and standard deviations between timely and delayed cases.

**Table 5.7 Means and standard deviations: timely versus delayed cases (scale 1-5)**

| Factor name | Code | Timely | | Delayed | |
|---|---|---|---|---|---|
| | | Mean | Std.dev. | Mean | Std.dev. |
| Suff. in marketing | CF1 | 3.4 | 1.2 | 2.0 | 0.8 |
| Suff. in technology | CF2 | 3.8 | 1.1 | 2.4 | 1.2 |
| Synergies | CF3 | 4.2 | 0.6 | 2.8 | 1.0 |
| Prod. superior | CF4 | 4.3 | 0.6 | 3.5 | 0.7 |
| Integration in NPD | CF5 | 3.7 | 0.9 | 2.3 | 0.5 |
| Proficiency in NPD | CF6 | 3.6 | 1.1 | 2.2 | 0.6 |
| Targets known early | CF7 | 4.2 | 0.7 | 3.2 | 0.9 |
| Communication | CF8 | 3.5 | 1.0 | 1.8 | 0.5 |

The means show higher values for timely than delayed cases for all factors. This confirms their relationship with rollout timeliness. The strength of this relationship was subsequently tested through a series of product-moment correlations. Both measures of rollout timeliness were used (see Table 5.8). First, the relationship between these factors and the perceptual timeliness measure on a -5 to +5 scale is discussed. This measure aimed to identify the degree to which the project adhered to the time schedule, where low negative scores (-5) indicate 'far behind schedule', (0) indicate 'stayed on schedule' and high scores (+5) indicate 'ahead of schedule'. Second, a discussion of the relationships between the 8 factors and the actual timeliness measure (calculated in months) is provided. The latter measure refers to the difference: *scheduled/ anticipated - actual* rollout time in months (timeliness = $dt \geq 0$ months; delays = $dt < 0$ months).

**Perceptual timeliness measure**

Correlation coefficients are strong between all factors and the perceptual rollout timeliness measures [*key* markets (PT-key) and *all* markets (PT-all)]. Figures range from a low of .48 to a high of .79, at strong levels of significance ($p \leq .01$ and beyond) (see Table 5.8).

Table 5.8 Correlation coefficients between factors and rollout timeliness ($n$ = 30, 2 tail significance)

| Factor name | Code | PT-key | PT-all | AT-key | AT-all | CF1 | CF2 | CF3 | CF4 | CF5 | CF6 | CF7 | CF8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Perceptual timeliness, key markets | PT-key | 1.00 | | | | | | | | | | | |
| Perceptual timeliness, all markets | PT-all | .96*** | 1.00 | | | | | | | | | | |
| Actual timeliness, key markets | AT-key | .64*** | .58*** | 1.00 | | | | | | | | | |
| Actual timeliness, all markets | AT-all | .65*** | .66*** | .74*** | 1.00 | | | | | | | | |
| Suff. in marketing | CF1 | .67*** | .71*** | .43** | .47** | 1.00 | | | | | | | |
| Suff. in technology | CF2 | .61*** | .58*** | .50** | .49** | .58*** | 1.00 | | | | | | |
| Synergies | CF3 | .48** | .53** | .51** | .49** | .58*** | .55*** | 1.00 | | | | | |
| Prod. superior | CF4 | .62*** | .59*** | .33* | .46** | .57*** | .57*** | .54*** | 1.00 | | | | |
| Integration in n.p.d. | CF5 | .66*** | .65*** | .43** | .55*** | .78*** | .72*** | .57*** | .69*** | 1.00 | | | |
| Proficiency in n.p.d. | CF6 | .66*** | .67*** | .36* | .52*** | .82*** | .70*** | .54*** | .66*** | .88*** | 1.00 | | |
| Targets known early | CF7 | .57*** | .57*** | .45** | .57*** | .70*** | .74*** | .61*** | .70*** | .75*** | .78*** | 1.00 | |
| Communication | CF8 | .76*** | .79*** | .52*** | .62*** | .68*** | .57*** | .53*** | .48** | .81*** | .77*** | .58*** | 1.00 |
| Average | | .66 | .63 | .47 | .52 | .67 | .64 | .56 | .63 | .81 | .77 | .68 | |
| Standard deviation | | .11 | .07 | .11 | .05 | .10 | .08 | .03 | .10 | .06 | .00 | | |

*$p \leq .10$; ** $p \leq .01$; ***$p \leq .001$

**Actual timeliness measure (calculated in months)**

When the measure changes to actual delay in months (timeliness = $dt \geq 0$ months; delays = $dt < 0$ months), the results still remain stable for all factors, with strong, although decreased, correlation coefficients. The means of correlation coefficients decrease from .63 to .45 for *key* markets (AT-key) and .64 to .51 for *all* markets (AT-all) (see Table 5.8).

It is also useful to note the statistical significance of correlation coefficients. The average of statistical significance of correlations in Table 5.8 for the 'timeliness to *key* markets' measure decreases from $p = .001$ for the perceptual to $p = .01$ for the actual timeliness measure calculated in months (see Table 5.9). The average of statistical significance of correlation coefficients in Table 5.8 for the 'timeliness to *all* markets' measure decreases from $p = .0005$ for the perceptual to $p = .005$ for the actual timeliness measure calculated in months.

**Table 5.9 Means of the statistical significance of correlation coefficients in Table 5.8**

| | Perceptual timeliness | | Actual timeliness in months | |
|---|---|---|---|---|
| | Key markets | All markets | Key markets | All markets |
| Means | .001 | .0005 | .01 | .005 |

The differences in correlation coefficients and statistical significance first indicate some cognitive biases of managers, in the sense that managers appear to inflate the success achievements of their new products in the perceptual measure. The use of two different timeliness measures, however, permits us to identify the scale of these differences. They are of the order of .17 for timeliness to *key* markets and .13 for timeliness to *all* markets (average of differences between correlation coefficients). It is interesting to note that the biggest reductions in the difference between correlation coefficients lie in specific areas (see Table 5.10). Decreases are of the order of .21-.27 for product superiority (CF4), proficiency in the NPD process (CF6), intensity of internal communication (CF8), and sufficiency in marketing (CF1). The smaller decreases in strength of correlation coefficients are in synergies (CF3), sufficiency in technology (CF2) and targets known (CF7). These mean that the biggest cognitive biases concern the superiority of the company's products and softer organisational elements such as communication, marketing ability and internal co-ordination. In contrast, biases seem to be smaller for more 'tangible' elements, including sufficiency in technology, actual synergies in product handling by the sales force and customer difficulty in operating the product.

Table 5.10 Differences between correlation coefficients in Table 5.8 for both measures of rollout timeliness

| Factor name | Code | Timeliness in key markets | | | Timeliness in all markets | | |
|---|---|---|---|---|---|---|---|
| | | Perceptual measure | Actual timeliness in months | Difference | Perceptual measure | Actual timeliness in months | Difference |
| Suff. in marketing | CF1 | .6721 | .4448 | .2273 | .7132 | .4526 | .2606 |
| Suff. in technology | CF2 | .6102 | .5106 | .0996 | .5835 | .4668 | .1167 |
| Synergies | CF3 | .4835 | .5373 | - .0538 | .5322 | .4814 | .0508 |
| Prod. superior | CF4 | .6270 | .3479 | .2791 | .5983 | .4577 | .1406 |
| Integration in NPD | CF5 | .6685 | .4523 | .2162 | .6544 | .5397 | .1147 |
| Proficiency in NPD | CF6 | .6621 | .3840 | .2781 | .6761 | .5159 | .1602 |
| Targets known early | CF7 | .5798 | .4612 | .1186 | .5769 | .5531 | .0238 |
| Communication | CF8 | .7689 | .5400 | .2289 | .7992 | .6201 | .1791 |
| Average | | | | .1742 | | | .1308 |

It is important, however, that the strong correlation coefficients and the small standard deviations of these correlation coefficients (as shown in Table 5.8) have remained stable despite some inherent managerial biases. This shows that the CF1 to CF8 factors strongly relate to and lead to rollout timeliness. This happens independently of what measure of timeliness is used.

Following these findings, the next step is to examine the strength of differences between groups (i.e., timely and delayed cases). Cases were assigned in two groups (one comprising the timely and one comprising the delayed cases). A dummy variable was created and subsequently used as dependent. The value of 1 was given to all timely rollout cases and the value of 2 was given to all delayed rollout cases.

A series of Kruskal-Wallis 1-Way Anova between the individual factors (the average scale of all items loading on each factor) and the dependent dummy variable were carried out. Kruskal-Wallis is a robust non-parametric test of differences in location for two (or more) independent samples with a total of *n* observations, and it is particularly appropriate for the present analysis.

The question answered by the test is whether the differences among the samples signify genuine population differences with respect to the variable under study, or whether they represent merely the kind of variations that are to be expected among random samples from the same population. The Kruskal-Wallis 1-Way Anova is an alternative to a single-factor analysis of variance or a *k*-sample median test. For one sample, the median test is a binomial test with observations dichotomised as being above or below the hypothesised median. In Kruskal-Wallis 1-Way Anova, the

scores in the combined samples are ranked, and the sum of the ranks, $R_i$, is found for each sample.

The test showed all differences in factor means between groups (i.e., timely and delayed cases) to be significant ($p < .005$) (see Table 5.11).

**Table 5.11 Kruskal-Wallis 1-Way Anova for individual factors between timely and delayed cases**

| Factor | Code | Mean rank timely | Mean rank delayed | $\chi^2$ | df | Signif. | Corrected for ties $\chi^2$ | df | Signif. |
|---|---|---|---|---|---|---|---|---|---|
| Suff. in marketing | CF1 | 20.10 | 10.90 | 8.19 | 1 | .0042 | 8.25 | 1 | .0041 |
| Suff. in technology | CF2 | 20.03 | 10.97 | 7.95 | 1 | .0048 | 8.07 | 1 | .0045 |
| Synergies | CF3 | 21.40 | 9.60 | 13.47 | 1 | .0002 | 13.63 | 1 | .0002 |
| Prod. superior | CF4 | 20.23 | 10.77 | 8.67 | 1 | .0032 | 8.85 | 1 | .0029 |
| Integration in NPD | CF5 | 21.13 | 9.87 | 12.28 | 1 | .0005 | 12.34 | 1 | .0004 |
| Proficiency in NPD | CF6 | 20.50 | 10.50 | 9.67 | 1 | .0019 | 9.71 | 1 | .0018 |
| Targets known early | CF7 | 20.17 | 10.83 | 8.43 | 1 | .0037 | 8.57 | 1 | .0034 |
| Communication | CF8 | 22.30 | 8.70 | 17.89 | 1 | .0000 | 18.08 | 1 | .0000 |

This indicates that all factors univariately relate and lead to rollout timeliness.

### 5.3.3 Conclusion

All eight hypotheses in this research question (RQ3) are accepted. There is a relationship between the above factors and timeliness in new product rollout. The interactions between the factors is discussed in more detail in research question 4.

## 5.4 Research question 4: What is the interaction between these factors and their direct and indirect effects upon rollout delay?

### 5.4.1 Introduction

Eight core factors were identified as relating to timeliness in new product rollout. This section focuses on the interaction between these core factors. A model is then presented. The total effect of each factor upon timeliness is subsequently ascertained through path analysis.

### 5.4.2 Modelling and the modelling process

Modelling was considered to be an adequate method to communicate the relationships. This is because a model is 'a simplified description of a system [system = a group of things working together as a whole] used in explanations, calculations

etc.' (Oxford dictionary). Such simplification is important, since it expresses the linkages between elements and clarifies their interaction, thus facilitating the generation of additional theoretical insights into the topic at hand. A theory is an abstract set of ideas that links together concepts, and a model is its formal representation in a way that approximates to reality (Jeffreys, 1983, p. 79). Social modellers seem to assume in this respect that social action can be captured in a rational, logical scientific model which may be depicted in a causal diagrammatic manner (Meadows, 1980, p. 25). Due to the approximate nature of models and the impossibility of observing causality, however, all causal inferences must be regarded as tentative.

The modelling process followed in the ensuing analysis was adapted from Randers (1980). It is divided into four stages: *conceptualisation*, *formulation*, *validation* and *implementation*. This four-stage process is considered to be powerful and its value is established in complex system dynamics modelling problems (Legasto *et al.*, 1980).

**Model conceptualisation and formulation**

The conceptualisation stage establishes the focus of the model. The formulation stage casts the chosen perspective into a formal representation. The resulting model gives a precise, though not necessarily accurate, description of a slice of reality and is capable of generating images of alternative figures. During the formulation stage, one attempts to select a means of relating model behaviour to system properties. The trial and error process to be followed can reflect one of two attitudes: viewing the model as a 'black box' where parameters are systematically changed and behaviour is then simulated and observed; or utilising the system equations to guide parameter selection. The first attitude was followed. The use of case research methodology in this project had already provided an oral, descriptive and experiential database that was large, comprehensive and rich in depicting causal relations and dynamic behaviour. This helped conceptualisation and model formulation.

**Model validation and representation**

The validation stage subjects both model structure and behaviour to various tests intended to establish the quality of the model. The goal is to identify weak points for further improvement and to establish the extent of model utility. Finally the representation stage seeks to transfer study insights to those who might use them

(Randers, 1980). Forrester and Senge (1980) contend that validity is determined by the confidence one has in the model; its assumptions, its plausible arguments, the consistency between model behaviour, dynamics and perceived important relationships. They argued on the matter:

> ***Validation is the process of establishing confidence in the soundness and usefulness of a model. Validation begins as the model builder accumulates confidence that a model behaves plausibly and generates problem symptoms or modes of behaviour seen in the real system. (p. 210)***

Such system verification is completed through a series of model structure and behaviour tests as follows (see also Legasto *et al.*, 1980):

- *Tests of model structure.* Verifying structure means comparing the structure of the model directly with the structure of the real system that the model represents. To pass the structure verification test, the model structure must not contradict knowledge about the structure of the real system. Other possible tests include parameter verification, the extreme conditions test, the boundary adequacy structure test and the dimensional consistency test.
- *Tests of model behaviour.* Behaviour reproduction tests examine how well model-generated behaviour matches the observed behaviour of the real system. Behaviour reproduction tests include symptom generation, frequency generation, relative phasing, multiple mode and behaviour prediction. The symptom generation test examines whether or not a model recreates the symptoms of difficulty that motivated construction of the model (Forrester and Senge, 1980, p. 217). Presumably the model is made to show how a particular kind of undesirable situation arises, so it can be alleviated. Unless one can show how internal actions and structure cause the symptoms, one is in a poor position to alter those causes. The multiple mode tests consider whether or not a model is able to generate more than one mode of behaviour (i.e., in the present model timeliness versus new product rollout delay). Behaviour prediction tests are analogous to behaviour reproduction test and focus on future behaviour. Within this type, the pattern prediction test examines whether or not a model generates qualitatively correct patterns of future behaviour. The event prediction test focuses on a particular change in circumstances which is found likely on the basis of analysis of model behaviour. Other tests include the behaviour anomaly test, the family member

test, the surprise behaviour test, the extreme policy test, the boundary adequacy test and the behaviour sensitivity test (Forrester and Senge, 1980).

At least three possible criteria can be used when implementing the tests:

- Does omission (inclusion) of the factor lead to a change in the predicted numerical value of the system?
- Does omission (inclusion) of the factor lead to a change in the behaviour of the system? For example, does it dampen or induce fluctuations in the system?
- Does omission (inclusion) of the factor lead to rejection of findings that were formerly found to have had a favourable/ unfavourable impact, or to reordering of effects?

The modelling process premises were followed for the present endeavour. A continuous reiteration between model formulation, validation and representation eventually assisted in the establishment of a model for timeliness in new product rollout across international markets. This model is presented hereafter.

### 5.4.3 Model of timeliness of new product rollout across international markets

In section 5.3, eight core factors (CF1, ...., CF8) were found to relate to timeliness in new product rollout. Each one of them leads to or detracts from the timely rollout of new products across international markets. The effect of one factor often depends, however, on the state of others. They constitute a complex dynamic system, through which many organisational characteristics influence timeliness. Yet, the system is an evolving one, in which one factor influences others. Rapid and timely rollout of a new product grows out of the self-reinforcing interplay of these factors, thus creating a situation in which it becomes likely or unlikely to achieve timely rollout across countries. The system is as important as the individual parts, or more so. The model has been initially explained in Chapter 3. Nonetheless, the implementation of the four stages of the modeling process (i.e., conceptualisation, formulation, validation and implementation) has permitted to refine both the sequence and position of each individual element in the model as well as the interaction between them. Figure 5.1 shows the representation of the refined model. Arrows suggest an interaction between two elements, the arrow head indicating the direction of effect.

Explanation of symbols is as follows:

CF1 = Sufficiency in marketing
CF2 = Sufficiency in technology
CF3 = Synergies in product handling and use
CF4 = Product superior
CF5 = Quality integration during the NPD process
CF6 = Proficiency of the execution of the NPD process
CF7 = Targets known at the start of the NPD process
CF8 = Internal communication between European HQ and subsidiary/agents and between subsidiaries/agents themselves

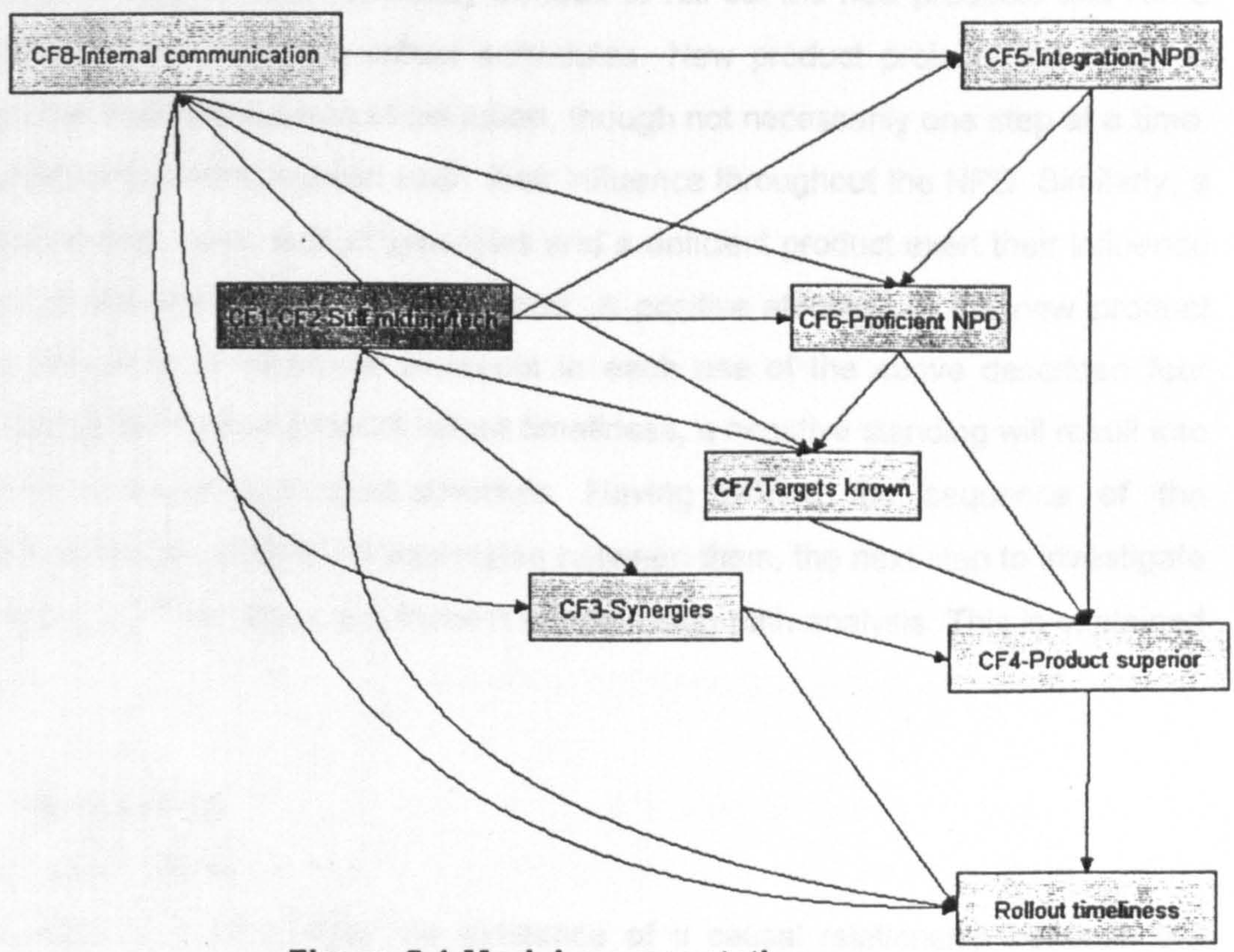


**Figure 5.1 Model representation**

The sequence of the model in its refined form is initiated with CF8 (communication) and CF1, CF2 (sufficiency in marketing and technology). CF3 (synergies), CF5 (integration in NPD), CF6 (proficient NPD) and CF7 (targets known) are intermediary elements that channel CF1; CF2 and CF8's effects upon CF4 (product superior) and rollout timeliness. These mean that new product rollout timeliness (conversely, delays) may be represented as a system of evolution where the first step of the evolutionary process regards resources (CF1, CF2) and communication (CF8) and

the last regards rollout timeliness itself. There are two intermediary steps. The first intermediary step regards CF3 and the NPD related factors (CF5, CF6, CF7) while the second intermediary step regards product superiority (CF4). If a new product does not receive sufficient and adequate resources and there is weak organisational communication, the first to suffer will be synergies in product handling and use and the NPD process. Then, the products will be deficient, technically inappropriate, inferior to competition and unacceptable by customers, sales personnel and independent distributors. Furthermore, sales staff will not be familiar with the new products, product features and rollout dates, which will prevent them from informing and educating customers about the new arrivals. These create obstacles that oblige managers to lengthen the necessary periods to roll out the new products and run a higher risk of delays in the rollout schedules. New product projects will undergo through this four-step system of evolution, though not necessarily one step at a time. Resources and communication exert their influence throughout the NPD. Similarly, a deficient NPD process, lack of synergies and a deficient product exert their influence throughout the new product rollout period. A positive standing of the new product project regarding all individual elements in each one of the above described four steps will result into new product rollout timeliness, a negative standing will result into delays in the new product rollout schedule. Having refined the sequence of the elements in the model and the interaction between them, the next step to investigate is the strength of the direct and indirect effects using path analysis. This is explained in turn.

### 5.4.4 Path analysis

#### 5.4.4.1 Introduction

Path analysis is used to infer the existence of a causal relationship between the variables. It was first used by the geneticist Sewell Wright (1921) for untangling genetic and non-genetic influences. Path analysis employees a series of multiple regression analyses to describe the relationships among a set of variables that are logically ordered (Yaremko *et al.*, 1982). It is assumed that this reflects a causal order, so that each variable is determined by one or more of the variables that precede it, and in turn may determine variables that follow it. The model is shown in a path diagram, with arrows representing the direction of influence. Path analysis expresses the same relationships by a set of regression equations, with each variable expressed as a linear function of the preceding variables plus the error term.

It is then concerned with estimating the magnitude of the linkages between variables and using these estimates to provide information about underlying causal processes (Asher, 1983). The simplest way to obtain the path coefficients is to regress each endogenous variable on those variables that directly impinge upon it, providing the regression assumptions are met, particularly the requirement that the residual variable in a structural equation be uncorrelated with the explanatory variables in that equation (Asher, 1983, p. 30).

One of the main advantages of path analysis is that it enables one to measure the direct and indirect effects of one variable on another. It must be recognised at the outset, however, that a causal model may never be established as proven by a given analysis; all that may be said is that the data are consistent with a given model or that they are not (Cohen and Cohen, 1983, p. 80). Furthermore, the conception of causality and the definition of cause have been the subject of intense discussion, a compelling resolution being available in Cook and Campbell (1979). For the purposes of the present study, the definition given by Cohen and Cohen (1983, p.79) will be employed. They argued that causal analysis as a working method may require no more elaborate conception of causality than that of common usage, indicating that 'A' is a cause of 'B' when:

- 'A' precedes 'B' in time, although they may be measured at the same time.
- The mechanism whereby this causal effect operates can be posited.
- A change in the value of 'A' is accompanied by a change in the value of 'B'.

Ordinary least squares (OLS) regressions were used to identify the magnitude of effects in the model. Standardised path coefficients were used because of the difference in scaling between the dependent and independent variables. Measures used in the model are the factors established through factor analysis, tested for reliability and presented earlier in this document (CF1-CF8). Statistical assumptions regarding the use of regression were satisfied. T-tests were used to identify the statistical significance ($p < .05$) of each partial regression coefficient. Some of the linkages between variables were found to be statistically non- significant. For reasons of model purification, these linkages were eliminated from further consideration and a new series of OLS regressions were carried out. Figure 5.2 shows the paths that retained statistical significance and their standardised regression coefficients.

Eliminated linkages can be grouped into three sets:

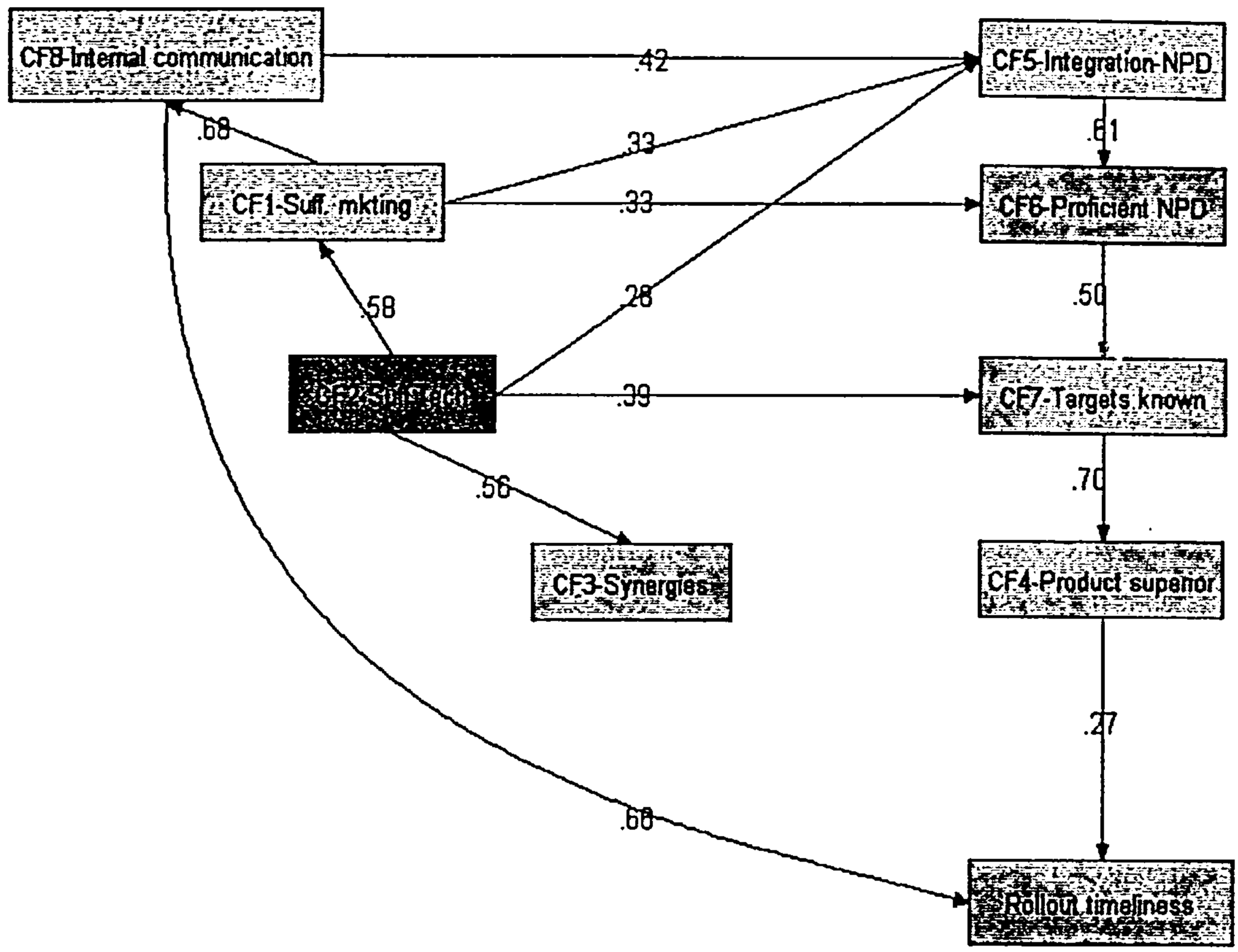


**Figure 5.2 Model representation: statistically significant paths and standardised coefficients**

Adjusted $R^2$ values:

| | | | | | |
|---|---|---|---|---|---|
| Rollout timeliness= | .67 | CF4= | .47 | CF7= | .66 |
| CF1= | .31 | CF5= | .79 | CF8= | .44 |
| CF3= | .29 | CF6= | .80 | | |

- One set of eliminated linkages is from CF1 (sufficiency in marketing), CF2 (sufficiency in technology) and CF8 (internal communication) to the NPD process. CF1 does not directly influence early product and target market definition (CF7) in a statistically significant manner. CF2 does not influence directly in a statistically significant manner the proficiency of the NPD process (CF6). Furthermore, the linkages from CF1 and CF2 to rollout timeliness were also eliminated, although they were marginally significant. This indicates that marketing and engineering resources (CF1 and CF2) mostly channel their influence indirectly on rollout timeliness. CF8 was also found to have a statistically significant influence only on the integration of the NPD process. CF8 affects neither the proficiency of execution of the NPD process nor early product and target market definition.
- A second set of eliminated linkages was between CF5 (integration during the NPD process), CF6 (proficiency during the process), CF7 (early product and target market definition) and CF4 (product superiority). Effects were found to be direct from CF5 to CF6, from CF6 to CF7 and from CF7 to CF4. These indicate that integration (CF5) leads to proficiency during the process (CF6), which leads in turn to early product and target market definition (CF7) and then to superiority of the product (CF4).
- The third set of eliminated linkages concerns CF3 (synergies in product handling by the sales force and in product use by the customers). CF3's effect upon rollout timeliness was marginal. The effect of CF1 (sufficiency in marketing) and CF8 (intensity of communication) upon CF3 were also eliminated, these also being marginal.

Model purification resulted in the following equations for the model:

| | |
|---|---|
| TIMELINESS = | $b_1$ CF4 + $b_2$ CF8 + $e$ |
| CF1 = | $b_3$ CF2 + $e$ |
| CF3 = | $b_4$ CF2 + $e$ |
| CF4 = | $b_5$ CF7 + $e$ |
| CF5 = | $b_6$ CF1 + $b_7$ CF2 + $b_8$ CF8 + $e$ |
| CF6 = | $b_9$ CF5 + $e$ |
| CF7 = | $b_{10}$ CF6 + $e$ |
| CF8 = | $b_{11}$ CF1 + $e$ |

where:

- $b_n$, $n$=1,...,11 are the standardised regression coefficients, $e$ is the error term;

- **TIMELINESS = timeliness in new product rollout.**
  The perceptual timeliness to *all* markets measure was used to avoid skewness of the dependent variable in the regression equations. Recall the existence of two cases acting as statistical outliers (z-scores ranged from 2.084 to 4.557) (see also p. 106). At the same time, very strong correlations exist between the different rollout timeliness measures( average .71, $p \leq .001$).

- **CF1 = sufficiency in marketing**
  (distribution channels, marketing personnel and funds to adapt advertising/ promotion, personnel to train sales staff and technicians; after-sales service personnel and equipment);

- **CF2 = sufficiency in technology**
  (R & D personnel and funds to adapt product, hardware adapted for different European countries, software adapted for different European countries);

- **CF3 = synergies in product handling and use**
  (sales force, distribution channels, product handling/'feeling' remained same for the customer, way user is informed about product function remained same, way user interacts with and controls operation of product remained same);

- **CF4 = product superior**
  (unique attributes and clearly visible benefits to the customer, superior quality, performance, value for money, product intended image consistent with corporate image, attributes also perceived as useful by the customers);

- **CF5 = quality integration during the NPD process**
  (integration between technical, marketing and manufacturing high, integration between these functions when in different sites in different countries high, final customers strongly involved and provided feedback, technical and marketing contributed accurate, on-time, high-quality input, subsidiaries/agents provided continuous feedback);

- **CF6 = proficiency of execution of the NPD process**
  (proficient execution of: tests of prototypes by customers/trial sales, co-ordination of distribution channels and logistics, co-ordination of advertising and promotion, predevelopment project planning, technical development and sorting out unexpected 'bugs', technical testing of the product);

- **CF7 = targets known at the start of the NPD process**
  (the firm knew at the start: the intended users, targeted countries and their needs and preferences, the product concept and product positioning, the final product specifications and technical requirements, the product final features and characteristics);

- **CF8 = internal communication between European HQ and European subsidiaries/agents and between subsidiaries/agents themselves**
  (extensive direct contact, meetings and interaction between HQ and subsidiaries/agents, direct contact, meetings and interaction between subsidiaries/agents, interdepartmental permanent committees between HQ and subsidiaries/agents, interdepartmental temporary forces between HQ and

subsidiaries/agents, a matrix system between HQ and subsidiaries/agents, a set of shared goals, values and beliefs shaping behaviour).

The LMTEST (Byrne, 1994) was requested at this stage. The LMTEST provides Lagrange univariate and multivariate estimators regarding the direction of flows between the model factors. The LMTEST indicated that the direction of flows between the model factors was accurate.

### 5.4.4.2 Effect decomposition (standardised values)

Total and indirect effects are presented below.

**Total effects**

Upon:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Timeliness= | +.518 CF1 | + .390 CF2 | + .274 CF4 | + .058 CF5 | +.009 CF6 | +.191 CF7 | + .667 CF8 |
| CF1= | | + .580 CF2 | | | | | |
| CF3= | | + .560 CF2 | | | | | |
| CF4= | +.245CF1 | + .474 CF2 | | + .213 CF5 | +.350 CF6 | +.700 CF7 | + .089 CF8 |
| CF5= | +.610CF1 | + .636 CF2 | | | | | + .420 CF8 |
| CF6= | +.705CF1 | + .578 CF2 | | + .610 CF5 | | | + .256 CF8 |
| CF7= | +.352CF1 | + .653 CF2 | | + .305 CF5 | + .50 CF6 | | + .128 CF8 |
| CF8= | +.680 CF1 | + .394 CF2 | | | | | |

**Direct versus indirect effects**

Upon

| | |
|---|---|
| Timeliness= | Direct effect of CF8 = .665; indirect effect of CF8 = .002 |
| CF5= | Direct effect of CF1 = .33; indirect effect of CF1 = .28 |
| | Direct effect of CF2 = .28; indirect effect of CF2 = .356 |
| CF6= | Direct effect of CF1 = .33; indirect effect of CF1 = .375 |
| CF7= | Direct effect of CF2 = .39; indirect effect of CF2 = .263 |

### 5.4.4.3 Discussion of effects

**Total effects**

**Upon Timeliness = +.518 CF1 + .390 CF2 + .274 CF4 + .058 CF5 +.009 CF6 +.191 CF7 + .667 CF8**

The decomposition of effects has noticeably shown that CF8 (internal communication between European HQ and European Subsidiaries/agents and between subsidiaries/agents themselves) and CF1 (sufficiency in marketing) have the

strongest total effect (.667 and .518 respectively) upon new product rollout timeliness.

This is followed by CF2 (.390), which is sufficiency in technology and CF4 (.274), which is superior product. CF3 was eliminated from the equation because its effect upon timeliness was marginally statistically significant.

**Upon CF1 = + .580 CF2;**

**Upon CF3 = + .560 CF2**

CF2 has achieved a prominent position since it seems to influence all other variables in the model. This may be due, however, to the nature of sampled cases (in high-technology electronics) positing engineering resources at the very heart of rollout timeliness and sufficiency of marketing resources (effect upon CF1 = .580). CF3 (synergies in product handling and use) is particularly affected by CF2 (.560). Marginally statistically significant effects of CF1 (sufficiency in marketing) and CF8 (internal communication) upon CF3 (synergies in product handling and use) were also witnessed. Yet, it is likely that abundant and high-quality technical inputs educate sales staff and customers rapidly, increasing thus, their familiarity with the new product.

**Upon CF4 = +.245 CF1 + .474 CF2 + .213 CF5 +.350 CF6 +.700 CF7 +.089 CF8**

CF4 (superiority of the new product) is excessively affected by CF7 (target known at the start of the NPD process), with a value of .700. It is also heavily influenced by both sufficiency in technology (CF2= .474) and proficient execution of the NPD process (CF6= .350).

The influence of internal communication (CF8) upon CF4 is small, however. This means that communication is only a means to achieve a superior product. Communication channels its influence upon CF4 only through the NPD process, an issue discussed next.

| | | | |
|---|---|---|---|
| **Upon CF5 =** | **+.610 CF1 + .636 CF2** | | **+ .420 CF8** |
| **Upon CF6 =** | **+.705 CF1 + .578 CF2** | **+ .610 CF5** | **+ .256 CF8** |
| **Upon CF7 =** | **+.352 CF1 + .653 CF2** | **+ .305 CF5 + .50 CF6** | **+ .128 CF8** |

CF5 (Quality integration during the NPD process) is equally and strongly affected by sufficiency in marketing resources (CF1= .610) and technology (CF2= .636). CF8 follows closely behind (.420). This indicates that quality integration leans upon

adequate marketing and engineering resources, but communication backing is necessary. The importance of adequate quality marketing and engineering input is also apparent in the other equations, even though it is clear that a successful NPD process necessitates integration, proficient execution and early product and target market definition.

**Upon CF8 = +.680 CF1 + .394 CF2**

CF8 is affected by both CF1 and CF2 indicating that intra-organisational integration does not take place without appropriate quality marketing and technical resources. It also seems that subsidiaries and agents co-operate because the company has all the technology and products necessary to be competitive in the local European markets.

**Indirect effects**

**Upon Timeliness = Direct effect of CF8 = .665; indirect effect of CF8 = .002**

The most noticeable feature is the difference (+ .665 versus .002) between direct and indirect effects of CF8: that is, internal, HQ-subsidiaries and cross-subsidiaries' communication. This shows that almost the entire influence of CF8 upon timeliness is direct. It becomes clear, therefore, that without direct and strong integration between European HQ and subsidiaries/agents' operations, a new product will invariably experience delays in its international rollout.

**Upon CF5 = Direct effect of CF1 = .33; indirect effect of CF1 = .28**
**Direct effect of CF2 = .28; indirect effect of CF2 = .35**
**Upon CF6 = Direct effect of CF1 = .33; indirect effect of CF1 = .37**
**Upon CF7 = Direct effect of CF2 = .39; indirect effect of CF2 = .26**

CF1 influences both directly and indirectly most of the other elements in the model. Thus, it influences CF5 directly (.33) and indirectly (.28); and CF6 directly (.33) and indirectly (.37). The same happens for CF2 which also influences CF5 directly (.28) and indirectly (.35) and CF7 directly (.33) and indirectly (.26)

Both CF1 and CF2 (marketing and engineering resources) therefore become essential because they affect multiple aspects of the new product rollout. Their influence starts at the beginning of the NPD process through the necessary integration between functions, sites and people, leads directly and indirectly to a proficient NPD process (recall that indirect CF2 influence upon CF6 = .578), carries through an indirect influence upon the setting of targets, and remains strong through

an indirect influence upon the superiority of the new product (recall effects upon CF4 = +.245 CF1 + .474 CF2). The role of the same elements (CF1 and CF2) persists through their influence upon the integration of operations between European HQ and European subsidiaries/agents.

Concluding, it seems that the three most important elements in the model are sufficiency in marketing (CF1), sufficiency in technology (CF2) and internal communication (CF8). More about the managerial implications of this finding follow in Chapter 6. First, however, the model is submitted to EQS package.

**5.4.4.4 Submission of the model to EQS: structural equations modelling (SEM)**

Structural Equations modelling (SEM) is one of the most elaborate and versatile heuristic and analytical tools in the social sciences today. Moreover, EQS is one of the most elaborate statistical packages for SEM (see Bentler, 1994). SEM joined modelling techniques from econometrics, psychometrics, sociometrics and multivariate statistics about two decades ago, when Ward Keesling and David Wiley, and subsequently Karl Jöreskog, merged the factor analytic and simultaneous equations modelling techniques (Bentler, 1994). SEM is a powerful generalisation of earlier statistical approaches. It consists of regression equations with less restrictive assumptions that allow measurement error in both the explanatory and dependent variables. In its fully expanded form, SEM consists of factor analyses that permit direct and indirect effects between factors and include multiple indicators and latent variables (Bollen, 1989). The primary task in this model-testing procedure is to determine the goodness of fit between the hypothesised variables and the sample data in a simultaneous analysis of the entire system of data. The structure of the hypothesised model is then imposed on the sample data and tests are carried out on how well the observed data fit this restricted structure. If goodness of fit is adequate, the model argues the plausibility of postulated relations among variables; if it is inadequate, the tenability of such relations is rejected (Byrne, 1994, p. 3).

It must be clearly stated, however, that the small sample of the present study makes the results highly suggestive for several reasons (see Bollen, 1989). The method is used here only as indicative of the likely generalisability of the findings (see Appendix 5 for a print-out of the run).

Examination of violation of assumptions and model specification has shown no problem. The formula $z$ = skewness/ $\sqrt{(6/n)}$ was employed to identify statistically significant univariate skewness. None of the variables was significantly univariately

skewed, something that was also reflected in the low Mardia's coefficient of multivariate normality (= -3.37). The five cases (case 4, 5, 12, 22, 28) identified as potential multivariate outliers had contributions to non-normality of .24-.34, values that are seen as moderately low (Byrne, 1994). No curtosis (low normalised estimate of -.65), no Heywood cases (negative estimators of variance), no upper or lower boundary constraints or multicollinearity between the variables were apparent. These were reflected in production of the *'no special problems encountered during optimisation'* message by the EQS package, a necessary condition for confidence in the results. The largest off-diagonal absolute standardised residual was low (.109) and the distribution of standardised residuals resembled normal distribution curve. As a matter of fact, 90 per cent of all residuals fell within the -.1 and +.1 range.

The model exhibited an excellent fit ($\chi^2$ = 22.445 for 23 *df*) with a probability much above .05 ($p$ = .49), even though this value must not be regarded as accurate due to small sample size (see Bollen, 1989). The Comparative Fit Index was strong though (CFI = 1.000) and coincided with a below .05 point estimator for the Root Mean Squared Error value (RMSEA= .018) and its lower ground (.000). Non-violation of distributional assumptions was confirmed and the Satorra-Bentler scaled chi-square test (S-B$\chi^2$) scored a highly adequate value (S-B$\chi^2$ = 25.034 $p$= .34). The S-B$\chi^2$ seems to be the most reliable test statistic for evaluating covariance structure models under various distributions and sample sizes (Satorra and Bentler, 1988a, 1988b; Byrne, 1994, pp. 86-8), but there is still insufficiency of simulation studies that explain the extent of estimate bias between samples of different sizes. An extract of the EQS printout with the various goodness of fit indices is presented in Table 5.12;

**Table 5.12 Extract from the EQS printout**

```
GOODNESS OF FIT SUMMARY
  INDEPENDENCE MODEL CHI-SQUARE =        215.780 ON    36 DEGREES OF FREEDOM
  INDEPENDENCE AIC =   143.77961   INDEPENDENCE CAIC =    57.33650
         MODEL AIC =   -23.55496          MODEL CAIC =   -78.78250
  CHI-SQUARE =       22.445 BASED ON    23 DEGREES OF FREEDOM
  PROBABILITY VALUE FOR THE CHI-SQUARE STATISTIC IS     0.49354
  THE NORMAL THEORY RLS CHI-SQUARE FOR THIS ML SOLUTION IS          20.795.4.
  SATORRA-BENTLER SCALED CHI-SQUARE =     25.0342
  PROBABILITY VALUE FOR THE CHI-SQUARE STATISTIC IS     0.34853
  BENTLER-BONETT NORMED    FIT INDEX=       0.896
  BENTLER-BONETT NONNORMED FIT INDEX=       1.005
  COMPARATIVE FIT INDEX (CFI)        =      1.000
  ROBUST COMPARATIVE FIT INDEX       =      0.990
  BOLLEN (IFI)             FIT INDEX=       1.003
  McDonald (MFI)           FIT INDEX=       1.009
  LISREL GFI               FIT INDEX=       0.863
  LISREL AGFI              FIT INDEX=       0.731
  ROOT MEAN SQUARED RESIDUAL (RMR)   =      0.363
  STANDARDIZED RMR                   =      0.090
  ROOT MEAN SQ. ERROR OF APP.(RMSEA)=       0.018
  90% CONFIDENCE INTERVAL OF RMSEA (       0.000,       0.146)
```

the reader is reminded though, that the results must be viewed cautiously.

In addition to modelling fit indices, the Lagrange Multiplier test (LMTEST) and Wald (WALD) test (Byrne, 1994) were also requested. The LMTEST provides Lagrange univariate and multivariate estimators regarding the misspecified paths (i.e., paths that are not specified in the model, but should be) that flow between the model factors. The LMTEST identified only one path which multivariately adds to the system. This path was found to be from CF3 to CF1. This indicates that CF3 (synergies in product handling by sales force and in use by customers) becomes an antecedent to marketing resources, thus forming a causal loop (CF2 affects CF3, which in turn influences CF1).

The multivariate WALD test was employed by simultaneous process to identify paths to delete for improvement of model fit. The WALD test showed that no deletion of any paths would improve model fit.

Chapter 6 discusses the managerial implications of these findings, the limitations of the study, and further research directions.

# Chapter 6

# Conclusions and implications

## 6.1 Conclusions and implications

Rolling out new products across multiple country markets is important for the continued success of organisations. Although a small number of studies have begun to look at factors that are associated with timeliness in NPD and launch as well as the order-of-entry across international markets, none has attempted to investigate:

- whether timeliness in new product rollout across multiple country markets relates to new product success;
- whether companies do roll out new products across their international markets simultaneously or sequentially;
- the factors leading to rollout delay;
- the interaction between these factors and their direct and indirect effects upon rollout delay.

Previous work on NPD and launch has shown that timeliness is an important issue; the current research extends these efforts to the timeliness of the international new product rollout. Nonetheless, it is important to remind the reader that rollout timeliness is a complex concept. The rollout diamond (see Figure 3.1 in Chapter 3) is useful in this respect. It provides a framework for the identification of at least 6 different comparative perspectives (see Table 3.1) in investigating the new product rollout phenomenon. This study has employed only one of the 6 possible comparative perspectives. Using multiple methods of data collection, this study reveals a number of important insights into the complex and risky decision of introducing new products across multiple country markets:

### 6.1.1 The relation between timeliness in rollout and new product success

*Conclusion: Timeliness in new product rollout relates to new product success*

The study found that a fast and timely rollout across multiple country markets strongly and positively correlates with higher sales and return on investment for the new product. This means that rollout speed and timeliness play indeed a fundamental role for a successful new product outcome. A wider number of countries is served in a relatively shorter time frame and the product's earlier availability result in higher sales and higher profits.

The product's earlier availability is clearly exhibited by the total period to develop and roll out the sample new high technology products. The completion of the

15 timely rolled-out projects was planned to last 20.3 months, on average (see Table 6.1). The completion of the 15 delayed rolled-out projects was planned to last 22.3 months, on average.

Eventually, the total time taken to develop and roll out the new products was 24.2 months for the timely rolled-out projects and 38.6 months for the delayed rolled-out projects, on average (see Table 6.1). The difference is 16.3 months (10.0 months delay in NPD and 6.3 months delay in rollout). This corresponds to a delay for the delayed rolled-out projects of 73 per cent of planned time for cross-country product availability (16.3/22.3 months). Fourty per cent of this delay is caused by delays in new product rollout (6.3/16.3 months).

**Table 6.1 Time from first meeting to consider the new product idea to product availability across country markets: timely versus delayed rollout cases (months)**

| | Timely cases (mean) | | | Delayed cases (mean) | | |
|---|---|---|---|---|---|---|
| | Planned | Actual | Difference | Planned | Actual | Difference |
| NPD | 14.6 | 18.5 | 3.9 | 14.0 | 24.0 | 10.0 |
| Rollout | 5.7 | 5.7 | 0 | 8.3 | 14.6 | 6.3 |
| Total | 20.3 | 24.2 | 3.9 | 22.3 | 38.6 | 16.3 |

The new product rollout may be considered therefore, as a strong discriminator between failed and successful projects. This happens because project failures are available for sale more than a year (3.9-16.3= -12.4 months) later than the successes. This period of 12.4 months is the time difference between timely and delayed rolled-out projects from first discussion of the new product idea to product availability in all European target country markets. This period of 12.4 months:

- leaves a substantial amount of time for sales free of competition to successful projects. The market may thus, become an oligopoly. Brand names will strengthen and customers will be compelled to buy the new product during this period, since there may not exist other substitute products available for purchase. Profitability will increase. The customers' ideal points will also move closer to the successful project's mix of product attributes.
- is also a substantial proportion of the products' life cycle. Recall that 40 per cent of the investigated products had a product/production obsolescence period of 1-2.5 years and an additional 40 per cent had an obsolescence period of 2.5-5 years. The delayed rolled-out new projects are likely to appear in the market in the mature stage of their life cycle and they are closer to the end of their life cycle.

### 6.1.2 Simultaneous versus sequential new product rollout and the role played by the nature of product technology; the factors relating to delays in rollout schedule; the interaction between these factors.

*1st conclusion: What matters is internal organisational elements including the existence of sufficient resources to support the new product rollout. External environment elements including the nature of technology have little direct effect upon the new product rollout and rollout delays.*

The role of technology is not decisive regarding the simultaneous versus sequential new product rollout even though specific product technologies in the areas of telecommunications or measurement are more prone to sequential introduction of new products across countries and subsequent delays. Consider the following:

- Technological heterogeneity was anticipated to lead to rollout delays because of the need to adapt the new product to individual country requirements.
- Weak pervasiveness, weak attack intensity of competitive action and long technological obsolescence were anticipated to lead to long rollout periods and possible rollout delays because of no need for the firm to capture windows of opportunity, or to respond quickly to a competitor's new product.

The nature of product technology, the customisation of product technology across target country markets and the complexity of such customisation, like other external environment elements (i.e., heterogeneity of segments and the pervasiveness and attack intensity of competitive action), did not emerge as critical factors that impeded or slowed down the rollout of the sample new products. These broader external factors were only of secondary importance to rollout timeliness. Many of the principal causes of delays in international product rollout were associated with the firm's own internal environment, including failure in organisational communication and insufficient availability of adequate quality company resources for the development and rollout of the specific new product.

The broader external factors influence indirectly new product rollout in that they affect the accumulation of the necessary engineering and marketing resources allocated to the specific new product. It is more difficult to reach sufficiency in resources when the technological environment across countries is heterogeneous and where customisation of product technology is complex. Moreover, competitive pervasiveness and attack intensity may force the company to consider a rapid rollout,

although without the resources to support such a rollout, the international launch will not succeed.

The capacity to 'leverage' resources is a strong indicator of the likelihood of successful fast and timely new product rollout across countries. Timeliness in rollout is constrained by, and dependent on, such 'leverage' of resources. Resources differentiate from a strategic point of view the chances a new product has for timely rollout. The underlying logic is that the current company products and activities constitute a unique bundle of tangible and intangible resources and capabilities, a notion similar to that argued by Penrose (1959) and Wernerfelt (1984) in the resource-based theory of the firm. This bundle of resources serves each individual new product differently and to a varying extent. As a new product targets specific segments and countries, it requires a unique bundle of tangible and intangible firm resources and capabilities. Each new product is idiosyncratic in this sense, since it necessitates a specific resource configuration, i.e., it asks for a portfolio of different organisational assets and organisational practices for both its development and roll out.

When there is 'leverage', a balance and compatibility exists between what is required for the development as well as the roll out of the specific new product (for example distribution channels or knowledge of the sales force) and what is already available in sufficient and adequate quality within the company.

The absence of the capacity to 'leverage' resources has a negative impact on the rapid completion of NPD and new product rollout, increasing the risk of product launch failure. The capacity to 'leverage' resources is thus, in aggregate, a fundamental determinant of the firm's 'positioning' and likelihood regarding:

- the launch of the new product across countries simultaneously rather than sequentially ;
- shorter than longer rollout periods; and
- the timeliness rather than delay in new product rollout.

Recall that 73 per cent of the sample firms planned to roll out their new products in a sequential rather than simultaneous manner across countries. It is not surprising that all 15 delayed rollout cases were initially planned to roll out sequentially across countries. In contrast, all simultaneously planned launches were timely and they took place in a much shorter time frame. Firms with adequate resources can not only

develop the new product sooner, but also roll it out rapidly and on schedule. Firms with inadequate resources will need more time to develop the new product, opt for a sequential rollout and tend to face delays. Constraints and resource needs are also higher for 'novel' product activities compared to product line additions or replacements of older products. A new project in 'novel' product areas is less likely to benefit from synergies in engineering and marketing resources. As a result:

- No project should be allowed to proceed to the development stage without considering the necessary resources to back up both its development and *rollout*. These include both engineering and marketing inputs.
- Companies should be extremely cautious when the new projects are in 'novel' product areas as these are more prone to problems that will lead to sequential rollout and rollout delays.

Specific product technologies (as in the measurement and telecommunications' areas) also seem to affect negatively firm marketing and engineering resources. Product technologies in these areas are complex and seem to require a relatively higher level of organisational resources for a simultaneous, fast and timely new product rollout.

*2nd conclusion: Internal communication elements between the subsidiaries/agents in different countries, the NPD team and the HQ eliminate the obstacles to a rapid and timely new product rollout.*

Internal communication between the subsidiaries/agents in different countries and the NPD team results in a more proficient NPD process. Better integration ensures that there is early identification of the technical and market targets for the new product. The firm rapidly proceeds to the development of the new product guided by a concrete *protocol* and a "*sharp quality of feedback*". Time and efforts are not wasted and resources are consciously 'leveraged' to achieve new product goals..

Internal communication between the subsidiaries/agents in different countries and the HQ *helps to set up an infrastructure* (sales force and intermediaries) *across countries* to service and support the new product. Extensive internal communications permit different country managers to:

i. develop awareness of the new product, its embodied technology and target users;

ii. assimilate the new product technology and understand how to handle the sales of the new product; and

iii. complete all the necessary marketing actions for the product launch, ranging from the preparation of marketing channels to new product announcement.

These are explained in more detail here below:

Extensive internal communications are clearly important to assist the transfer of skills for new product commercialisation across countries. A simple transplantation of hardware/software (that is, 'ship the product, and let the subsidiary/agents find out the rest') is likely to fail.

Communication differentiates from a strategic point of view the chances a new product has of timely rollout. The underlying logic is that different organisational procedures result in differences in the flow of knowledge, information, capabilities, skills and expertise between subsidiaries/agents, the European HQs and the NPD team. The more intensive the integration between them, the greater the information-processing capacity of the firm and the more effective the communication and co-ordination between units. Communication becomes, in this respect, another major determinant of an organisation's effectiveness in the speedier and timely rolling out of new products across multiple international markets.

Furthermore, intensive communication facilitates interaction between people, rapid transfer of knowledge, quicker resolution of conflicts and better understanding of customer requirements. It assists company adaptiveness to environmental uncertainty across countries; accelerates adoption of company innovations by subsidiaries/agents in various countries (see also Ghoshal and Bartlett, 1988); and strengthens the product's competitive advantage in the market place. Exchange of knowledge, expertise and other flows is engaged in two ways (see also Gupta and Govindarajan, 1991). One way is inflow from the (European) HQs to each individual subsidiary/agent, the other is outflow from every subsidiary/agent to the rest of the corporation. These result in the following:

- The amalgamation of country and organisational cultures quickly into a distinct sociocultural system with a set of shared beliefs and common goals for all managers and agents.

- The increase in interdependence between subsidiaries/agents, HQs and the NPD team in a conscious effort to benefit from comparative advantages available in different countries, units, and people.
- Sharing of marketing and technological resources. The most experienced and equipped subsidiaries/agents contribute more to the development, timely rollout and success of the company's new products.
- The rapid identification and provision of the resource bundle required by each new product.
- A more proficient NPD process which leads to higher product superiority. The integration between technical, marketing and manufacturing functions in different sites and in different countries is high, the views of final customers are rapidly transferred to the NPD team, and quality input is accurate and on time. This integration leads to proficient execution of tests of prototypes by customers/trial sales, technical development and sorting out unexpected 'bugs'. It also leads to technical testing of the product, co-ordination of distribution channels and logistics, co-ordination of advertising and promotion, predevelopment project planning and early product and target market definition.

When these occur, new products are more likely to offer unique attributes and clearly visible and useful benefits to the customer, superior quality, value for money and performance. This means that the new product is superior and likely to be successful. Distribution channels rapidly become familiar with the upcoming new products, and sales staff prepare the market and educate their customers. When the new product comes out, the scene is set for its reception.

### 6.1.3 Other important findings

The study also unveiled additional insights. These are:

*a. Timeliness in new product rollout facilitates customer acceptance. Technical proficiency is of less relevance.*

In terms of impact on new product performance, customer acceptance and technical performance are secondary to the actual product availability for sale. Rapid availability of the new product may force customer acceptance because of its uniqueness compared to competitive offerings. It even overshadows the importance of technical performance. A late arrival, although technically superior will achieve

lower sales and profitability than a less technically outstanding product that is rolled-out quickly and on time.

Many firms currently strive to produce new products that are technologically advanced. Innovativeness and pioneering technology may bring fame, but they will not necessarily yield higher product sales and profits. A technologically less advanced product that is rapidly and timely rolled-out for sale across the world, will, in contrast, bring greater sales and profits. This happens for the following reasons:

- Less time is spent on product development and education of the sales force;
- Poorly educated customers failing to understand advanced product technology are not discouraged; and
- The company beats competition by capturing customers who can be satisfied by a product of less advanced technology.

Firms therefore, must make a trade off. Not the 'better mousetrap', (i.e., technical performance), but the speed of product availability is the key to international new product success.

*b. Timeliness in rollout is more important than timeliness in NPD for a successful new product.*

Cooper and Kleinschmidt (1994) found a meagre positive link between timeliness in NPD and the financial performance of a new product project. These authors showed that this relationship is not nearly as strong as one might have expected and certainly 'far less than the direct or almost one-to-one links the 'hype' seems to imply' (p. 393). This may be explained by the notion that a rapid timely rollout is more important than a timely NPD for both sales and return on investment for the new product.

This implies that high-tech firms wishing to maximise the potential of their new products should attempt to rapidly penetrate multiple country markets by quickly transferring their new products across the globe. It is the rapid rollout of the new product that makes the difference!!!

*c. Timeliness in rollout relates to proficiency in NPD.*

Executives should be careful. A timely new product rollout and a proficient NPD process go together. A non-proficient NPD process may imply that the company would face difficulties in achieving international new product rollout in a timely

manner. A rapid and time efficient rollout is invariably accompanied, complemented and reinforced by a rapid and time efficient NPD process.

*d. The potential effects of nationality bias*

The focus of this research was not to seek out a bias regarding rollout timeliness and firms' country-of-origin. The observations did suggest, however, that the Japanese companies studied were more adept at achieving on-time rollout, compared to their western counterparts. Assuming that such nationality bias regarding speed and timeliness in new product rollout is confirmed by other studies, there are some longer-term effects at both sectoral and national level. These tentative effects are discussed here below in more depth:

Japanese companies in this study were strategically oriented towards specific product technology sectors (e.g., printers), where new products replaced older-generation products with minor technology and marketing changes, and where technology needed limited customisation across countries. As a result Japanese firms were easily able to deploy their resources and gain 'leverage'. Multiple timely new product rollouts and their positive effects upon sales and profitability may have been primary agents of growth for Japanese companies. These agents may have assisted the rapid accumulation of engineering resources, the building of a strong marketing base by Japanese companies over the years, and the entry and proliferation of new Japanese products in multiple markets. This, in turn, have assisted the rapid diffusion of Japanese technology in many high-technology sectors and further strengthened their marketing muscle. Organisational learning has increased, customer familiarity with the Japanese products has increased, resources have been better utilised, better resources have been acquired and complementary competencies have been achieved in many technological areas. Timely new product rollout may, in this respect, have sustained Japanese expansion across countries.

British and other western companies may, in contrast, have followed a different pattern. They may have remained in product technology sectors where timely rollout is difficult because of the nature of product technology. Multiple delayed new product rollouts by British and western companies may have:

- undermined the accumulation of engineering resources by British and western companies over the years;

- eroded their marketing muscle across many international markets;
- constrained their proliferation into new product areas and foreign markets;
- permitted the entry of companies from Japan or other nations into areas where western companies were once the major force.

Disassembling capability in this way, may have weakened the ability of British and western companies to improve their market presence, sales and profitability. It may have affected their NPD process too. Organisational learning has not increased, customer learning of products has diminished, resources have not been better utilised, better resources have not been acquired and complementary competencies have not been achieved.

The ultimate result is aptly described by Hart (1996) using the extreme case of the world shipbuilding industry. The British share of the market has declined from producing around 80 per cent in 1890 to less than 4 per cent in 1974, while by 1969 Japan's share had risen to 40 per cent (Ughanwa and Baker, 1989). Japanese companies may have, therefore, emerged as the winners. Their evolution over a relatively long period of time took place in a sequential manner and in line with unexpected opportunities. Such a sequential pattern of development is endorsed by Chang (1995) in his study of Japanese investment in electronic manufacturing in the USA between 1976 and 1989.

Inferring further, it is likely that Japanese companies strategically enter technological areas which are complex and with no standards, as laser printer technology used to be. They remain in this area for a number of years, during which international technology standards appear, and then they fully exploit the potential. Keeping the complexity of their operations low, they can opt for a simultaneous rollout for their new products. This, combined with marketing competence and resources, leads to rapid and timely availability of their new products across countries, sales and profitability.

**Theoretical and managerial implications**

This research has helped shed some light on an issue which has been unexplored to date. Some of the drivers of a timely new product rollout, such as firm marketing resources across countries were largely expected. The role of other drivers such as the synergies in product use by the customer, was uncovered. Improvement upon the eight drivers identified by this research may help reduce time spent on new

product rollout across countries. The link between timeliness in rollout and new product success also provides a warning to executives who may pay a disproportionate emphasis on NPD at the expense of timely, rapid new product rollout. The results of this study have several important theoretical and managerial implications:

**Theoretical implications**

- The likely existence of an evolutionary model of timeliness in new product rollout across international markets. The model which may consist of four layers is depicted in Figure 6.1 for illustrative purposes.

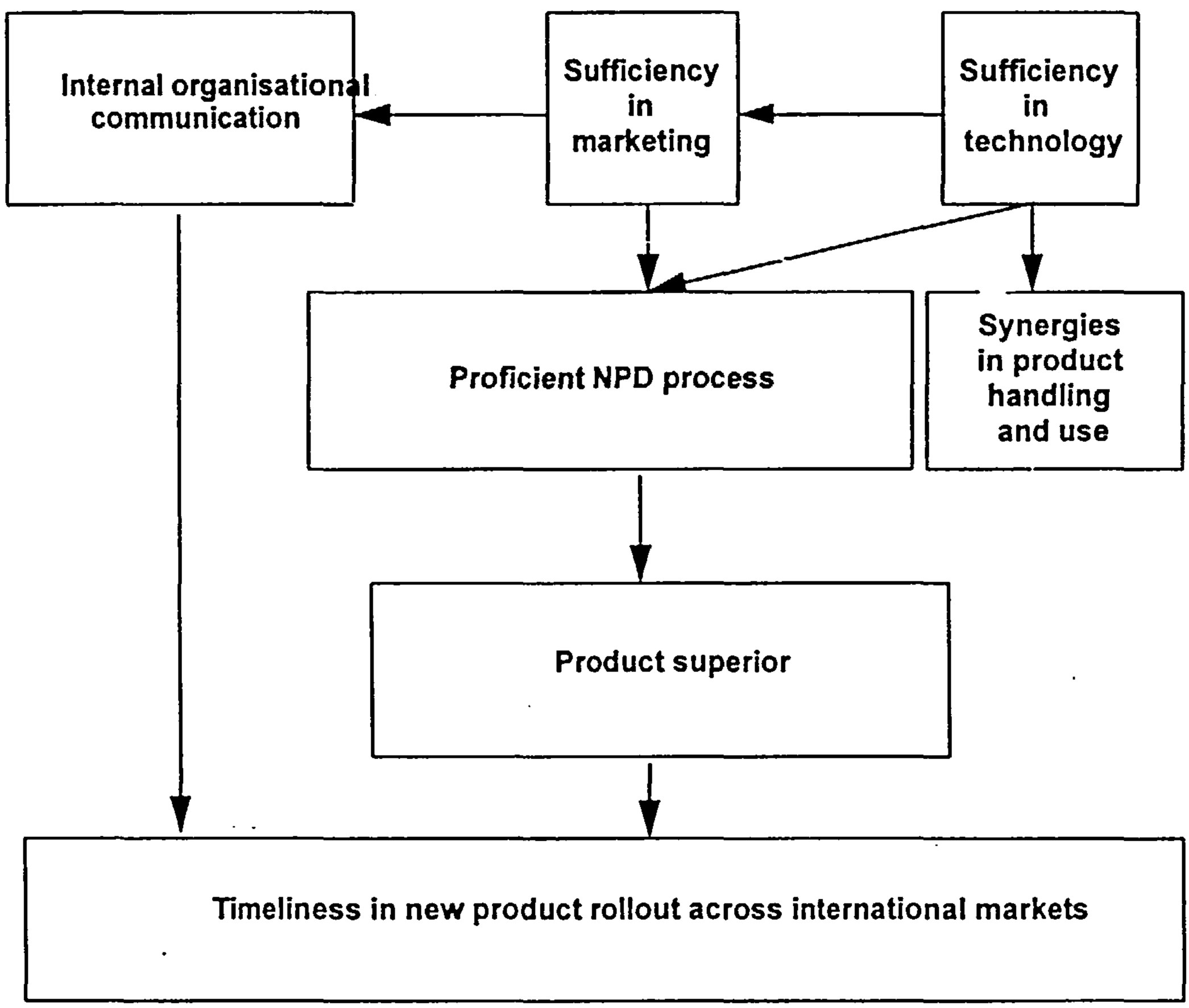


**Figure 6.1: Conceptual evolutionary four-layer model of timeliness in new product rollout across international markets**

Figure 6.1 constitutes a reshaping of Figure 5.2 in a more conventional manner for easier understanding. The marginal or additional potential effects are also included for the sake of completeness. Thus, the light black coloured arrows suggest:

- the probable causal loop between synergies in product handling and use and sufficiency in marketing and technology (see section 5.4.4.4);
- the marginal effect of sufficiency in marketing and communication upon synergies in product handling and use (see section 5.4.4.1); and
- the marginal effect from synergies in product handling and use upon new product rollout timeliness (see section 5.4.4.1).

Elimination of the two intermediary layers can then result into a reduced two-layer model (Figure 6.2) where the most important factors for new product rollout timeliness are internal organisational communication and sufficiency in marketing and technology.

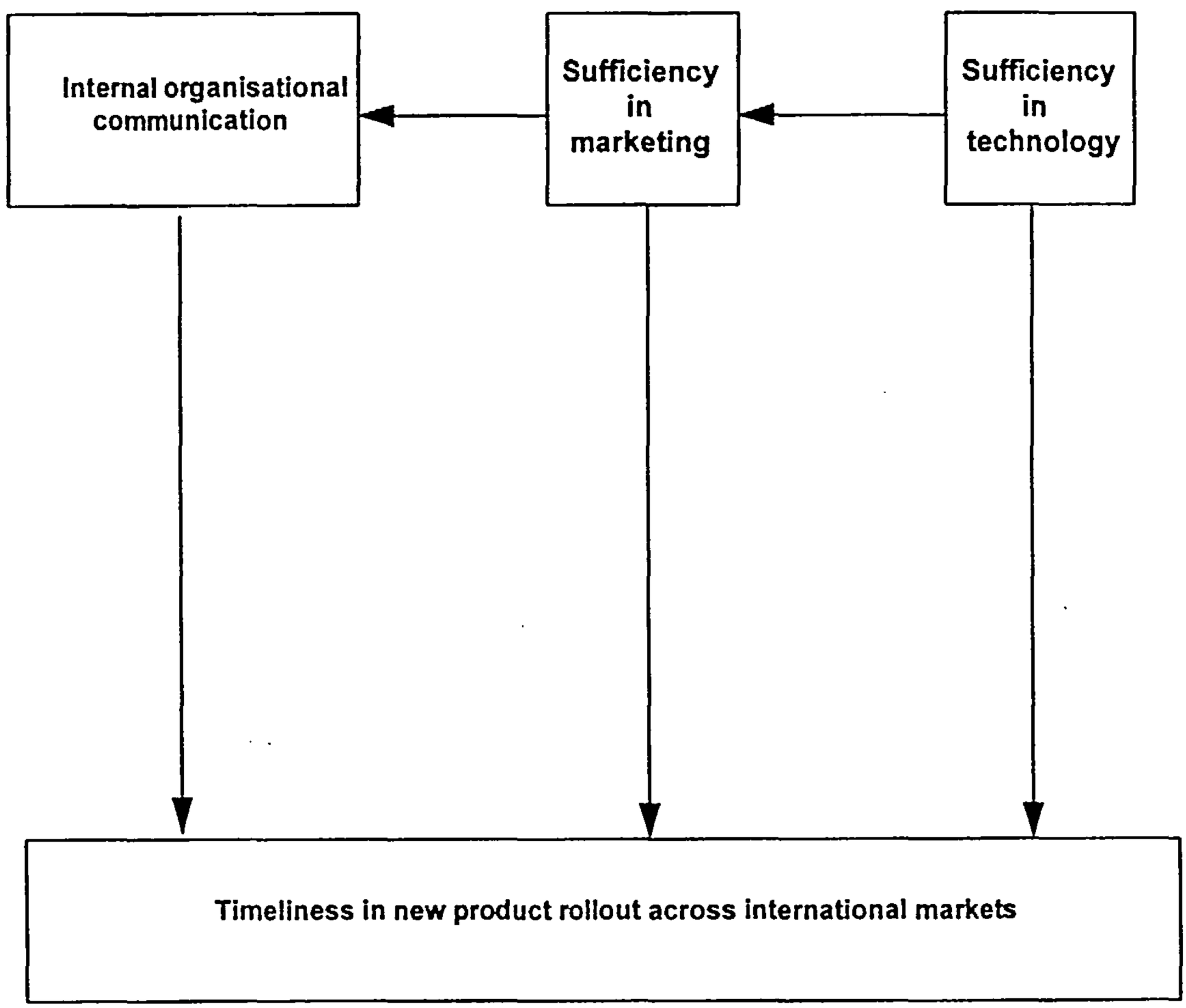


**Figure 6.2: Conceptual evolutionary two-layer model of timeliness in new product rollout across international markets**

- The position of the commercialisation stage in the NPD process. This study shows the need to rethink of the place of the launch step as among the last ones in the NPD process. It is necessary to take the rollout decisions far earlier in the NPD process and capitalise in the meantime for the co-ordination of the new product launch.

- Mascarenhas (1992a; 1992b) examined the intermarket and intramarket order of entry and first-mover effects within the context of international markets. He argued that simultaneous entry into multiple markets occurs in the mature stage of the product life cycle and the smaller markets are served later when the uncertainty regarding the product future is reduced. This study shows that market entry does not necessarily occurs at the mature stage of the product life cycle as Mascarenhas (op. cit.) suggested. This may not be so. Despite catering for similar needs world-wide the 'quarter of the century elapsed' (see section 2.3.5.5) was probably due to product technology adaptation and lack of sufficiency in company marketing mix elements. Mascarenhas (op. cit.) also argued that market entry occurs in large developed and highly centralised markets. This study shows that this may happen because such countries may be the key target company markets. Moreover, simultaneous versus sequential launch may both happen, this depending upon the configuration of organisational, marketing and technological elements for each individual product.

- Research in organisational structure in MNC has initially provided some insights about the importance of organisational elements in NPD and international new product launch. The findings of this research project and qualitative evidence from the case studies suggest that a hierarchical organisational model (Stopford and Wells, 1972; Franko, 1976) is likely to be inappropriate in today's environment. In contrast, it seems that a 'heterarchical' model (Hedlund, 1986) is more suitable. This happens because a 'heterarchical' model in developing and launching a new product permits to increase the horizontal lateral decision making. This results in a better combination of activities and co-ordination of resources within the MNC boundaries and promotes innovation.

- Customisation versus standardisation debate. It is necessary to realise that some elements may become a 'bottleneck' in the companies' attempts to standardise

marketing operations across countries. Customisation versus standardisation seems to take place at the individual product level. Thus, elements such as distribution channels, after-sales personnel, customer familiarity with each new product as well as the 'hidden' elements of product technology may become major obstacles in companies' attempt to standardise their operations across countries. The immediate result will be the sequential manner in launching the new product in international markets, while the ultimate result will be a likely delay in such rollout schedules.

- Globalisation strategy and diffusion research. This study suggests that the effect of likely external globalisation drivers (i.e., market factors, competitive factors, technology factors and environmental factors) is channelled through internal organisational and resource factors. This permits to argue that globalisation strategy is probably organisation-led and not consumer or market-driven. This affects in turn diffusion research in the sense that diffusion of company innovations is affected by internal organisational factors despite potential market demand due to rapid transcending of national boundaries of consumers' word-of-mouth. That is, international diffusion of new products is not consumer-pull, but organisation-led.

- Douglas and Craig (1989) presented a model where the evolutionary process of international marketing strategy evolves through four phases: pre-international, initial entry, local market expansion and global rationalisation. Internal communication and resource elements may hinder on a product-by-product basis such evolution. Accumulation of multiple such obstacles may counter-affect and cancel any positive impact of favourable external triggers (i.e., market growth) or other positive internal triggers (i.e., management motivation), meaning that the company may not proceed further into its organisational evolution. On the other hand, rapid international new product rollout may exhibit the existence of facilitating agents for a quick company evolution through the same stages.

**Managerial implications**

- New product rollout timeliness is fundamental for sales and profitability, and is an integral part of new product success. Managers have to monitor rollout time and

accord to it the same precision they accord to sales and costs for the new product. Timeliness in rollout seems to be more important than timeliness in the NPD process in terms of new product success.

- Timely new product rollout across multiple countries occurs when the organisation has a clearly defined segment/technology focus and such focus is 'within the reach' of the organisation. This essentially means company involvement in specific product technology areas where there is compatibility between company resources and resource requirements for success. Incompatibility leads ultimately to confusion, disappointment, waste of time and resources and failure. Gaining competitive advantage through timely new product rollout across multiple countries may require for some organisations therefore, new approaches to perceiving the market, whether this be segmenting, targeting or positioning; and new approaches to perceiving the way the technology can be applied. Identification of new segments for existing technology may be preferable to delayed launch of new product innovations in current markets.

- Timely new product rollout across multiple countries is achieved when the organisation couples resources with communication. Their interaction create the forces that shape the likelihood, direction and speed of NPD and rollout. These forces lead, in this respect, to simultaneous versus sequential and subsequently, timeliness versus delay in new product rollout. For a fast and timely rollout of new products, managers must create, redress or sustain the opportunity to 'leverage' engineering and marketing resources and manage communications between HQs and subsidiaries/agents. This requires thorough understanding of technical, marketing and organisational elements, and acute managerial judgement. Undiscerning, imperceptive or insensible judgement will result in either over or underestimation of the company's actual abilities, misinterpreted positioning and confusion. Gaining competitive advantage through fast and timely new product rollout across multiple countries may thus require, a new approach to organising global and regional (i.e., European) procedures and activities. It requires procedures and mechanisms that help the organisation to screen and correctly capture the current internal resource and communication profile, and then redress or sustain it. Redressing and sustaining the profile needs continuous and subtle control over operations.

The availability and interpretation of information is central to all the above, first in the case of proper segment/technology focus, second in identifying the 'profile' regarding resources and communication. Timeliness occurs when managers realise the actual obstacles and perceive the areas for improvement. Inappropriate organisational functioning in the HQ, the NPD site or the various subsidiaries/agents may well stifle the development and rollout of new products. Organisational functions in this respect must be viewed as a system.

An analogy to human biology can be drawn. The human body needs to use a series of internal elements for its functions. Breathing, digesting and moving are such functions. The individual components/organs, work in harmony with each other. Breathing uses the heart, the lungs and the liver. Digesting uses the stomach, the pancreas, the kidneys and several other body organs. When one of these organs stops operating, execution of the function stops, other functions face difficulties and the entire body is driven into collapse.

## 6.2 Limitations and further research

This study is restricted to the UK and the views of personnel from the European HQs. A much larger study should investigate the views of subsidiaries/agents across Europe and the views of corporate HQs located elsewhere (e.g., the USA or Japan). The findings of this study are also based upon a limited number of cases. A larger study should expand on the number of investigated cases, the time spent in each company or the number of sites and countries where personnel are interviewed.

Attention should also be paid to the exploration of the nature of technology in each product. There is limited guidance in the extant literature concerning the way to define technology in a given product. Each new product contains multiple technologies from a number of different scientific disciplines and areas (e.g., technologies used in a laser printer are in the areas of plastics, toner, photocopying, metal, paper, microprocessing, data transfer, etc.). Unless there is a coherent framework for separating primary from secondary and major from minor technology, confusion arises. While there is substantive knowledge about the way to analyse marketing customisation to foreign markets (see Chapter 2), there is also limited guidance on how to measure technology customisation. The nature of technology

and technological customisation were discussed in this thesis. However, the measures should be validated through a larger scale, empirical study.

An appropriate extension of this study would be to examine the simultaneous versus the sequential rollout pattern for larger populations of Japanese, UK, US and European companies.

Another extension of this study would be to examine new product rollout from an information-processing perspective (i.e., the nature of information and patterns of information flows). Also, what are the more effective and efficient methods of such communication (i.e., how meetings take place, where, who participates, how decisions are taken)? What are the more effective and efficient organisational structures to be used for rolling out new products across international markets? The 30 cases in the present study provide some preliminary evidence which would benefit from further and more detailed analysis. This evidence suggests that there may be specific methods, procedures and organisational structures that are particularly important in enabling the Japanese companies to be more effective and efficient than their western counterparts in occurring timely international new product rollout. It would be interesting to examine if similar or different methods, procedures and organisational structures have been adopted by western companies in their operations.

There is also much left to be done. It is important to recall that the data examined in the current study are cross-sectional and do not allow any strict causal inferences. Thus, the findings are tentative and would benefit for further confirmation by new studies. In this sample, technological resources were found not to influence directly proficiency of the NPD process in a statistically significant manner. This point needs further exploration. It would also be useful to investigate more precisely the financial and market performance implications of timeliness in rollout over several generations of new products. This would permit to identify the role of rollout timeliness within the wider context of longer-term competitive dynamics. Finally, is rollout timeliness an issue for service organisations, and are the causes of delays the same? These questions all warrant further investigation.

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# Appendices

# Appendix 1
# Cover letter and mail documentation

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***George Chryssochoidis***
*NEWPROD Research Project Director*

***Attention: «Person»***
***«Title»***
***«Name»***
***«Address», «City», «Code»***

*Dispatched Recorded Delivery*
Cardiff, Date

Dear ***«Person»***

**NEWPROD RESEARCH PROJECT**
***Delays in the roll out of new products across international markets***

We are conducting an important 3-year national study among managers and executives which is being co-ordinated by a team of academic researchers at the Cardiff Business School, University of Wales and Warwick Business School, University of Warwick. *The project is aiming to*

1. *investigate what methods and organisational procedures are used to achieve on-time product roll out across multiple countries;*
2. *measure the effect of each factor upon financial and market success of new products;*
3. *attempt benchmarking of the delay effect upon new product success.*

Many well respected US, Japanese and UK companies have already provided a substantial input to this study. We need however, further information from a number of additional companies. Your firm has been selected as part of this small, representative sample of firms and it is vital to the success of the study that you participate. We would be grateful if you could co-operate with us. It is your involvement with new product development and roll out that qualifies you to provide the most reliable views. The results of this leading-edge study will be of enormous benefit to all those who are concerned with development and commercialisation of new products across international countries.

Would it be possible to meet you? The task should take only a short time. There is no financial cost involved and we will visit you in your office, at your own convenience. We can not stress enough how vital your responses are to the accuracy of our research findings. Information will only be seen by the academic researchers involved in this study. The results from this study will be scientifically analysed and subsequently presented at conferences and published in managerial journals. As a token of appreciation for those who participate in the study, we intend to offer a copy of the study results soon after we have completed our analysis. We also intend to run a feedback session in Cardiff and give you the opportunity to discuss *with other executives who contributed to the study and may face the same business challenges as you do.* This will give participants a significant advantage in having evidence and information to guide their strategic decisions.

Greatly valuing this meeting with you, we enclose some additional details for your information, and we believe that the interaction and outcomes will be of considerable benefit to both you and your organisation. May I thank you in advance for your co-operation.

Yours faithfully

**George M. Chryssochoidis, B.Sc., M.Sc (Sorbonne), M.Phil**
***NEWPROD Research Project Director«Next Record»***

## New Products: Best Practice for On-Time Roll-Out Across International Markets

**Invitation to participate in this study**

We are inviting you and your company to participate in a pioneering new project comparing UK, European, US and Japanese best practices in rolling-out international product lines. This is a project undertaken by researchers in the area of international strategy and its purpose is to

1. investigate what methods and organisational procedures are used to achieve on-time product roll out across multiple countries;
2. measure the effect of each factor upon financial and market success of new products;
3. attempt benchmarking of the delay effect upon new product success.

**The Problem and the Focus:** Business managers agree that technology and competitive pressures will further intensify. Four arguments are put forward:

1. each new generation of products requires an even shorter development and commercialisation period (the so called "acceleration trap").
2. such an acceleration demands redesigning of product development processes.
3. co-ordination of operations in multiple countries is usually complex.
4. premature/"rushed" launch strategies run into the danger of either inadequate, faulty products or inappropriate adaptation to real market needs across different countries.

The present seeks to examine what are the organisational "soft" factors, mechanisms, methods and procedures which work in parallel with technology development and guarantee on-time product development and roll out across countries.

In 1993-4, an investigation of current knowledge on the subject, has shown that very little is known in this extremely important area. In 1995, twenty executives from US, UK and European companies provided an initial feedback on the aspects which should be investigated. Researchers reviewed the answers and decided that it would be appropriate to consult more widely for useful advice. We are currently looking to interview twenty more executives.

**What About Your Company?** If you are directly involved in rolling out or developing new products for 3+ European countries, then you are in a unique position to help us. If you or your organisation have experienced delays from your time schedule, especially in roll out, then please let us know. Your company can contribute to this co-operative effort and help us investigate further the issues involved.

**Benefits of participation**

*In return for your participation, we will provide you with a copy of our large final report which will show how UK data compares to US, European and Japanese data, from many different perspectives. We intend to carry out the analysis on disaggregate product category level if data permit. These will provide concentrated experience within a single volume by many companies. We also intend to arrange a meeting with all the other study participants for an open discussion in Cardiff.*

**Whom would we like to talk to?**

*We would primarily like to talk to the person who has been responsible for development and roll out across Europe of a recently developed major new product/line.*

It would be excellent though, if we can also interview two additional members of staff from different functions (i.e. manufacturing) regarding the same product/line, if possible. We are not expecting each meeting to be longer than *2h'*.

# Appendix 2: Case protocol

### Company description

- Description of the company and its products
- Type of project under consideration
- Importance of international operations
- Why the company has developed this product

### Success

- Extent of success and nature of success

### Time

- Time for product development (time planned and time spent on NPD)
- Time for product rollout (time planned and time spent on rollout) across key and all markets
- Whether these delays (if any) were considered to be important or not
- Time for competition to develop new products and rollout
- Details about the marketing practice regarding the rollout; drivers: product announcement, major exhibitions, seasonality, competition launches

### Type of markets and heterogeneity

- Where product is marketed-segments and countries (key and secondary)
- Heterogeneity of markets, segments in marketing, technology and product specifications' issues
- Extent of effort to customise product and adapt technology to country and segments' requirements

### Availability of adequate quality resources

- Technology and R & D, skills and resources (in-house or bought in)
- Existing products and other marketing mix resources including distribution systems, sales force, etc.
- Production and human resources
- Company practice in circumventing insufficient resources

### Characteristics of the product and synergy with existing operations

- Technology and R & D, skills and resources (in-house or bought in)
- Existing products and other marketing mix elements including distribution systems, etc.
- Production and human resources
- Complexity of product use (technical complexity of product, use by the customers and sales force)

### Development process of the product and product success characteristics

- Product superiority and other product-specific success characteristics
- Within company: integration between personnel, accurate timely inputs, on same site & across sites
- Within company: conflict resolution, decision procedure (hierarchical vs participative), info flow

- Within company: job scheduling (sequential vs autonomous)
- Between company and subsidiaries/agents: extent of communication/feedback/prototypes, progress
- Between company and customers: extent of communication/feedback on prototypes, progress
- The firm knew intended market and technical from the beginning of the NPD process
- Proficient execution of NPD elements, major problems: production & R&D/technical issues
- Proficient execution of NPD elements, major problems: marketing (4 Ps) issues

**Co-ordination of relationships with agents/distributors**

- Geographical spreading of activities and markets
- Extent of co-ordination of the NPD process and rollout
- The variations in concentration, formalisation, centrallisation and normative integration
- The inputs of subsidiaries upon the rollout decision: freedom in accepting/rejecting products-time
- Practice in informing subsidiaries about rollout (time schedule-precise time of letting know & NPD)
- Communication methods, travelling and meeting practice
- The effects of culture, psychological/geographical/language distance

**Corporate interdependencies**

- The importance of Europe and the European markets for the corporation, market share and size
- R & D, production and marketing skills, expertise and resources in Europe and elsewhere

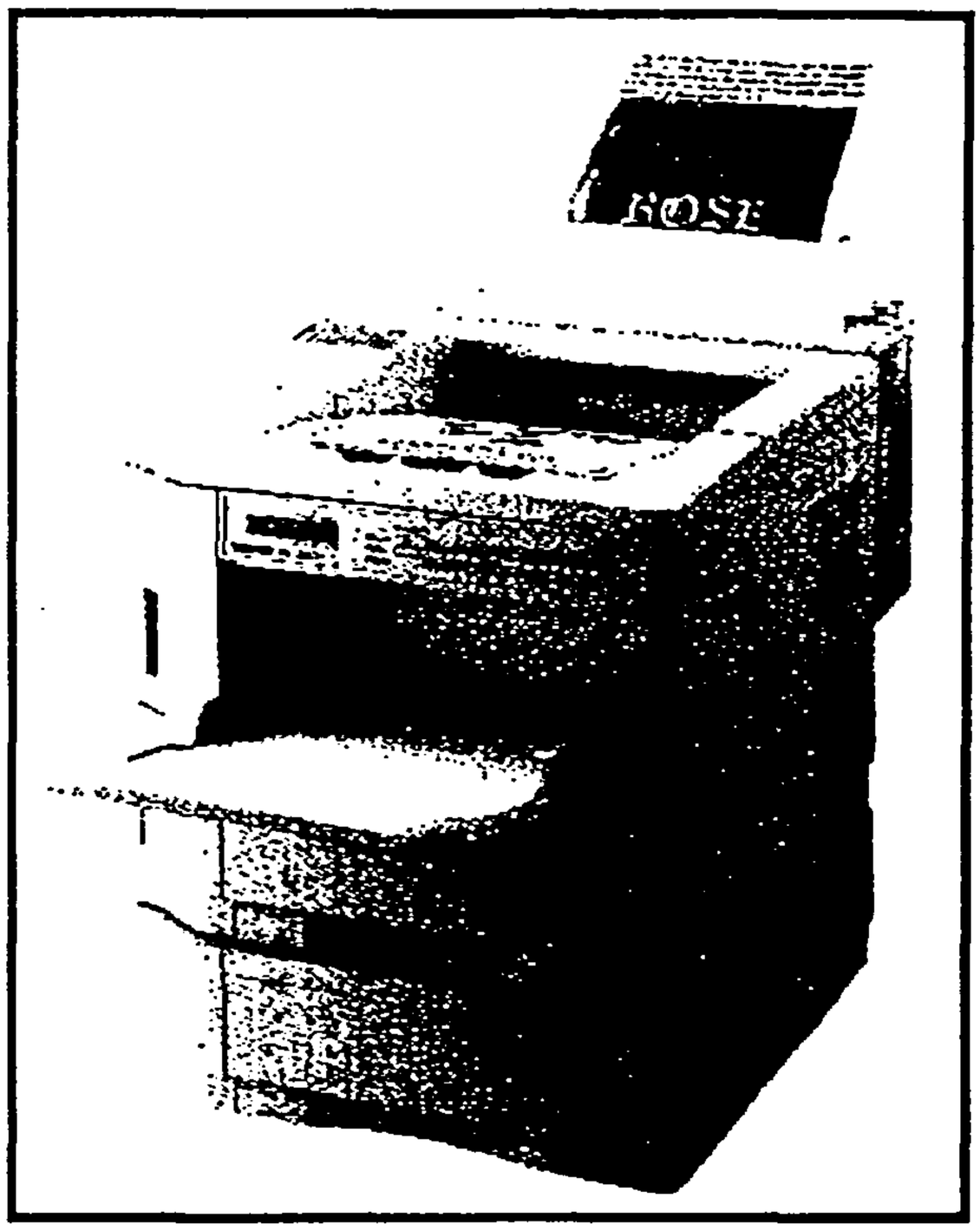
# Appendix 3

# Timely cases

# Brother International Europe Ltd.

Brother International Europe Ltd. is the European HQ for Brother Industries, a Japanese manufacturing company active in two business areas: 'fashion' and 'image'. The 'image' business (office equipment and computer peripherals) accounts for some 70% of the total corporate turnover. Europe represents 50% of Brother activities outside Japan (the other 50% is in the US) in the 'image' industry. Printers represent 30% of the European sales in revenue terms.

Brother manufactures two printer product ranges: one destined to the domestic/small office market and another one targeted to the high-end laser printer segment (banks, insurance companies). Brother's second product range consists of one single model (HL-1260), the focus of the present discussion (see figure).



## The product and its characteristics

The HL-1260 is a product that possesses the features which are usually required by the typical user. It is an energy-saver 600/1200 dpi laser printer at 12 ppm. The machine has enhanced memory management, a RISC-based high speed controller, network suitability and the option of an additional feeder (see picture). The HL-1260 replaced a previous generation of laser printers (the HL-10V and HL-10H). The product emulates all the major software drivers in the market, making it appropriate for use with all major software. In addition, the product has all characteristics available in Hewlett Packard printers and other leading products in the laser printer market.

## Standardisation of the European market

**Technology customisation, complexity of such customisation and approvals:**

European markets are homogeneous in terms of product specifications, features, and technology. Some minor differences across countries concern:

- cable type and electric currency fluctuation.

- printer software drivers in local language. This is not a substantial product customisation issue since the major software platforms (Windows 3.1 or Windows 95) are the same across the world.

The company's subsidiaries across Europe have developed an expertise in acquiring safety, and electromagnetic inference approvals because they carry multiple product lines (fax machines, typewriters, etc.) in each country market and these approvals are not complex.

**Market:**

The company is present in almost all European markets either through its own subsidiaries or through agents. Brother's *key* European markets represent some 80% of total European printer sales. The biggest country markets are the Germany (22%), UK (18%), Switzerland (18%), France (14%) and Belgium (7%). Holland, Norway, Sweden follow with Italy and Spain being the least important countries for the company in terms of sales of the HL-1260 printer. Some sixty per cent (60%) of sales of the product take place between September and December with a second peak in March-May. These peaks correspond to the end of budgeting semesters. The product is targeted to corporate clients. Size of order depends, orders ranging from a few to several hundred machines.

## Availability of adequate quality engineering and marketing resources

**Engineering:**

- Substantial R&D and technology resources exist. Back in the 80's Brother used Canon engines in its laser printers. However, the cost of purchasing Canon engines was high and Brother investigated the possibility of developing their own engines. Brother continues to use Canon consumables, but they now produce on their own some 200,000 laser engines and printers a year, a figure that corresponds to some 10% of the European market. This positions the company among the most important world laser printer manufacturers.
- The HL-1260 and its predecessors (HL-10 H and HL-10 V) use the same print method (electrophotography by semiconductor laser beam scanning).
- Plain paper fax machines and laser printers share similar technologies and Brother is an important global player in fax machines.
- Brother also had adequate software drivers for the European market. The printer drivers were already available since the HL-10 V and HL-10 H products used them. The product also emulates all other major laser printers in the market (i.e., HP LaserJet III and Laserjet 4, BR-Script, Diablo 630, IBM Proprinter XL, Epson 850). Such simulation technology is widely available.

**Marketing:**

- The HL-1260 laser replaced the older HL-10 V and HL-10 H laser printers and targeted the same segments as its predecessors.
- The company has faced resource limitations in secondary markets, where it is lagging behind its competitors, but it possesses very strong direct sales capabilities in its key target markets (Germany, the UK, Belgium and Switzerland and France). Direct sales is the best method of promoting the HL-1260. Brother employs some 1500 employees across its European subsidiaries and agents, with a strong sales monitoring and product management team being located in the UK HQ.
- The decision of the European HQ to centralise translations of the user guides in the UK also permitted the company to closely monitor production of product brochures and documents.
- The company's marketers and engineers remain with the company for many years. This life long type of employment permits accumulation of marketing and engineering expertise and capabilities.
- If the company ever faces delays in product availability because of delays in its actual development process, they air freight stock for one month of sales. By the end of this period, sufficient stock has arrived by sea (shipment from Japan takes 30 days).

## Synergies in product handling by the sales force or use by the customer

The new product is not complex and the final user does not experience problems with it. It is a typical laser printer, similar in its features to Hewlett Packard's products (the market leader). Installation and functioning are relatively easy for any computer literate person, and corporate clients have their internal engineering personnel for staff assistance.

## Co-ordination of relationships with subsidiaries/agents

Brother International Europe is organised in 4 sections, one of which is responsible for the computer peripherals business. Seven people are working exclusively for the printers' business. Their activities are divided between sales monitoring, order processing, shipment checking, forecasting, sales leaflets and pricing negotiations with Japan. Marketing support and product management is carried out by the business development group consisting of five people and the technical support is carried out by the technical support group consisting of some fifteen more people.

As Brother's operations are grouped in 4 sections (fax machines, printers, labeling products and typewriters/ wordprocessors), the company runs separate discussion groups. Technical or sales sessions of one or more days are arranged regularly (every 1-2 months), with a core of senior staff from all European subsidiaries/agents attending both. Ideas about future products, updates upon new products and information about launches are exchanged during these meetings. Some of the meetings are devoted to decisions regarding pricing,

delivery dates and quantities required. Others are devoted to transfer of technical knowledge and specifications for the new products.

European HQ staff fly frequently to Japan. The European operations are also headed by Japanese personnel which keeps its links with the corporate Japanese HQ. There is also a constant flow of fax messages and control. One of the respondents characteristically said: 'We continuously check every single detail. We check, we check, we check'.

## New product development process

Two R & D facilities are located in Japan (Nagoya) and a third one in US (Memphis). The first facility focuses upon development of new technologies and products in completely new product areas. The second facility focuses on improving manufacturing processes and existing products for printers and fax products. The third one focuses on fax or labeling products for the American market. The company practice for the development of the HL-1260 was to bring initially the new product idea for discussion in one of the frequent meetings between the new product development team (in Japan) and sales personnel (from Japan, Europe and US). Then a decision was made regarding 'SPDQ' (Specifications, Price, Quantity, and Delivery) for the product. This helps Brother's engineers because they knew since the start of the new product development process the final characteristics of the product.

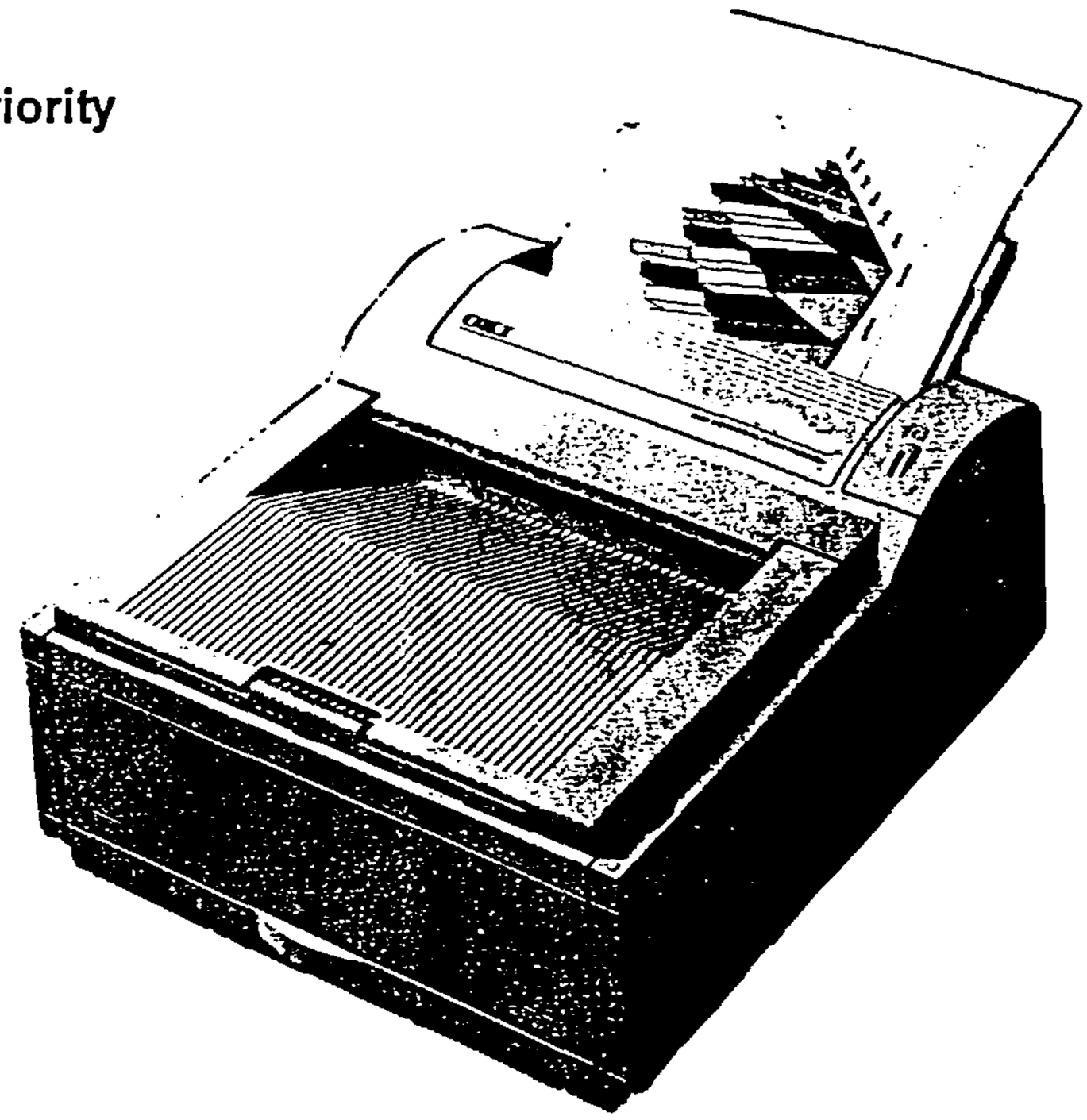
Strong interaction between Japanese and European HQ and UK-managers across European countries permitted to incorporate agents' and subsidiary personnel's views on the features and other characteristics of the new product. Extensive was also the communication and feedback on prototypes and progress of the project. The company hasn't consulted the final customers though. Managers in the European HQ would wish to do that, but it becomes extremely difficult to coordinate customer/ final user feedback for their entire range of products. They trust though, the opinion of attendants of the discussion sessions. Also, there was a strong and continuous flow of information from Japan to Europe and the European country managers through the regular technical and sales sessions as explained in the previous section.

The product was planned and eventually rolled-out simultaneously across all but one European markets for the product as follows: Germany (December 1994), Switzerland (December 1994), Belgium (December 1994), France (December 1994/January 1995), UK (January/February 1995).

# OKI Europe Ltd

OKI Data Corporation is part of OKI Electric Industries Co., Ltd, a major player in telecommunications, information processing systems and electronic devices. OKI Data Corporation (henceforth OKI) develops and markets 5 different printer product groups (dot matrix printers, non-impact printers, low-end printers, ink-jet printers and facsimiles/multi-functional products (i.e., desktop document processing systems). The company's non-impact printer range comprises a 4-, 6-, 8- and 12-ppm (pages per minute) laser printers.

## The product and product superiority



The focus of the present discussion is the 6 ppm laser printer called OL 610ex, designed for personal/small business use. This product replaced the OL 410ex (4-ppm) as part of OKI's regular upgrading of product lines. The OL 610ex offers a series of clearly visible benefits and value for money to the user. More precisely:

- The product enables the use of separate toner and drum consumables within the printer (unlike the combined units of most other printer manufacturers) leading to cost advantages for the user.
- The characteristics of the product are also in line with competing products. They include density of resolution (600 dpi), use of industry standard interfaces (emulation of the HP Laserjet 4 through a PCL5e compatible emulation), a standard 100 sheet paper tray, compliance with saving energy standards, little weight (7.7 Kg), short time to first page print (17 seconds), use of different letter and envelope sizes.
- The product is equipped with a powerful R3000 RISC processor (at 25 Mhz clock speed using 16 bit bus width), possesses a sufficient number (45) of scaleable fonts and uses an adequate 2MB of memory (for comparable purposes HP's LaserJet 4 printing 12ppm offers similar memory).
- The product has an Apple talk interface on an optional Adobe Postscript Board for the printing of intensive graphic applications and desktop publishing.
- The product is backed up by a 5 year warranty for the printer head and a minimum life of 180000 pages corresponding to at least 5 years of intensive use (calculated at 270 pages/day).

## Standardisation of the European market

**Technology customisation, complexity of such customisation and approvals:**

European markets are homogeneous in terms of product specifications, features, and technology. Some minor differences across countries concern:

- cable type and electric currency fluctuation.
- printer software drivers in local language. This is not a substantial product customisation issue since the major software platforms (Windows 3.1 or Windows 95) are the same across the world.

The company's subsidiaries/agents across Europe have developed an expertise in acquiring safety, and electromagnetic inference approvals because they carry multiple printer and fax product lines in each country market and these approvals are not complex.

**Marketing:**

There is a great variation in the type of target market segments and channels across Europe. Printer speed is a major criterion for segmentation of markets by OKI, yet the boundaries between sub-segments remain hazy. While there is a clear distinction between buyers of the low and high-end printers (4-and 12-ppm), it is difficult to distinguish the type of customers for the middle 6-ppm printers (both consumer and business buyers). Users spread across all economic and social groups, but it is not a major problem in marketing the product. OKI Europe is active in 20 European country markets. The most important key markets are Germany (35%), UK (15%), France (10%) and Scandinavia (30%).

## Availability of adequate quality engineering and marketing resources

**Technology**

The company had sufficiency of engineering resources for the OL 610ex product:

- There is sufficient technical personnel and R & D funds to develop laser printers, the entire company being primarily focused upon development and marketing of printer products.
- The OL 610ex has benefited from synergies with its predecessor and the company's other printers. The product is part of a much wider laser printer range, it uses technology that is fully compatible with technology and shares components with other products. The print technology (OKI's microfine spherical toner technology) and microprocessor (R3000 RISC) are, for instance, the same as in the OL 810ex and the OL1200ex printers.

**Marketing**

OKI Europe has a skilled and substantial resource base for the OL 610ex:

- The product targets existing markets, something that increases accuracy of prediction of sales, and costs.
- OKI dominates the European market in the business and professional segment in the dot matrix printers and they are currently at the third place regarding non-impact printers.
- The company has opened its first European sales offices more than 20 years ago, and Europe is now one of OKI's largest markets for non-impact printers (1/3 of total corporate sales).
- OKI Europe is active in 20 different European countries. It has 10 subsidiaries in the UK, Denmark, Germany, Spain, France, Holland, Ireland, Italy, Norway, and Sweden and agents in ten more European country markets.
- OKI's staff has considerable skills and knowledge of the European market. Existing sales and marketing devote all their time and efforts to marketing and sales of printers and related products because printers is the company's main business. The company has adequate marketing channels and a sufficient number of quality local repair centres.
- The European HQ co-ordinate promotion and advertising across all European countries.
- The company launches multiple similar product lines and has accumulated experience regarding the potential of each product.

## Synergies in product handling by the sales force or use by the customer

No special set-up directions are required for the use of the product. The printer is a fairly standard laser printer for straight-from-the-box use. OKI's sales force do not also need any specific training and service/maintenance requirements remain the same as for most laser printers. The handling or 'feeling' of the product has not changed for the customer compared to its predecessor or other products and the way the user is informed, by the product about its function, is similar to most laser products.

## Co-ordination of relationships with subsidiaries/agents

OKI Data Corporation is organised in terms of its 5 main product groups (dot matrix printers, non-impact printers, low-end printers, ink-jet printers and facsimiles/multi-functional products) at corporate level.

- One Japanese Vice President (called 'Process Owner') is in charge of each one of these 5 corporate activities. The 'process owners' regularly initiate global meetings. These global meetings are attended by marketing and technical staff from Europe, USA and Asia and staff from the Japan-based manufacturing, R & D, finance and procurement.
- OKI Europe is also organised around the same 5 product groups. There are 5 European product managers. These European product managers visit extensively every European

country (at least twice a year) and constantly communicate with their individual European country counterparts.

- Each local European market also employees, in turn, 5 country product groups corresponding to the same 5 corporate product groups. They handle promotion, advertising methods, segments to serve in each country, channels to use and pricing.

In addition to the 5 product groups at corporate, European and country level, there also exist:

- Product Line Teams (PLTs). The 5 most competent people for each individual product line (drawn from any European country), marketing and technical staff from the European HQ form PLTs at European level. There are also PLTs at individual country level. The PLTs meet at regular intervals to clarify and consolidate the European position for each specific product line. Their role is central regarding technology, specifications and time to launch. The PLTs prevent problems of product acceptability through early identification of the common requirements of all European countries. They negotiate differences at the initial phases of the new product development process both before and after the PPT (see below) world level-meetings.
- Product Planning Teams (PPTs). A PPT world level-meeting is attended by at least 50 different people who provide engineering advice. These meetings typically take place 4 times a year and last 3-4 days. All products are discussed in their respective corporate product groups. Video conferencing is used between world meetings for communication and discussions.
- A Strategic Planning Group (SPG) at world level. The SPG considers plans development of new products

At the same time OKI controls very tightly its European subsidiaries through intensive formalisation. The company uses cost and profit centres, comprehensive management information systems, formal performance appraisals, written marketing strategies, written procedures and master marketing plans.

## New product development process

OKI Data Corporation has spread its manufacturing, R & D and sales across the world. Manufacturing facilities are in Japan (Fukushima), Thailand, US (New Jersey) and the UK (Scotland). R & D facilities are in the US (San Jose, CA) and Japan (Takasaki and Fukushima). Sales are managed from OKI Data in the US (San Jose, CA), OKI Europe Ltd (in the UK) and OKI Electric Industry Co., Ltd (in Japan).

OKI extensively co-ordinates its new product development activities. Decisions are taken in a participative mode, conflicts are resolved at the initial stages of the development process and flow of information is frequent. Subsidiaries and agents are strongly involved. They

provide inputs and receive continuous feedback by OKI. The new product development process followed by OKI for the OL 610ex is presented in turn:

- An individual country PLT first met to discuss the market opportunity identified for a product similar to the OL 610ex. They quantified opportunity, price and expected market share for the product.
- The new product idea was communicated to the European Marketing and Strategic Planning Manager who agreed for it to be discussed at the next meeting of the European level-PLT.
- After the European level-PLT considered the new product idea at face value, individuals from the proposing country communicated the idea to other European countries asking for comments and opinions for the development of a European Review and Business Plan.
- This was followed by a recommendation to the Strategic Planning Group (SPG) at world level. The SPG considered the plan for the new product and gave permission to proceed into a Formal Product Review which consists of four (4) design reviews (DR1, DR2, DR3, DR4). Specifications and a business plan for the entire world and a time schedule of some 12-15 months were set during the first design review.
- A PPT world level-meeting considered the business plan and endorsed the development of the new product.
- European marketing managers initiated at this point a 14-point list of activities (this expands to 32 points list if the product is a new instead of replacement product). An original 32-point list is presented here below for information purposes. It comprises activities, responsibilities, scheduled start, scheduled finish, actual finish and remarks for pending issues. This 32-point (or 14-point) list also plays the role of the master schedule for the rollout of the new product across Europe.

The product development process for the OL 610ex was similar to most other OKI products. OKI planned to have developed the product over 15 months from initiation of the development process to first sales. It eventually took 18 months for technical reasons. A potential delay was incorporated though, in the schedule and has not affected the launch. Product was available on time in all countries in order to benefit from seasonal higher sales (October-December). The product was announced in the CeBit Fair in March 1995 and was made available in October 1995.

Sheet of new product development and launch

| No. | [redacted] | Responsibility | Scheduled start | Scheduled finish | Actual Start | Actual finish | Remarks |
|---|---|---|---|---|---|---|---|
| 1 | PI Document | Harry | | | | Yes | |
| 2 | OEL Kick-off meeting | Phil | | | | Yes | |
| 3 | Introduction to OSCs | Harry | | | | Yes | |
| 4 | Product spec | Harry | | | | Yes | |
| 5 | Marketing brief | Harry | | | | Yes | |
| 6 | Sample unit received | Harry | | | | Yes | |
| 7 | Sample unit evaluation | Steve | | | | Yes | |
| 8 | Alpha unit received | Harry | | | | Yes | |
| 9 | Alpha unit evaluation | Steve | | | | Yes | |
| 10 | Competitive evaluation | Steve | | 20/09/95 | | Yes | LBP430W, Star 4000, NEC 610, 400ex |
| 11 | Demo page | Mike | | | | Yes | Demo page sent to ODA - waiting for feedback |
| 12 | Beta unit received | Harry | | | | Yes | B Driver 6/02/95 |
| 13 | Beta unit evaluation | Steve/Orhan | | 15/02/95 | | Yes | |
| 14 | FOB cost agreed | Phil | | | | Yes | |
| 15 | Transfer price to OSCs finalized | Phil | | | | Yes | |
| 16 | Local RRP finalized | OSC's | | | | Yes | |
| 17 | Printer driver Win 3.1 | Orhan | | 8/E | | Yes | Window 3.1 driver on schedule. Win '95 pending |
| 18 | Printer Driver Win '95 | Orhan | | 11/M | | | |
| 19 | Product release judged for PSU | Phil | | | | Yes | |
| 20 | Production starter units | CL | Shipped 28/2/95 | | | Yes | 1,000 units shipped with old front panel / firmware to be updated |
| 21 | First volume production | CL | | 20/03/95 | | Yes | 4,000 units |
| 22 | FCS | OSC's | | 01/10/95 | | | |
| 23 | Sales training for OSCs | Steve/Mick/Harry | | 22/02/95 | | Yes | |
| 24 | Maintenance training for OSCs | Steve | | TBD | | | Basic Windows training to be held in OUK 11/04/95 3.00pm |
| 25 | Operator's manual | Mike | | | | Yes | New software being written |
| 26 | Product specifications | OBK | | TBD | | | |
| 27 | Maintenance manual | OBK | | TBD | | | |
| 28 | Photography to OSCs | Fiona | | Yes | | Yes | |
| 29 | Packing design | Fiona | | Yes | | Yes | Packaging sent to Cumbernauld |
| 30 | Launch support kit | | | TBD | | | |
| 31 | PR materials to OSCs | Fiona | | Yes | | | |
| 32 | Brochure | Fiona | | Yes | | Yes | |

OEL: OKI Europe
OSCs: Local European countries

The company is active in all three main trade blocs (North America, Europe and Japan). Each one of these trade areas accounts for 1/3 of its sales. The global HQ are in the West Coast of US and the company's manufacturing base is in Singapore. It is a production-volume led manufacturer targeting the wide and established segments of the computer network market. Its five divisions are:

- unmanaged network products,
- managed network switches and products,
- network adapter cards,
- ATM, and
- network management software.

The company does not develop products that need customisation across the US and Europe, it avoids to pioneer technology and it does not target emerging markets. The focus of the present discussion is the AT-2560TX 10/100 Fast Ethernet Adapter Card for PCI-bus motherboards.

## Product and product superiority

The AT-2560TX is an upgrade generation over existing company products. It marks the company's transition of the company from the 10BASE-T standard to the emerging 100BASE-T standard. The product offers unique attributes and clearly visible and useful benefits to the user as well as superior quality, performance and value for money. The product targets those users who want to buy equipment which will not need replacement when the new 100Mbps technology becomes widespread. These are the major characteristics of the product:

- The product uses the TX standard which:
    - is a faster version of ordinary Ethernet, it has technological and pricing advantages for demanding network applications and permits access to 100BASE-X technologies.
    - permits quicker transfers and facilitates handling of video, audio and data all in one full-duplex bundle (especially helpful in a server connection, where the need for two-way traffic often arises).
    - is fully compatible with ATM and ATI access switches. The ATM is the future standard for data transfer. It is still very expensive but in use by big users (banks etc.). The ATI is in use by ISA-bus motherboards which is another widely adapted type of bus in workstations.

- permits access to other standard technologies including the Media Access Control, the CSMA/CD, the Fiber Distributed Data Interface, and the Physical Layer (see *Byte*, October 1994).

- The product uses the PCI-bus which offers a number of advantages including independence from the CPU (Central Processing Unit). This frees the CPU for additional processing and increases the performance of data-intensive peripherals. Testing results show a higher throughput than competition and low CPU utilisation.
- The product uses a connector to an external transceiver that provides conversion between wiring schemes.
- The product is a 'plug-and-play' card and has full European Community Safety and Electromagnetic approvals.
- The card has received approvals from the main operating systems developers (Microsoft and Novel) for compliance with Windows NT, Windows 95 and 3.1 and Novel Netware and supports Banyan Vines, DEC Pathworks, IBM LAN Server and other operating systems in an attempt to appeal to the mass of network users.
- The product's software drivers automatically sense the hub's speed and set the adapter accordingly. It can also perform auto-negotiation. Switching from 10 to 100Mbps can be done by simple reset of the network (automatic determination of speed by both the card and the hub). There are external speed indicators, too.
- The card is backed with a Lifetime Warranty and free technical support. New and enhanced software drivers and features are available 24h/day via BBS or Compuserve.

## Standardisation of the European market

**Technology customisation, complexity of such customisation and approvals:**

The 10BASE-T LAN is a standardised technology, but the move to 100BASE-T technology has been accompanied by disagreement between major manufacturers. Thus, there were in February 1996 four 100 Mbps Ethernet standards: three media standards for 100BASE-T (part of the so called 802.3 standard) and an additional one for 100VG-AnyLan, which are explained in turn:

- The TX standard which uses only two pairs of Category 5 wiring just like the 10BASE-T which is the actual current de-facto Ethernet standard. This is followed by Intel, SMC, 3COM and Digital Semiconductor.
- The T4 which uses unshielded twisted pairs (i.e., 8 wires total) has no duplex option and is promoted by Broadcom (a company that manufactures T4 transceiver components).
- The proposed T2 standard which supports a different type of signaling but it is not in production yet.
- The 100VG-AnyLan which uses a separate protocol and is not an 802.3 standard.

The TX standard is fully compatible with existing LANs though, and appeals to the largest section of the LAN market across countries, estimated at 30+ million Ethernet nodes. No product customisation is required from market to market, with the exception of the electrical input. This is not considered to be an important product adaptation.

**Market:**

Most of the segments resemble across countries because of common technology requirements across Europe and the US. European customers (LAN network managers in organisations) closely follow developments in the USA. United States serve as the technology leader and the setter of market trends. There are no specific government regulations with the exception of minor electromagnetic interference and safety. Approvals by Microsoft, Novell and other network Operating Systems developers are necessary. This is not difficult however, since the AT-2560TX like most competitive products are designed in accordance with widely disseminated specifications by these developers.

European sales are split between the UK (15 per cent of sales), Germany (20 per cent), France (18 per cent), Italy (14 per cent), Scandinavia and Denmark (15 per cent), Eastern Europe (15 per cent), Benelux and other European countries (the rest). The UK is also responsible for sales to Scandinavia (Finland, Denmark, Sweden and Norway). The German office is responsible for sales to East Europe (The Check Republic and Russia) and Switzerland. The French office is responsible for sales to Benelux, and the Italian office for North Africa, Greece, Spain, Turkey and Israel.

## Availability of adequate quality resources

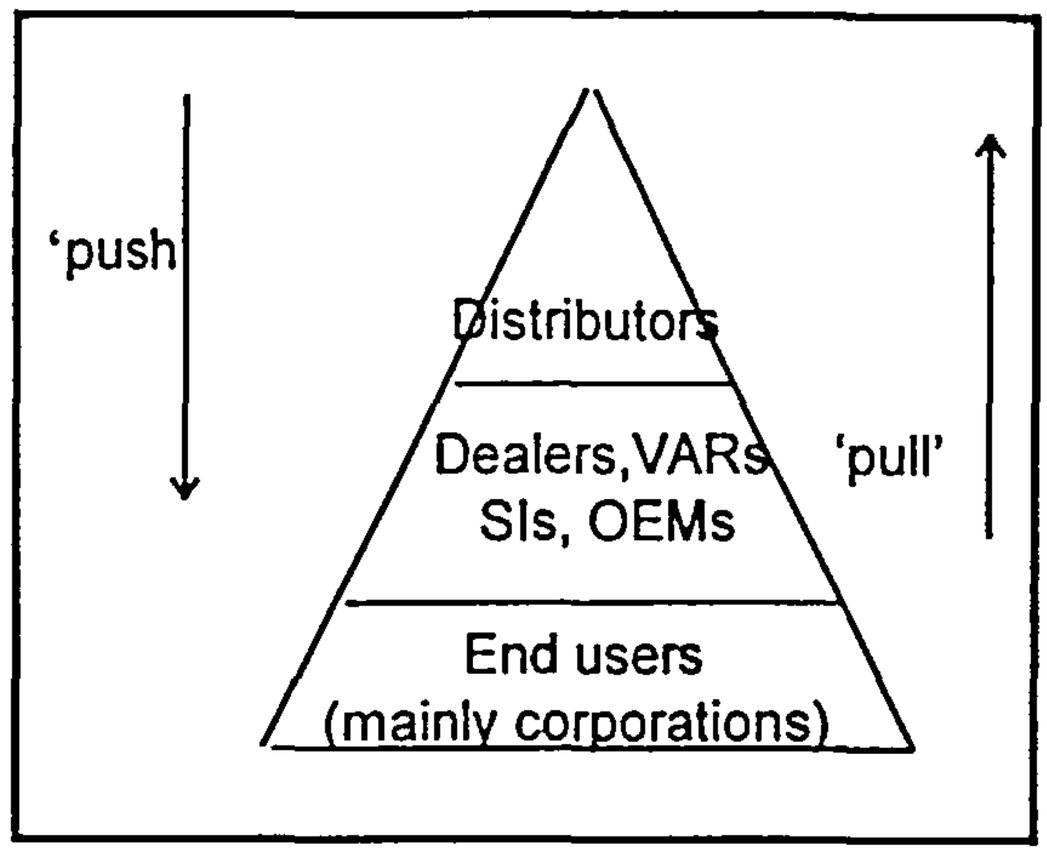
**Engineering:**

- The AT-2560TX is an upgrade to existing technology and fully compatible with existing LANs. It appeals to the largest section of the LAN market across countries. The market for Ethernet is large and the move towards the 100BASE-T is spreading throughout the world. A proportion of the 100BASE-T installations are already in the market.
- No product customisation is required from market to market with the exception of the electrical input. Multilingual user guides may also be needed. The company insists in providing US cabling only in a conscious effort to avoid any customisation.
- All tools created for the standard 10Base-T Ethernet may be used with minor modifications in the 100Base-X environment.

**Marketing:**

- Target segments remain the same as for the previous generation products. Also, the company markets a wide range of products to these segments.

- The company has insufficient availability of marketing and technical support personnel for all countries, but this is of no importance. Ninety per cent of sales is absorbed by distributors, OEMs accounting for the rest (10 per cent). The company has appointed 4 main distributors in the four main European countries to supply dealers, system integrators (SIs) and value added resellers (VARs) (see figure right). These vary from 200 to 1000 per country. SIs, VARs and dealers have substantial own technical support personnel and Allied Telesyn's AT-2560TX uses technology the business community is familiar with.




Among the dealers, SIs and VARs only a small number (circa 20 per country) are the most important and most regular clients. They are considered to compete successfully in their respective markets.

- This small number (20 main clients per country) permits extensive communication and makes easier direct mail of product information. Allied Telesyn also dispatches - prior to product launch- samples of its new products to country managers, press release agents and main clients' engineers.
- The European marketing staff create the internal and external product documentation ahead of the USA. This leaves enough time to proceed with translations.
- Allied Telesyn has its own sales and technical support offices in its main European countries including the UK, Germany, France and Italy.

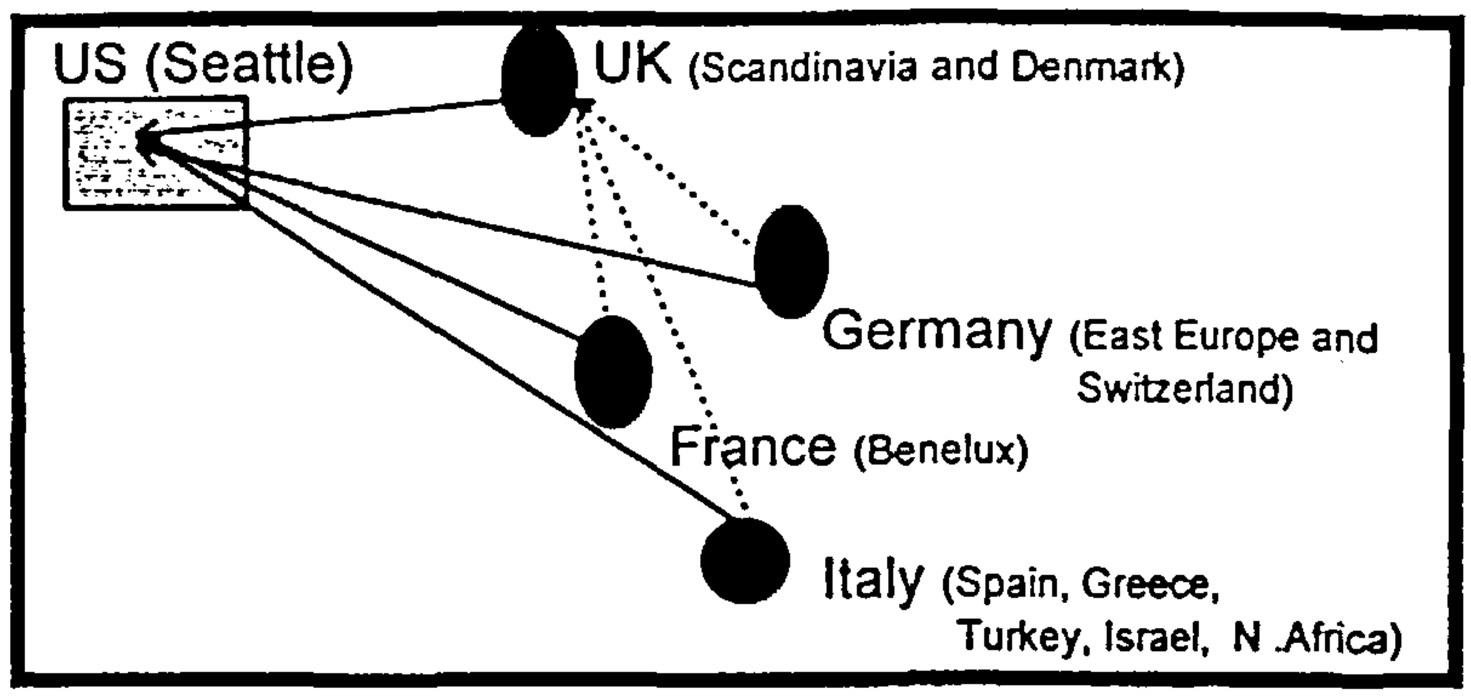
## Synergies in product handling by sales force and use by customers

Complexity of use and handling by the sales force and end users are higher than for the current 10BASE-T products. Nonetheless, dealers, SIs, VARs and final users are familiar with most of the technical solutions and requirements.

## Co-ordination of relationships with subsidiaries/agents

There is a 'cut-throat competition' culture within the company which creates difficulties. Communication though, is extensive and informal. The company makes limited use of cost and profit centers or formal appraisal and no use of written marketing strategy, procedures and fixed rules. While there are some master marketing plans and schedules, operations are left with the individuals who are expected to perform through their own initiatives.

Any under-achievement usually results in redundancy. There is:




- one European Business Manager (EBMr) responsible for all European operations who is located in Seattle, US. From a French-US origin, he is fully familiar with circumstances and developments in the European market. The EBMr operated 3 years from France and has been instrumental in initiating and developing business in Europe, The EBMr visits the four offices once a year and holds additional meetings during the company's Global Strategic Planning Conference (once a year in the US) and during the major trade shows.

- There are four Managing Directors responsible for the four European offices (UK, Germany, France and Italy). While these four MDs report direct to the US-based EBMr (continuous lines in the figure), the UK MD serves as a privileged liaison with the US (see figure). The UK MD meets his three counterparts at a daily meeting in Heathrow Airport prior or after his monthly visits to the US.

- Under the UK MD there is 1 European Marketing Director (E-Mrk-D), 4 European Product Marketing Managers (E-PMrk-M) and a Marketing Communications team (translations, advertising material, press releases, dispatch of product information to resellers and coordination of European trade shows). The E-Mrk-D keeps flying out to US once per month and spends at least one week in both the East and West Coast sites of the company in order to influence business developments.

- There is in each of the main European countries:
    - 1 person acting as 'Distribution' Manager exclusively dealing with logistics and flow of products to the 3-4 major distributors of Allied Telesyn products per country; and
    - 1 person acting as 'Liaison' Manager between the European HQ and the local market. The remaining of sales personnel are responsible for 'talking' to dealers, VARs and SIs. Total sales and technical support personnel totals 27 people in the UK, 30 in Germany, 15 in France and 8 in Italy.

The E-PMrk-M and the E-Mrk-D fly out to the main European countries on a regular basis (every 1-2 months), and the E-PMrk-M is in direct and frequent fax, e-mail and telephone

contact with both the 'Distribution' and the 'Liaison' Managers in each country. This takes place on top of the regular monthly meetings between:

- MDs at Heathrow Airport,
- the visits by the EBMr,
- the meetings during the international and local trade shows,
- the company's Global Strategic Planning Conference where some 50 people attend. Although such a number of people make difficult a genuine planning exercise, the 4-day conference and the streams of parallel meetings permit a strong interaction between the EBMr and the personnel in the UK, Germany, France and Italy.

Salesmen also travel extensively. They frequently visit local buyers in the remaining European countries.

## New product development process

New Product Development is separate from Product Management (henceforth NPD and PM respectively). The responsibility of three (3) marketing people in each division of 5 existing divisions (unmanaged network products, managed network switches and products, network adapter cards, ATM and network management software) is to liaise with sales, manufacturing and feedback to NPD teams, track the market developments and produce internal and external documentation including technical data and newsletters. The PM Divisions have no control over actual new product development undertaken by the NPD teams.

Three of the most knowledgeable people of the company (1 person from Germany and 2 from the UK) decide upon what features and characteristics of new products to suggest to the US-based PM Divisions. The country offices have limited input in technology, specifications for new products and their pricing, but wider freedom in choice of segments served and how to serve their clients with the new product.

The decision to develop the AT-2560TX was taken back in October 1995 in consultation between the PM division, NPD, and the US, European and Japanese Business Managers. This is followed by the initiation of a formal procedure applied to all new products. A 'market requirement document' was generated in the US and sent to Europe. The European Marketing Manager in consultation with the European Product Marketing Manager and the 'Liaison' and 'Distribution' Managers in Germany, France and Italy commented upon the document within a week. Changes were debated and a product development plan with expected completion and availability date were established.

This was the only official information that UK received from the US for its new product for the AT-2560TX. It has been commented as representative of the one-way flow of information from European offices to the US-based PM Divisions of the company. European HQ staff

complain that the US-based NPD team is not aware of European requirements and have difficulty in understanding the differences between the US and European market. This is a main reason for the regular monthly trips of the E-Mrk-D to East and West Coast sites of the company.

The project completion date for the AT-2560TX project was set for December 1995. This date would be 3 months after initiation of the development of the new product and in line with competitive launches of major manufacturers such as 3Com's Etherlink 3C595-TX (December 1995). The project has not evolved though as expected. The NPD teams did not consider the PM Adapter Card Division marketers to be in a position to understand technology, be good at suggesting new products and prompted the replacement of the PM Divisional Manager in November 1995. Following this, 4 new marketing people were brought into the company and 1 more was promoted.

These changes resulted in a delay in the actual target day for product availability from the Singapore manufacturing facility. In a fire-fighting exercise, Allied Telesyn decided to outsource the product sub-contracting production to third parties and a new launch date was established for February 1996. This was easy because the company is a technology follower and know-how was available in the industry.

Samples of the AT-2560TX were eventually dispatched to country managers, press and technical support people across Europe on January 20th, 1996. A product information sheet was also sent to Allied Telesyn's 20 major clients per country (SIs, VARs and dealers). The product was eventually simultaneously rolled-out across all Europe at the beginning of February 1996.

Final customers were not involved in the development process of the AT-2560TX and they did not provide any feedback. This was not important however, since the trends are set by a few technology leaders and there is rapid dissemination of the characteristics and features of emerging technology across the globe.

# Hitachi Denshi UK

Hitachi Denshi (UK) Ltd. (henceforth HD/UK) and Hitachi Denshi (Europa) GmbH (henceforth HD/D) are the European HQ for Hitachi Denshi's (HD) industrial and professional (i.e., reporter recording) cameras. HD is also active in North America (USA and Canada), South East Asia and China.

The European operations are split between the UK and Germany. HD/UK is responsible for sales to France, Holland, Belgium, UK, and Iceland, and HD/D is responsible for the rest of Europe. Even though the two offices are separate, they share the same Managing Director. The focus of the present is a series of small black and white cameras designed to capture moving objects in the factory automation and machine vision industrial areas.

## The product and product superiority

The KP-M1 Series accounts for some 40 per cent of HD/UK sales. The Series consists of several models developed on the basis of the older KP-M1 Type camera of the company. The products are small, light weight black and white cameras with maximum shutter speed of about 10,000 frames/second. The Series was launched in July 1993 and more models added into it in July 1994. It has replaced the first generation single product launched in 1992. Compared to the previous single product generation, each model in the current multiple product range has the ability to perform different functions. For instance, the KP-MB1 model offers an extremely compact and lightweight camera head, by separating, by a distance of up to 1m, the lens and CCD assembly from the camera electronics, making it ideal for optical uses. In the KP-MC1 model, the lens/CCD assembly is rotated around the normal position for reducing the front-to-back depth of the camera. This camera is appropriate for machine vision applications, where little depth is available for camera mounting. The KP-MD1 camera offers high precision mounting. The CCD inclination and position with respect to the centre of the optical axis is set with micron accuracy. This precision makes the camera ideal for critical image input applications and object positioning.

The KP-M1 Series has some characteristics that differentiate it from competition. Some of the models are available in right-angle versions, something rare, and image is captured through square instead of rectangular pixels. This makes computation of distances between objects very accurate. Moreover, the characteristics and functionality make them flexible in several situations, an advantage over competition.

## Standardisation of the European market

**Technology customisation, complexity of such customisation and approvals- Marketing customisation:**

The cameras are used for the recording of the movement of machine objects, mechanical parts, or positioning of parts in factory automation tasks. Clients for this type of products require substantial customisation related to the task at sight. The diversity of applications in factory automation is extreme, making the market for these products highly heterogeneous. The company follows however, a standardised approach, where some 85 per cent of total cameras sold are supplied without any customisation. This is harmful for the sales of the European offices since some customers are diverted to competition. Nonetheless, the range of products offers some flexibility since they can cover a number of different applications.

With some 10,000 units sold per year, sales to UK, France, Belgium, Holland and Iceland account for an estimated 7,5 per cent of HD world sales for the specific product range. Some 80 per cent of HD/UK's sales are directed to the UK itself. The rest is split between the rest of the company's European country markets as follows: France (8 per cent), Holland (8 per cent), Belgium and Iceland (4 per cent of sales).

## Availability of adequate quality engineering and marketing resources

**Engineering:**

- Corporate Hitachi has established an independent heavily funded corporate R&D unit focus upon basic research. New technologies regularly come out of its laboratories, and they are diffused or transmitted throughout the corporation. Because these new technologies are so diverse, it is up to the R & D teams in each unit of the corporation (such as HD) to identify which ones to use in their own products.
- HD pursues a policy of product standardisation in order to minimise heterogeneity of operations and increase synergies. Only 15 per cent of cameras sold by the HD/UK are modified locally after consultation with the Japanese R & D department.

**Marketing:**

- HD/UK and HD/D target SIs (20 per cent of turnover) and OEMs (60 per cent) which incorporate the cameras into their own automated machinery. These are estimated to be 100, in total, across all Europe. The number of actual major buyers for the KP-M1 Series is about 10 across the HD/UK's region of responsibility.
- The German office is a separate entity but organisationally close to its sister British subsidiary. They share the same Managing Director and the two subsidiaries exchange information, interact between themselves and source components or inventory items from each other.

- The KPM1 Series has benefited from existing resources. The company had successfully marketed its predecessor. Target market segments and sales force were the same and buyers were familiar with the product.

## Synergies in product handling by the sales force or use by the customer

The new product remained the same regarding its complexity compared to the older generation product. The HD/UK' engineers were able to handle support to buyers. The use of intermediaries (OEMs and SIs) who were well knowledgeable regarding their own activities also permitted the minimisation of support to final users. This is undertaken by the OEMs or SIs.

## Co-ordination of relationships with subsidiaries/agents

HD/UK and HD/D avoid to sell directly to end users. They primarily sell to SIs and OEMs for the following reasons:

- OEMs buy in large quantities. This minimises the need for interaction with the final user.
- The company through a policy of exclusive sales to intermediaries (OEMs, and SIs) and avoidance of sales to end users also benefited from good reputation. SIs and OEMs cease sourcing from suppliers, if they sell direct to final users. This has happened to HD's own competitors.
- Purchase of factory automation machinery is a capital investment project, rendering individual purchases infrequent. The final users are not repeat buyers.

Co-ordination of marketing is easy because of the small number (10) of actual major product buyers. The company employs one single salesman for the OEM buyers. The French distributor has its own local agents across the country and transmits back to London requirements and information. Due to its long co-operation with the company and product/market familiarity, the quality of transmitted information has increased. There is some room for improvement according to HD/UK personnel though. This became apparent in a recent exhibition when HD/UK realised that some salesmen were not fully aware of some of the features of the company's KP-M1 Series. The company intends to educate 2-3 salesmen in each buyer for improvement of communication and sales.

## New product development process

Personnel from Japan visit in their world tour, the regional Head offices twice a year. The Japanese team usually consists of the international sales representative based in Tokyo, and the Japanese Head Engineer. The European location for the meeting is rotating between the UK and Germany (once in the UK and once in Germany). The European personnel explain their product preferences and required features and the Japanese mission present their own ideas,

targets and world market trends. While US and Asian market preferences prevail most of the times regarding the type of products and features developed, HD/UK personnel is confident that justification of sufficient sales finds support in Tokyo by both the design and marketing teams.

HD often faces delays in the development of its new products. Judging from the overall company presence in its European markets over the years though, the HD/UK personnel has come to the conclusion that the company may lag some times behind competition, but other times is ahead of it. Technology incorporation derived from developments at the corporate Hitachi R & D unit is helping HD to compete head-on-head.

HD/UK finds easy to identify market trends across Europe. Re-transmission of customer requirements by OEMs or SIs increases company market knowledge despite limited communication between the company and the final users. The very nature of factory automated products requires extensive interaction between engineers from both HD and the buyer (OEM or System Integrator) side.

The first generation KP-M1 product was initially launched in 1992. Some of the replacing models (e.g. KP-KP-MB1; KP-MC1; KP-MD1; KP-ME1) were launched a year later (July 1993), Additional models were made available two years later in July 1994 (the KP-M1Z model). All models were made simultaneously available to all customers across all European markets. This has happened for the following reasons:

- The company was aware of the development and the time of availability of the forthcoming products long before the actual launch. Also, pre-sales information was sent to the company's customers by mail some 1-3 months prior to availability.
- HD/UK and HD/D engineers provided technical details and information to all those they were contacting during the company's regular activities.
- The company sent samples to its major clients for trial-tests.

# Appendix 4

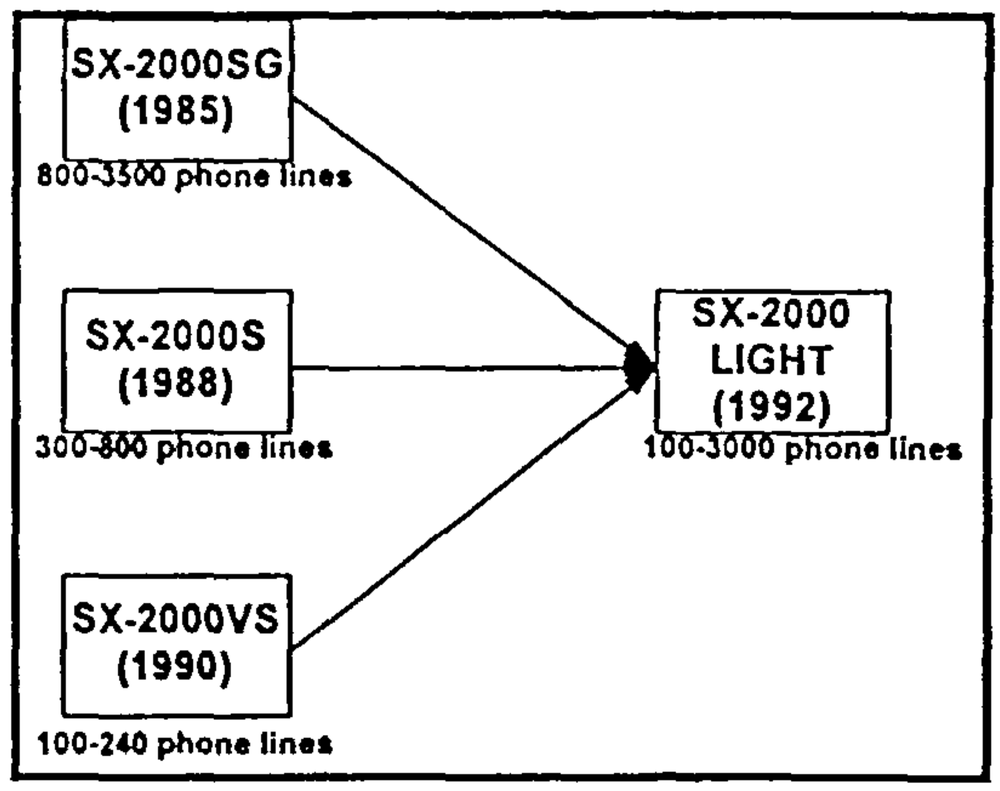
## Delayed cases

# Mitel Telecom Ltd.

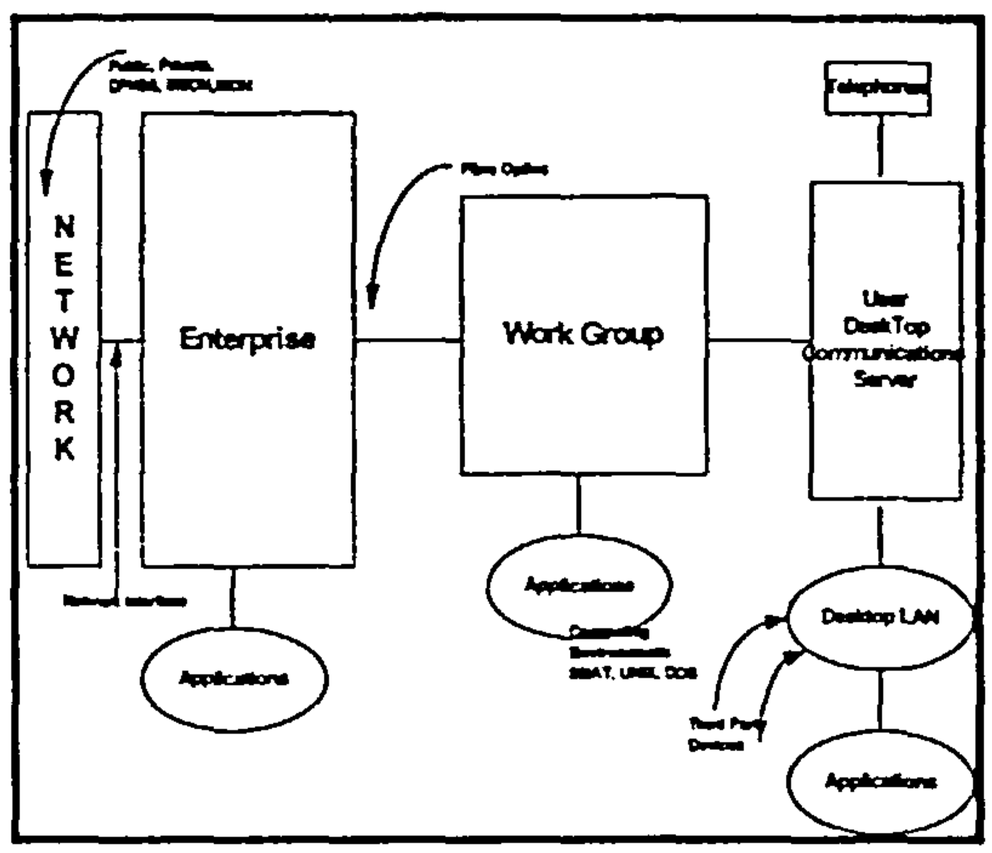
MITEL Telecom Ltd. (MT) is the European HQ of the US$500 million Mitel Corporation one of the major world operators in telecommunication. Its competitors include AT&T, Nortel and Siemens. US accounts for 52 per cent of Mitel's corporate turnover. UK and Europe account for 26 per cent of Mitel's corporate turnover (15 per cent of which derives from product sales and the rest from services). The focus in the present is upon Mitel's main product, SX2000 LIGHT.

## The product

The SX2000 LIGHT replaced three older products: the SX2000SG developed in 1985 (800-3500 phone lines), the SX2000S developed in 1988 (300-800 phone lines) and the SX2000VS developed in 1990 (100-240 phone lines) (see figure).The SX2000 LIGHT consists of modules serving needs of different sizes (100-3000 lines).




Mitel also markets the SX50 (from 4 lines and 8 extensions up to 32 exchange lines and 160 extensions). However, the SX2000 LIGHT is by far more important than the SX50 for MT's operations. The SX2000 LIGHT accounts for 95 per cent of MT's product sales.




A private branch exchange broadly consists of the telephone network gateway, the central processing unit (CPU), the internal network interface and a variety of peripherals. The product discussed here consists of the network gateway, the CPU and the internal network interface seen in the figure right as 'network'.

The product is designed around a central processing tower (18 inch tall) with individual modules interconnected by high-bandwidth fibre. Using fibre-optic connections and digital technology, the tower unit has an integral peripheral capability to support up to 128 universal devices, expandable through the addition of peripheral nodes to 768 ports (seen as 'applications' in the figure right). 'Applications' can be standard plain old telephones, modern voice routing platforms, networked computers or independent computer servers. Each 'application' can be customised with its own selection of software and peripheral support, enabling separate work groups to have the communications system that best meets their

function. A system can be located in one site or at different sites through a public or a dedicated switched network.

## Standardisation of the European market

**Technological customisation of markets, complexity of such customisation and approvals:**

Some components of the product remain the same, other change:

- The main hardware components remain the same and they do not need customisation across countries. Machine software and the set of modules to choose from, are standardised from country to country.
- The public switched telephone networks vary from country to country with a substantial, and several times incompatible, variety of analogue and digital standards.
- There is a substantial variety of peripherals. Applications (like voice mail or data-base information gateways) use many different technologies. These are client-specific and require extensive configuration to cooperate with the system.

**Approvals' complexity:**

Local country approval are necessary for the SX2000 LIGHT. This has acted as an inhibitor to the launch of the new product because it is difficult to satisfy every country's own requirements. Countries like Holland have the shorter and France have the longest list of requirements, despite European Community's attempts to harmonise the telecommunication standards. Safety, transmission, ringing tones, delays in ringing before connection, etc. vary. France and Spain also apply non tariff barriers during the approval procedures in an attempt to assist their local telephone operators (Alcatel and Telefonica). The company did not experience problems with approvals in the UK for the following reasons:

- Its own personnel has established strong connections with top executives in the UK approval mechanism.
- The company has permission to have an in-house Certified Testing Laboratory. This means that Mitel's products have priority, they are free for sale when certified by Mitel's own personnel and technical details are not disseminated to outside bodies.

MT did not encounter problems with approvals in Germany either. The company hired a local engineer/ approvals-expert who completed the procedure on-time. MT faced however, substantial problems in other European countries. The company has explicitly avoided to get approval in France at that time, because the French PTT's nationalistic attitude would not let MT's products to be easily approved. Major obstacles were also faced at the same time in Italy for reasons which will be explained later.

**Market:**

Purchasers of the SX2000 product split into multinationals which purchase centrally and require the same telecommunication equipment throughout the world (some 15 per cent of total number of target clients) and independent purchasers. An estimated 80 per cent of buyers in Europe cluster in the services sector. Buyers are in the utility, financial and insurance services in the UK; media, IT and hotels in Europe. Applications and product requirements are sector-specific.

## A short history of the company, the place of the SX2000 for the sale of the company and the product failure in the German and Italian markets

By 1990, Mitel was owned by BT. BT has acquired Mitel in its mid-80's diversification strategy. Increasing losses and a plunge in share prices forced BT management to initiate a retraction strategy. Almost two years (1990-1992) passed before Schroder Ventures-a venture capitalist group, buy BT's 51 per cent of Mitel shares in June 1992.

These two years were a period of high uncertainty for Mitel. Investors had no interest for purchase of Mitel shares and Mitel had huge losses for a number of consecutive quarters. Mitel's management decided to initiate an innovative new product program that would improve the company's image. The new product development was initiated in 1991. Since the US market accounts for over half the total company sales, little consideration was given to the requirements of the European markets.

Eventually, the first internal announcement for the new product was made in 1992 by the time the company had changed ownership. Rollout across Europe was planned to start with an initial launch of the new product in the UK in September 1992, to be followed by Germany (December 1992), Italy and Ireland.

Inadequate communication between the MT and European subsidiaries first resulted in a late initiation of the approval procedures. The product was unveiled in Germany the same month as in the UK (March 1993). It was not until the end of 1993 that the company installed two single systems in Germany on a trial basis. Turnover of the MT's German and Italian subsidiaries reached only 45 and 30 per cent of total company expenses in these countries in 1992-1993. These losses mounted up to an estimated 20 per cent of total company turnover during the same period.

**Table 1 MT's revenues and expenses in the German and Italian markets in 1992-3**

| Country | Revenues Scale=100 | Expenses |
|---|---|---|
| Germany | 100 | 222 |
| Italy | 100 | 361 |

These adverse developments are also apparent in the evolution of total company sales during the 1992-1995 period.

**Table 2 MT's sales (1992-1995)**

| Country | 1992 (%) | 1995 (%) |
|---|---|---|
| UK | 78 | 82 |
| Germany | 6 | 2(*) |
| Italy | 6 | 2(*) |
| Hong-Kong | 6 | 12 |
| M. East- Africa | 6 | 4(**) |
| Increase in sales (1995/1992) | | +31 |

(*) =half the 1992 sales (**) =equal amount of sales

Among the 30 people employed in the German subsidiary, 1 was responsible for approvals, 2 for marketing, 7 were the sales force and 7-10 were technical personnel. Similar was also the structure in Italy. In an attempt to break away from the deadlock (no sales in Germany and no sales or approvals in Italy), MT transferred two Directors. One split his working time in the UK and Italy (2 weeks in the UK and 2 weeks in Italy) and another one moved to Germany for 6-7 months. Unfortunately this decision was taken too late. Both offices closed soon afterwards. More details regarding the causes of failure follow:

## Availability of adequate quality engineering and marketing resources-Synergies in product handling by the sales force and in use by customers

**Germany:**

- Deficiency in sales force and distribution. The previous MT operations in Germany were strongly concentrated on sales of the SX50 product (80 per cent of total company turnover in Germany). This product was targeting the segment of 30-100 lines, mainly consisting of small hotels. The sales force could not handle the SX2000 LIGHT because it is more complex than the SX50. MT also considers that recruitment of the sales force in the German market has not attracted talented and knowledgeable people.
- No distinctive advantage against other competing products and weak corporate and brand image in the German market:
  - Competitors capitalised on German nationalism suggesting to corporate clients that MITEL is an 'outsider', a 'foreign'. They were an 'English-Canadian' company that does not have anything to do with Germany. At the same time, Germany is the domestic market of Siemens and a manufacturing base for Alcatel.
  - Little consultation took place between Mitel US and the local European Offices when the brand name SX2000 LIGHT was chosen in the US. The sound of the product name in the German language reminds of 'weak beer' and inferiority.
- Deficiency in engineering and marketing support and resources. A local third party company which was used for technical support did not have sufficient knowledge of Mitel's products. MT's own technical personnel had to fly out to Germany for training sessions, but

this was not effective because of language barriers. Technical documents were also not translated into German, either.

- MT did not attract any major and reputable initial buyers (show cases). This is very important since buyer decision is heavily influenced by existing installations at reputable sites. Two of its existing clients decided to test the product after an entire six months no-sale-period from actual product availability in Germany.

The German subsidiary closed in July 1995 with 30 redundancies.

**Italy:**

- The Italian subsidiary failed to have the SX2000 LIGHT approved on time in Italy despite an earlier approval for the older generation products. Reasons relate to bureaucracy of the Italian State. It was characteristically mentioned in the interviews that the Italian Ministry of Communications has 72 departments in a 15 story building. It was also reported that the financial failure of the company in Italy was also due to increased financial payments to Italian Mafia in order to 'push' the approval procedure of the SX2000 LIGHT through the Italian Ministries. MT expected the approval procedure to last 1 month. It eventually took 6 $^1/_2$ months.
- Inappropriate new project management in MT. The initiation of approval procedures should have started much earlier.
- Deficiency of the sales force. The Italian sales force failed to expand into new sectors and acquire new clients. They also kept their sales concentrated in a narrow geographic area, did not segment its market and did not sell to big hotels where MT has the biggest competitive advantages for the SX2000 LIGHT. MT also considers that recruitment of salesmen in Italy, like in Germany, has not attracted talented and knowledgeable people.

The Italian subsidiary closed in March 1994 (just one year after the planned launch date in February/March 1993) with 40 redundancies amid financial losses, a series of law suites and court settlements.

**The success- Middle-East and Africa.**

MT decided that Middle East and Africa would be the last markets to roll out the new product. Despite no remote training packages and the need to fly out for the training sessions, the product was rolled-out on time and succeeded. Organisations in several African countries (Egypt, Bahrain, Kuwait, S. Arabia, Botswana, Tanzania) purchased the SX2000 LIGHT. Reasons include:

- Middle East and Africa are served by a small number of MT's expert personnel in an organisationally self-contained unit. They have substantial marketing and technical experience in these countries and a substantial number of links and acquaintances.
- The main PTT operators act as agents of MT in these countries. There are no rigid telecommunication standards, so the time consuming approval procedures are avoided. Purchases are channeled through the main PTT operators. A within-24-hours quotation service provides rapid response to customer questions.
- The number of requests is small (a few hundred quotations per year). This permits central handling of MT sales to these regions.

## Co-ordination of relationships with subsidiaries/agents

The decision making and flow of information between MT and European subsidiaries at the time of the launch of the SX2000 LIGHT were hierarchical. There was little direct contact between the sub-ordinates at lower levels of the organisational structure. The German and Italian operations were reporting to their heads who, in turn, were reporting to the European UK-based VP for Sales. He would transmit information to the heads of the other company functions within MT who would then pass the information to their own personnel. This has proved to be inadequate. Information was filtered and distorted. Deadlines were continuously postponed. The company has radically altered its internal structure and the structure of its channel relationships after the failed rollout of the SX2000 LIGHT. Changes include:

- Closing of all direct MT operations in European countries. There is no MT's own marketing personnel in any of its target European markets.
- MT agreed a pan-European distributorship with a pan-European consortium and separate agentships in the European countries. It is independent VARs and SIs that have undertaken the responsibility to market MT's products.

MT has since rolled-out the SX2000 LIGHT into Italy, Germany, Jersey, Ireland, France, Holland, and Spain. For 'mature' agent relationships (like in Jersey), MT conducts regular training sessions of several days, particularly at period preceding local trade shows. For less 'mature' relationships (as in Holland) an account manager, a system architect and a system engineer regularly fly out at the time of the sale meetings to assist the local agent.

## New product development process

The product development was initiated in the US in 1991 but faced delays. The product was initially developed for the US market by a US-Canadian team and it was inadequate for the European market. Limited communication took place between US and MT's European subsidiaries. The one-way communication flow from US to UK consisted of simple

announcements regarding the evolution of the SX2000 LIGHT project. MT was then passing the information to Germany and Italy. When the product was eventually announced, MT were left with the task to adapt it for the UK and Europe. MT decided to adapt the product initially for the UK and subsequently for the German and Italian markets.

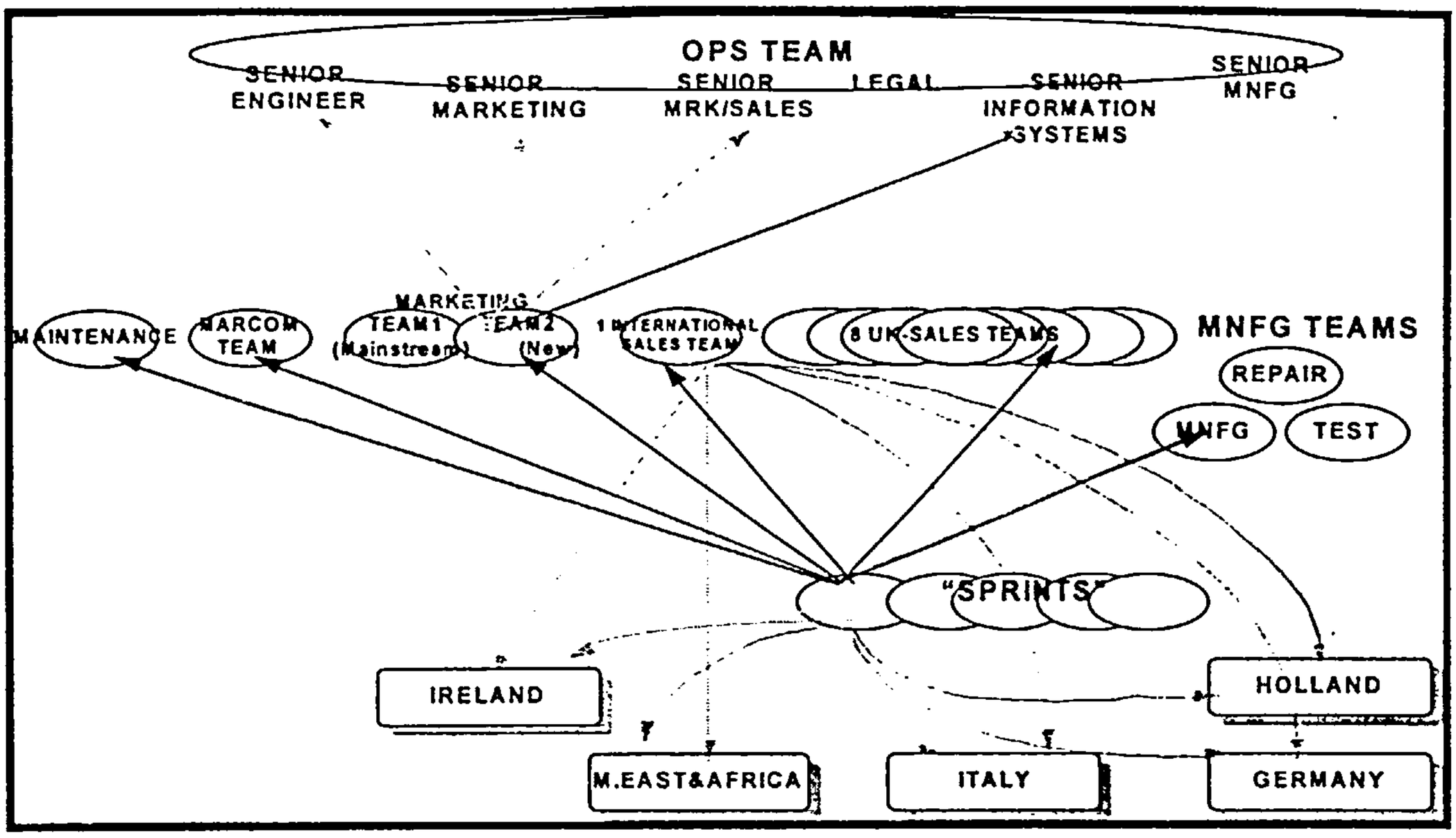
MT followed a 'list' approach, where the actions were summarised on a document, and personnel (in both the UK-located HQ and the European subsidiaries) were assigned specific tasks and deadlines for execution. Little communication with the local German and Italian subsidiaries took place. This communication was also difficult and hierarchical as explained earlier. The above were not effective or efficient and they resulted into continuous postponement of new product availability and rollout.

It is notable that in contrast to the problems faced during the development and customisation of the SX2000 LIGHT project, MT has not faced any delays in the development and rollout of the SX50 product. Even though information is dating, there was a strong agreement that the product was developed and rolled-out on time. The SX50 was launched in 1986 in the UK and shortly afterwards across other European countries. It was developed in the UK only, without the intermediation of the US or Canadian new product development teams. Variants for most European countries were also performed in the UK. Sales of the product, albeit not phenomenal were satisfactory.

Following the failure of the European rollout, MT drastically altered its internal organisational structure including the process of new product customisation. Due to these changes some 70 per cent of the people, who were employed at the time of the SX2000 LIGHT rollout, have left. The company's structure in February 1996 is depicted in the figure below. The existing structure is opposite to the structure the company used three years earlier:

- The top authority remains with a handful of personnel who meet every Friday and decide collectively, even though the Managing Director has the casting vote. This is called the OPS team. The OPS team is available for consultation by any member of staff. Their offices, previously accessible with difficulty, have been transferred to open space in the middle of the company's site. This OPS team consists of 1 specialist in engineering, 1 marketing, 1 sales/marketing, 1 legal, 1 information technologist, 1 manufacturing, 1 human resources manager and 1 finance expert.
- The rest of the company is now structured into teams headed by a team leaders. While the OPS specialists overview the respective functions of the teams, the teams and the team leaders can request advice from anyone they consider appropriate. There are:
    - 3 teams in manufacturing (one responsible for production, one for repairs, and one for testing).

- 2 teams in information technology (one for maintenance, and one for development of new systems).




- 9 sales teams (8 for sales in the UK and 1 for international sales).
- 2 product management teams. One is responsible for new products until their release. Currently, the members of the new product development team seek the maintenance of a strong communication link with the Mitel North American operation. They regularly fly out to United States and Canada (every 4-5 weeks) and stay there for a week spending time with the NPD N. American shop floor engineers. This team transfers product responsibility, within 3 months from product launch, to teams which overview the already launched products. These teams are in 4 areas:
    - the 'installed base' (1st area),
    - the 'new' domestic UK buyers (2nd area),
    - the 'new' international customers (3rd area), and
    - new services (4th area).
- A 'sprint' team is assigned the responsibility of new product rollouts. These 'sprint' teams are formed for a period of about 6-7 months. MT has an average of 5-6 'sprint' teams at any time (mainly for peripherals). They are given specific product launch responsibility, they are time bound and receive all the resources they require.

# Rhetorex Europe Ltd.

Rhetorex Europe Ltd. (RxE) is the European HQ of Rhetorex Inc., a US company, founded in March 1988 with the specific goal of becoming the industry leader in micro-computer digital signal processing computer telephony (voice processing). Rhetorex offers three computer telephony hardware product groups (see p. 241):

- voice processing platforms,
- telephone network interface cards, and
- companion technologies.

The core applications include voice messaging, inbound and outbound call processing, information services and database access via telephone. An example will be given here. Incoming callers are transferred from a standard telephone to a PC voice card and are given a greeting (..thank you for calling.....). After they are asked if they have a touch-tone telephone they are switched to a speech recognition port for provision of information or sent of a hard copy. They can also download a fax copy (through a fax port) or be transferred to the operator.

## The product

Voice processing platforms are available for use in the US, British and international telephone environments. Products include the top-of-the-line Vantage series, the mid-range RDSP series, and the low-cost Prelude series. The company provides open architecture through compliance to industry-standards [the Multi-Vendor Integration Product (MVIP) and the analogue bus connectors] considered as necessary for compatibility between products from different manufacturers and a wide variety of peripherals.

The project under consideration is the RDSP/9400-I Series of high performance voice processing boards for international markets (see pp. 242-3). The company occupies an estimated 25 per cent (£1m) of the European market[1] for this type of products. At the time of its development, it was a truly new product targeted to an emergent market, Rhetorex being among the pioneers in the sector. These are the characteristics of the product:

- It can be used with either 2 or 4 different telephone lines. It supports applications such as voice mail, automated attendant, audiotex, interactive voice response, outbound marketing or dictation.
- It is designed for IBM PC/AT or ISA bus compatible computers and supports multi-tasking operating systems such as OS/2, Unix, Qnx, Solaris, Windows NT as well as MS-DOS.

1. For comparative purposes, the prices for a small typical 6 port voice system start at $ 400 while a combined voice/fax can start at $600. A move to 8-12 ports will increase the cost to $2000.

## ardware Platforms

- 2, 4, 8, 12, 16, 24 and 32 ports
- alf-size and full-size form factors
- nalog loop start, ground start, DID, earth call, and ANI
- Digital T1 and CEPT
- Complete line of foreign approvals
- Multi-Vendor Integration Protocol (MVIP™)
- Analog Bus Connector (ABC)
- Open Architecture

## oftware Algorithms

- AccuTalk™ — six digitization and compression rates with volume control, AGC, record cue, voice-activated record, and dual-channel record
- AccuDigit™ – DTMF detection and generation
- AccuCall™ — call progress analysis
- AccuRate™ — speech speed control
- AccuPitch™ — pitch-corrected speech control
- AccuTone™ — MF detection
- AccuPulse™ — on-board rotary pulse detection
- AccuSwitch™ — MVIP switching
- Positive Voice Control — answer detection
- Optional Algorithms Available

## oftware Utilities

- Visual Voice Editor — prompt editor
- AccuCall Plus — advanced call progress monitoring
- AccuCall Library — allows integration of AccuCall functions into application
- AccuSpan™ — T1 configuration utility
- RDSPtest — automatic system set-up
- AccuLock™ — application software security

## perating System Software

- MS-DOS • QNX • Xenix
- UNIX • Solaris • Windows 95
- OS/2 • Windows NT

## pplications

- Voice Mail
- Automated Attendant
- Audiotex
- Interactive Voice Response
- Computer-Telephone Integration (CTI)
- Outbound Telemarketing
- Dictation
- Call Centers
- Fax-on-Demand
- Fax Broadcast
- LAN or Network-Based Voice Services
- Many more custom applications

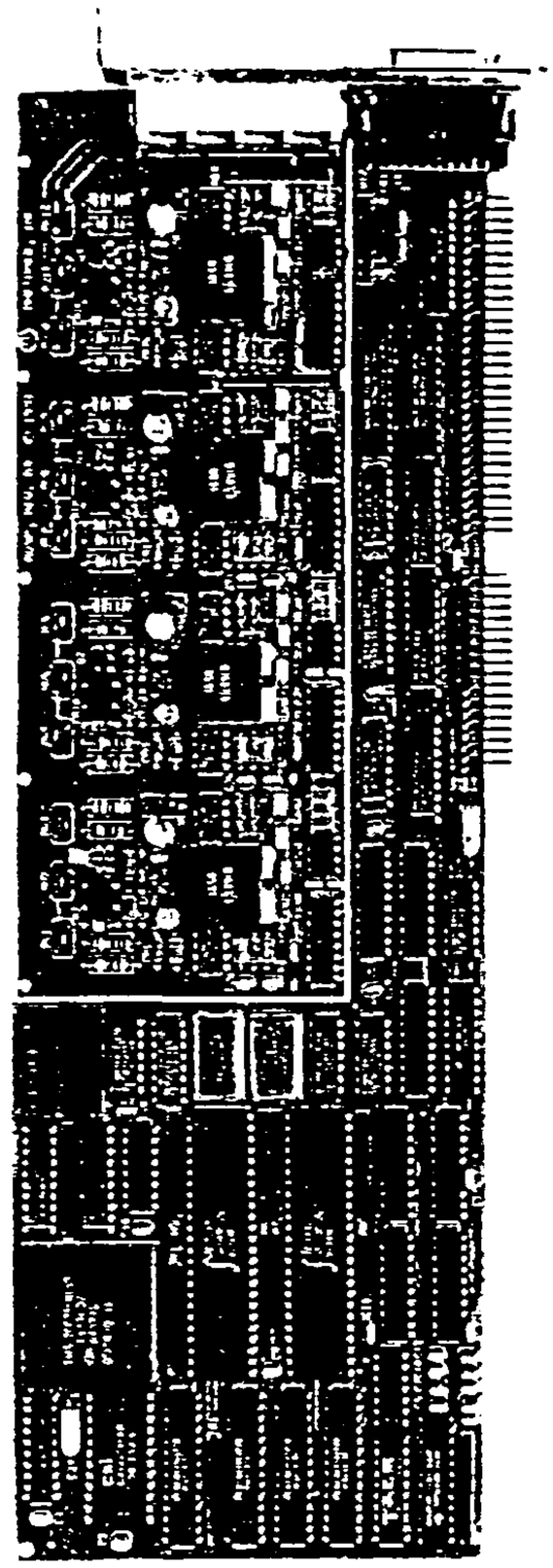
MVIP™ DEVELOPER

# THE RDSP™/9400-I SERIES

## RDSP/9432-I, RDSP/9232-I and RDSP/9464-I

## High-Performance Voice Processing Capability for International Markets

RHETOREX



### PRODUCT OVERVIEW

The Rhetorex™ RDSP/9400-I series platforms are state-of-the-art voice processing boards for IBM PC/AT or ISA bus compatible computers. Designed specifically for the international marketplace, the RDSP/9432-I supports 4 telephone ports. A two-port version, the RDSP/9232-I, is also available. The RDSP/9464-I version supports the AccuPulse™ rotary pulse detection algorithm.

The RDSP/9400-I series has a high-performance 16-bit interface and supports multi-tasking operating systems such as OS/2, UNIX, QNX, Solaris and Windows NT as well as MS-DOS. The RDSP/9400-I series' telephony interface is approved by many national telecommunications authorities worldwide and is well-suited for high-end voice processing systems requiring optimal performance.

The RDSP platform architecture utilizes the latest in high speed Digital Signal Processing technology to perform continuous signal analysis on multiple ports simultaneously and independently. All features are implemented through high-quality software algorithms. The algorithms and associated firmware are downloaded into the RDSP's memory from the host computer and reside there during run time.

**APPLICATIONS**

- ❑ Voice Mail
- ❑ Automated Attendant
- ❑ Audiotex
- ❑ Interactive Voice Response
- ❑ Outbound Telemarketing
- ❑ Dictation

### SOFTWARE ALGORITHMS

The RDSP/9400-I series platforms support all Rhetorex Advanced Voice Processing Algorithms, providing the user with all the functions required to develop state-of-the art voice processing systems. Standard algorithms include AccuTalk™, with six digitization and compression rates with volume control; AccuRate™ speech speed control; advanced call progress analysis with AccuCall™ Plus; AccuDigit™ DTMF detection with talk-off rejection; AccuTone™ multi-frequency detection; and Positive Voice Control, which detects answers within milliseconds by distinguishing between voice, call progress signals, noise, and silence. For the RDSP/9464-I, AccuPulse provides rotary pulse detection of digits 3 - 9 and 0. All algorithms are implemented through software and may be updated without any hardware modifications to the RDSP.

### HARDWARE

RDSP/9400-I series platforms are capable of running in 286, 386, 486 and Pentium class ISA-bus compatible systems in either 8 or 16 bit mode addressable anywhere in the 16Mb range. Multiple RDSP's in a system share the same interrupts, as well as the same memory segment, reducing the need for additional memory allocation. This scheme allows for a large number of RDSP's to operate simultaneously in a single system. Configuration

options such as the segment address and hardware interrupts are set by software. The RDSP/9400-I series includes additional on-board memory for increased speech buffering and additional optional Rhetorex Software Algorithms.

## TELEPHONY INTERFACE

Each RDSP port supports either loop start or earth recall configurations and is capable of detecting incoming ring and loop current drop with on/off hook capability under program control. Each telephone line interface provides high VAC isolation and meets the specifications of the British Approvals Board for Telecommunications (BABT) and others. The RDSP/9400-I series includes an Analog Bus Connector (ABC) for connection to other PC-based voice or data communication resources. Each board also includes line-level audio inputs and outputs for external audio equipment.

## DEVICE DRIVER

Control of the RDSP is through a set of industry-standard preprogrammed terminate-and-stay resident (TSR) driver routines. The Rhetorex MS-DOS and multi-tasking operating system device drivers include high level 'C' interface routines, as well as full documentation. Voice files are standard DOS files and may be backed up using conventional methods. The RDSP/9400-I series supports all optional Rhetorex MS-DOS software utilities as well multi-tasking operating system device drivers for UNIX, QNX, Solaris, Windows NT and OS/2.

## SPECIFICATIONS

Host Interface: IBM PC/AT, 286, 386, 486 or Pentium class ISA-bus compatible

Bus Operation: 8 or 16 bit, software selectable

Bus Speed: 8MHz, 0 Wait States or 10MHz, 1 Wait State

Interrupts: 2 — 7, software selectable

I/O address: one location 0000-03FF, jumper selectable

Memory base address: anywhere in 16MB on 4k boundaries, software selectable

Maximum number of boards/system: Application dependent

**TELEPHONY INTERFACE**

- ❑ Loop Start and Earth Recall (software selectable)
- ❑ Line Isolation: 3000 VAC
- ❑ Loop current detect: 10 - 120 mA, polarityinsensitive
- ❑ Impedance: 600 ohm nominal
- ❑ Frequency Response: 300-3300Hz +/- 30Hz
- ❑ Ring Detection: 40-130 Vrms 15.3-68.0Hz

**POWER**

- ❑ +12v 20mA
- ❑ -12v 40mA
- ❑ +5v 1.0A
- ❑ -5v 0A

**ENVIRONMENT**

- ❑ Operating Temperature: 0 to 50 C
- ❑ Storage Temperature: -10 to 70 C
- ❑ Humidity: 8 - 80% non-condensing

**PHYSICAL**

- ❑ IBM PC/AT form factor
- ❑ 4.80"h x .750"w x 13.250"l

**CONNECTORS**

- ❑ Phone line: Two RJ11 for RDSP/9232-I; Four RJ11 for RDSP/9432-I
- ❑ External Audio Connector: 15-pin D sub (interfaces to RDSP-AC)
- ❑ Analog Bus Connector (ABC)

**FEATURES**

- ❑ Digital Signal Processing (DSP) based
  - Real-time operation
  - Features implemented entirely through software; no hardware modifications required
- ❑ Enhanced Voice Processing Algorithms:
  - AccuTalk
  - AccuRate
  - AccuDigit
  - AccuTone
  - AccuCall
  - Positive Voice Control
  - AccuPulse *(9464-I only)*
- ❑ Meets or exceeds industry standards
- ❑ Two or four ports per RDSP
  - Approved by national telecommunication authorities worldwide
  - Direct connection to the phone line
  - Modular design, increase capacity at any time
  - Requires only one interrupt per system
  - Line level audio input and output
  - Software Configurable
- ❑ MS-DOS support standard
  - Also supports UNIX, QNX, Solaris, Windows NT and OS/2 operating systems
- ❑ Supports Rhetorex Software Utilities
  - Visual Voice Editor (VEdit)
  - AccuCall Plus and AccuCall Library
  - RDSPtest
- ❑ Application Software Security (AccuLock)



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- It is capable of running on 286, 386, 486 and Pentium class ISA-bus compatible systems in either 8 or 16 bit mode allowing for a large number of applications to operate simultaneously in a single system.
- It uses digital signal processors and complex software algorithms. These algorithms[2] provide all functions [playback speed control, security coding, selectable speech digitisation rates, call progress monitoring (frequency and cadence), pulse or tone detection, volume control and speech detection] for the development of advanced voice processing systems.

## Standardisation of the European market

**Technology customisation, complexity of such customisation and approvals:**

**Hardware and approvals:**

The computer telephony integration market experiences a phenomenal and explosive growth. Strongly linked to the appearance of strong PC microprocessor and robust operating systems (i.e., OS/2, Windows NT), it was a nascent technological area just a few years ago. Nonetheless, the core applications for voice processing have remained relatively constant and even today, most are sold into the following markets:

- voice messaging;
- inbound and outbound call processing;
- information services;
- database access via telephone.

There is a substantial heterogeneity between hardware technologies in different countries regarding both digital and analogue applications. Many of the digital products available today are developed for use on North American T1 circuits. Unfortunately, European and North American digital networks are technically very different. The variation in digitisation and incompatibility between digital line interfaces is due, among others, to differences in data rates, coding of speech and signalling. At present, the digital line interface specifications in some European countries are 'hybrids', other countries having their own fully digital protocols with a variety of interfaces and proprietary PBX switches. The analogue communication products have an even greater heterogeneity because of the multitude of individual country protocols.

There is a need to undergo long, complex and laborious approval procedures, regarding safety, harness and electromagnetic/radio frequency inferences in most countries. The products are tested in specific laboratories on a country-by-country basis, something

2. One of them for instance is the AccuTalk which provides high fidelity audio compression and reproduction with automatic gain control, record cue, voice-activated record and dual-channel record. Another algorithm (the Rhetorex AccuDigit) provides reliable DTMF detection with talk-off rejection. Another one (AccuCall) provides precise programmable call progress monitoring with quick disconnection and PBX integration capabilities. A fourth one (Rhetorex' AccuRate) provides a linear speed control option for voice, control of speed-up or slow-down of recorded messages. A fifth one (Rhetorex' AccuPulse) provides on-board rotary pulse detection.

difficult for smaller companies because of long waiting lists and the need to test-retest in case of product no-compliance to the standards.

**Software and software platforms:**

Voice processing has been characterised by:

- Multiple operational systems despite similarity of performed functions by the applications. It is only very recently that there is a shift towards common interoperability (via the TAPI and API standards) for telephony and call control.
- An increasing use of common software development tools and incorporation of multi-vendor integration (MVIP) programs for greater compatibility and interconnectivity between uses[3].

Rhetorex supplies common software development tools to its clients with the first order. They include an MS-DOS driver, utilities, demo system and programming manual for use with multiple versions of the most commonly used C programming language (development tools, software algorithms, utilities, libraries and operating system drivers).

**Market:**

The company develops voice processing hardware and the software directly associated with the operation of the boards. It focuses its sales upon voice system developers. Buyers of RxE' products are falling into the following 5 groups:

- large companies with in-house engineers;
- system resellers who can provide software development (VARs);
- switch manufacturers with own software engineers;
- system integrators; and
- independent developers, or distributors and engineers with no software development support.

These segments require different type and extent of customer support. Big multinationals with own in-house personnel need lower support than smaller independent distributors or engineers. Furthermore, each client uses different software platforms and develops or sells different applications.

In terms of countries, RxE has 4 key country-markets: UK (40 per cent of European sales), Germany (20 per cent), Italy (5 per cent), Spain (5 per cent) and 15 secondary country-markets (30 per cent). The company has some 200 customers spread across Europe. Only a

3 The use of MVIP products allows indeed higher capacity and a common interface for different manufacturers products permitting integrated switching and resource sharing, bridge for audio and video conferencing, interface for digital and analogue telephone lines, multi-channel fax and speech recognition between users.

few among them are repeat-purchase-major-clients (a mere 10 per cent of total clients), but they account for 60 per cent of company turnover.

## Availability of adequate quality engineering and marketing resources

**Engineering:**

There are substantial synergies between this product and other company products regarding hardware and software, but the tightness of approval requirements has not permitted the company to capitalise on these synergies. These synergies are:

- *Core hardware architecture:* Synergies in hardware design architecture are rooted back to the time of incorporation of the company. Rhetorex had an excellent hardware engineer who developed the original core hardware architecture. This core architecture has evolved without substantial changes and became a standard in the sector;
- *RxE expertise in hardware customisation:* One RxE engineer is expert in circuitry design. He spends an estimated 3 months/year in the US-based Rhetorex' HQ and he communicates daily with the USA-based 3-people strong hardware development team. The UK-based laboratories have excellent testing facilities; obtained all European technical specifications; and developed emulators for different country specifications;
- *Software standardisation and compatibility with older applications*: Most of the software is common for all products independently of target country or segment. Advanced digital signal processing software algorithms are also robust and well proven. These have resulted in stability of software and compatibility between older and new applications, a substantial competitive advantage for the company. It is noticeable that applications written by third developers 4 years ago, are still running on today's boards, in an industry where a 6 months is long time. Unfortunately though, the company still has a limited number of engineers able to write advanced digital signal processing software algorithms and buying-in is expensive;
- *Synergies in manufacturing:* Reasons include:

    - Circuitry does not require expensive state-of-the-art manufacturing lines (i.e., narrow width circuitry printing facilities).
    - There is a multitude of circuitry printers who work on a sub-contracting basis and can supply an unlimited number of boards in days.
    - Printing of such boards is cheap (i.e., the actual cost of the board is in the range of $20).

These have not played an important role though, because of:

- The need to adapt the product to different country requirements;
- All the necessary preparation to acquire government approvals in the different European markets; and

- The need to provide strong technical support to many smaller clients.

**Marketing:**

Information about new products rapidly transcends national boundaries and attendance to computer shows like CeBIT (every March in Germany) draws visitors from all countries. The company tries to be in close contact with its smaller and repeat-purchase-major clients. Smaller independent developers and engineers are a major force in the field because of their innovativeness. RxE supplies up-to-date technical information and elaborate engineering support when necessary. These are hindered however, by:

- The RxE's lack of language ability despite the extensive use of English in the sector;
- The actual number of RxE's available engineers;
- The actual number of technical support personnel; and
- Financial and resource constraints of RxE at the time (early 90's) of intended launch of the RDSP/9400-I Series in Europe). RxE was an one-man company;
- The view adopted by the corporate executives regarding the scope of the US market. Given the sheer size, technological homogeneity and explosion of the US market in terms of growth for voice processing and computer telephony integration products, much of Rhetorex' attention was directed to their domestic US market, leaving RxE on its own to solve problems regarding the European market.

These had an adverse impact upon the rollout of the specific new product.

## Synergies in product handling by the sales force and in use by customer

The product complexity as perceived by the final customer, and the amount of training the various developers need to handle the product, is quite extensive. These happen because the product area is very rapidly evolving in technological terms and several of the developers active in the sector are engineers working from home at their spare time. They need substantial technical support.

## Co-ordination of relationships with subsidiaries/agents

RxE sells direct to all its five different client groups. RxE has handled sales from the UK, even though the company is moving now into the appointment of engineers as agents in major markets (Italy, Germany). It has also been imperative for RxE to keep close contact with most its clients. Reasons include:

- The computer telephony is a new technological area and there are few engineers across Europe familiar with the technology;
- The smaller clients need continuous support. In addition to sending programming code and a library of utilities with every sale, RxE uses its own personnel to support client applications

and deal with testing procedures for local country approvals of its own products. The company invites all its 200 clients to product shows in its different country markets[4] and provides them with technical information and transfer of know-how.

At the same time, RxE tries to keep a close contact with its US parent company. As mentioned earlier, RxE's expert in circuit design spends an estimated 3 months/year in the US. The company also sends its new recruits to USA for training and familiarisation with the US engineers. The Managing Director also visits the US HQ 3-4 times a year.

## New product development process

Shortly after the incorporation of the company, Rhetorex initiated the development of the RDSP/9400-I Series with intention of product availability in USA 6 months later, and in the UK and Europe in 1991 (a total of 2 years). Severe delays in new product development happened. The time taken to complete the final prototype was 2 $^1/_2$ years for the original US product and 5 years (end of 1993) for completion of versions for the European market (Holland, Belgium, Norway, Poland, Denmark and Sweden). Reasons include the following:

- The product was primarily developed in the US for the US market. At the time of the development of the RDSP/9400-I Series, the European market was playing a minor role, so the product primarily targeted the US market. Final customers in Europe have not been involved and they have not provided feedback to the project engineers. Neither the technical, nor the marketing US-based engineers had access to information regarding approval procedures;
- Technical problems and continuous re-design. The forthcoming new EU requirements for electromagnetic compatibility were much tighter than foreseen. The company increased the processor speed; engineers had no enough experience of circuit design; and Rhetorex was attempting to design the full product on a single board using few layers of copper. No less than 12 reworkings of the board were then carried out and the design eventually failed regarding the number of required layers of copper.

The company also failed to meet its 6-month rollout plan regarding its key and 14-month regarding its secondary European target country markets. The company has not still (end 1995) acquired government approvals in all its intended target country markets.

These development and rollout delays are so important that the RDSP/9400-I Series is to be replaced soon by a second generation product (the Vantage VPS Series), whose development is now complete. The VPS Series also faced delays. The VPS Series was announced in March 1993 for immediate availability, yet the company achieved to have the final prototype pass the tests only in January 1996.

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4 For information purposes, Rhetorex carried out 9 different shows in the last 6 months in France, Germany, UK (1 day), Switzerland (12 days), the Check Republic (1 weekend) and Italy (1 weekend).

# Laminex International

Laminex International (LxI) is a British company which specialises in the manufacture and supply of laminated ID cards. Its products fall into two distinct categories:

- plastic/paper lamination products, consisting of roll-fed and desktop laminators, film and laminated ID cards (see brochures, pp. 250-1).
- two PC-based ID-card data base, handling and lamination systems. The first product is a DOS software driven card reader/personnel database system (PMS). The second one is a Windows software driven system which acquires video images/photographs and prints laminated ID cards/badges on a laser printer.

The two PC-based systems are new products for the company and constitute a major shift from the company's core activity. The product under investigation here is LxI's video imaging photo-ID handling Windows software driven system (henceforth VI-ID System) (see brochures, pp. 252-4). The company has faced increased competition in its traditional laminated products' domestic market with many Far East and European companies entering the British market. The company has decided to expand its European operations with the VI-ID system, but has failed in the rollout of the new product. The company has sold some 30-40 VI-ID systems in the two years since initiation of sales in the UK, and none in its European markets. This figure is unsatisfactory compared to US sales (200 systems).

## The product

The VI-ID System is a versatile system which basically captures (through camera or scanner) the card-holder's portrait as a video image, processes it through a database management facility and prints on laserjet, inkjet. PVC card printer or laser printer a laminated badge or ID card. This budge/card can be magnetically encoded. There are only a few competitors in the laminated ID card business. Big multinational competitors like Kodak or 3M are focusing on the wider image capturing/processing or security access business.

## Customisation of the European market

**Technology customisation, complexity of such customisation and approvals:**

The domestic UK market is the major focus of the company's activities. Exports account for a small percentage of company business. They target Holland (70 per cent of exports), France (20 per cent of exports) and Germany (5 per cent of exports). The remaining 5 per cent is spread across Spain, Austria and Switzerland.

The new product basically targets corporate clients (blue chip organisations, government establishments, exhibitions centres, hospitals) needing the rapid production of a


6 Translucent Plastic Badge Holder

6a Beadchain Necklace (Metal)

7 Plastic Loop for Luggage

7a Leather Strap for Luggage

8 Spring Jaw Clip

8a Spring Jaw Clip with adhesive pad

8b Brooch Pin with adhesive pad

9 Vinyl Badge Holders/Stiff Backed

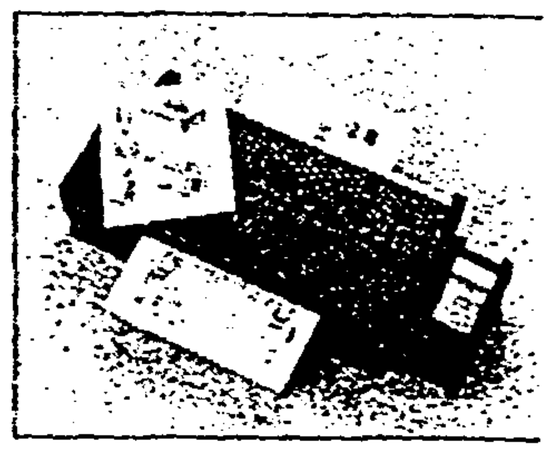
*Lamination turns ordinary paperwork into something special.*
*By heat-sealing documents, print or photographs inside a double coating of tough, clear plastic, lamination adds visual appeal and increased durability.*

# Laminex

## Desk Top Laminators

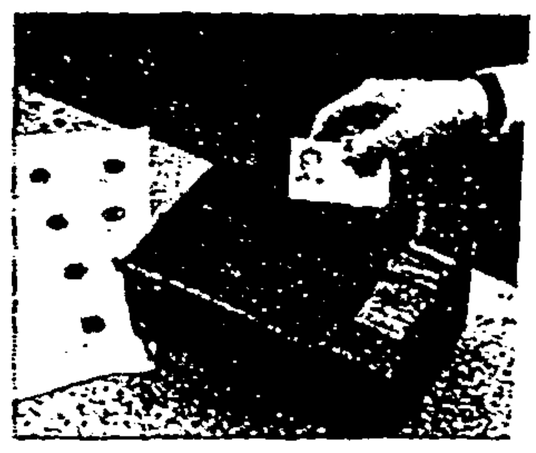
### Features:

- Extremely quiet operation
- Easily adjustable temperature (no tools needed)
- Thermal protection cut-out
- Heat only option - in standby mode
- Detachable mains lead with IEC connector
- Complete with moulded plug (UK models only)
- Stylish black injection moulded case with blue anodised cooling plates
- Thermostatically controlled



**LX12**
Gross weight – 6 kg
Net weight – 4 kg
Dimensions – 222mm x 466mm x 100mm
Electrical – 230V AC 50/60 Hz, 780 watts 3.4 A

**LX4**
Gross weight – 3 kg
Net weight – 2 kg
Dimensions – 222mm x 237mm x 100mm
Electrical – 230V AC 50/60 Hz, 275 watts 1.2 A
110V AC available



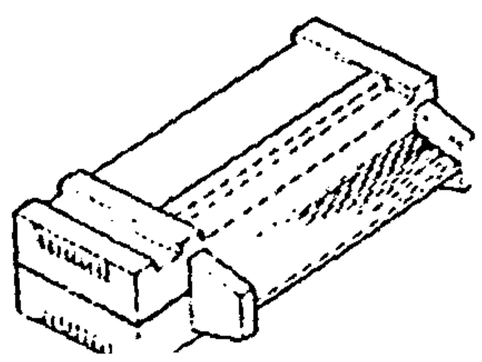
The laminating process requires the use of a carrier (supplied)

### Thousands of uses include:

- Long-lasting notices which can be used inside or out - even in the wet
- Menus which still look appetising after constant handling
- Point-of-sale material with the power to attract
- Maps, charts and posters with write-on/wipe-off practicality
- Educational material, teaching notes, instruction sheets . . . we could go on . . . and on!

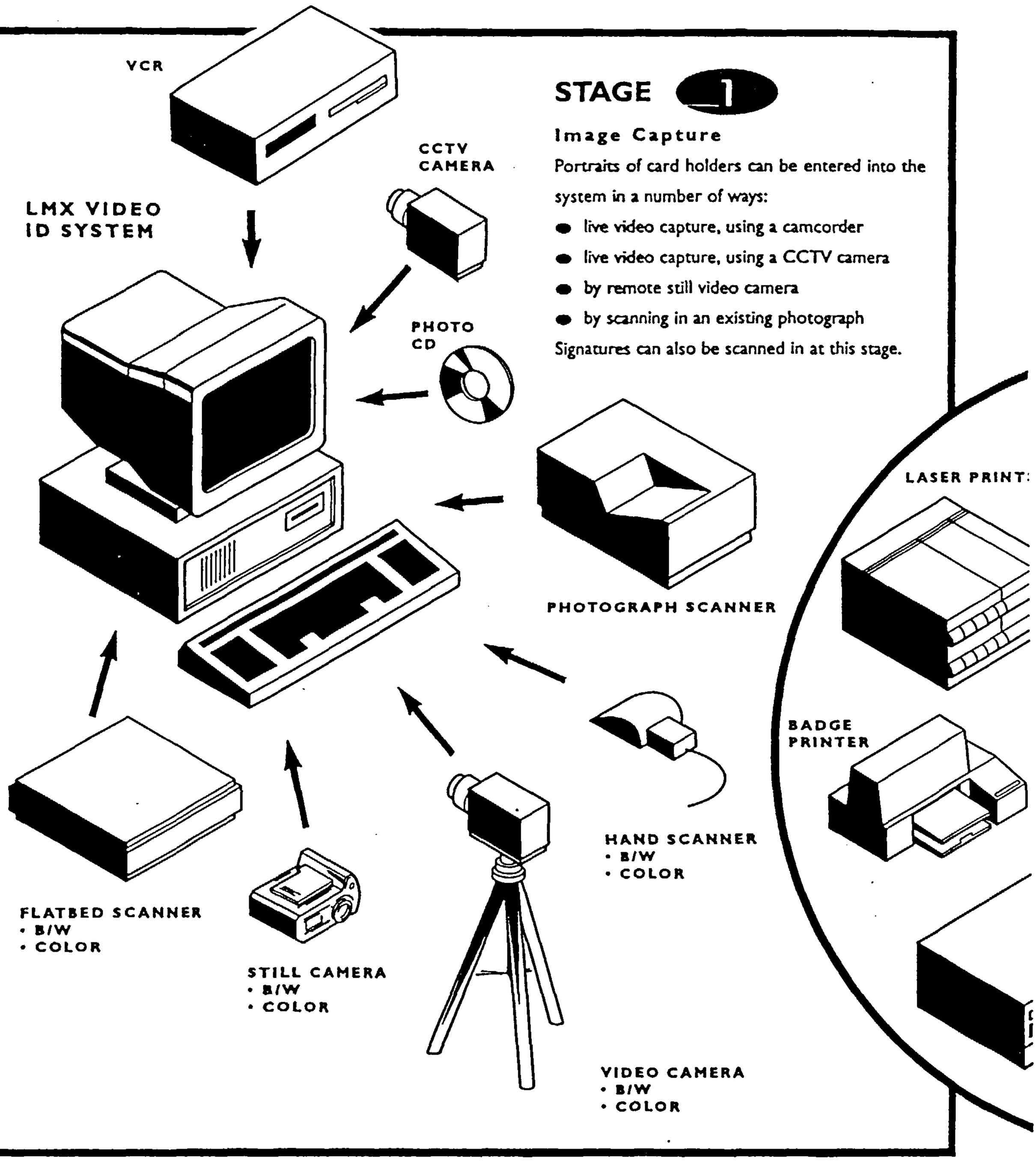
### Whatever your application, Laminex has the ideal desktop laminator.

Choose the **LX4** pouch laminator for rapid and economical production of tags, tickets, membership or ID cards.
Or the **LX12** pouch laminator for low-cost lamination of posters, notices, menus and anything up to full A3 size.
Both machines share the same robust construction and safe, reliable mechanism inside attractive and durable cases. Designed to complement modern office equipment, and to work quickly, cleanly and unobtrusively whenever needed.



# INTRODUCTION

Laminex International has introduced a video-imaging system designed to provide a comprehensive solution to a wide range of photo-ID applications. The process of capturing an image, through to card printing is complete in just four simple stages . . .



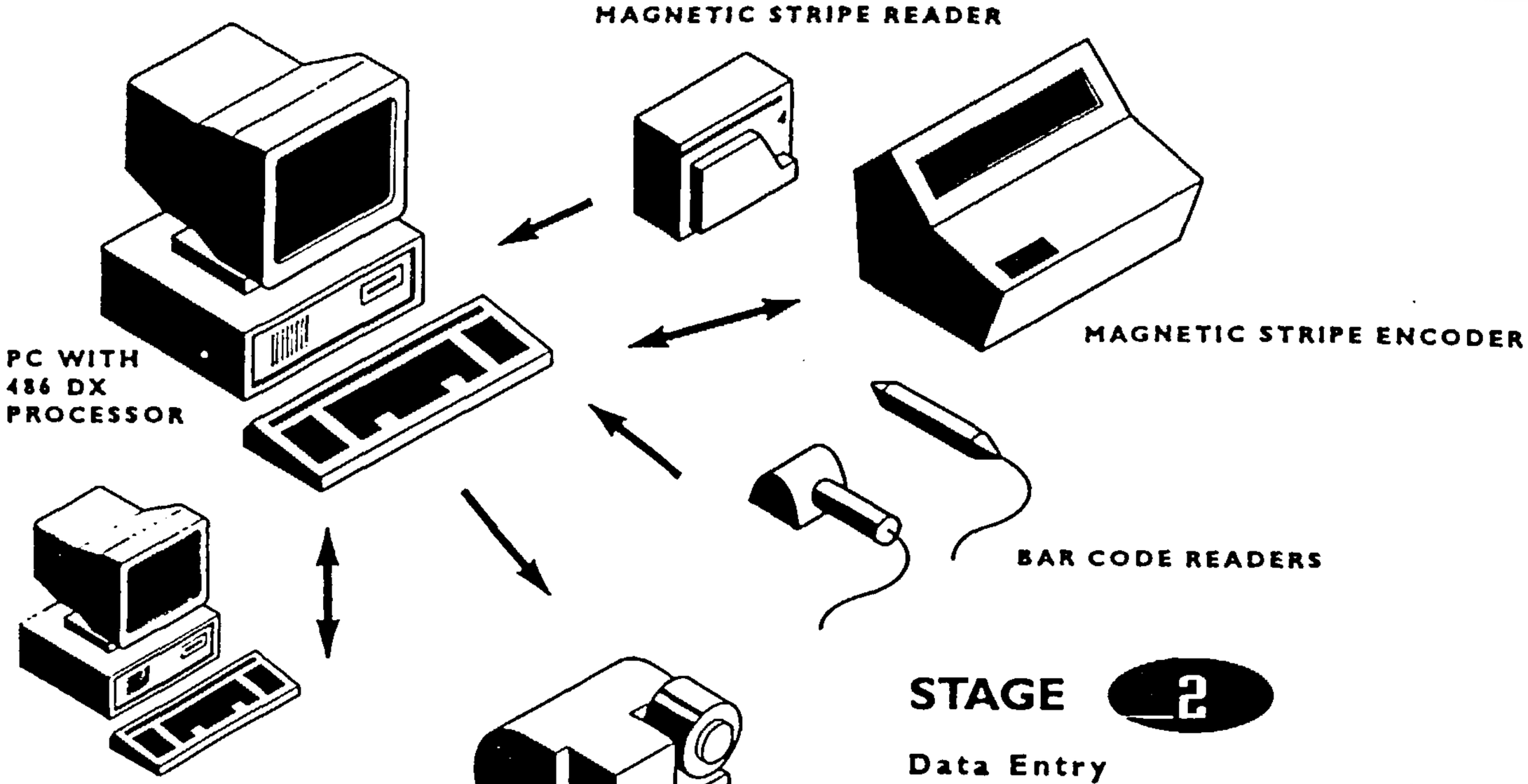

## STAGE 1

### Image Capture

Portraits of card holders can be entered into the system in a number of ways:

- live video capture, using a camcorder
- live video capture, using a CCTV camera
- by remote still video camera
- by scanning in an existing photograph

Signatures can also be scanned in at this stage.




## STAGE 2

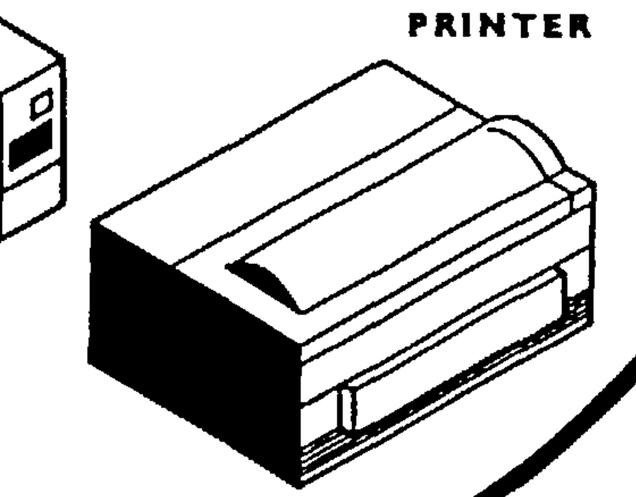
### Data Entry

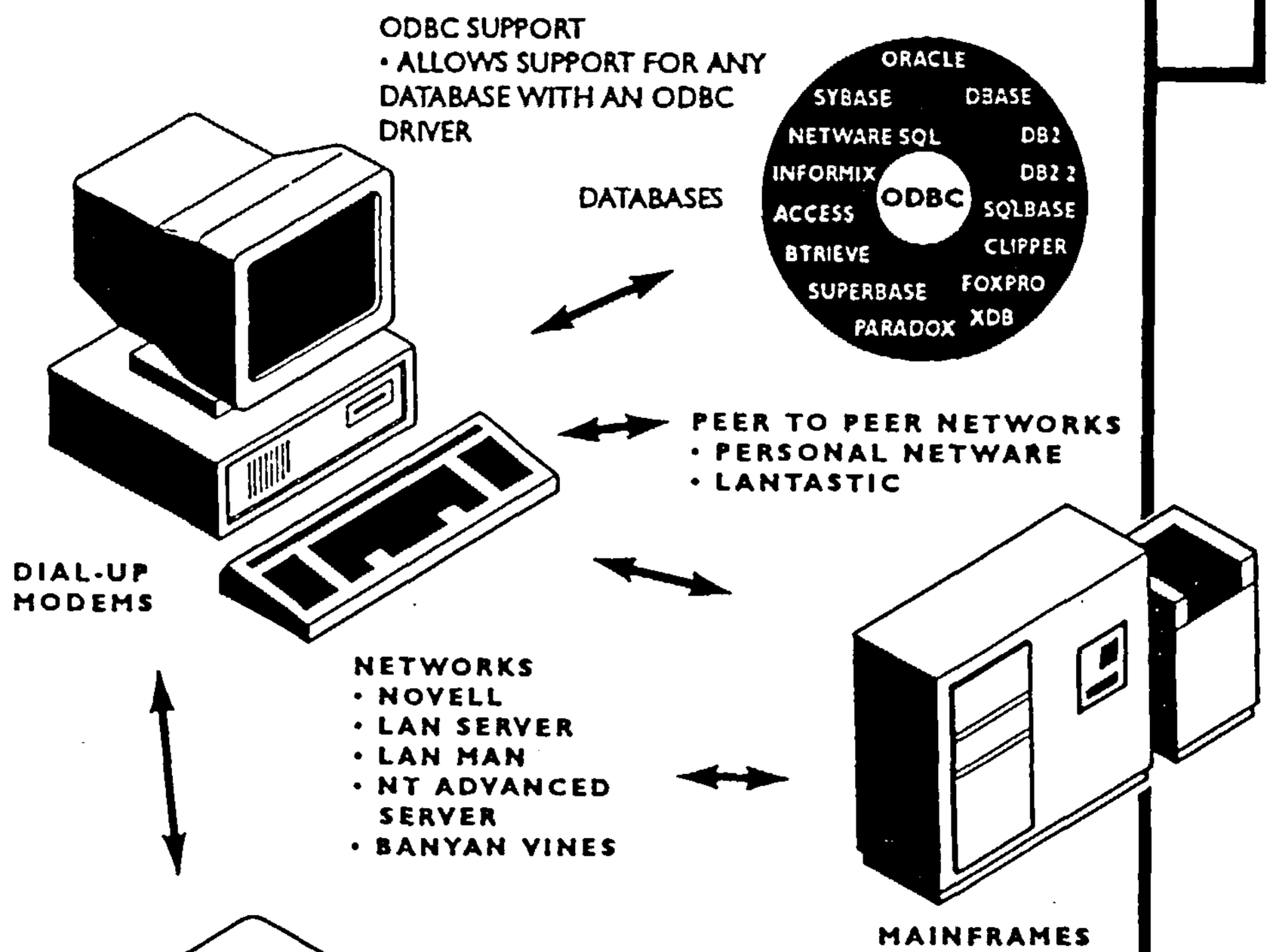
Data — name, title, department, etc. are then entered at the keyboard. Database extendable to cover personnel/HR and security applications. Password protection to limit access.

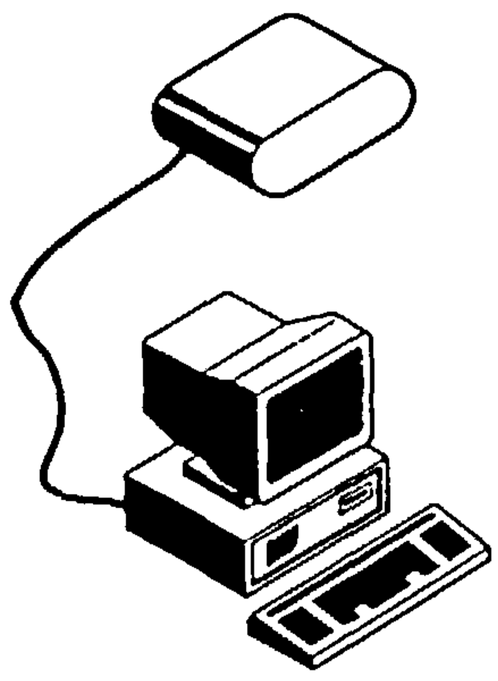
## 3

ed card is produced on a printer of
– range includes:
- for reports, individual and multiple
and one-off labels, e.g. for
e delegates

printer (colour/black and white)
ting via dye diffusion thermal
D2T2) for use with polyester type




## STAGE 4

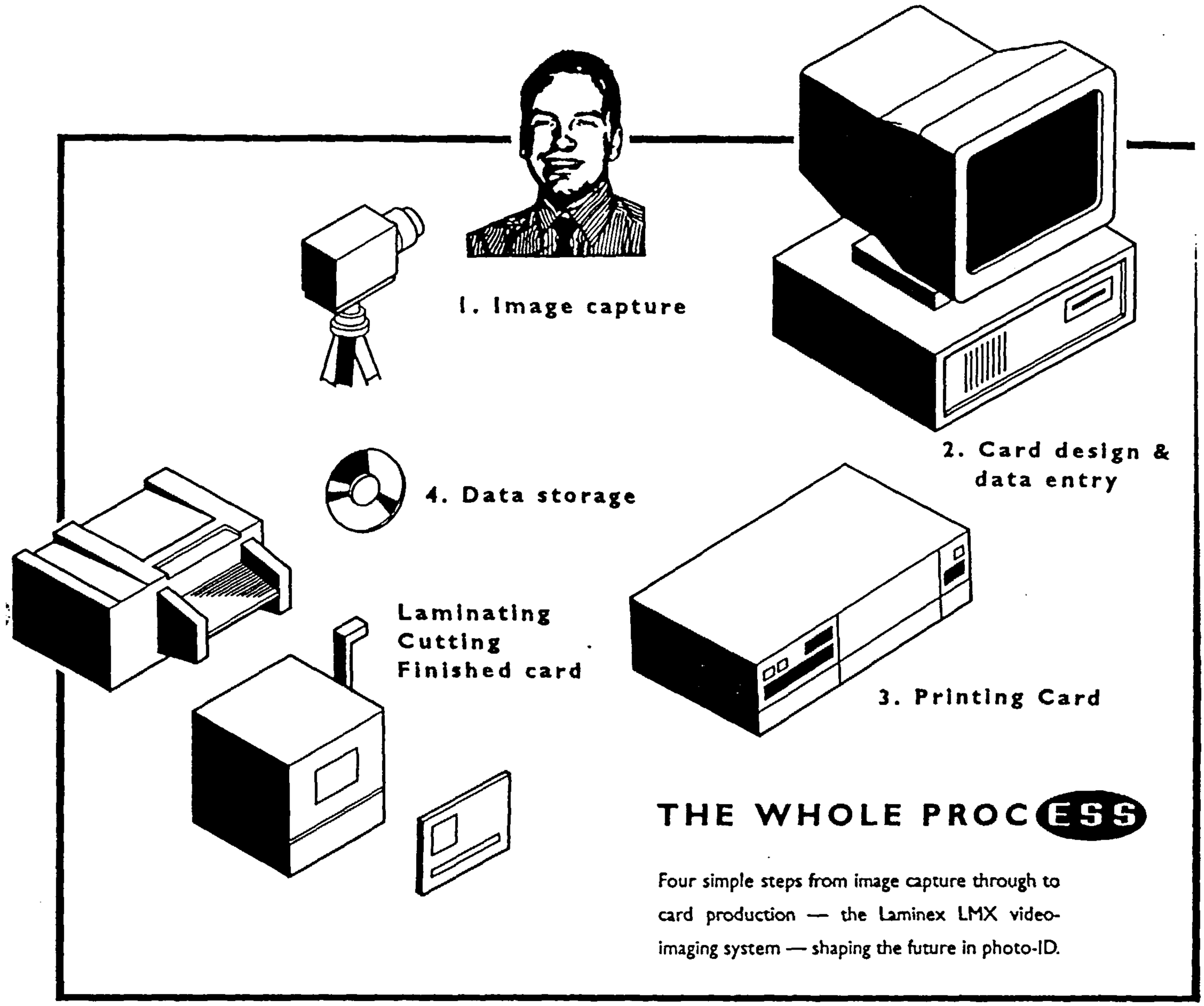
### Data Storage

Multiple card and badge designs can be held on the system at any one time.

The volume of records stored is limited only by the size of the hard drive.

Data sharing across different departments — e.g. security and personnel.

An extensive range of Windows and DOS-based networks can be catered for.




## THE WHOLE PROCESS

Four simple steps from image capture through to card production — the Laminex LMX video-imaging system — shaping the future in photo-ID.

## SPECIFICATION

**Laminex LMX System comprises:**

**Hardware:**

IBM - compatible PC with 486DX processor running at 33 MHz, 8MB RAM, 128K cache, minimum 170MB hard drive, 1.44MB 3.5" disk drive, modem (9600 baud) and 250MB tape streamer. SVGA non-interlaced single-colour monitor operation, video board, extended keyboard, mouse and software protection key. LMX software pre-configured with customer's choice of ID-card design. Superbase 4 database software, DOS version 6, Windows 3.1.1.

**Software:**

Consists of two customer-choice ID-card layouts and all software options, including single dossier, multiple dossier, data import/export utility, image file export, audit trail report, badge history and database import.

**Image capture:**

The LMX system is compatible with a broad range of image capture devices, such as CCTV and still video cameras, and image scanners, etc.... versatility to match individual customer requirements.

**Print devices:**

The flexibility of the LMX system also extends to print devices, in a selection which includes deskjet, laserjet and PVC card printers. Fast, single-colour images (suitable for visitor registration and conference delegates), and high quality colour images (for durable ID cards) are just two of the options available with the LMX print device range.

LAMINEX
International Ltd
Brownfield Industrial Estate, Mold, Clwyd CH7 1JR, United Kingdom
Telephone: National (01352) 758444 International +44 1352 75844
Telefax: National (01352) 752065 International +44 1352 75206

personalised security access ID card. A base system can handle, for instance, at least 3,500 individual records. The basic configuration of Lxl's VI-ID system costs £8,000. More advanced configurations, including video capturing, scanner and alternative printing options or LAN connection, can reach £30,000. The technology of the new product does not require customisation across countries, but customers require a tailored product offering. Reasons include:

- The market is highly segmented. There is a variation of target customers and specifications because of user differences regarding security and restrictions of access. The type of budge/ID-cards design, installation and operator's training vary too;
- The potential use of multiple image capturing means, including digital still camera, flatbed or hand scanner, video camera, Polaroid instant camera, photo-CD, CCTV camera or VCR;
- The multitude of data entry means, including typing, bar code reader, magnetic tripe reader, while other options comprise magnetic stripe encoding, remote viewing stations via LAN; and
- A multitude of report-generating software modules, including audit trail reports and multiple user data bases.

## Availability of adequate quality engineering and marketing resources

The company has first launched the product in the UK with the intention to subsequently launch it across Europe. It has faced though, severe delays in the rollout of the new product. Reasons include the following:

**Engineering:**

- Configuration of the system to the requirements of each individual customer is complex despite the easiness of purchasing the individual hardware components (i.e., a 486- PC, laser printers and image capturing equipment).
- There is lack of software skills in Lxl. It is US-Laminex Inc, that has developed the software of the system and Lxl has not actively participated in the design and development of the new product. The VI-ID system is bought from Laminex Inc by Lxl on a royalty base. Even though Lxl closely co-operates with a small independent UK software company (Euclid), such access provides minimal synergies. Euclid has not sufficient knowledge of the Windows operating platform. It specialises in DOS-based software products which is substantially different from Windows-based software products.
- Lxl has not easy access to, and lacks communication with, the US-based NPD team. Laminex US and Lxl are two completely independent companies.
- Product deficiencies (software instability) have not been solved by the US-based NPD team. This has resulted in many customer complaints in the UK.

In view of these, Lxl has decided to hold back the sales of the VI-ID system in Europe.

**Marketing:**

Severe lack of appropriate marketing resources and skills is evident in Lxl:

- The company's UK sales force are not in a position to handle sales of both paper/plastic budges/ID cards and the VI-ID system. The lamination industry has undergone a major technology shift. Security ID activity has moved from a plastic/paper base to electronics in only few years. Lxl's sales force, used to sell plastic/paper laminated ID cards, have found difficult to comprehend the software and hardware details necessary to handle sales to communication and security officers of sophisticated corporate customers. The company has decided to hire marketing personnel from the computer/computer, but is further delaying this until Euclid develops the new mid-range Windows based VI-ID system.
- The same difficulties in handling of the product were experienced by Lxl's traditional distribution channels across Europe. The company's distributors and agents, used to handle paper products, are not in a position to handle the VI-ID products' sale.
- Lxl has been lacking marketing information regarding potential distribution channels for the product in Europe.

## Co-ordination with subsidiaries/agents

The company's European country markets are served through agents:

- Holland is served by an ID card specialist agent who also sells laminating machines.
- France is served by one exclusive agent covering the business equipment, printing and binding markets, and a second one concerning the consumer market.
- Germany is served by two agents/distributors active in binding and document presentation materials and a third one active in laminating film.
- Sales to the rest of the countries take place through other independent distributors in a infrequent manner.

There is basically no co-ordination of the company's European agents. The company used to employ two salesmen for export sales across Europe. Both of them have left however, at the period of introduction of the VI-ID system to the UK market. Since their departure, only export order processing is taking place ( by one single employee). Also, none in the company possesses information regarding either the company's existing export sales or prospect segments for the new product. These are attributed to the currently low contribution of exports to the company's total turnover.

## New product development process

The actual product development started in 1991 with a 12-month completion period target. It eventually took 24 months to complete the new product, the product being eventually available in 1993. The problems faced during 1993-1995 have eventually resulted in the company's decision to indefinitely withhold the sales of the VI-ID system to Europe. Reasons include the following:

- Laminex Inc., didn't know from the beginning of the process the final features required by the UK or European markets. This product was LxI's first product in the electronic higher-end laminated budge/ID cards markets and the LxI had limited prior knowledge of the sector.
- Integration between LxI and the NPD team in the USA was not particularly strong and communication was difficult for the following reasons:
    - Non proficient execution of market screening activities for the UK and European markets. The focus of the US team was the US market. Also, there was limited availability of marketing information about European markets.
    - Communication obstacles between Laminex Inc. and LxI during the development of the product, despite travelling of the Technical Director (once/month) to US. The Managing Director complained for myopia of the US team and their limited understanding of the differences between the US/UK markets. He has further complained about the time differences. The UK operation used to transmit its demands at 3:00-4:00 pm British time corresponding to 09:00 am Eastern US time. By the time US required more information or feedback, it was late night in the UK. This was seen as an American intrusion to British privacy and relaxation.
- Problems of product instability and difficulty of communication with the US-based NPD team to satisfy customisation requirements of UK customers.

LxI recently decided to invest in the acquisition of a 10-people strong UK-based software development company (Euclid). LxI is expecting Euclid to develop a mid-range Windows VI-ID software product to be sold through established software retail distribution channels. This software product will be sold for use with common laser printer printable multiple budge A4-size pages.

# Instron Holdings Ltd.

INSTRON Holdings Ltd. is subsidiary of a US company, established some 50 years ago. The total corporate turnover reached $ 122,827,000 and profitability reached $ 2,485,000 in 1993. Instron is manufacturing testing equipment. Manufacturing is performed in Massachusetts, US and High Wycombe, UK. Operations in North and South America, Japan and Asia are controlled from the US based corporate HQ. Sales to Europe, Middle East and Arab countries are managed from the UK HQ. The company has replaced all its products in the last 3 years. Instron is currently manufacturing the following dynamometer testing equipment:

- Series 4400 & 5500 (low-end products). A reduction in the number of product versions took place in this recent NPD programme regarding the number of products. Instron used to have 3 products within the Series 4300 and two products within the Series 4500 (the older replaced products);
- Series 8500; and customised testing systems (called 'structures') (see brochures pp. 260-1).

The investigated product here is the Series 4400 and 5500 (see brochures p. 262).

## Product and its characteristics

The differences between the product lines lie in the physical dynamic capacity (e.g., load to be exercised) and sophistication of controls. For instance, the model 8580 is a digital system used to control multiple servohydraulic actuators for simulation testing (multi-axial structural testing) or to simultaneously control a number of independent single-channel testing systems. The Series 4400/5500 is equipment designed for simpler applications. In terms of difference in prices, '*structures*' may cost £ 0.5m compared to a mere £ 30,000 for a Series 4400 machine.

There are several available models for each product. The Series 4400/5500 consist of 20 models. The Series 8500 consist of 6 models. They regard different physical dimensions of load frames, dynamic capacities (e.g., kgs of applicable load) and number of column frames (2-4). There is a wide range of accessories for the different products (cameras, etc.). The Series 4400/5500 type of products compared to its predecessor incorporated:

- a major change in electronics (introduction of product-control through Windows-based software); and
- a minor change in testing frames. Multiple frames were replaced by a single one of higher specifications.

The rollout of the Series 4400 & 5500 has failed and the company has experienced since a drop of between 40% and 50% in sales (see Tables 1 and 2).

**Table 1 Instron products, turnover and number of units sold (1993)**

| Products | Turnover % | Instron UK sales |
|---|---|---|
| Series 4400 & 5500 | 60 | 500 units |
| Series 8500 | 20 | 200 units |
| Structures | 20 | 40 units |

**Table 2 Number of units sold of Series 4400 versus 4300 and 5500 versus 4500 (units)**

| Product | 1993 Jan-June | 1993 July-Dec | 1994 (Jan-May) |
|---|---|---|---|
| Series 4300 | 220 | | |
| Series 4400 | | 120 | 60 |
| Series 4500 | 100 | | |
| Series 5500 | | 60 | 20 |

## Standardisation of the European market

**Technological customisation of markets, complexity of such customisation and approvals:**

The products are standardised across both US and UK but customised across the main European countries. This customisation was easier to accomplish when the products were manually controlled. The incorporation of the Windows based software has rendered product customisation more difficult.

The company does not possess precise quantitative information about the size of the individual segments in the countries where it operates, this partly due to the character of the products and applications. Clients (industrial laboratories, educational and training institutions, to support, maintenance and calibration services) greatly vary (see Table 3).

**Table 3 Sales of Instron per industrial sector and type of applications**

| Industry | Sales % | Applications |
|---|---|---|
| Metals | 31.9 | Strength, stress and strain from bolts and rivets through sheet metal and castings |
| Plastics | 20.2 | Hairdryers, compact disks, power tools, automotive |
| Composites | 10.0 | Material selection and product design in aircraft, aerospace, automotive, sporting goods |
| Textiles | 7.6 | Evaluation of wear and tear of fabrics, strength of cord and yarn from clothing to furniture and commercial carpeting. |
| Ceramics | 7.1 | Testing from high temperature structures to electronic substrates (mounting of computer chips) |
| Rubber | 5.5 | Shock and vibration mountings in components such as hoses, belts, tires. |
| Biomedical | 5.2 | Testing endurance life for products like orthopaedic implants, dental restoration, sutures and sterile packaging. |

The company's products target different industrial sectors and can be used in a wide range of different applications (see Table 3). This renders the product hardware less functional and more expensive than competition. There are enormous differences in the requirements between applications. Software is also generic. It is available in a single software programme and takes a

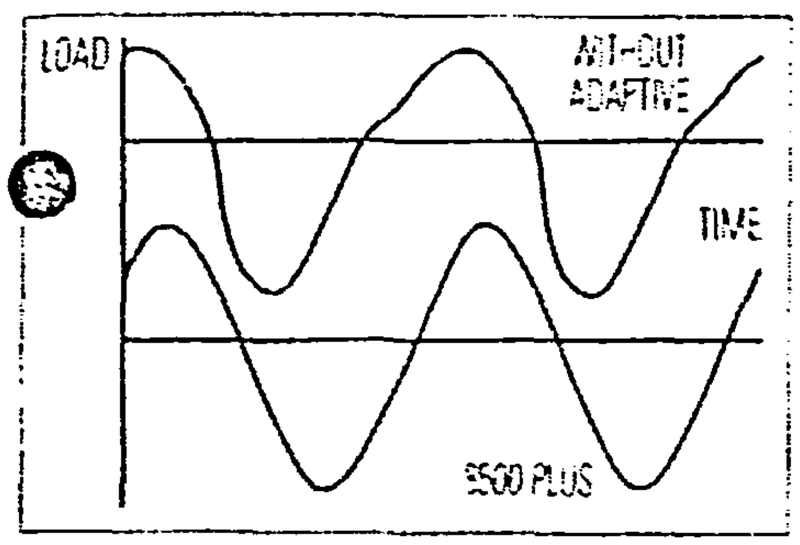
## Adaptability - why Adaptive Control means easier testing.

The dynamic performance of a servohydraulic testing system is directly affected by the stiffness of the test specimen. To get the best performance from the system, it is therefore necessary to tune the response of the system (by adjusting the PID terms) every time a different type of specimen is tested.

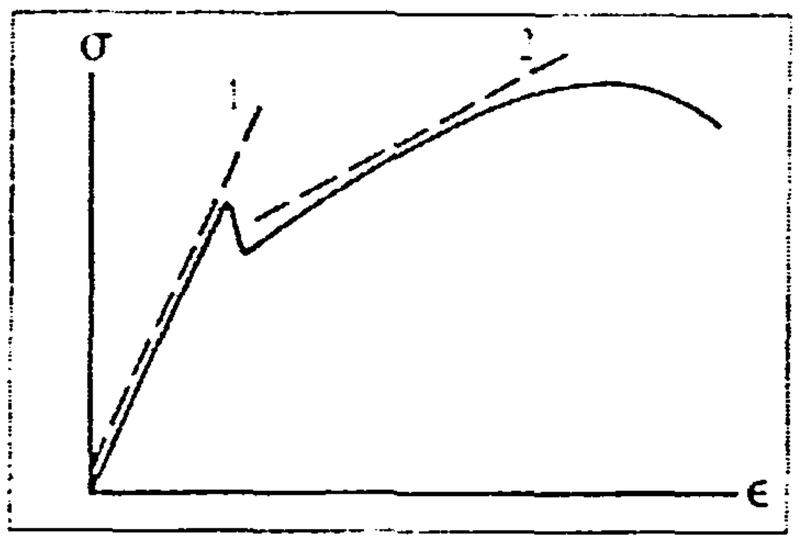
This poses two problems with conventional testing systems: firstly, since tuning is generally carried out manually, it can result in human errors. Secondly, even if the system is tuned correctly at the start of the test the change in stiffness of the specimen during the test will produce inaccurate results.

8500 Plus is the first testing system to tune response automatically, both at the beginning and then throughout a test, by adjusting the PID terms. It does this using a unique new form of Adaptive Control. The result is more consistent test data, less operator training, and no more wasted specimens.

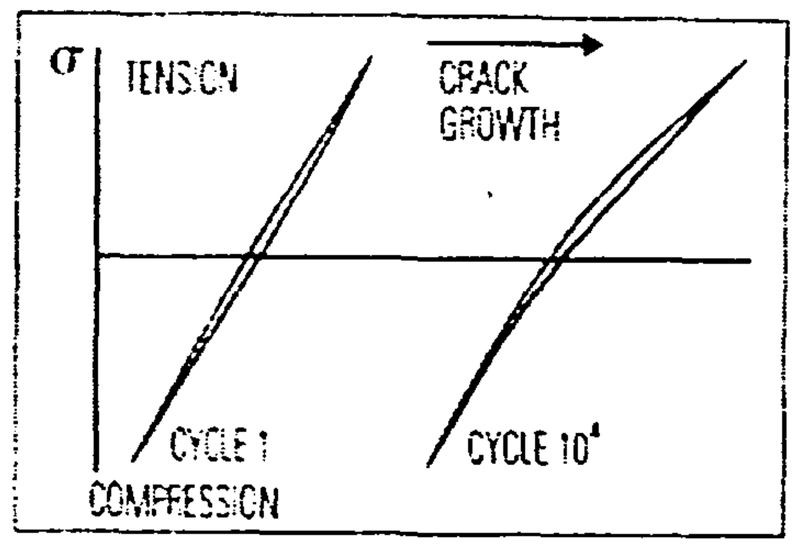
## Simply insert a specimen and go



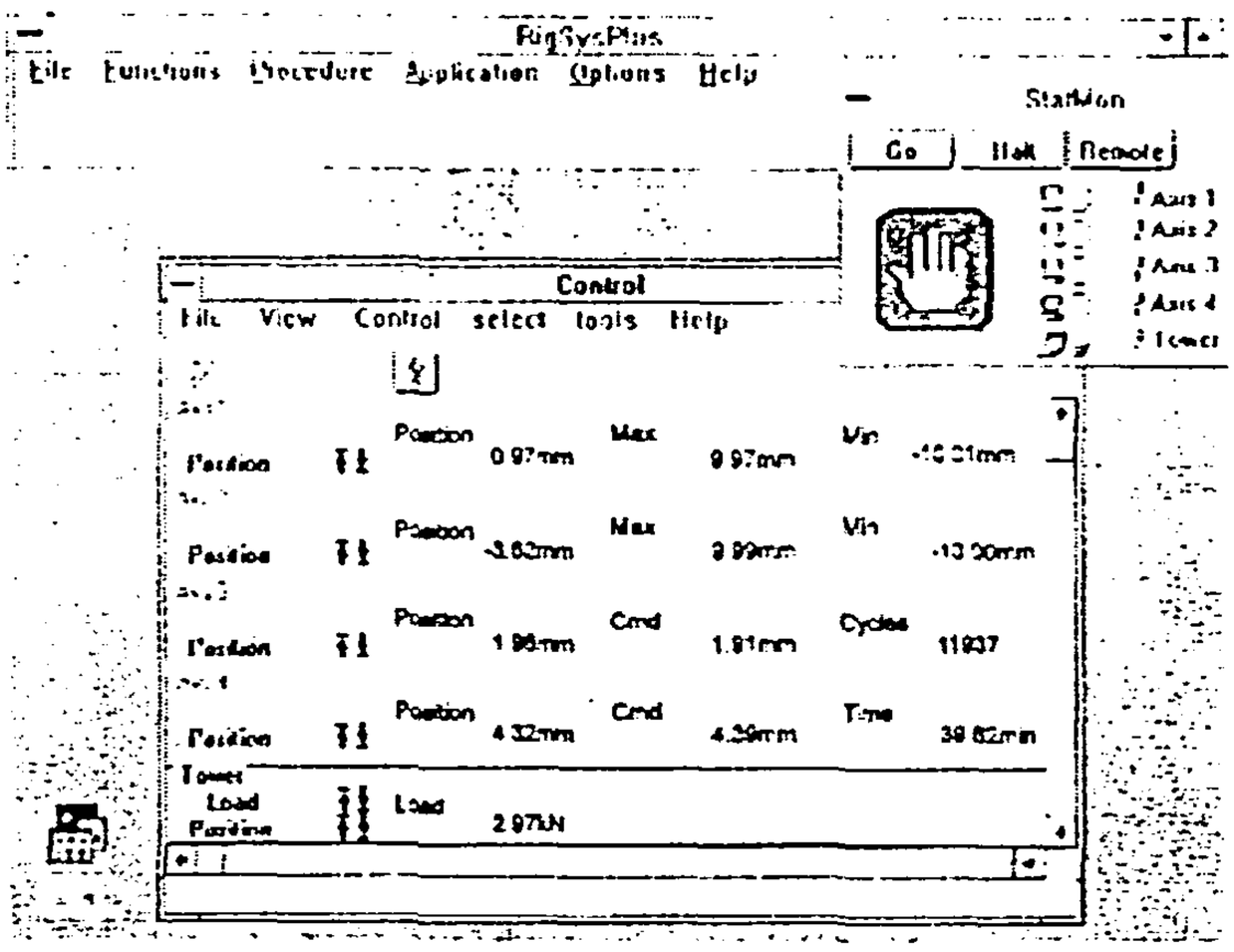

*Component testing has traditionally posed challenges to machine control. Elastomeric components, for example, are inherently non-linear, which means that manual optimisation of response is impossible. Adaptive Control, however, continually tunes response to ensure that the system output matches the demand signal. It can even do this on more than one loading axis, ensuring that multiaxial tests can be carried out with optimum response.*



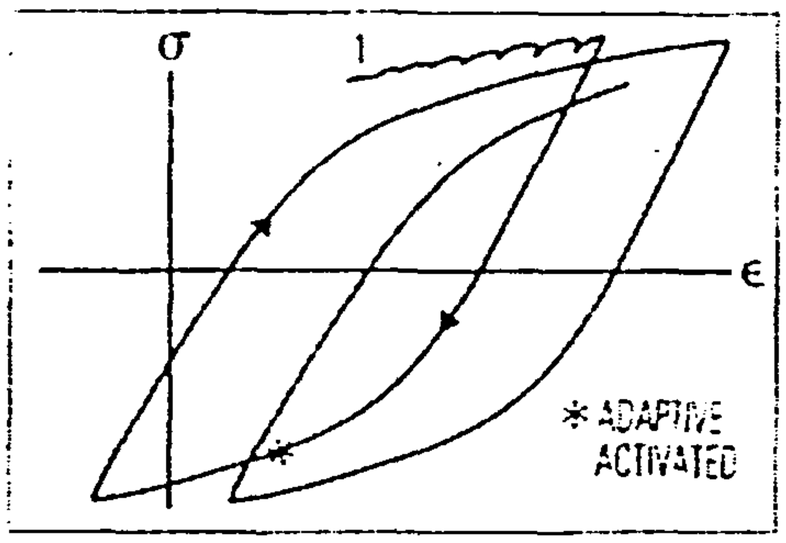

*In tensile testing, strain control offers the most accurate method of obtaining modulus and proof stress results. However, the majority of materials display a significant reduction in stiffness when they yield. If the system is tuned for optimum performance in the elastic region (1), response is compromised after yield (2). Adaptive Control ensures that the system operates at optimum response both before and after yield.*




*High cycle fatigue and crack growth testing is carried out in the elastic region of the material. As the material starts to crack, the specimen maintains its stiffness in compression but, as the crack opens, loses stiffness in tension. In progressive cycles, this results in loss of response in tension. Adaptive Control maintains a consistent, optimum response throughout the entire test.*




*8500 Plus gives you the choice of a fully-featured operator panel (left) or software interface (right).*




*In low cycle fatigue tests, the specimen is repeatedly cycled between the elastic and plastic regions, so in one cycle alone, there are four changes in specimen stiffness. The only way to ensure optimum performance is to re-tune the response of the system continuously. Adaptive Control optimises the system response throughout the entire test, eliminating the instability shown in (1) above.*

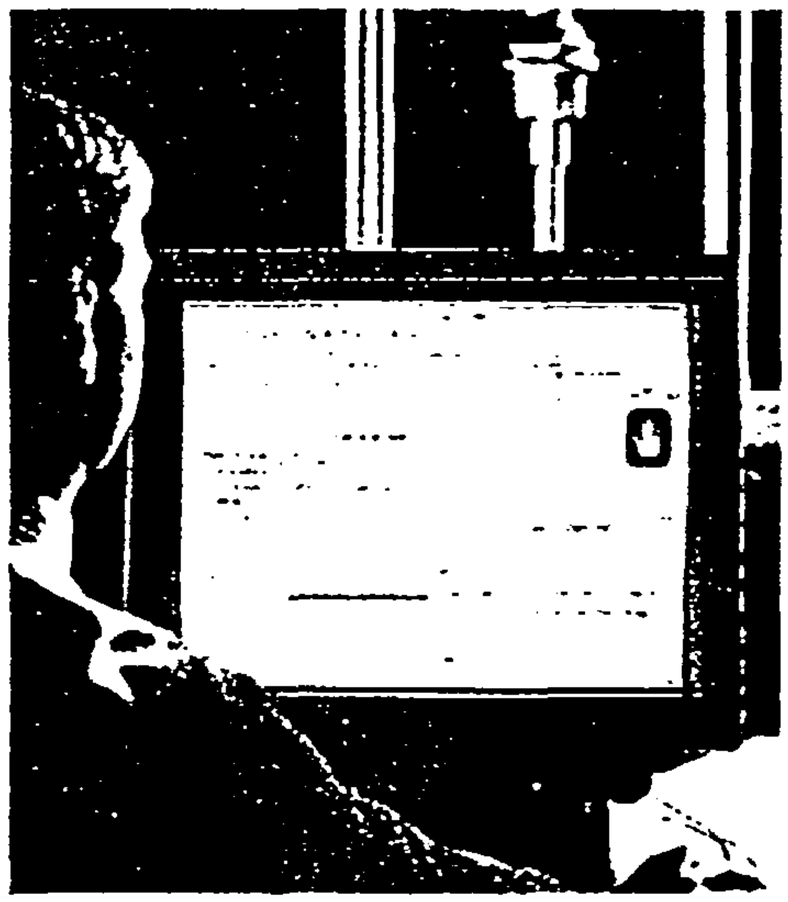
# A design strategy that lets you raise test capabilities to the power level you need

[illegible] testing power. Instron has applied a design strategy to serve materials testing which reflects the changing requirements in laboratories and ensures that the system you purchase can be developed for changing needs, protecting your investment in the system. It achieves this by creating three levels of testing power.

The robust standard GPIB interface inside the 8500 Plus makes it part of the family of GPIB instruments. There are over 1,000,000 GPIB instruments currently in use worldwide. The GPIB interface gives you access to any computer platform and operating system you wish - PCs, Macintoshes, UNIX workstations, and mini computers, DOS, *Windows, OS/2, UNIX, and Windows NT.

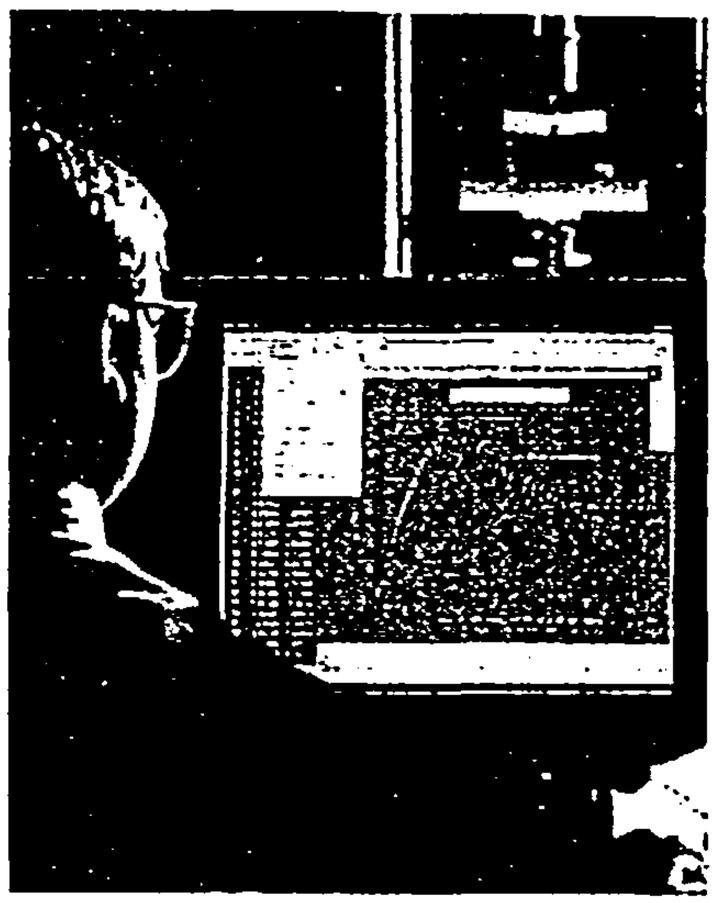
## Power 1

For many tests, such as high cycle fatigue, testing beats the simplicity and convenience of the 8500 Plus operator panel. Its dedicated pushbuttons allow instantaneous implementation. Relevant test functions and status displays are available at a glance throughout the test. You can set the parameters and required limits for up to 8 independent controllers and all test functions, such as [illegible] available at the end of the test.



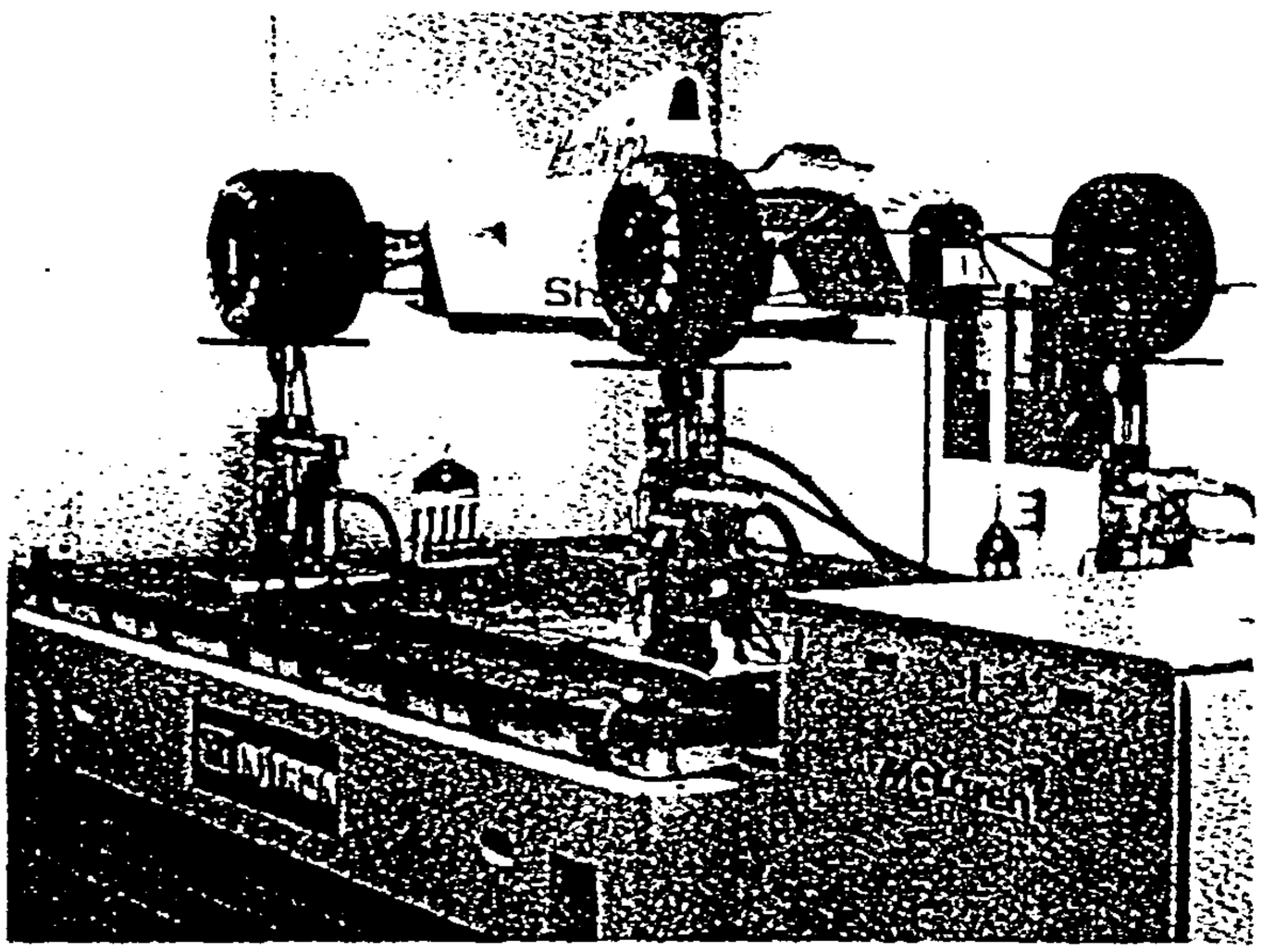
## Power 2

At the second level you can add a computer running Instron's powerful FLAPS Plus and RS Plus dynamic testing packages which run under MS-Windows. They are flexible multipurpose programs for tests ranging from simple constant ramps and amplitudes to complex programming and sophisticated service life simulations. FLAPS Plus and RS Plus are designed for creating fatigue tests such without the need to be a computer expert. [illegible] provide real time control, data acquisition, real time graphics, analysis and report generation and ASCII data output to third party software.



## Power 3

For special applications, 8500 Plus can be used with a range of tailored Instron application programs for dynamic testing, or with Series IX, the world-leading software package for tension, compression, flexure, peel, tear and friction testing of materials. Dynamic packages provide real-time screen plots and reports allowing monitoring of the test, while post graphical and tabular reports clearly show the results. Examples of Power 3 applications include advanced fatigue tests to [illegible] K[illegible], ISO shock absorber and damper packages, Series IX [illegible] electromechanical and servohydraulic systems, and the same user interface and [illegible] set up [illegible].



MCLAREN INTERNATIONAL USES THIS ROAD SIMULATION SYSTEM TO EVALUATE NEW COMPONENTS FOR ITS FORMULA ONE RACE CARS

THE NEW SERIES 4400 IS BEING USED AROUND THE WORLD IN A BROAD RANGE OF PRODUCTION QUALITY CONTROL AND RESEARCH APPLICATIONS

lot of computer memory and drive space. Many of the software components are not necessary in individual applications. In contrast, competition is application-specific and sells at lower prices. Due to the above problems, 50 per cent of current engineering time goes into cost reduction. There is no need for special approvals for the product, but the product needs to conform to individual country specifications.

**Market:**

The company targets a variety of industrial sectors, each one having individual needs (see Table 3). In terms of importance of individual countries, Italy, France, Germany and UK account for 60% of total European turnover (see Table 4)

**Table 4 Sales of Instron per country (Series 4400 & 5500)**

| Country | % |
|---|---|
| Italy | 20 |
| France | 15 |
| Germany | 10 |
| Spain | 5 |
| UK | 15 |
| Eastern Europe | 15 |
| Others | 20 |

## Availability of adequate quality resources

Manufacturing, design, R & D and NPD is performed in both the USA and UK in close co-operation. The company acquired two smaller companies (in US and Germany) in materials harding testing, something which increased the company's engineering expertise and technological leadership in the dynamometers' sector. Instron faced though, substantial delays in the adaptation and rollout of its Series 4400/5500 to the European countries. These were due to problems which will be developed below:

## Synergies in product handling and use by customers

European sales force and customers were used to manually-handled-equipment. The adoption of the Windows interface rendered the Series 4400/5500 a sophisticated testing equipment, and has resulted in difficulties of handling by the sales force and use by the final customer. The new product required extensive training and an important investment in buyers' technical personnel time to learn how to control it. Many technicians were confused with how to use it.

## Co-ordination of relationships with agents/distributors

The company owns 11 subsidiaries and 18 sales offices in different countries, among which the principal European markets. The company employs a handful of salesmen in its major European countries (France, Italy, Spain, Germany). Contacts are infrequent and there is lack of detailed

feedback to the European HQ from these subsidiaries. Limited communication also takes place between the subsidiaries themselves, each one focusing in its respective domestic market.

It has been reported that this organisational structure is unsatisfactory and currently under change. The company plans to reorganise its distribution channels across Europe. Alternatives under consideration is the organisation of the subsidiaries into business units or into application areas across individual country borders.

## New product development process

It took two years to develop the new Series. The initial decision was to develop the Series 5500, a Windows based software controlled testing equipment with a generic interface for many applications (see brochures pp. 250-1). The software was going to be designed in English and then translated into other foreign languages. Such an equipment:

- requires lengthy familiarisation by the technician,
- comprises unnecessary software components, and
- is expensive to build.

Six months within the Series 5500 project, the company understood that they may face problems with the launching of the Series 5500 and decided to develop a manual version of it (the Series 4400) (see brochures, pp 248-9). Launching of the Series 5500 took place simultaneously in UK and USA in March 1993 (the new product would be available in June 1993). The product launch in the US market was successful for the following reasons:

- The product was a great improvement over the previous versions.
- It was fully compatible with other machinery and software.
- It was fully compatible with existing standards in the US.
- It permitted the integration of dynamometer testing with all other Windows software available in the US market in a single operational platform.

Launching of the Series 5500 in European countries was planned to take place 3 months after product launch in the British and American markets (September 1993). This has eventually faced delays for the following reasons:

- The instability of the system and difficulties to customise the software to the measurement requirements and standards of the company's main European markets. Rolling out to Germany was characteristic of the company's difficulties. The DIN system is different to the UK/US system of standards and the Windows environment had not penetrated the German market to the same extent as in US and the UK at the time of the rollout of the new product.

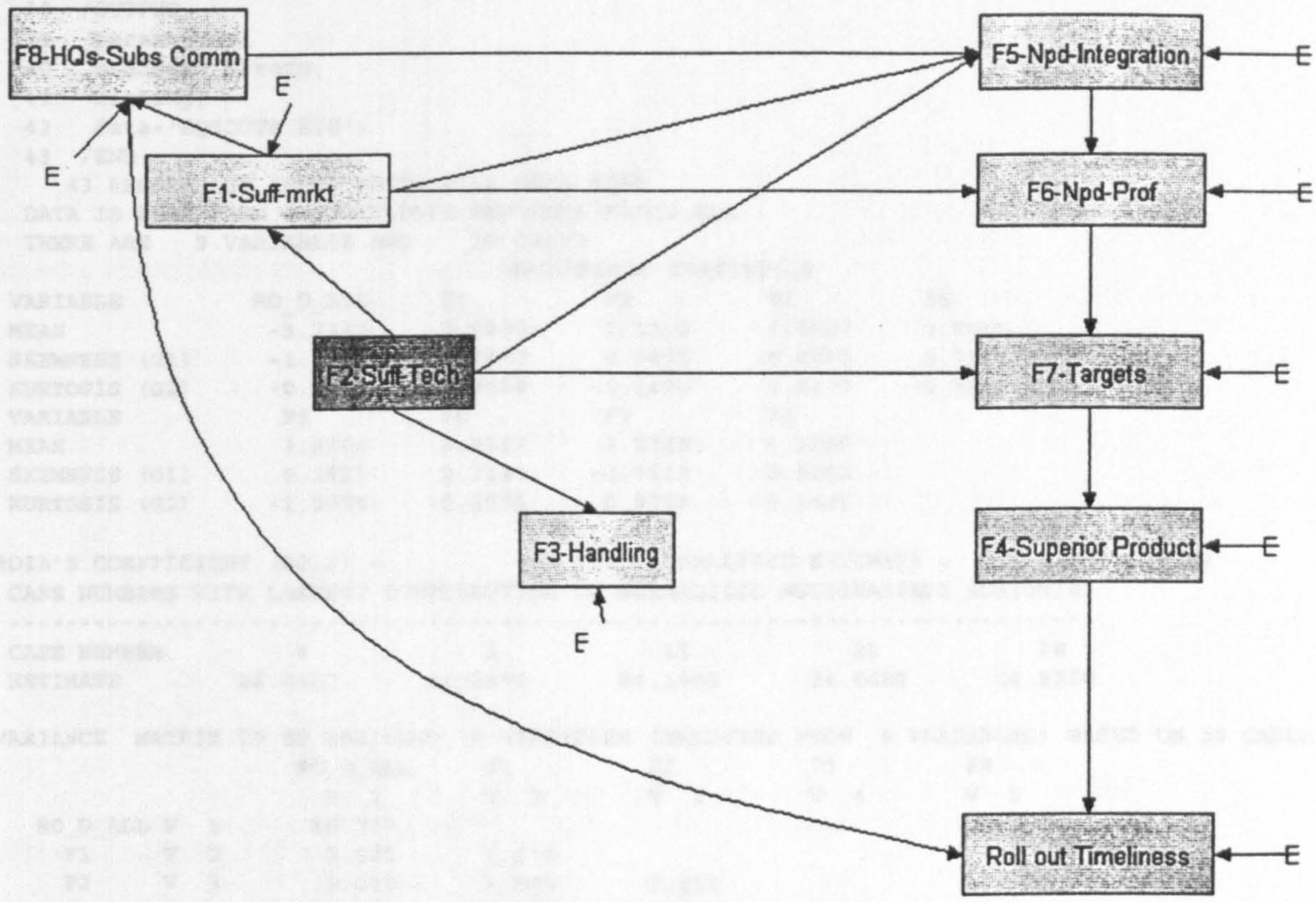
- Language difficulties in operating the machine as well as training and support resources. The size of the company did not permit rapid translation of the software into 6 different languages (among them German, French, Italian and Spanish). Finding software developers for Windows environment products was also very difficult. Instron's technicians were unfamiliar with the Windows software and there few software developers who also possess specific technical knowledge in dynamometer engineering.
- Lack of specific market focus. The focus and requirements of individual applications varied greatly from country to country in Europe. The Series 5500 was inferior to tailored products offered by competitors. Instron did not focus its product development on specific industries or applications. !ts generic approach to target markets resulted in high prices compared to competition.
- The company drive to make available a substantial number of accessories (e.g., cameras) and software features to its potential buyers. These accessories were not on schedule by the time of the development of the core equipment. Important software features were also not available.

Faced with problems of high prices, generic application of the software, competitors marketing a more customised product to the particular needs of every industry, windows acceptance across Europe and problems of translation, Instron's sales force in the different European countries rapidly abandoned sales of the more sophisticated Series 5500 for sales of the manual controlled Series 4400. The sales right up to the time of the interview were seriously biased in favour of the Series 4400 and in an overall decline for the entire product line (Series 4400 and 5500).

# Appendix 5

# EQS print output

M O D E L




```
EQS, A STRUCTURAL EQUATION PROGRAM                MULTIVARIATE SOFTWARE, INC.
  COPYRIGHT BY P.M. BENTLER                         VERSION 5.1 (C) 1985 - 1995.
PROGRAM CONTROL INFORMATION
 1  /TITLE
 2
 3  /SPECIFICATIONS
 4   DATA='E:\TEXT\DATA-END\DATA\PATH2.ESS'; VARIABLES=  9; CASES=   30;
 5   METHODS=ML;
 6   MATRIX=RAW;
 7  /LABELS
 8  V1=RO_D_ALL; V2=F1; V3=F2; V4=F3; V5=F8;
 9  V6=F5; V7=F6; V8=F7; V9=F4;
10  /EQUATIONS
11  V1 =  + *V5 + *V9 + E1;
12  V2 =  + *V3 + E2;
13  V4 =  + *V3 + E4;
14  V5 =  + *V2 + E5;
15  V6 =  + *V2 + *V3 + *V5 + E6;
16  V7 =  + *V2 + *V6 + E7;
17  V8 =  + *V3 + *V7 + E8;
18  V9 =  + *V8 + E9;
19  /VARIANCES
20  V3 = *;
21  E1 = *;
22  E2 = *;
23  E4 = *;
24  E5 = *;
25  E6 = *;
26  E7 = *;
27  E8 = *;
28  E9 = *;
29  /COVARIANCES
30  /LMTEST
31   PROCESS=SIMULTANEOUS;
32   SET=PVV,GVV,BVV;
33  /PRINT
34    effect=yes; covariance=yes; correlation=yes; parameter=yes;
35   digit=3;
```

```
36   linesize =80;
37   fit=all;
38  /OUTPUT
39   parameters;
40   standard errors;
41   listing;
42   data='EQSOUT&.ETS';
43  /END
   43 RECORDS OF INPUT MODEL FILE WERE READ
DATA IS READ FROM E:\TEXT\DATA-END\DATA\PATH2.ESS
THERE ARE   9 VARIABLES AND    30 CASES
                                UNIVARIATE STATISTICS
VARIABLE          RO_D_ALL     F1          F2          F3          F8
MEAN               -3.2333     2.9000      3.1333      3.6667      2.7000
SKEWNESS (G1)      -1.0734     0.2843      0.0495     -0.9762      0.7143
KURTOSIS (G2)      -0.2790    -0.9618     -1.3420      0.3177     -0.5023
VARIABLE            F5         F6          F7          F4
MEAN                3.0000     2.9667      3.8333      4.1000
SKEWNESS (G1)       0.1815     0.2120     -0.7613     -0.5852
KURTOSIS (G2)      -1.0078    -0.8505      0.5708     -0.1405

MARDIA'S COEFFICIENT (G2,P) =          -3.3715 NORMALIZED ESTIMATE =          -0.6562
   CASE NUMBERS WITH LARGEST CONTRIBUTION TO NORMALIZED MULTIVARIATE KURTOSIS:
   ---------------------------------------------------------------------------
   CASE NUMBER          4           5           12          22          28
   ESTIMATE        26.0422     24.8996     24.1993     34.0688     24.8350

COVARIANCE  MATRIX TO BE ANALYZED: 9 VARIABLES (SELECTED FROM  9 VARIABLES) BASED ON 30 CASES.
                        RO_D_ALL     F1          F2          F3          F8
                          V  1       V  2        V  3        V  4        V  5
     RO_D_ALL V  1       18.737
       F1     V  2        2.562      1.679
       F2     V  3        3.032      1.083       2.051
       F3     V  4        2.402      0.897       0.977       1.402
       F8     V  5        3.341      0.866       0.972       0.690       1.459
       F5     V  6        2.586      0.966       1.103       0.655       0.931
       F6     V  7        2.613      1.238       1.108       0.713       0.955
       F7     V  8        2.546      0.879       1.023       0.667       0.672
       F4     V  9        1.783      0.597       0.676       0.448       0.410

                           F5         F6          F7          F4
                          V  6       V  7        V  8        V  9
       F5     V  6        1.103
       F6     V  7        0.966      1.275
       F7     V  8        0.759      0.856       0.971
       F4     V  9        0.552      0.624       0.569       0.645

PARAMETER ESTIMATES APPEAR IN ORDER,
  NO SPECIAL PROBLEMS WERE ENCOUNTERED DURING OPTIMIZATION.
  CORRELATIONS OF PARAMETER ESTIMATES
                    1          2          3          4          5          6          7          8          9         10         11
                  V3,V3      E1,E1      E2,E2      E4,E4      E5,E5      E6,E6      E7,E7      E8,E8      E9,E9      V2,V3      V4,V3
  1   V3,V3       1.000
  2   E1,E1       0.000      1.000
  3   E2,E2       0.000      0.000      1.000
  4   E4,E4       0.000      0.000      0.000      1.000
  5   E5,E5       0.000      0.000      0.000      0.000      1.000
  6   E6,E6       0.000      0.000      0.000      0.000      0.000      1.000
  7   E7,E7       0.000      0.000      0.000      0.000      0.000      0.000      1.000
  8   E8,E8       0.000      0.000      0.000      0.000      0.000      0.000      0.000      1.000
  9   E9,E9       0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      1.000
 10   V2,V3       0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      1.000
 11   V4,V3       0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      1.000
 12   V6,V3       0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
 13   V8,V3       0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
 14   V1,V5       0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
 15   V1,V9       0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
 16   V5,V2       0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
 17   V6,V2       0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
 18   V6,V5       0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
 19   V7,V2       0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
 20   V7,V6       0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
 21   V8,V7       0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
 22   V9,V8       0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000      0.000
```

| | | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | V6,V3 | V8,V3 | V1,V5 | V1,V9 | V5,V2 | V6,V2 | V6,V5 | V7,V2 | V7,V6 | V8,V7 | V9,V8 |
| 12 | V6,V3 | 1.000 | | | | | | | | | | |
| 13 | V8,V3 | 0.000 | 1.000 | | | | | | | | | |
| 14 | V1,V5 | 0.000 | 0.000 | 1.000 | | | | | | | | |
| 15 | V1,V9 | 0.000 | 0.000 | -0.304 | 1.000 | | | | | | | |
| 16 | V5,V2 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 | | | | | | |
| 17 | V6,V2 | -0.514 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 | | | | | |
| 18 | V6,V5 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.475 | 1.000 | | | | |
| 19 | V7,V2 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 | | | |
| 20 | V7,V6 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -0.732 | 1.000 | | |
| 21 | V8,V7 | 0.000 | -0.596 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 | |
| 22 | V9,V8 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |

RESIDUAL COVARIANCE MATRIX (S-SIGMA) :

| | | RO_D_ALL V 1 | F1 V 2 | F2 V 3 | F3 V 4 | F8 V 5 |
|---|---|---|---|---|---|---|
| RO_D_ALL | V 1 | 0.729 | | | | |
| F1 | V 2 | 0.190 | 0.000 | | | |
| F2 | V 3 | 1.113 | 0.000 | 0.000 | | |
| F3 | V 4 | 1.488 | 0.381 | 0.000 | 0.000 | |
| F8 | V 5 | 0.189 | 0.000 | 0.414 | 0.424 | 0.000 |
| F5 | V 6 | 0.443 | 0.000 | 0.134 | 0.193 | 0.106 |
| F6 | V 7 | 0.401 | 0.000 | 0.149 | 0.256 | 0.166 |
| F7 | V 8 | 0.758 | 0.046 | 0.067 | 0.211 | 0.175 |
| F4 | V 9 | 0.240 | 0.108 | 0.116 | 0.182 | 0.119 |

| | | F5 V 6 | F6 V 7 | F7 V 8 | F4 V 9 |
|---|---|---|---|---|---|
| F5 | V 6 | 0.069 | | | |
| F6 | V 7 | 0.032 | 0.015 | | |
| F7 | V 8 | 0.091 | 0.045 | 0.037 | |
| F4 | V 9 | 0.161 | 0.149 | 0.022 | 0.013 |

AVERAGE ABSOLUTE COVARIANCE RESIDUALS = 0.2095
AVERAGE OFF-DIAGONAL ABSOLUTE COVARIANCE RESIDUALS = 0.2379

STANDARDIZED RESIDUAL MATRIX:

| | | RO_D_ALL V 1 | F1 V 2 | F2 V 3 | F3 V 4 | F8 V 5 |
|---|---|---|---|---|---|---|
| RO_D_ALL | V 1 | 0.039 | | | | |
| F1 | V 2 | 0.034 | 0.000 | | | |
| F2 | V 3 | 0.179 | 0.000 | 0.000 | | |
| F3 | V 4 | 0.290 | 0.248 | 0.000 | 0.000 | |
| F8 | V 5 | 0.036 | 0.000 | 0.240 | 0.296 | 0.000 |
| F5 | V 6 | 0.097 | 0.000 | 0.089 | 0.155 | 0.084 |
| F6 | V 7 | 0.082 | 0.000 | 0.092 | 0.191 | 0.122 |
| F7 | V 8 | 0.178 | 0.036 | 0.048 | 0.181 | 0.147 |
| F4 | V 9 | 0.069 | 0.104 | 0.101 | 0.191 | 0.123 |

| | | F5 V 6 | F6 V 7 | F7 V 8 | F4 V 9 |
|---|---|---|---|---|---|
| F5 | V 6 | 0.062 | | | |
| F6 | V 7 | 0.027 | 0.012 | | |
| F7 | V 8 | 0.088 | 0.040 | 0.038 | |
| F4 | V 9 | 0.190 | 0.164 | 0.028 | 0.020 |

AVERAGE ABSOLUTE STANDARDIZED RESIDUALS = 0.0916
AVERAGE OFF-DIAGONAL ABSOLUTE STANDARDIZED RESIDUALS = 0.1097

LARGEST STANDARDIZED RESIDUALS:

| | | | | |
|---|---|---|---|---|
| V 5,V 4 | V 4,V 1 | V 4,V 2 | V 5,V 3 | V 7,V 4 |
| 0.296 | 0.290 | 0.248 | 0.240 | 0.191 |
| V 9,V 4 | V 9,V 6 | V 8,V 4 | V 3,V 1 | V 8,V 1 |
| 0.191 | 0.190 | 0.181 | 0.179 | 0.178 |
| V 9,V 7 | V 6,V 4 | V 8,V 5 | V 9,V 5 | V 7,V 5 |
| 0.164 | 0.155 | 0.147 | 0.123 | 0.122 |
| V 9,V 2 | V 9,V 3 | V 6,V 1 | V 7,V 3 | V 6,V 3 |
| 0.104 | 0.101 | 0.097 | 0.092 | 0.089 |

DISTRIBUTION OF STANDARDIZED RESIDUALS

```
   ----------------------------------------
   !                                      !
 30-                                      -
   !                                      !
   !                                      !
   !                                      !
   !                 *                    !
   !                 *                    !
 20-                 *                    -
   !                 *                    !
   !                 *                    !
   !                 *  *                 !
   !                 *  *                 !
 10-                 *  *                 -
   !                 *  *                 !
   !                    *  *              !
   !                 *  *  *  *           !
   !                 *  *  *  *           !
   ----------------------------------------
     1  2  3  4  5  6  7  8  9  A  B  C
```

| | RANGE | FREQ | PERCENT |
|---|---|---|---|
| 1 | -0.5 - -- | 0 | 0.00% |
| 2 | -0.4 - -0.5 | 0 | 0.00% |
| 3 | -0.3 - -0.4 | 0 | 0.00% |
| 4 | -0.2 - -0.3 | 0 | 0.00% |
| 5 | -0.1 - -0.2 | 0 | 0.00% |
| 6 | 0.0 - -0.1 | 4 | 8.89% |
| 7 | 0.1 - 0.0 | 24 | 53.33% |
| 8 | 0.2 - 0.1 | 13 | 28.89% |
| 9 | 0.3 - 0.2 | 4 | 8.89% |
| A | 0.4 - 0.3 | 0 | 0.00% |
| B | 0.5 - 0.4 | 0 | 0.00% |
| C | ++ - 0.5 | 0 | 0.00% |
| | TOTAL | 45 | 100.00% |

EACH "*" REPRESENTS 2 RESIDUALS

MODEL COVARIANCE MATRIX FOR MEASURED AND LATENT VARIABLES

| | RO_D_ALL V 1 | F1 V 2 | F2 V 3 | F3 V 4 | F8 V 5 |
|---|---|---|---|---|---|
| RO_D_ALL V 1 | 18.008 | | | | |
| F1 V 2 | 2.372 | 1.679 | | | |
| F2 V 3 | 1.920 | 1.083 | 2.051 | | |
| F3 V 4 | 0.915 | 0.516 | 0.977 | 1.402 | |
| F8 V 5 | 3.153 | 0.866 | 0.558 | 0.266 | 1.459 |
| F5 V 6 | 2.143 | 0.966 | 0.969 | 0.462 | 0.825 |
| F6 V 7 | 2.212 | 1.238 | 0.959 | 0.457 | 0.789 |
| F7 V 8 | 1.788 | 0.833 | 0.956 | 0.455 | 0.498 |
| F4 V 9 | 1.543 | 0.488 | 0.560 | 0.267 | 0.291 |

| | F5 V 6 | F6 V 7 | F7 V 8 | F4 V 9 |
|---|---|---|---|---|
| F5 V 6 | 1.035 | | | |
| F6 V 7 | 0.934 | 1.260 | | |
| F7 V 8 | 0.668 | 0.812 | 0.934 | |
| F4 V 9 | 0.391 | 0.475 | 0.547 | 0.632 |

MODEL CORRELATION MATRIX FOR MEASURED AND LATENT VARIABLES

| | RO_D_ALL V 1 | F1 V 2 | F2 V 3 | F3 V 4 | F8 V 5 |
|---|---|---|---|---|---|
| RO_D_ALL V 1 | 1.000 | | | | |
| F1 V 2 | 0.431 | 1.000 | | | |
| F2 V 3 | 0.316 | 0.583 | 1.000 | | |
| F3 V 4 | 0.182 | 0.336 | 0.576 | 1.000 | |
| F8 V 5 | 0.615 | 0.553 | 0.323 | 0.186 | 1.000 |
| F5 V 6 | 0.496 | 0.732 | 0.665 | 0.383 | 0.671 |
| F6 V 7 | 0.464 | 0.851 | 0.596 | 0.344 | 0.582 |
| F7 V 8 | 0.436 | 0.665 | 0.691 | 0.398 | 0.426 |
| F4 V 9 | 0.457 | 0.474 | 0.492 | 0.283 | 0.304 |

| | F5 V 6 | F6 V 7 | F7 V 8 | F4 V 9 |
|---|---|---|---|---|
| F5 V 6 | 1.000 | | | |
| F6 V 7 | 0.818 | 1.000 | | |
| F7 V 8 | 0.679 | 0.748 | 1.000 | |
| F4 V 9 | 0.484 | 0.533 | 0.712 | 1.000 |

GOODNESS OF FIT SUMMARY
INDEPENDENCE MODEL CHI-SQUARE = 215.780 ON 36 DEGREES OF FREEDOM
INDEPENDENCE AIC = 143.77961 INDEPENDENCE CAIC = 57.33650
MODEL AIC = -23.55496 MODEL CAIC = -78.78250
CHI-SQUARE = 22.445 BASED ON 23 DEGREES OF FREEDOM
PROBABILITY VALUE FOR THE CHI-SQUARE STATISTIC IS 0.49354
THE NORMAL THEORY RLS CHI-SQUARE FOR THIS ML SOLUTION IS 20.796.
SATORRA-BENTLER SCALED CHI-SQUARE = 25.0342
PROBABILITY VALUE FOR THE CHI-SQUARE STATISTIC IS 0.34853
BENTLER-BONETT NORMED FIT INDEX= 0.896
BENTLER-BONETT NONNORMED FIT INDEX= 1.005
COMPARATIVE FIT INDEX (CFI) = 1.000
ROBUST COMPARATIVE FIT INDEX = 0.990
BOLLEN (IFI) FIT INDEX= 1.003

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McDonald (MFI)              FIT INDEX=      1.009
LISREL GFI                  FIT INDEX=      0.863
LISREL AGFI                 FIT INDEX=      0.731
ROOT MEAN SQUARED RESIDUAL (RMR)  =         0.363
STANDARDIZED RMR                  =        .0.090
ROOT MEAN SQ. ERROR OF APP.(RMSEA)=         0.018
90% CONFIDENCE INTERVAL OF RMSEA (        0.000,        0.146)

ITERATIVE SUMMARY
                      PARAMETER
 ITERATION            ABS CHANGE          ALPHA                FUNCTION
     1                 1.136608          1.00000                9.14345
     2                 0.605995          1.00000                6.13782
     3                 0.350986          1.00000                3.71007
     4                 0.094168          1.00000                2.46747
     5                 0.097717          1.00000                1.43356
     6                 0.065062          1.00000                0.89346
     7                 0.038164          1.00000                0.77819
     8                 0.012843          1.00000                0.77408
     9                 0.001912          1.00000                0.77397
    10                 0.000297          1.00000                0.77397
MEASUREMENT EQUATIONS WITH STANDARD ERRORS AND TEST STATISTICS
 RO_D_ALL=V1  =  1.843*V5    +1.592*V9    +1.000 E1
                  .504         .765
                 3.660        2.080

   F1    =V2  =   .528*V3    +1.000 E2
                  .136
                 3.869

   F3    =V4  =   .476*V3    +1.000 E4
                  .126
                 3.796

   F8    =V5  =   .515*V2    +1.000 E5
                  .144
                 3.574

   F5    =V6  =   .243*V2    + .323*V5    + .256*V3    +1.000 E6
                  .107         .099         .085
                 2.271        3.281        3.009

   F6    =V7  =   .471*V2    + .463*V6    +1.000 E7
                  .104         .133
                 4.525        3.489

   F7    =V8  =   .449*V7    + .256*V3    +1.000 E8
                  .117         .092
                 3.826        2.781

   F4    =V9  =   .586*V8    +1.000 E9
                  .107
                 5.462
VARIANCES OF INDEPENDENT VARIABLES
                                  V                                F
 V3  -  F2                    2.051*I                              I
                               .539 I                              I
                              3.808 I                              I
                                   E                              D
E1  -RO_D_ALL                 9.741*I                              I
                              2.558 I                              I
                              3.808 I                              I
                                    I                              I
E2  -  F1                     1.108*I                              I
                               .291 I                              I
                              3.808 I                              I
                                    I                              I
E4  -  F3                      .937*I                              I
                               .246 I                              I
                              3.808 I                              I
                                    I                              I
E5  -  F8                     1.013*I                              I
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                          .266 I                                  I
                         3.808 I                                  I
                               I                                  I
E6  -  F5                 .285*I                                  I
                          .075 I                                  I
                         3.808 I                                  I
                               I                                  I
E7  -  F6                 .245*I                                  I
                          .064 I                                  I
                         3.808 I                                  I
                               I                                  I
E8  -  F7                 .325*I                                  I
                          .085 I                                  I
                         3.808 I                                  I
                               I                                  I
E9  -  F4                 .312*I                                  I
                          .082 I                                  I
                         3.808 I                                  I
DECOMPOSITION OF EFFECTS WITH NONSTANDARDIZED VALUES   PARAMETER TOTAL EFFECTS
RO_D_ALL=V1  =  1.227 V2    +1.906*V5    + .194 V6    + .419 V7    + .932 V8
                1.592*V9    + .936 V3    +1.000 E1    +1.227 E2    +1.906 E5
                 .194 E6    + .419 E7    + .932 E8    +1.592 E9

  F1    =V2  =   .528*V3    +1.000 E2

  F3    =V4  =   .476*V3    +1.000 E4

  F8    =V5  =   .515*V2    + .272 V3    + .515 E2    +1.000 E5

  F5    =V6  =   .410*V2    + .323*V5    + .473*V3    + .410 E2    + .323 E5
                1.000 E6

  F6    =V7  =   .661*V2    + .150 V5    + .463*V6    + .468 V3    + .661 E2
                 .150 E5    + .463 E6    +1.000 E7

  F7    =V8  =   .297 V2    + .067 V5    + .208 V6    + .449*V7    + .466*V3
                 .297 E2    + .067 E5    + .208 E6    + .449 E7    +1.000 E8

  F4    =V9  =   .174 V2    + .039 V5    + .122 V6    + .263 V7    + .586*V8
                 .273 V3    + .174 E2    + .039 E5    + .122 E6    + .263 E7
                 .586 E8    +1.000 E9

DECOMPOSITION OF EFFECTS WITH NONSTANDARDIZED VALUES  PARAMETER INDIRECT EFFECTS
 RO_D_ALL=V1  =  1.227 V2    + .063*V5    + .194 V6    + .419 V7    + .932 V8
                  .386         .045         .125         .242         .480
                 3.181        1.403        1.552        1.733        1.944

                  .936 V3    +1.227 E2    +1.906 E5    + .194 E6    + .419 E7
                  .284         .253         .495         .093         .201
                 3.295        4.845        3.848        2.080        2.080

                  .932 E8    +1.592 E9
                  .448         .765
                 2.080        2.080

  F8    =V5  =   .272 V3    + .515 E2
                  .418         .505
                  .651        1.021

F5    =V6  =   .167*V2    + .216*V3    + .410 E2    + .323 E5
                  .069         .089         .113         .139
                 2.417        2.439        3.630        2.325

F6    =V7  =   .190*V2    + .150 V5    + .468 V3    + .661 E2    + .150 E5
                  .073         .063         .142         .134         .212
                 2.600        2.390        3.284        4.919         .705

                  .463 E6
                  .141
                 3.293

F7    =V8  =   .297 V2    + .067 V5    + .208 V6    + .210*V3    + .297 E2
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                .087          .033          .081          .212          .249
               3.403         2.027         2.578          .991         1.191

                .067 E5     + .208 E6     + .449 E7
                .462          .103          .223
                .145         2.013         2.013

   F4     =V9  =  .174 V2     + .039 V5     + .122 V6     + .263 V7     + .273 V3
                .060          .021          .052          .084          .347
               2.888         1.901         2.332         3.134          .788

                .174 E2     + .039 E5     + .122 E6     + .263 E7     + .586 E8
                .404          .788          .150          .324          .721
                .430          .050          .812          .812          .812
DECOMPOSITION OF EFFECTS WITH STANDARDIZED VALUES   PARAMETER TOTAL EFFECTS
 RO_D_ALL=V1  =  .375 V2     + .542*V5     + .046 V6     + .111 V7     + .212 V8
                .298*V9     + .316 V3     + .735 E1     + .304 E2     + .452 E5
                .024 E6     + .049 E7     + .125 E8     + .209 E9

   F1     =V2  =  .583*V3     + .812 E2

   F3     =V4  =  .576*V3     + .817 E4

   F8     =V5  =  .553*V2     + .323 V3     + .449 E2     + .833 E5

   F5     =V6  =  .522*V2     + .384*V5     + .665*V3     + .424 E2     + .320 E5
                .525 E6

   F6     =V7  =  .763*V2     + .161 V5     + .419*V6     + .596 V3     + .619 E2
                .134 E5     + .220 E6     + .441 E7

   F7     =V8  =  .398 V2     + .084 V5     + .219 V6     + .522*V7     + .691*V3
                .323 E2     + .070 E5     + .115 E6     + .230 E7     + .590 E8

   F4     =V9  =  .283 V2     + .060 V5     + .156 V6     + .372 V7     + .712*V8
                .492 V3     + .230 E2     + .050 E5     + .082 E6     + .164 E7
                .420 E8     + .702 E9
DECOMPOSITION OF EFFECTS WITH STANDARDIZED VALUES  PARAMETER INDIRECT EFFECTS
 RO_D_ALL=V1  =  .375 V2     + .018*V5     + .046 V6     + .111 V7     + .212 V8
                .316 V3     + .304 E2     + .452 E5     + .024 E6     + .049 E7
                .125 E8     + .209 E9

   F8     =V5  =  .323 V3     + .449 E2

   F5     =V6  =  .212*V2     + .304*V3     + .424 E2     + .320 E5

   F6     =V7  =  .219*V2     + .161 V5     + .596 V3     + .619 E2     + .134 E5
                .220 E6

   F7     =V8  =  .398 V2     + .084 V5     + .219 V6     + .311*V3     + .323 E2
                .070 E5     + .115 E6     + .230 E7

   F4     =V9  =  .283 V2     + .060 V5     + .156 V6     + .372 V7     + .492 V3
                .230 E2     + .050 E5     + .082 E6     + .164 E7     + .420 E8

  STANDARDIZED SOLUTION:
 RO_D_ALL=V1  =  .525*V5     + .298*V9     + .735 E1
 F1     =V2  =  .583*V3     + .812 E2
 F3     =V4  =  .576*V3     + .817 E4
 F8     =V5  =  .553*V2     + .833 E5
 F5     =V6  =  .310*V2     + .384*V5     + .361*V3     + .525 E6
 F6     =V7  =  .544*V2     + .419*V6     + .441 E7
 F7     =V8  =  .522*V7     + .379*V3     + .590 E8
 F4     =V9  =  .712*V8     + .702 E9
MULTIVARIATE LAGRANGE MULTIPLIER TEST BY SIMULTANEOUS PROCESS IN STAGE  1
PARAMETER SETS (SUBMATRICES) ACTIVE AT THIS STAGE ARE: PVV GVV BVV
STEP  PARAMETER    CHI-SQUARE  D.F.  PROBABILITY        CHI-SQUARE  PROBABILITY
---- -----------  ----------  ----  -----------        ----------  -----------
  1     V2,V4        4.050      1      0.044              4.050       0.044
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