SUCCESSFUL PRODUCT INNOVATION; A STUDY OF THE APPLICATION OF KNOWN SUCCESS FACTORS

Thesis submitted in accordance with the requirements of the University of Liverpool for the degree of Doctor in Philosophy by Mark Howard Benson.

June 1989.

ABSTRACT

This research has examined how companies can change their organisation to improve the process of product innovation and increase their chances of new product success.

Careful analysis of the previous research studies into new product success and failure identified five key attributes that were found to be strongly associated with new product success.

A mailed questionnaire survey of 149 UK engineering companies identified general trends and attitudes in the management of new product development. The survey clearly showed a definite lack of awareness amongst managers, of previous research studies that have identified the factors associated with new product success. It was clear from the survey that the process of new product development needed improvement, yet evidence of constructive and planned change to new product development organisations was was found in only 5 out of 149 companies surveyed.

Further analysis of the type of changes being made, through a series of ten structured interviews, showed that the majority of changes were "legislated" changes based on experience and in general imposed by senior management. Few organisational changes were classed as "planned changes".

A methodology to improve the process of new product development was developed and tested within the sponsoring company. This methodology combines the five key attributes associated with new product success with a planned programme of change. The methodology was successful in identifying problems associated with new product development and stimulating change.

ACKNOWLEDGEMENTS

This thesis would not have been submitted without the help of the following:-

The support and guidance of my supervisor Ian Barclay. Thank you Ian.

The support and commitment of the staff at Delco Electronics especially Bill Johnston, Paul Milburn, Anne Hierons, Jim Johnston, Peter Ward, Peter Reed-Clayton, Colin Rogers, Jim Bannon, Tony Francis, Bob McHattie, John Higham and Roger Middlebrook. Thank you all for your time, support and commitment to the research. May I also sincerely thank Delco for their financial support.

The staff of the department of Industrial Studies, Liverpool University especially Professor John S. Halliday, and Pauline Hobson. Thank you all.

All the companies associated with the research, including Mark Ashcroft of Leyland Trucks ltd. and Gorden Humphries of Renold plc. who helped substantially during the early stages. Those managers, far too numerous to mention, who took the time and effort to complete questionnaires and especially those senior managers and directors who gave their time, effort and knowledge essential to complete the structured interviews that formed the final case studies.

I am also indebted to my colleagues in the Listerhills warehouse development team, and the management at Grattan plc. for their support and tolerance during the many evenings spent using their facilities.

Finally I am indebted to the Science and Engineering Research Council, who in collaboration with Delco Electronics made this research possible.

To Jenny

CONTENTS

6. RESULTS FROM THE INITIAL SURVEY

LIST OF APPENDICES

Appendices part 1

Appendices part 2

Appendices XIII to XXII The Structured Interview Case Studies

LIST OF FIGURES, TABLES, AND DIAGRAMS

LIST OF ABBREVIATIONS

CAD.	Computer Aided Design
CADAM.	Computer Aided Design and Manufacturing
Co.	Company
CPA.	Critical Path Analysis
DEOC	Delco Electronics Overseas Corporation
dept.	department
IEEE.	Institute of electrical and electronic engineering
MD.	Managing Director
NP.	New Product
NPD.	New Product Development
OD.	Organisation Development
PC.	Personal Computer
SAPPHO.	Scientific Activity Predictor from patterns with Heuristic Origins
SERC.	The Science and Engineering Research Council
SIC.	Standard Industrial Classification
tech.	technology
UK.	United Kingdom
US.	United States (of America)

PREFACE

This preface is intended as a brief introduction to the subject area and the problems from which the research arose.

The problem

It has long been recognised that innovation and technological change play an essential role in economic growth. Indeed, one of the reasons often cited for the accepted decline of UK., US., and other western industries during the late 1970's and early 1980's, is a lack of innovative activity. Innovation is essential for company growth and future national prosperity. For the nation as a whole the need for successful product innovation has never been more pressing.

With an ever accelerating rate of technological change, increased competition in a global market environment, changing market demands and shortened product life cycles, industry today is facing more turbulent conditions than ever before. The number of new products being developed is increasing at a dramatic pace as is the recognition of the importance of product innovation. Sustained product innovation is vital to success. Management of the product innovation process is a key issue within the organisation.

In recent years the UK. balance of payments deficit has escalated to reach an all time high. The main cause of this can be attributed to consumer spending growing at a greater

rate than British industrial output. As the trade deficit grows, causing concern in financial markets, the government has reacted by increasing interest rates to curb spending. One of the root problems behind the balance of payments trade deficit is that consumers prefer foreign goods to British goods. No long term solution to this problem is possible until the root cause is tackled.

There will always be room for improvement in the quality, quantity and choice of British goods. This can only be possible through the improvement of the innovation process. British companies need to be able to offer good alternative products. The future economic strength of Britain lies in the hands of the entrepreneurs and innovators that will develop these products.

Research into the process of product innovation, carried out by academics world wide, has identified many of the factors associated with the success and failure of new products. Collectively the research studies represent a consistent picture of what leads to successful product innovation. Yet despite this work new product failure rates remain high. The research has identified what leads to success, but not put forward methods of applying the lessons learnt.

In order to survive, companies must adapt and change their organisations to fit with tomorrow's dynamic environment. Despite the recognition of the importance of this change process, substantial work has yet to be undertaken on how companies should adapt and change. In many

cases organisations are designed to maintain established corporate objectives rather than meet the challenges of a rapidly changing commercial environment.

Little research has been undertaken into how companies can change their organisation and improve their chances of new product success. Twiss (1985)[141] found that although a substantial amount of research had been conducted into technological policy and the process of technological change, none of the major research organisations were addressing the problems associated with the application of their research findings. Twiss's conclusions are echoed in many other studies. Achieving successful innovation is a problem that has not yet been tackled by British industry. The success rates of new products need improving, it is currently estimated that over a third of new products fail . Research has identified the factors associated with success yet there appear to be no effective methods of applying this research.

Quinn (1979)[100] commented "it is essential that technological managers and policy makers learn from past successes and failures those patterns that lead to important innovations. Only then may there be hope that we can reverse some of the tragic trends in our current national posture." Although the economic prosperity has improved substantially since the early eighties, competition is still increasing not only from advanced nations, but also from newly industrialised nations such as Taiwan and Singapore. The

importance of product innovation is only just being recognised by industry. There is a definite need to improve the innovative ability of UK. companies. This research investigates the factors associated with successful product innovation, and examines organisational change methodologies for applying these in industry.

The research

This research has investigated the product innovation process with special reference to how companies adapt and change their organisations to improve the chances of new product success. One of the main objectives of the research was to identify a methodology through which companies could apply factors that have already been proven to be associated with new product success.

Following a review of the main research studies into the success and failure of new products, a mailed questionnaire survey was carried out covering a sample of 149 UK. engineering companies. The objective of the questionnaire was to identify current trends relating to new product development in the UK. Ten companies were selected from the questionnaire for further investigation, and a series of case studies built up to examine how successful companies change and adapt their new product organisations.

In parallel to this investigation, an experiment was carried out, within the company sponsoring the research, to

test the practical use of organisation development as an intervention strategy to improve the product innovation process. The aim was to develop a methodology that would enable any company to continually adjust and change its new product organisation to improve its chances of new product success.

1. INTRODUCTION

"Innovation is the specific tool of entrepreneurs, the means by which they exploit change as an opportunity for a different business or a different service. It is capable of being presented as a discipline, capable of being learned and capable of being practised. Entrepreneurs need to search purposely for the sources of innovation, the changes and their symptoms that indicate opportunities for successful innovation. And they need to know and apply the principles of successful innovation."

(Drucker 1985)

1.1 Product innovation

Innovation has been defined in a variety of different ways all of which have different emphasis. Quinn (1979)[100] defined innovation as the "creation and introduction of an original solution". Kanter (1983)[65] referred to innovation as the "process of bringing any new problem solving idea into use". Clearly innovation is about new ideas and change, however an exact definition regarding the degree of innovation or "radicalness" is a matter of contention.

Parker (1985)[94] defined innovation as "the creation of a new idea, often an invention, together with its progression to the marketing of a new material, process or system". He continued "innovation implies a discontinuity sufficiently great to merit an examination of its possible effects on the company's strategies, structure and

attitudes". Parker clearly distinguished between innovation and what he termed "evolutionary developments"; work aimed at continuous improvement to meet changing market needs. He described these evolutionary developments as "often misleadingly referred to as incremental or continuous innovation". Parker's view was that innovation is not a progression via small steps, but a radical operation rarely free from risk and demanding exceptional skill and determination. Souder (1987)[132] too referred to innovation as "a high risk idea which is new to the sponsoring organisation, and which the organisation itself believes has high profit potential or other favourable commercial impacts".

Defining innovation in this way is restrictive as it is often the case that radical changes in technology are better described as inventions. Marquis (1969)[85] argued that too narrow a concept of innovation would mean ignoring important industry transformations, as well as ignoring a vital mechanism for change, imitation, or adoption of a technical idea. Innovation encompasses the whole process through which new ideas, incremental or radical, are conceived, diffused, and successfully exploited.

In discussing innovation, it is important to distinguish clearly between innovation and invention. As early as 1939, Schumpter[126] argued that innovation need not embody invention at all. His definition was simply that innovation is the commercial exploitation of a new "thing" or a new way of doing something. Marquis (1969)[85] was quick to point out the distinction between innovation and

invention, and along with Utterback (1974)[145], took the economist Jacob Schmookler's (1966)[124] definition as a clear interpretation of the terms. Schmookler defined invention as "a new combination of pre-existing knowledge which satisfies some want". Innovation is a more subtle concept and here again Schmookler's definition was clear "when an enterprise produces a good or a service that is new to it, it makes a technical change. The first enterprise to make a given technical change is an innovator, its action innovation." Thus, as Marquis (1969)[85] pointed out, innovation can be thought of as a unit of technological change.

Many authors, when discussing innovation seem to refer only to technological change. However as Kanter (1983)[65] pointed out "innovation is the generation, acceptance and implementation of new ideas, processes, products or services. It can thus occur in any part of a corporation, and can involve creative use, as well as original invention. Application and implementation are central to this definition, innovation involves the capacity to change or adapt." Innovation is by no means *restricted to technical* changes, it can occur in law, medicine, politics or management, etc. It is useful therefore when discussing technical changes to refer to technological innovation.

Technological innovation is not the same as technological change, Hill & Utterback (1979)[52] commented that "while the distinction is not always easy to draw in practice, the latter encompasses any change in a product or a production process, such as the adoption of an existing but better method by a producer. Technological innovation is

said to occur when a product, process or system embodies a new idea". Bright (1964)[14] described technological innovation as "a unique chronological process involving science, technology, economics, entrepreneurship and management in a medium that translates scientific knowledge into the physical realities that are changing society".

From these definitions it is clear that the process of technological innovation involves far more than research and development. Successful technological innovation begins with the identification of customer needs, combines those needs with new knowledge and ends with the satisfaction of needs.

Such a process can never be the responsibility of one department within a company. Twiss (1986)[141] suggested that technological innovation by its nature implies a company wide approach to the profitable application of technology rather than a description of the activities of one department responsible for research and development. According to Twiss technological innovation stresses the importance of the whole innovation process through to commercial exploitation; and it leaves the door open to new technology which originates outside the company.

Technological innovation is the process that drives technical change and ultimately leads to economic growth and change in society. Technological innovation is continually forcing companies to change. Mansfield (1971)[84] showed that industries, old or new, shift their location, their characteristics and the nature of their work force in response to technological change. Mansfield also pointed out that the mechanisms and style of management change as new

technology filters into the boardroom, as well as the shop floor.

Technological innovation includes product, process and system innovations. The present research however focuses on product innovation, more often referred to as new product development. The process is considered from concept through to the satisfaction of customer needs. The process involves far more than the physical development of a new product, or the activities covered by the research and development departments. New product development is, in effect, the process of product innovation and concerns all aspects of that process, from idea generation and technical development to the successful marketing and commercialisation of a new product. New products are the life blood of a company. Without successful new products companies will fall into decline.

1.2 The importance of product innovation

There are many factors that demonstrate the importance of product innovation. From a company point of view it is crucial to the long term survival of business enterprises and remains one of the most important routes to corporate growth (Rothberg(1976)[110]). New products have to be continually developed to adapt to new markets, more aggressive competition, new technologies and new management abilities. At a national level successful product innovation is a major contributor to the economic growth and the success of the British industry.

One of the major driving forces behind product innovation is technological change. Generally, technical change leads to improvements in the quality of human life. As technology improves, more outputs can be produced from the same inputs of human and natural resources. Hill & Utterback (1979)[52] argued "few people could disagree with the assertion that the quality of life has been greatly enhanced by the development of technologies for disease prevention and treatment, communication, transportation, housing, clothing, food production and so on. In a very real sense intelligent development and the use of tools (technology) is what distinguishes human kind from the rest of nature".

The rate of technological change is greater than ever before, making innovation an essential requirement for company survival. Quinn (1979)[100] proposed that, before the end of the century, new technology will have to:

- support a growing population,
- meet vastly increased energy demands,
- meet additional demands for food,
- improve living, working, educational, urban and environmental habitats,
- increase health standards,
- employ more people and achieve all the above without fatally disturbing the natural equilibria or causing a resource crisis that could lead to war.

Many authors have discussed the importance of technological change on economic growth (Mansfield (1968)[83], Schott (1981)[125], Hayes & Abernathy (1980)[50]). Hill (1979)[52]

described the use of new technology as one of the main engines of economic growth. Hill went on to show that of five macroscopic indicators that reflect the strength of the economy (economic growth, productivity, inflation, employment and balance of trade) technological innovation is a major contributor to them all.

Governments pursue the goal of economic growth in order to improve the quality of human life. Changes in technology do lead to improvements in the quality of life, but they can also affect the environment and deplete scarce resources. New technology presents both an opportunity and a threat to the modern organisation. Competition is increasing on a global basis not only from advanced countries, but also from newly industrialised countries, such as Singapore and Taiwan.

Hayes and Abernathy (1980)[50] argued that the decline of the US. economy has been due to the lack of innovation. Other authors have argued a similar case for the UK. economy. Edge (1985)[38] commented that "the management of technology is all too ineffective in the UK., government funding is misdirected and companies do not organise for innovation. British companies and products have lost out in international competitiveness as foreign competitors have become more agile at using innovation to seize and maintain a competitive advantage". Roy (1985)[118] commented that the decline in share of world trade held by products made in the UK. and the increasing penetration of imported goods has caused widespread discussion and concern over the past fifteen years.

One way out of this decline is to improve the quality

of innovation. Rothwell and Zegveld (1985)[117] argued that re-industrialisation and economic growth are linked to the emergence of new technological activities, and future national prosperity depends on industrial performance. The relationship between innovation and economic growth is a strong one and has been demonstrated by a number of authors. Rothwell and Gardiner (1985)[116] concluded that achieving higher rates of technological innovation is the major task confronting British management today. More recently Rothwell and Bessant (1987)[115] commented that public policies in advanced economies (and increasingly in other industrialised nations) are placing more and more emphasis on the generation and diffusion of technological innovation.

At a company level, innovation is an important factor in corporate success, which ultimately leads to economic growth. As Johne (1985)[59] pointed out, product innovation is fundamental for corporate survival. Foster (1986)[39] argued that the key to success lies in constant innovation. Companies owe their existence to the successful application of technology in evolving new products and improving manufacturing processes.

Similarly the decline of companies is strongly associated with their inability to successfully apply technology (Hayes and Abernathy(1980)[50]). Decline is only partly due to the absence of invention or initial innovation, many innovators fail to convert technological creativity into a profitable business operation. Drucker (1985)[37] commented that "an established company which in an

age demanding innovation is not capable of innovation is doomed to decline and extinction. And a management which, in such a period does not know how to manage innovation is incompetent and unequal to its task." Drucker went on to conclude that "the ability to develop and market a genuinely innovative product, or to continue to launch new generations of products is central to most successful and fast growing corporations". Twiss (1985)[142] showed that companies which have failed to maintain their innovative momentum have been overtaken by more youthful and vigorous organisations.

Establishing and generating new business through the development of new products is an essential part of any company's strategy for survival and growth. If companies do not develop new products then decline is inevitable. A study by the British Institute of Management (Randall (1980)[102]) showed that 94% of companies had launched at least one new product within the last three years. Such effort, clearly demonstrates the importance of new product development. The process of new product development, however, attracts little in the way of research despite its position as perhaps one of the least understood yet most important activities within a company today.

1.3 Success and failure of product innovations

It has been commonly cited that the majority of new products fail. A frequently quoted figure is 80%. In 1968, Booz Allen and Hamilton (1982)[13] estimated that 58 new product ideas were needed to make one new product. Twiss

(1986)[141] suggested that commercial success rates were frequently as low as 10% of the projects initiated.

Crawford (1979)[33] published a summary of every new product success or failure study covered in the new products management literature. The results showed that many past studies on new product failure rates were unreliable, and had put the failure rate at too high a level. Crawford examined 32 sources and found that:

- Seven turned out to be opinions and were not based on any studies. (Average failure rate = 82%)
- Four were studies of individual firms. (Average failure rate = 48%)
- Six were suspected of being non existent. (Average failure rate = 81%)
- Six were European studies and the data not applicable to the United States. (Average failure rate 41%)

Crawford put forward the following studies as acceptable, although again each one could be seriously questioned as to its method or applicability:

table 1.1 Research into new product failure rates

	Percent failed
Booz Allen and Hamilton	37% (consumer) 38% (industrial)
Buzzell	27% (food)
Cochran/NICB	30% (mixed)
Gallagher	41% (mixed)
Graf/Nielsen	42% (food)
Hopkins & Bailey/CB	40% (consumer) 20% (industrial)
Mansfield and Wagner	26% (industrial)

The results showed that around 25% of industrial new products and 30 to 35% of consumer products, failed to meet the expectations of their developers.

Crawford (1983)[35] suggested that although trends in failure rates and causes have not been studied systematically, the data suggests that a long term improvement in new product management capability has been offset by the many other constraining factors. The actual failure rate seems not to have changed, indicating that either (1) greater effort was needed to hold it constant or (2) it is the nature of the industry's management to keep the failure rate at around the 25 to 35% level. Johne (1985)[59] suggested that the wide variation in the average failure rates implies that some firms are now much better at developing new products than are others.

Some writers justify failure as the price to be paid for success in the future, (Hopkins & Bailey (1971)[55]). Maidique & Zirger (1985)[82] take this a step further arguing that success and failure goes in cycles. That is, in order to be successful companies must have some failures. Accurate measures of success and failure are dogged by poor documentation.

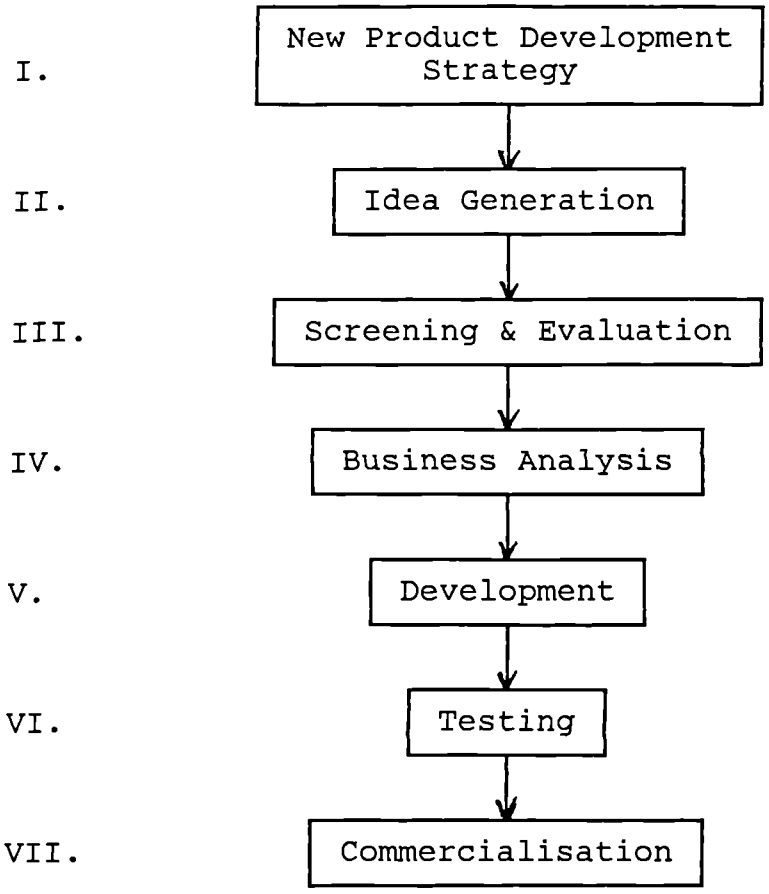
1.4 The process of product innovation

New product development is a complex process involving the interaction of many departments and resources within a company. Its inherent complexity and iterative nature makes it a difficult process to define. The process generally

begins with a concept and ends with the launch of a new product. Booz Allen & Hamilton (1982)[13] put forward a seven step new product development process identifying the activities involved in bringing new product ideas to the marketplace.

figure 1.2 Seven step new product development process

Booz Allen & Hamilton (1982)[13]



This model differed from an earlier Booz Allen & Hamilton model with the addition of a first step to include strategy. The authors also noted that the various stages were becoming more iterative.

Many other conceptual models have been proposed to describe the process of new product development, yet as Saren (1984)[121] pointed out in a review of these, "the absence of a definitive model compounds the problems of semantics and definitions when discussing innovation". Numerous models are available, these describe new product development in a variety of ways; as a series of events, decisions, activities or departmental stages. Saren (1984)[121] categorised the variety of models into 5 different types:

1. **Departmental stage models**; a simple approach, that breaks down the innovation process into a series of stages associated with departments in the firm.
2. **Activity stage models**; that identify the particular activities that are performed during innovation.
3. **Decision stage models**; break the process down into a series of decisions.
4. **Conversion process models**; that represent the innovation process as a system, with inputs and outputs.
5. **Response models**; where innovation is represented as the firm's response to some external or internal stimulus.

Saren concluded that despite the range of literature and number of models, little attention has been given to describing exactly what goes on in the firm during the innovation process.

There is no one model or type of model that can adequately describe the process of new product development.

Each one will be suited to different applications. There are so many options available during the new product development process that it is extremely difficult to define. Each company will have its own perspective of what is involved, and will view the process from different angles depending on how it organises for new product development.

Crawford (1983)[35] clearly recognised the problems of describing the new product development process. In his model the development process is shown as three parallel activities during which the marketing and technical departments interact to develop and evaluate the product concept. Takeuchi & Nonaka (1986)[135] argued that with certain high technology products the new product development process must be carried out in parallel to complete developments on, or ahead of schedule. They proposed that speed and flexibility are essential in any new product development and thus a holistic approach is needed as the old sequential method is too inadequate. The recognition that the new product development process is a series of parallel and iterative events is only recently documented in the literature. It is an essential part of any model as few of the development stages will be carried out sequentially.

Cooper (1983)[29] stated that an ideal process model would satisfy four main requirements. Firstly it must be sufficient in detail to act as an action guide to managers, yet not too pedantic so as to discourage its use. Second it must be strongly market orientated, building in market research and market planning throughout the process. Thirdly the model must be multi-disciplinary and foster internal

communication among key groups. Finally it must recognise the high failure rates and risks of new products by building in evaluation and bail out points throughout the process.

Cooper proposed a flow model approach to new product development to meet these requirements. This model clearly demonstrates the need for parallel activity especially between the marketing and technical activities. This model is described in figure 1.3.

Cooper's model however, only takes into account activities carried out within the firm. Utterback et al. (1976)[146] examined the relationship between outside influences and the firm's innovation process, and found that nearly a quarter of the ideas for innovation originated from outside the firm. Clearly therefore any model of the product innovation process also needs to take into account external variables.

Shrivastava & Souder (1987)[129] proposed a broad model (figure 1.4) to take into account additional environmental and organisational variables. This model is oriented towards the strategic management of new product development and incorporates three types of new product development transfer that can be tailored for different organisations;

1. **Stage dominant**; where formal groups, or organisational entities are technically and organisationally specialised.
2. **Process dominant**; where no discrete or definite transfer points between organisational groups exist.
3. **Task dominant**; where staff are all strongly oriented to completing the task and achieving the end product.

figure 1.3 A flow diagram of the 7-stage new product process model Cooper (1983)[29]

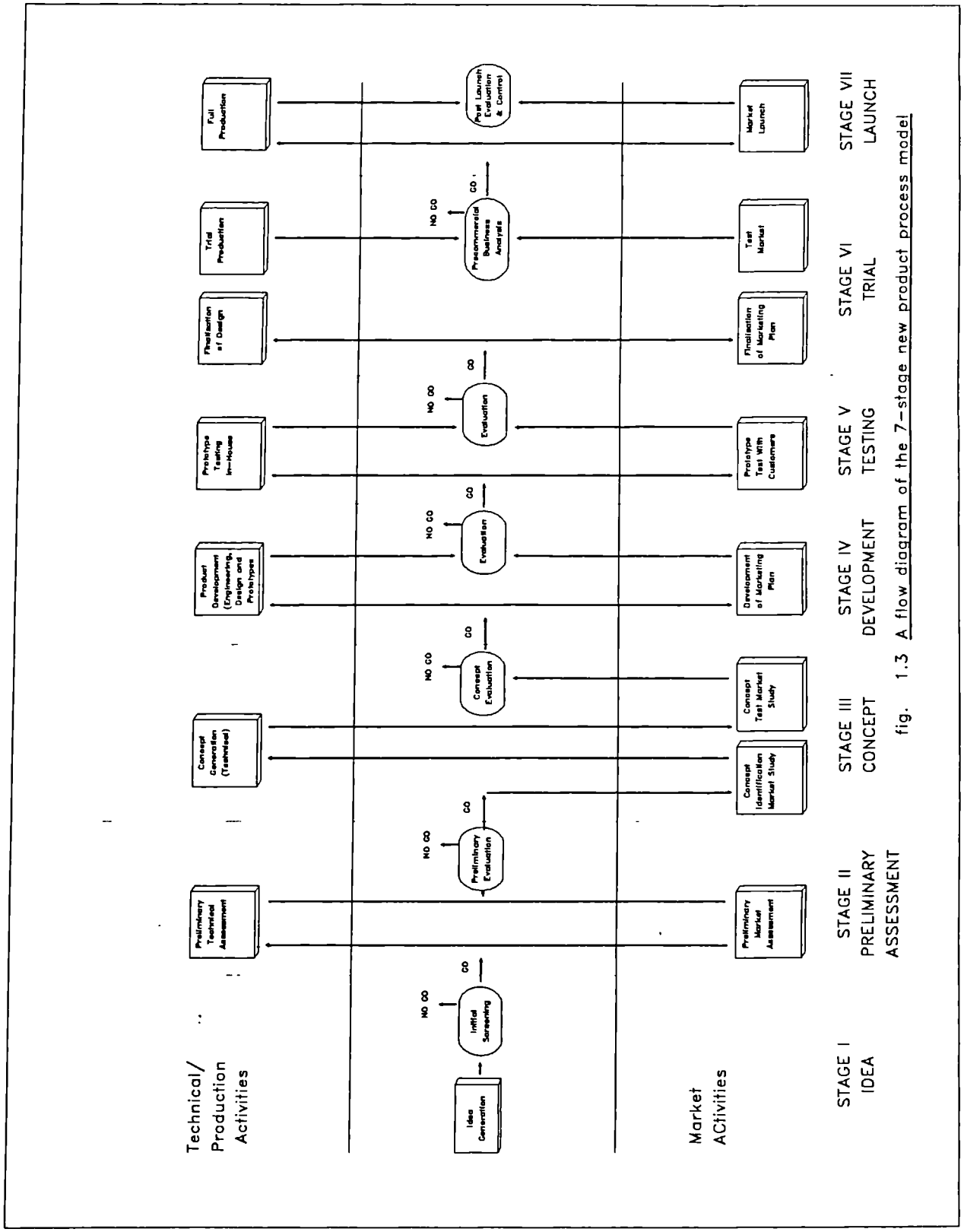
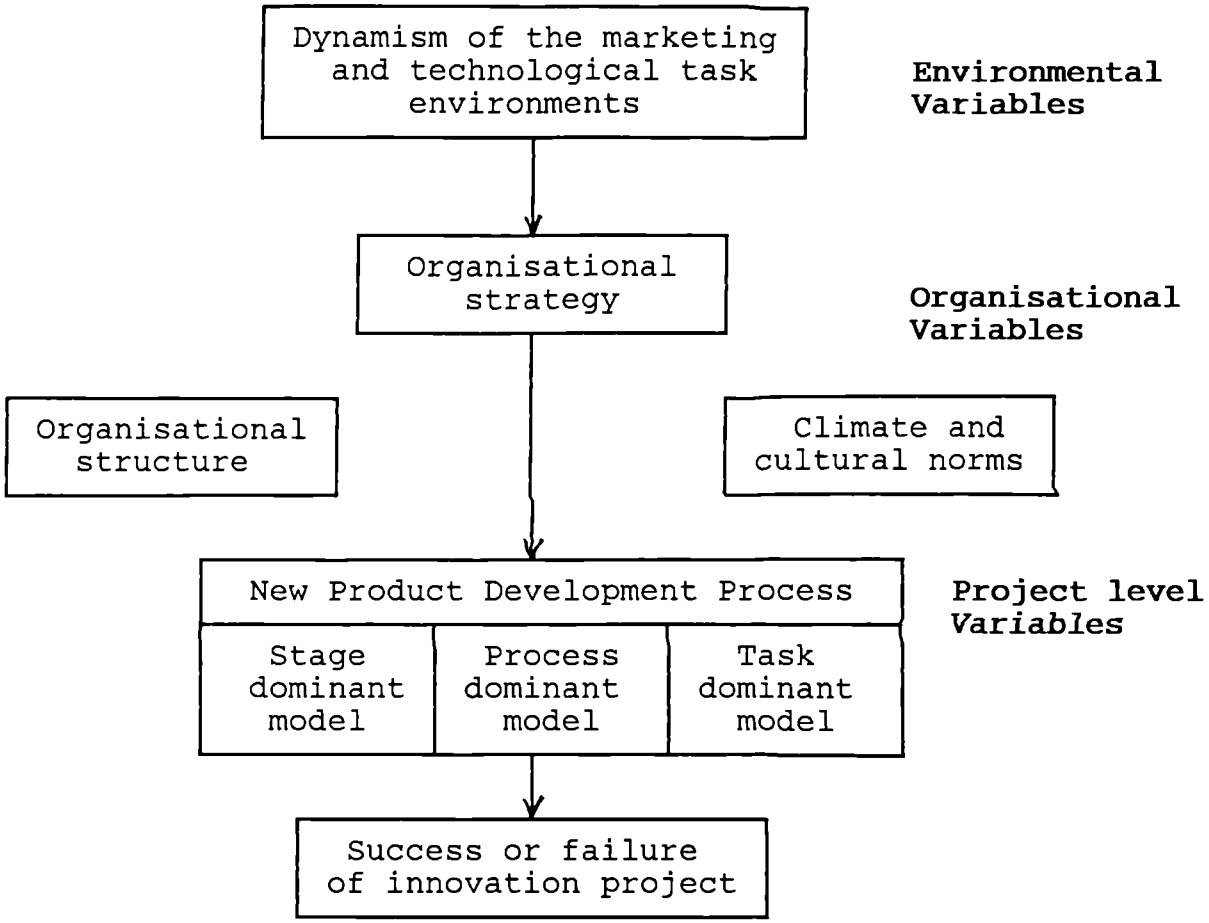


fig. 1.3 A flow diagram of the 7-stage new product process model

figure 1.4 Contingency model of the innovation process

Shrivastava & Souder (1987)[129]



This model has the advantage that it includes environmental and organisational variables and can be applied across a variety of situations. The authors emphasised the importance of managing the integration of innovation processes and the variables that influence it.

It is not surprising when one lists the requirements of a process model that a comprehensive model does not exist. The process of new product development is extremely complex and will vary significantly from company to company. Almost

every major function within a company is involved. Marketing will be required to identify customer requirements and ensure that the product launch goes according to plan. Engineering will not only be responsible for designing the product, but also identifying the manufacturing requirements. These and other aspects of development such as research, idea generation, creativity, financial aspects need careful coordination and planning. A multi-disciplinary approach is needed with many parallel developments not only between departments, but also within departments (Takeuchi & Nonaka(1986)[135]). A company's internal development process needs to be closely tied in with its corporate objectives, and linked to the external environment to allow new ideas into the organisation.

Saren (1984)[121] concluded that a general model is required which accurately segments and describes what occurs in the firm during the innovation process. Johne & Snelson (1987)[61] also concluded that further empirical work is needed into the process of new product development.

1.5 Summary and conclusions

It could be argued that man's entire existence revolves around improving the quality of his own life, that of others around him and that of future generations. Improvements to the quality of life occur through change and the majority of these changes are driven by technological changes. The rate of technological change has increased to a level never before experienced (Hawthorne(1978)[49]).

Innovation is the process through which any new idea is taken from its concept through to commercial exploitation and launch. It incorporates a range of ideas that result in small changes through to radical inventions. Innovation encompasses the whole process through which new ideas, incremental or radical are conceived, diffused and successfully exploited.

Product innovation involves the creation and introduction of new products, it is the process through which an idea is translated into a physical product. The importance of product innovation is demonstrated by its strong links to economic growth. Product innovation is crucial to the long term survival of manufacturing industry, future national prosperity and improving the quality of life. Without a regular flow of new products, any company will struggle to survive.

It is without doubt, that continual development of successful new products leads to economic strength, a fact supported strongly by Japan's growth and emergence as an economic superpower since the second world war. Much of Japan's success can be put down to its continual development of quality products that satisfy customer needs. The whole process of achieving successful technological innovation is more than just innovation. Success depends on the linking of innovation to business ability, it is a case of managing technological innovation for profit.

There is a definite need to improve the product innovation process and the chances of new product success within the UK. New product failure rates are high, at over

34% of all products produced. Improvements in the product innovation process should lead to better new products, and a reduction in the new product failure rate. In effect, better product innovation will lead to more successful new products, leading to greater company success and national prosperity. In order to improve the chances of new product success, changes to the new product organisation will be required. Companies are facing an environment in a constant state of change, therefore their organisations must also adapt as the environment, technology and customer needs change.

Interest in, and recognition of, the process of new product development has grown dramatically over the past thirty years. The process is complex and thus difficult to define. Innovation is a process involving an enormous amount of uncertainty, chance and creativity (Twiss (1986)[141]). Despite this, it is the contention of this research that there are identifiable patterns of innovation that lead to more success. A substantial amount of research has been carried out to identify the factors associated with successful product innovation. Many of the factors identified as being associated with new product success are within managerial control. As Twiss (1985)[142] commented, the barriers to effective technological change in the U.K are managerial.

Successful innovation cannot be left to chance, it must be carefully managed, controlled and exploited.

Baran et al. (1986)[5] commented that innovation does not just happen, it needs to be supported and managed to flourish. Despite this, and its importance to company survival, and national prosperity, product innovation is probably the least understood, least managed, and least researched activity within British industry today.

The need to improve the process of new product innovation has stimulated the need for this research. The research has investigated all aspects of successful product innovation. This has involved a detailed study of the factors associated with successful product innovation and their application to improve the chances of new product success. The main hypotheses being tested by the dissertation were:-

1. The factors associated with successful innovation have been clearly identified.
2. Industry and new product managers are making few if any attempts to apply the findings of research studies and, in the majority of cases, are not even aware of the research.
3. The most effective way to apply the research findings is through the use of a planned programme of organisational change.

This thesis is broken down into nine chapters. Chapter 2 reviews the literature on the success and failure of new products and, after critical examination of the methodologies used, draws from this work five attributes

associated with new product success. Chapter 3 goes on to discuss organisational aspects of new product development and identifies a framework that can be used to analyse the new product development organisation.

Chapter 4 describes the research methodologies and the choice of population. Chapter 5 describes the planning of the initial questionnaire survey, on new product innovation and success. Chapter 6 discusses the results from this initial questionnaire.

Chapter 7 describes the planning and the results from ten case studies carried out to identify the type of changes companies are making to improve their product innovation process. Chapter 8 describes an experimental case study, the aim of which was to develop a methodology that could be used to improve the chances of new product success. Finally chapter 9 draws the work together in the form of a discussion and conclusions.

2. RESEARCH INTO NEW PRODUCT SUCCESS AND FAILURE

2.1 Introduction

In the past thirty years a large number of research studies have been carried out to identify the factors associated with successful innovation. These studies have differed in terms of sample size, the methodologies used, the industries studied and their definitions of success. Yet despite these, and other methodological differences, the results for the research as a whole are strikingly similar. Many studies have identified similar factors as being associated with successful product innovation.

The factors identified through the research are not intended to guarantee success. Similarly because an innovation does not posess any of the identified success factors, their absence cannot be used to predict failure. Twiss (1986)[141] commented that "the research has shown that success requires the presence of a number of factors. In the absence of these factors the product will not be doomed to failure, there will always be exceptional cases where the benefits accruing from an innovation are so outstanding that it will succeed despite its management. However these exceptions and their presence does not absolve management from trying to improve the process".

Early research into the factors associated with the success and failure of innovations consisted mainly of case studies (Carter & Williams (1957)[18], Myres and Marquis (1969)[91], Langrish (1972)[70]). Utterback (1974)[145] reviewed

many of the early case studies and commented that they were of a distinctly descriptive and non-cumulative nature. Utterback concluded that the case study method offered a source of ideas and hypotheses for further research, but did not give the means for a deep understanding of the innovation process.

Prior to the early seventies the research concentrated on identifying the factors associated with either success or failure. Many of the studies concentrated on failure as researchers felt it easier to identify what went wrong, than what went right. It was reasoned that an understanding of past failures was the first step to a prescriptive solution. Some of the early research also looked specifically at new product success. It was not until project SAPPHO (Rothwell et al. (1974)[111]), however, that successful innovations were compared with unsuccessful innovations of the same type. This method was used to identify the differences between success and failure. Most major research studies since SAPPHO have involved a similar method. In recent years the research into new product success and failure has tended to become more empirical (Cooper(1979)[26]), using larger samples and more quantitative analysis techniques.

The results from the research have, in the main, been presented as lists of factors or conclusions on innovation success. Recently Cooper (1983)[29] expressed concern that few of the research studies had presented clear methodologies allowing advantage to be taken of the lessons learnt.

With any attempt to improve the process of innovation it is important that managers are aware of the factors

associated with success or failure. This chapter reviews the key research studies into new product success and failure. Ten of the key research studies that have probed into the innovation process are considered in detail. These studies have made a substantial contribution to research in this area and there are many lessons to be learnt from the techniques they have employed. The results, in terms of the factors identified seem to have changed little over the last twenty years. This is demonstrated especially through the conference board studies (Cochran & Thompson (1964)[21], Hopkins & Bailey (1971)[55], Hopkins (1981)[54]). The ten key research studies are as follows:

(a) Carter and Williams (1957)[18]

(b) The Conference Board (1964)[21], (1971)[55] & (1981)[54]

(c) Myres and Marquis (1969)[91]

(d) Langrish (1971)[70]

(e) Globe Levy and Schwartz (1973)[43]

(f) Rothwell et al (1974)[111]; **Project SAPPHO II**

(g) Rubenstein (1976)[120]

(h) Gerstenfeld (1976)[42]

(i) Cooper (1979)[25], **Project Newprod.**

(j) Maidique and Zirger (1984)[81], **SINPRO**

Section 2.3 goes on to describe similar studies that have examined general aspects associated with successful innovation. Section 2.4 questions the methods used by the research and discusses the problems that need careful consideration when researching the new product development process. The research studies considered in this chapter were analysed using a computer spread sheet, a summary of

which can be found in appendix I.

Section 2.5 goes on to describe five key attributes associated with new product success that have been drawn from the literature. Finally the methodologies that have been presented for applying the research are discussed.

2.2 Key research studies

2.2.1 Carter and Williams

One of the first major studies was carried out in 1956 by Carter and Williams (1957)[18] who identified twenty four characteristics associated with technically progressive firms. The study looked at the speed and application of science in a wide range of British industries. Information was collected through a series of case studies, and involved a total of 269 firms. Carter and Williams believed that a full and speedy application of science was essential for economic growth.

The study considered only technically progressive firms. These were judged as being those firms which "kept close to the best which could be reasonably achieved in the application of science and technology". New product development is one of the major applications of science and technology, and it is for this reason their study is considered as one of the first relevant.

Carter and Williams examined case studies from those firms which were judged as being highly progressive. The characteristics that were common to all or most of them were

then listed. They identified twenty four characteristics that were found to be present in the progressive firms. These characteristics also proved to be absent in unprogressive firms. These twenty four characteristics were:

1. High quality of incoming communication.
2. A deliberate survey of potential ideas.
3. A willingness to share knowledge.
4. A willingness to take new knowledge on licence and to enter joint ventures.
5. A readiness to look outside the firm.
6. Effective internal communication and coordination.
7. High status of science and technology in the firm.
8. A consciousness of costs and profits in the research and development departments.
9. Rapid replacement of machines.
10. A sound policy of recruitment for management.
11. An ability to attract talented people.
12. A willingness to arrange for the effective training of staff.
13. Use of management techniques.
14. Identifying the outcome of investment decisions.
15. A high quality chief executive.
16. Adequate provision for intermediate managers.
17. Good quality in intermediate management.
18. An ability to bring the best out of managers.
19. Use of scientists and technologists on the board of directors.
20. A readiness to look ahead.
21. A high rate of expansion.

22. Ingenuity in getting round material and equipment shortages.
23. An effective selling policy.
24. Good technical service to customers.

Today the study could be criticised as being very general in some ways as it does not focus on one particular type of innovation, or industry. Carter and Williams included both product and process innovations over a wide range of industries. Also the author's methods of judging technically progressive (ie. successful) firms did not include many quantitative measures.

This initial research however, based on a series of case studies laid the foundations for many future hypotheses and research studies. Despite the age and approach, many of the factors identified are similar to those raised by later studies. The report on the study aimed at stimulating the further examination of the difficulties in adopting new technology. Carter and Williams also presented measures that offer hope in speeding up the rate of adoption of science.

2.2.2 Conference board record studies

Three major studies have been carried out by the Conference Board (Cochran & Thompson (1964)[21], Hopkins & Bailey (1971)[55], and Hopkins (1981)[54]). Despite the sixteen year interval between these studies the results are strikingly similar.

The Conference Board studies focused specifically on

new product innovation and development. The first study, Cochran and Thompson (1964)[21], involved a sample of 87 US. companies each of which had introduced a major new product within the last five years. The study identified the following reasons for the failure of new products:

1. Inadequate market analysis
2. Product defects
3. Higher costs than anticipated
4. Poor timing
5. Competition
6. Insufficient marketing effort
7. Inadequate sales force
8. Weakness in distribution

Over half the companies surveyed mentioned that the first three factors; inadequate market analysis, product defects and high costs had contributing strongly to failure.

The study also questioned what positive steps companies had been taken to strengthen their new product programmes and hence increase the likelihood of new product success. The major remedies identified included; better screening and research for new product ventures, improving procedures and communications, the strengthening research and development efforts and ensuring better control and quality throughout the process.

Nearly a decade later Hopkins and Bailey (1971)[55] carried out an identical study. This time the sample involved 125 members of the Conference Board's senior marketing executive panel. Again the study concentrated on the causes of failure, and the results were almost identical

to those of Cochran and Thompson. The principal causes of failure of new products or services were found to be:-

1. Inadequate market analysis
2. Product problems or defects
3. Lack of effective marketing effort
4. Higher costs than anticipated
5. Competitive strength or reaction
6. Poor timing of introduction
7. Technical or Production problems

The latest Conference Board study, Hopkins (1981)[54] involved 91 medium to large sized firms from the United States. Yet again the results were almost identical. The most common causes of failure being; poor marketing research, technical problems in design or production and improper timing. Recommendations again called for market research to be improved.

The Conference Board studies are quite unique in the fact that they have repeated an almost identical survey over a period of time. The studies clearly show that little has changed during the 16 year interval between the first and most recent study.

2.2.3 Myres and Marquis

Myres & Marquis (1969)[91], analysed over five hundred innovations before presenting their ideas as to the various characteristics associated with successful innovation. The two year study was carried out for the National Science Foundation. The study covered innovations that had occurred

within the last 5-10 years and was based on a sample of 121 companies. The sample encompassed five main industries; railroad companies, railroad suppliers, housing suppliers, computer manufacturers, and computer suppliers. The innovations were identified by responsible executives who judged them as being important. The authors then contacted the technical people who could best provide the information needed. Each innovation used in the research was documented through interviews with an individual who had been closely involved in the project. The interviews were undertaken by a professional interviewer and Myres and Marquis took great care in defining clearly the terms used in the survey.

The findings were largely descriptive, and the general theme of the results suggested that minor innovations can be programmed or planned for in some way, whereas major innovations were generally unpredictable and almost accidental in nature. The following conclusions were drawn:

1. Technical change is to a significant extent based on small incremental innovations.
2. Recognition of demand is a more frequent factor in successful innovation than recognition of technical potential.
3. Adopted innovations as well as those originating in the firm contribute significantly to commercial success.
4. Ideas for innovations are often evoked by new information input. It is important that these new ideas have a receptive climate.
5. Major inputs to innovations are predominantly

within the last 5-10 years and was based on a sample of 121 companies. The sample encompassed five main industries; railroad companies, railroad suppliers, housing suppliers, computer manufacturers, and computer suppliers. The innovations were identified by responsible executives who judged them as being important. The authors then contacted the technical people who could best provide the information needed. Each innovation used in the research was documented through interviews with an individual who had been closely involved in the project. The interviews were undertaken by a professional interviewer and Myres and Marquis took great care in defining clearly the terms used in the survey.

The findings were largely descriptive, and the general theme of the results suggested that minor innovations can be programmed or planned for in some way, whereas major innovations were generally unpredictable and almost accidental in nature. The following conclusions were drawn:

1. Technical change is to a significant extent based on small incremental innovations.
2. Recognition of demand is a more frequent factor in successful innovation than recognition of technical potential.
3. Adopted innovations as well as those originating in the firm contribute significantly to commercial success.
4. Ideas for innovations are often evoked by new information input. It is important that these new ideas have a receptive climate.
5. Major inputs to innovations are predominantly

general in nature, widely diffused and readily accessible.

6. Personal experience and personal contacts are the principal sources of innovation for successful innovations.

Overall Marquis concluded that the management of innovation is a corporate wide task that is too important to be left to any one specialised functional department.

2.2.4 Langrish

Langrish (1972)[70] published a list of factors associated with a firm's success in technological innovation. This study involved a series of eighty five case studies, the objective being to identify factors important to technological innovation. Langrish's sample was based on companies that had achieved the Queens Award for innovation and hence this was also his measure of success. The following factors were found to be important to success:

1. Top person: the presence of an outstanding person in a position of authority. Either by identifying a useful area to work in or generating enthusiasm by taking a special interest and ensuring the necessary resources are available.
2. Other person; some other type of outstanding individual. A key individual who sometimes described as a "mechanical genius"; a person who possessed some unique area of knowledge that otherwise would not have been at the disposal of the firm.

3. Clear identification of need.
4. The realisation of the potential usefulness of a discovery.
5. Good Cooperation
6. Availability of Resources
7. Help from Government Sources

Langrish also listed six factors which were found to cause delays to innovation:

1. Some other technology not sufficiently developed
2. No market or need
3. Potential not realised by management
4. Resistance to new ideas
5. Shortage of resources
6. Poor cooperation or communication

The study was intended to outline the factors associated with success and not provide conclusive proof.

2.2.5 Key factors in innovation, Globe, Levy and Schwartz

Globe, Levy and Schwartz (1973)[43] studied eight outstanding innovations. The case studies were chosen jointly by the National Science Foundation and the project team. They included the following:-

1. The heart pacemaker
2. Hybrid grains and the green revolution
3. Electrophotography
4. Input-Output economic analysis
5. Organophosphorous insecticides

6. Oral contraceptives
7. Magnetic ferrites
8. Video tape recorder

The study was carried out by identifying the key events that occurred for each case during the innovation process. These key events were analysed and twenty one factors believed to be important to the key events were then identified. The results showed that no factor was judged important for every event yet every factor was important for one event. Those factors that proved important in over 50% of events were:-

1. Recognition of technological opportunity; the opportunity to attain a technological improvement.
2. Recognition of need; market pull.
3. Internal R&D management
4. Management venture decision
5. Availability of funding
6. Technological entrepreneur
7. In house colleagues

The study also identified characteristics common to the case histories. From these, the following conclusions were drawn; The technological entrepreneur occurred in nine out of ten of the innovations. Early recognition of need also appeared in nine of the innovations and this clearly substantiates the importance of market pull. Adequate funding emerged as another important consideration.

Finally the study analysed the 533 significant events that occurred during the various stages of innovation. From this analysis, it was found that: the time span from first conception to first realisation is not growing shorter and,

as the innovation process progresses, mission oriented research and development events become more dominant.

The authors concluded that innovation cannot be fully controlled or planned. Their analysis showed the importance of funding. Management should therefore ensure that there is sufficient funding during the initial stages, as this will not only allow the R&D to proceed, it will also give confidence to the R&D team.

2.2.6 Project SAPPHO

In the early 1970's project SAPPHO (Rothwell et al. (1974)[111]) became the first empirical study to systematically compare successful innovations with unsuccessful innovations from the same market. Project SAPPHO was a comparative analysis of "paired" successful and unsuccessful technological innovations, where one of the pair was a commercial success and the other a commercial failure. The project was undertaken in two phases. Phase one involved 29 pairs, and during phase two this grew to a total of 43 success/failure pairs, 22 from the chemical process industries and 21 from scientific instrument industries. The results from phase one were confirmed when the same five underlying factors were identified in phase two. The SAPPHO study identified that successful innovators:

1. Had a much better understanding of user needs.
2. Paid more attention to marketing and publicity.
3. Performed their development work more efficiently than failures but not necessarily more quickly.

4. Made more use of outside technology and scientific advice, not necessarily in general, but in the specific area concerned.
5. Had responsible individuals for successful attempts in more senior positions with greater authority than their counterparts.

The results from project SAPPHO showed that innovation is very dependent on key people. Good management techniques and performance can enhance results, but there is no substitute for managers of quality, flair and ability. The results also showed that there is no simple formula or panacea for success. Successful innovators outperformed across in all aspects thus success depends on doing most things well in a balanced and coordinated manner. Rothwell concluded that successful innovation is a coupling process in which the company matches its technological capacity to the needs of the marketplace.

2.2.7 Rubenstein et al.

Rubenstein et al. (1976)[119] aimed to identify the barriers and facilitators in the innovation process. The study was concerned with research and development projects. The sample included a total of six different firms involved in the manufacture of household consumer products, industrial products, chemicals, engineering products, naval machinery and defence related products. A total of 103 different projects were analysed from interviews with 118 respondents. The projects were carefully selected and the

following variables measured:

1. The nature of the firm
2. The impetus for innovation
3. Project decision process and criteria
4. Project structure and process
5. Organisation structure and process
6. The outcome of the project in terms of its technical progress, commercial success and overall success.

Rubenstein identified, through a detailed analysis of the work, a number of myths. The results showed that organisation structures do not make R&D projects successful. Formal aspects such as the structure, control mechanisms, formal decision making processes were shown to have little effect.

Many of the projects showed that individuals had played key roles in the initiation, progress and outcome of a project. Rubenstein pointed out quite clearly that there is no one factor governing success and noted that in some cases one company's facilitator was another's barrier. Too much management support was found to be a barrier as personnel could be tied down to the wrong approach, or an unpromising objective.

He did find however that the factors associated with both technical and commercial success fall into three groups: The establishment of a defined market with a well specified need, communication patterns and information flows within the organisation and the interest and support of top management.

The study was surprising in some ways as it failed to

find statistical evidence to back up previous studies. The study concluded by making various policy recommendations advising company managements to take action to help overcome some of the barriers turned up. Two areas where organisation redesign and policy effort should concentrate were:

1. The need for improved communication in terms of frequency, openness and timing.
2. Major improvements in methods of data gathering, analysis and decision making.

Rubenstein's study clearly demonstrated the importance of people within the new product development process.

2.2.8 West German Study; Gerstenfeld

Gerstenfeld (1976)[42] studied 11 successful, 11 unsuccessful and 10 ongoing projects from the chemical, electro-technical and automotive component industries in West Germany. This study looked at innovations from four standpoints: demand pull verses technology push, level of effort, product verses process innovations and finally, the motivating forces for projects in work. The study was based on previous research into the advantages of pursuing demand pull products rather than technology push.

Information on the projects was collected through a series of personal interviews with 50 R&D managers and project engineers. Respondents were asked to recount specific instances of project success and failure. Successful projects were defined as those where at least one man year of effort had been spent, and the project showed

every sign of continuing. Unsuccessful projects were classed as those that had a minimum of one man year of effort followed by termination and no sign of continuation.

The study concluded that indeed there was a strong positive relationship between demand pull and the success of the project. Gerstenfeld recommended that managers should look carefully at the origin of projects and recognise that a higher probability of success would result from outside demands. In terms of level of effort, the study found that successful projects had greater average effort than unsuccessful ones although the average times elapsed were identical. Gerstenfeld concluded that management should continually monitor ongoing projects and revaluate the probabilities of success with the goal of reducing efforts currently being expended on projects that eventually fail. The chemical industry was found to place much more emphasis on process innovations and product innovations were much stronger in the electro-technical industry. Finally Gerstenfeld observed that the motivating forces for projects were diffuse and stressed the importance of improving methods of getting new technological information into the firm.

2.2.9 Project Newprod. (Cooper.) (1979)

In the later half of 1977 a large and comprehensive study, project Newprod., was carried out by Cooper (1979)[25-28]. Project Newprod. was an extensive investigation into what separates successful from unsuccessful industrial new products. This study, like SAPPHO contrasted new product

successes with failures.

Cooper reviewed previous research and identified many of the variables that had been found to influence new product outcomes, this led to the development of a conceptual model. Cooper believed that this model lent structure to the research by identifying as its elements the main groups of factors that influence new product outcomes. These groups of factors were:-

1. The commercial entity
2. The information acquired
3. Proficiency of process activities
4. Nature of the market place
5. Resource base of the firm
6. Nature of the project

Cooper broke down these six groups to develop a list of 77 variables that were thought to influence new product outcomes. A random sample of 177 firms were selected from a list of active industrial product producers and a mailed questionnaire was then used to measure each of the variables. Appropriate respondents were identified by phone and were chosen to be "functionally neutral", with an overall knowledge of the firm's total new product development efforts.

The questionnaire was mailed to each respondent who was requested to select two typical new products, one that had been a commercial success, and the other a failure. Success was defined from the point of view of each firm and, to avoid difficulties that could have arisen from this definition, managers were asked to select clear cut

successes and failures. The respondent was then asked to characterise each venture on the 77 variables that made up the six groups. The eventual sample numbered 102 successes, and 93 failures from a total 103 firms.

Initial analysis showed the need to collapse the variables into more manageable subsets. By correlating the results Cooper showed that the 77 variables could be explained by a handful of underlying dimensions. In total 18 dimensions or factors were identified that described the new product projects. Of these, 11 were found to differentiate between new product success and failure. These were presented in terms of three keys to success, three barriers, three facilitators and two weakly related factors.

Cooper showed that projects that were high an all these three dimensions had a 90% chance of success. Conversely 93% projects that were low on all three dimensions failed. The three dimensions were:

1. Introducing a unique and superior product, that is;
   - A product that meets customers needs better than competing products.
   - A product that offers unique features or attributes to the customer relative to competing products.
   - A higher quality product than competitive products.
   - A product that does a unique task or job for the customer; something that cannot be done with existing products.
   - A product that is highly innovative, or totally new to the market.
   - A product that permits the customer to reduce his

costs.

2. Having market knowledge and marketing efficiency;
   - Proficiency in undertaking a detailed market study.
   - Having a well targeted sales force and/or distribution effort at launch.
   - Performing a good preliminary market assessment early in the product project.
   - Executing the market launch well.
   - Proficiently undertaking a test market or trial sell prior to launch.
3. Having technical, production synergy and proficiency.
   - Having a strong technological and production synergy between the project and the firm.
   - Having a good fit between the engineering and design skills of the firm and the project undertaken.
   - Undertaking technical and production activities proficiently.
   - Strong technical and production know how within the firm.

Cooper went on to describe three barriers and three facilitators to success, although these dimensions were not as strongly related as the first three. The barriers to success were:

- Having a high priced product relative to the competition with no economic advantage to the customer.
- Being in a dynamic market where new products are introduced regularly.
- Entering a highly competitive market where customers

are already well satisfied with competitors offerings.

The facilitators to success were:

- Having a good "product/company fit" with respect to managerial and marketing resources.
- Having strong marketing communications and a strong launch effort.
- Being in a large, growing, high need market.

Two other weakly related factors included; avoiding products new to the firm and having a market derived idea with considerable investment involved.

Cooper's results were presented in much more detail than other studies. They differ slightly in content, from other studies, in that they are more orientated towards the product and market characteristics and put little emphasis on the management, communication, and people aspects associated with new product development. The initial conceptual model on which the study was based took into account very few of these management and communication oriented factors. Clearly if the conceptual model did not include these factors it would be impossible to identify them during the study.

2.2.10 The Stanford Innovation Project (1982)

The Stanford Innovation project (SINPRO) began in 1982 as a long term study of US. industrial innovation. This study focused on the electronics industry. The electronics sector was chosen because of the rapid technical change it

is continually facing. Maidique and Zirger(1984)[81] believe that high technology industries, such as electronics, provide a fertile ground for the study of new product success.

The methodology chosen by the SINPRO researchers was such that it attempted to address some of the gaps that had been left by previous research into new product success. The study itself was divided into three parts, conducted serially so that progressive refinements could be made to the hypotheses. The research sample was based on 120 participants of the Stanford AEA Executive Institute, who meet annually at Stanford University. Participants in the programme are mainly presidents, vice presidents or functional managers of electronics firms. Each stage of the survey had a specific purpose.

Part I was used to identify the variables associated with the success and failure of new products. This involved a series of open ended questions based around an innovation pair, one success and failure, selected by the respondent. Out the initial 120 surveys given out, 79 were completed to form the initial research database.

The second stage involved a detailed questionnaire similar in nature to the SAPPHO study. The innovation pair selected in part I were compared against 60 variables. The respondents were asked to indicate whether the variables influenced the success or failure of the innovation pair selected.

The questionnaire was sent to the respondents of the first survey and obtained 59 responses. The third and final

stage involved in depth case studies in 20 of the companies that participated in parts one and two. Maidique and Zirger presented their results as a list of factors associated with new product success. These were:-

1. Market Knowledge gained through frequent and intense customer interaction, which leads to high benefit to cost products.
2. Planning of the new product process especially the R&D phase.
3. Coordination of the new product process, especially the R&D phase.
4. Emphasis on marketing and sales.
5. Management support for the product throughout the development and launch phases.
6. The contribution margin of the product.
7. Early market entry.
8. Proximity of the new product technologies and markets to the existing strengths of the developing unit.

Again the study emphasised the importance of market knowledge, and management support.

2.3 Other key literature

There are many other studies that have looked at new product success and failure, the previous section covered ten of the most relevant. Other literature in this area includes reviews of these and other research studies, and also larger more encompassing surveys of innovation in

general.

The centre for the study of industrial innovation[19] produced a report in 1971 on the non technical reasons for the failure of R & D projects. These were broken down into environmental and organisational categories. The environmental factors for failure included:

1. An unattractively small market
2. Uncertainty with monopolistic buyers
3. An unattractive level of competition
4. Obsolescence

The organisational factors associated with failure were:

1. Lack of marketing capacity or expertise
2. Lack of production capacity or expertise
3. Faulty communications with associated firms
4. R & D cost escalation
5. Shortage of R & D resources

In 1977 Rothwell[113] reviewed much of the research carried out during the seventies, including project SAPPHO, and listed the characteristics of successful innovators and technically progressive firms. The factors Rothwell found to be associated with success were:-

1. Good communication and effective collaboration.
2. Innovation as a corporate wide task.
3. Efficient development work.
4. Careful planning and the use of management techniques.
5. The quality of management, personnel policy and management style.
6. Marketing and user needs.

7. After sales service and user education.

8. Key individuals in greater positions of authority.

In 1982 Booz Allen & Hamilton[13] published the results of a study carried out to identify the best "practices" in new product management. This was based on a comprehensive mail survey to executives and product managers of Fortune 1000 companies. Part of the survey included a section that identified the factors that contributed to the success of new products. These factors included:

1. Product fit with market needs.
2. Product fit with internal functional strengths.
3. Technological superiority of product.
4. Top management support.
5. Use of a multiple step new product process.

Peters and Waterman (1982)[96] in a study of successful US companies in general, identified eight attributes that characterise innovative companies these can equally be applied to product innovation:

1. A bias for action, for getting on with it.
2. Close to the customer.
3. Autonomy and entrepreneurship; foster innovators and leaders throughout the company.
4. Productivity through people; respect for the individual.
5. Hands on, value driven; leadership and management support.
6. Stick to the knitting; stay close to the business you know.
7. Simple form, lean staff.

8. Simultaneous loose tight properties; centralised and decentralised.

Cooper (1983)[29] reviewed many of the key research studies and identified some of the lessons that can be learnt from a synthesis of the studies:

1. For industrial new products a much stronger marketing orientation is needed.
2. New product success is largely amenable to management action.
3. There is no easy explanation for what makes a new product a success.
4. The product itself - a unique product with real customer advantages - is central to success.
5. A well conceived properly executed launch is vital to success.
6. Internal communication and coordination between internal groups greatly fosters successful innovation.

Lin (1986)[74] put forward the tangible and intangible reasons for new product failure. Again as with other studies, for the tangible factors there was heavy emphasis on marketing and the strength of the product in terms of quality and concept. The intangible factors included unsupportive corporate structure and emotional decision making.

Twiss (1986)[141] suggested that the most crucial factors found to be important in a wide range of successful innovations are:

1. A market orientation

2. Relevance to the organisations corporate objectives
3. An effective project selection and evaluation system
4. Effective project management and control
5. A source of creative ideas
6. An organisation receptive to innovation
7. Commitment by one or a few individuals

One of the more recent studies was carried out by Souder (1988)[132]. This study was based on a large database of 289 new product development innovations and from the results he noted that the following characteristics were repeatedly found in successful products:

1. A high degree of understanding of the technical problems and the users' needs,
2. A high degree of fit between the technology and the company's level of expertise,
3. A high quality of resources.

The studies discussed above and in section 2.2 provide a comprehensive insight into the factors associated with new product success. Again and again the same factors are identified. Yet despite the number of studies and reviews, none of the literature appears to adequately summarise the research as a whole. Consequently, the studies were analysed in detail to identify the key factors associated with new product success. Before drawing out these key factors it was felt important to question the methodologies used in the research, as differences in the results are likely to be due to differences in the research methodologies.

2.4 Methodological differences in the research studies

Early work on the success and failure of new products was based on case studies. Although essential to generate future hypotheses, these studies did not provide concrete proof of the factors associated with the success and failure of new products. It is only in recent years that research into product innovation has become more empirical and quantitative. Despite such improvements, there are a large number of methodological differences with which the research into new product success and failure has been carried out.

Cooper(1983)[29] argued that there are methodological ailments with research into new product success and failure. Having reviewed much of the work prior to Project Newprod. he concluded that:

(a) Operational definitions were often vague and inconsistent.

(b) Sample sizes were typically small, and methods of sample selection suspect.

(c) Data analysis techniques were naive.

(d) From a marketing point of view and international usage the research lacked relevance.

Each of these aspects is considered in more detail in this chapter. A summary of the main surveys covered in this thesis is given in table 2.1 and shows the range of sample sizes, industries covered and the focus and origin of the research. A more detailed analysis is contained in appendices I and II.

table 2.1 The research studies covered in terms of their sample size, the industries studied and their focus.

Study/Author	Sample Size	Industries Studied	Focus & Success/Failure
1. Carter & Williams	269 firms	Various British Companies	Technically progressive firms
2. Conference Board Record Studies	87 firms (1964) 125 firms (1971) 91 firms(1980)	Various US. Companies	New Product failures
3. Myres and Marquis	567 innovations (121 firms)	US Companies: Railroad companies Railroad suppliers Housing suppliers Computer manufacturers Computer suppliers	Successful Innovations
4. Langrish	85 case studies	Winners of the Queens Award for Innovation	Successful Innovations
5. Key Factors in Innovation / Globe et al	8 key innovations	Eight outstanding innovations from various companies	Successful Innovations
6. Project SAPPHO / Rothwell	43 "pairs"	British Instrumentation and Chemical companies	Successful and Unsuccessful Innovations

table 2.1 (cont.)

Study/Author	Sample Size	Industries Studied	Focus & Success/Failure
7. Rubenstein et al.	103 projects (6 firms)	US. Companies: Household consumer goods Industrial products Engineering products Heavy machinery Defence related products	Successful Project Innovations
8. West German Study / Gerstenfeld	32 projects	German Chemical, electro technical and Automotive companies.	Successful and Unsuccessful product and process innovations
9. Project New Prod / Cooper	195 projects (177 firms)	Canadian Industrial product produces	Successful and Unsuccessful new products
10. The Stanford Innovation project / Maidique & Zirger	79 surveys 59 questionnaires 20 case studies	US. Electronics firms	Successful and Unsuccessful new products

(a) Operational definitions

Myres and Marquis (1969)[91] took great care in defining terms such as innovation, the firm and the establishment, the product and the relative scale of the innovation. In the research as a whole however few studies have put forward such clear definitions, perhaps because the area itself is difficult to define precisely. Definitions in the research can vary tremendously even down to whether a product is a physical entity or a service. The major definitions relevant to the research include; the focus of the research, the definitions of new product success and failure, and the newness of the products sampled.

Defining the focus of the research

The research has covered many different aspects of innovation. Some early research studies looked at both product and process innovation and did not make a distinction between the two. Cochran and Thompson (1964)[21], were one of the first studies to look specifically at new product innovation. Gerstenfeld (1976)[42] considered both product and process innovations with the intention of comparing the two. He found that chemical industries emphasised process innovation, whereas electro-technical industries put more emphasis on product innovation. With project SAPPHO two industrial sectors were chosen for study. The chemicals sector, involved in producing major new processes and the scientific instruments sector involved in producing new products. These structural difference were

later reflected in the results.

There are considerable differences between product and process innovation and consequently the emphasis on the factors associated with success may also be different. The majority of recent studies have clearly distinguished between the two types of innovation and the research considered in this thesis has looked specifically at those studies based on, or dominated by, product innovations.

Defining and measuring new product success and failure

One of the main, and most contentious, operational definitions is the measurement of new product success. Clearly if one is to establish what makes a new product successful it is essential that there is a clear definition of new product success itself. Few studies have discussed this in detail and there is no universally accepted definition, each study has assumed its own.

Crawford (1983)[35] described two methods of success measurement used in studies of corporate success or failure on new products. The first, known as the mortality rate, takes into account all new product ideas from the concept stage through to marketing. During the exploratory stages of new product development a large number of ideas will be generated. As these ideas pass through various selection and screening processes, a serious mortality rate will occur. Crawford (1983)[35] suggested that only two percent of early projects will end up going to market, the mortality rate being in the region of 98%. In 1968 Booz Allen and Hamilton(1980)[13] found that 58 new product ideas were needed

for every one successful new product. In a similar study, carried out in 1980, the same authors found that only seven new product ideas were found to be required to generate one successful new product. It is however difficult to measure accurately the mortality rate as in many companies it would be impractical to count the number of new product ideas.

The second method described by Crawford (1983)[35] is more common, and measures the percentage of products actually marketed that succeed. This method much more realistic and practical to implement.

In terms of defining success, some authors have distinguished between commercial and technical success, however these definitions are by no means watertight. Commercial success, for example, could mean the acquisition of a worthwhile net monetary gain, or an increase in market share. On the other hand technical success could refer to the successful development or the quality or the performance of a new product. Overall success becomes even more complicated, and the definition will vary depending on the product in question. Maidique and Zirger (1985)[81] stated that "success is defined as the achievement of something desired, planned or attempted".

While financial return is one of the most easily quantifiable measures it is far from the only important one. New product failures can result in other important "by products" including organisational, technological and market developments. Some new product failures lead to dead ends and result in very limited organisational growth. On the other hand many others are important milestones in the

development of the innovating firm. As Maidique and Zirger (1985)[81] found, some failures were the clear basis for major successes that followed thereafter.

Measuring success has proved difficult for researchers. Definitions of product success vary from company to company and often within the company itself. Rubenstein's study (1976)[119] was one of the few to qualify different types of success. Rubenstein differentiated between technical success, success in meeting time and cost schedules and the ultimate commercial success of projects. In some studies the authors themselves decided whether a particular innovation or product was successful. Others have used completely different measures, Langrish (1972)[70] for example used the Queens Award for innovation as a measure of success.

The most common solution to the problem seems to have been to let each company define whether its own product has been successful (Cooper (1979)[25]). Myres and Marquis (1969)[91] asked "responsible executives" to define their successful products. Letting each company define its own successful products seems to be an easy and consistent solution. However in cases where only one respondent is used this could be quite dangerous as the solution has a number of flaws:-

1. Each company will have its own definition of success and in the final survey these different definitions of product success will be compared equally.
2. Variances on the degree of success of particular project may differ significantly within the company. The judgement as to whether a product has been

successful will very much depend on the respondent selected. A technical manager may hold a different opinion to that of a financial manager.

3. The company may not itself carry detailed measures of new product successes. Consequently the respondent may believe a particular product to be a success but this may not in fact be the case. In these cases success is very much the opinion of the respondent in the survey.

There is no easy solution to the problem of measuring new product success as there in no universal quantitative definition that companies can use. Each product and company is unique and any definition must be tailored to that particular case.

Defining the "newness" of a new product

There is no consistency in the "newness" of products studied as many of the research studies have neglected to qualify how "new" the new products are that have been studied. Of those that have been specified, again definitions vary considerably. A range of new products has been covered in the literature. Myres and Marquis (1969)[91] considered over 500 incremental innovations. Globe, Levy & Schwartz (1976)[43] looked at only eight outstanding innovations. Again there is no common measure that can be used to categorise these innovations. Booz, Allen & Hamilton (1982)[13] however, described six different categories of newness:

1. **New to the world products**; new products that create

an entirely new market

2. **New product lines**; new products that for the first time allow a company to enter an established market.
3. **Additions to existing product lines**; products that supplement a companies established product lines.
4. **Improvements in, or revisions to, existing products**; new products that provide improved performance.
5. **Repositionings**; existing products that are targeted to new markets or market segments.
6. **Cost reductions**; new products that provide similar performance at lower cost.

Randall (1980)[102] in a survey on new product management, classified the various types of new product as;

- in company innovations
- modifications to a company's existing products
- modifications of innovations from outside the company.

These two breakdowns of the "newness" of new products are both useful yet represent completely different views on defining and measuring the degree of innovation incorporated in a new product. No studies appear to have used the same measures. Many have even omitted to define how "new" their surveyed new product are.

(b) Sample sizes, method of sample selection and basis of the research

In the studies considered sample sizes have varied from eight key innovations (Globe Levy and Schwartz (1973)[43]) to

567 incremental innovations (Myres and Marquis[91]). It is difficult to compare these sample sizes in terms of straight "numbers", as the quality of the sample will differ, as will the "newness" of each innovation. Globe et al. (1973)[43] considered eight key innovations each of which was a major breakthrough in their respective technologies. Myres and Marquis however looked at over 567 innovations, the majority of which were incremental developments.

In the main, sample sizes have been small and methods of sample selection are questionable. The larger the sample the more valid the results. Size however is often constrained by the resources available to the researcher. Few studies discuss in detail the nature of their samples and the majority do not disclose how their samples were selected. Selected samples need to reflect the population under study and care needs to be taken to ensure a random sample is selected. Maidique and Zirger (1984)[81] for example chose their sample from a selection of executives attending a conference. This sample may not have been an accurate cross section of the population they were studying. Good sample selection is a crucial part of any research study as poor samples can lead to bias, and difficulty in validating the results.

Many of the research studies do not seem to have a sound structured basis. The results of any study can only be as good as the model and methodology on which they are based. The initial case studies tended to be very open ended and not based on such models, this was intentional as they were exploring and identifying new concepts. Few of the

studies covered have been based on solid conceptual models. Cooper (1980)[27] was one of the first to clearly define the model he used, but this model did not cover all the management aspects and variables that influence new product outcomes. Most of the research studies have been based on the findings previous studies. It is essential to examine earlier studies to learn from their techniques, results and mistakes.

(c) Methodologies used

The three main methodologies used in the research into new product success and failure include; case studies, interviews and postal questionnaires. Case studies have proved invaluable as an initial exploratory techniques Utterback (1974)[145]. Interviews appear to be the most efficient methodology for collecting data as the research area lacks clear definitions, and the majority of questions that arise can only be answered in the interview situation. Postal questionnaires have been used in several cases, although useful in obtaining a large sample this technique does not lend itself to a detailed analysis of the product innovation process.

(d) Relevance of the Research

No study was identified that had researched the differences in success factors across different countries. Cooper (1983)[29] suggested that factors developed in one

country are not relevant in others, however there is little evidence to support this. Differences in the results are more likely to be explained through differences in the methodologies used than in the samples considered. Studies similar to SAPPHO, carried out in various European countries have produced very similar results. Rothwell (1974)[112] compared SAPPHO with a similar Hungarian study. He concluded that the results were remarkably similar.

The majority of differences in the research findings can generally be explained through differences in the research methodologies. Further research into the factors associated with new product success and failure is inevitable. Future studies need be more structured and careful thought must be given to the previous research studies and the methodologies used. Clear definitions and a sound structured methodologies are essential.

2.5 The attributes associated with the success and failure of new products

The factors affecting success and failure form a complex set of variables that will differ for product and company. Despite this complexity, the variables or factors can be grouped together into five key attributes that have been associated with new product success. Of the 18 studies considered in 2.2 and 2.3 a total of 140 factors associated with new product success were identified. In a review of these studies it was concluded that no one study or review

summarised the findings of the whole research accurately. It was decided therefore to analyse the factors presented so as to break them down into suitable attributes.

The factors were analysed with the help of a computer spread sheet. The factors were listed and arranged into suitable groups. A copy of the analysis can be found in appendices I and II. It is difficult to simplify and classify these factors as many overlap and interrelate, however the following five attributes were found to be of exceptional importance in new product success:

1. A unique and superior product that clearly meets customer wants and needs.
2. Good communications and coordination.
3. Proficiency in technological activities.
4. An open minded, supportive, and professional management.
5. A good market knowledge and strategy.

The attributes are not intended to be in order of importance. No "hard and fast" rules were used to select the five, they stood out from the factors as a whole and in each case the attribute was identified as a factor contained in well over 50% of the studies, as demonstrated in table 2.2. Each of the five factors is discussed in section 2.5.

table 2.2 Analysis of the attributes associated with new product success

	ATTRIBUTE	% of studies in which attribute is identified	number of factors in total
1.	A unique and superior product that clearly meets customer wants and needs.	67%	10
2.	Good communications and coordination.	56%	14
3.	Proficiency in technological activities.	56%	17
4.	An open minded and professional management.	78%	30
5.	A good market knowledge and strategy.	78%	23

2.5.1 A unique and superior product that clearly meets customer wants and needs.

It has long been noted and indeed most research studies undertaken into new product success and failure have emphasised the importance of understanding user needs. Myres & Marquis (1969)[91] identified that the majority (over 79%) of innovations were stimulated by market demand as opposed to technological advances. They advised that management should concentrate on analysing such demands and needs. Gerstenfeld (1976)[42] found that out of eleven successful innovations, eight arose as a result of demand pull, compared to failure where nine out of the eleven were as a result of technology push. Rothwell et al.(1974)[111] from

project SAPPHO concluded that "successful innovators had a much better understanding of user needs". Cooper (1983)[29] argued that a unique product, with real customer advantages is central to success. Maidique & Zirger (1982)[81] found that successful organisations, through an in depth understanding of the customers and the marketplace, introduced products with a high performance to cost ratio.

The recognition of the importance of user needs is not new. As early as 1971 Utterback[143] concluded "it appears that neither cost nor the technical knowledge required in producing an innovation are the crucial constraints faced by a firm. The primary limitations on a firm's effectiveness in innovation appear to be its ability and perhaps aggressiveness in recognising needs and demands in its external environment".

The quality and value of the product itself is central to its success. Any product developed must meet customer needs. Yet despite the literature and the obvious nature of the argument, failure to meet customer needs is by far the most commonly cited cause of failure. Randall (1980)[102] in a BIM study concluded that despite the large number of research studies, recognition of market need was only quoted by a minority of the 330 UK. companies involved in the survey. Randall found that most ideas for new products arose as technical knowledge or bright ideas from salesmen. Only a minority of firms relied on market research.

Clearly a product must be designed to meet the customer requirements. The product must have significant or unique advantages over competitors products, and thus meet customer

needs better than competing products. Cooper (1983)[29] found this factor crucial in determining new product success. Good design, based on a clear interpretation of user needs is crucial. Companies need to erase the "we know best" syndrome often present in their designers. It is important that firms make the necessary enquiries of users, and designers recognise customer needs and fulfil these without trying to satisfy their own egos. Cooper (1983)[29] concluded that the product needed to be unique and superior in the eyes of the customer and not just in the opinion of the R&D department. It is essential that companies build into the product a certain amount of innovative flair and style that will distinguish it from its rivals.

The achievement of this attribute will be strongly interlinked with the other four attributes. Understanding user needs and achieving a superior product will be closely linked to obtaining good market information. Clear and effective communication of ideas is needed from the customer right through to the designer. This communication often passes through marketing and R & D departments. If companies are to achieve success in this attribute they will also need the technical and design skills to develop products of higher quality and reliability than those of competitors products. These technical skills have to be coupled with the communication and marketing skills to identify user needs. As Shaw (1987)[128] points out, a key factor is the ability of the firm to match its technological capability with an appropriate set of user needs.

2.5.2 Good communications and coordination.

Rothwell (1977)[113] in his review of innovation research studies found that the importance of good communication to success was drawn as a conclusion in all nine studies. The majority of studies covered in this chapter have also cited in one form or another the need for good communication. There is a strong body of evidence that demonstrates the positive link between good communication, coordination and successful innovation.

A strong and clear communication link is needed between the user and the designer. Often this communication link is the responsibility of marketing. Yet as Twiss (1986)[141], and other authors have commented the linking of R&D and marketing poses one of the most serious technological barriers in the process of successful innovation.

The majority of such communication can only be achieved through the combined efforts of the designer and his company. The company and other departments, must recognise this and make every effort to make these communication flows as clear and as short as possible. If interdepartmental rivalries exist this link could be easily destroyed; teamwork is essential.

Good communication is needed both inside and outside the company and during every stage of the innovation process. Communication needs to be effective so as to ensure collaboration and coordination of the new product development activities across the many departmental boundaries. Companies must communicate well with their

customers, end users and suppliers so that they are aware of changing wants and needs.

It has also been noted that companies benefit from good communications and links with universities, polytechnics and other scientific institutions (Rothwell (1977)[113]). These links will aid the flow of new technology and ideas into the company. Careful planning and the use of a structured, logical new product development process has also proved an attribute in achieving new product success. This communication tool is essential to ensure efficient collaboration with the people involved.

2.5.3 Proficiency in technological activities

Cooper (1983)[29] found that a good "fit" between the new product being developed and the company, in the area of technology and production, combined with a strong proficiency in undertaking technical and product development activities are both attributes strongly associated with new product success. Companies need to ensure that the resources are available and that the technical and production skills match the new product development being undertaken. The launch of the new product into production should be a smooth and efficient activity, and other development activities such as design and prototype testing need to be undertaken in a systematic and professional manner.

2.5.4 An open minded, supportive and professional management

Of the studies analysed, by far the most common factor cited was that of management style. A good management style is essential in generating a creative and innovative atmosphere that will lead to success. A clear need here is that management should provide strong support for new product development (Rothwell (1977)[113]). Management need to be able to create an atmosphere of trust, coordination and control.

A common factor identified by many studies is the importance of a key individuals. A key individual will often play a vital role during the innovation process (Langrish(1972)[70]). It is important that any such individuals are in a position to make crucial decisions or obtain the necessary support. Management need to take a professional approach and plan carefully using appropriate systems and effective management techniques.

2.5.5 A good market knowledge and strategy.

It would make sense for companies to look to the customer and the market for the majority of their new product ideas (Cooper(1983)[13]). Ideally everyone involved in the new product development should have a clear understanding of user wants and needs. A detailed market assessment should be undertaken, together with a thorough analysis of customer preferences. The sales department

should be well targeted and have a strong and aggressive sales force.

The five attributes form a complex and strongly interrelated set of variables that have proved to affect the chances of new product success. Most of the variables that have been identified are within company control. There are few environmental variables that are totally outside the influence of the company. Developing all of the attributes that have been associated with success will not guarantee success, but it should certainly improve the chances. Other factors were identified by the studies included, timing, and strong launch efforts. There are many smaller factors, but it is felt that the majority of the ideas and attributes are captured by the five key attributes.

It is one thing to list the factors associated with success and point out where management is going wrong. Few studies seem to have taken this a step further and proposed clear solutions or methodologies through which the factors can be applied to improve the new product development process.

2.6 Methodologies for application of the research

Although it is often pointed out that many of the factors associated with new product success are within management control (Twiss (1985)[142]), practically no research studies have laid down clear guidelines through which managers can apply the research results. Authors keep

concluding that management action is required, as if managers will automatically know exactly what action to take.

Rothwell and Gardiner (1985)[114] found that the take up by managers of the SAPPHO study[111] and Carter and William's[18] work was slight. They put this down to (as well as lack of awareness or just plain indifference) the fact that none of the studies offered prescriptions or recipes for success, but rather just a set of broad guidelines and identified crucial areas for management action. Cooper (1983)[29] concluded that the results of many of the research studies are not amenable to management action due to their poor presentation. Cooper goes on to argue that the lessons point to a flow process model. Hopkins (1981)[54] concluded that companies are changing their organisation and procedures, upgrading their market research capabilities, and sharpening their sales forecasting.

One of the most recently suggested methods of applying the research was suggested by Arleth (1987)[3]. Arleth proposed Danprod., a computer based package based on the results of Cooper's work on project Newprod. (1980)[27]. The computer model is intended as a decision tool for evaluation of new product ideas and concepts. A questionnaire is completed by the new product manager, the results of which when processed are used to draw up a profile of the new product's chances of success. Such a model could be useful in the selection of new product ideas for further consideration.

No clear methodologies for applying the factors exist,

the results are in most cases lists of factors followed by statements such as "managers should look at these more carefully". Few managers will have the time or inclination to research the factors in detail. They are presented across a wide range of literature. Of the managers that do take time, few will be in a position to implement the changes required, if indeed they have developed a clear and accurate picture of the changes necessary.

It is not important that managers have a detailed set of rules to follow but merely a set of techniques, guidelines, sources of information and support, with which to set up a continual process of renewal and exploration that can combine both experience and proven research factors, and direct this into appropriate change.

2.7 Summary and conclusions

Research studies into the process of new product success and failure have clearly identified the factors associated with successful product innovation. There are however considerable variations in the methodologies used to identify the factors associated with new product success. Many of the approaches taken are questionable and despite the number of studies there is still considerable scope for more detailed and quantitative research in this area.

From the research studies identified, no one study was felt to adequately describe the research as a whole. Eighteen studies were analysed in detail and from these five key attributes associated with new product success were

identified. These five key attributes were:

1. A unique and superior product that clearly meets customer wants and needs.
2. Good communications and coordination.
3. Proficiency in technological activities.
4. An open minded and professional management.
5. A good market knowledge and strategy.

The research studies have presented the results as lists of factors and despite the 18 studies, no literature has put forward clear methodologies to improve the process of product innovation.

3. ORGANISING FOR PRODUCT INNOVATION

3.1 Introduction

There is no one best way to organise for new product development. Johne (1984)[57] commented that "it seems that reorganising the product development function is a common and regularly administered solution to any perceived new product malaise. It is as though new product managers keep seeking some form of perfect organisation that will lift their work to new levels of success". Within industry, the variety of organisational possibilities ensures a multitude of completely different new product development organisations all of which may achieve the same desired effect. The continual changes in the environment surrounding the new product development organisation will force change in the organisation itself (Reddin(1970)[103]). As soon as one organisation is developed to its potential it will become outdated due to continual technological, market and management changes.

Organising for new product development is a complex and ongoing problem due to the nature of the new product development process itself. New product development is made up of a series of activities usually controlled by different departments each with different structures, skills, cultures, people and resources. Overall control of the process is inevitably difficult. Crawford (1983)[35] emphasised importance of the new product development task and concluded that it is second only to corporate strategy,

involving all aspects and functions of management. Any new product organisation will need to draw all these aspects and functions together to ensure successful product innovation.

The idea that successful new product development requires effective collaboration across the whole organisation is nothing new. As early as 1965 Lawrence & Lorsch[72] indicated that an effective organisation was key to providing good collaboration and communication between scientific innovators, sales, and production specialists.

Before we can examine in detail how companies adapt and change their new product development organisations we need to look carefully at how companies currently organise for product innovation. It is important to carefully define the new product organisation. Perhaps the most common representation of any organisation is the formal organisation structure; the framework, often referred to as the "family tree", of the company's departments showing lines of authority. Such diagrams can only partly describe any organisation. In reality an organisation is a multitude of factors, made up of structure, people, skills, goals, culture and systems.

In order to structure a discussion on the new product development organisation it is helpful to use a model to analyse the various factors. This will ensure that the major parts making up the organisation are covered. Numerous models are available with which to analyse organisations (Pugh et al (1964)[98], Leavitt (1978)[73], Shrivastava & Souder (1987)[129], Handy (1976)[46], Reed (1985)[104]) but by far the most outstanding and simplest is the McKinsey 7 S model

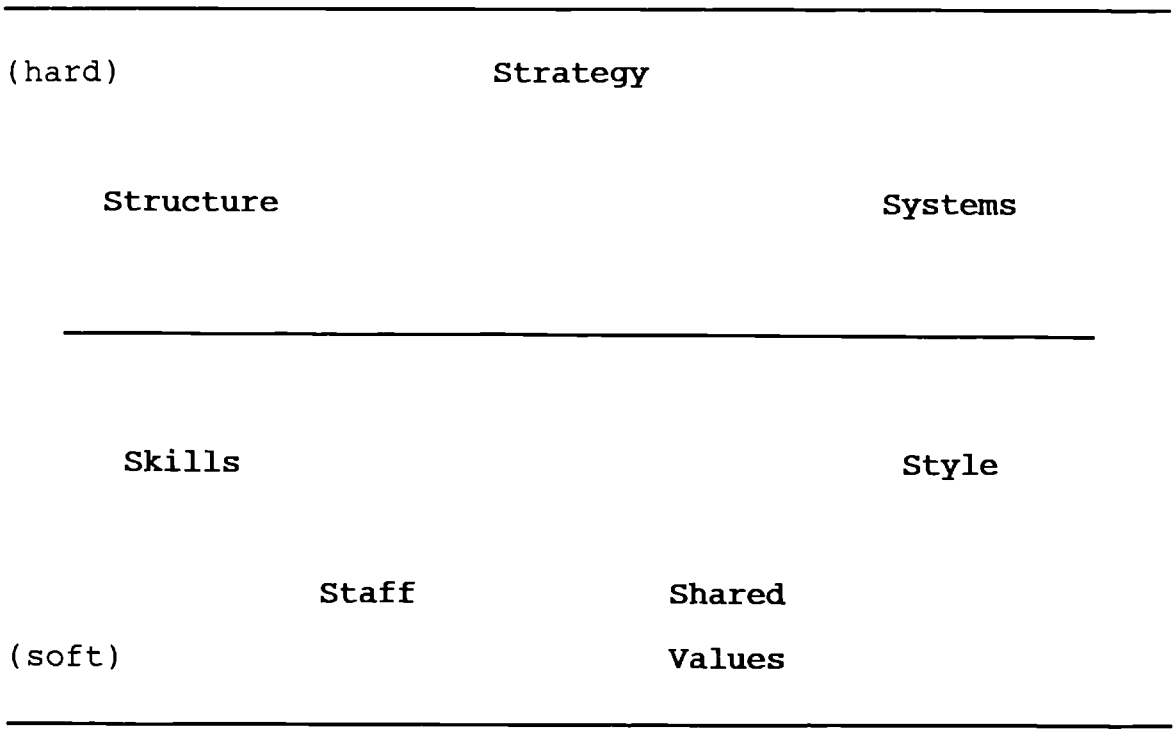
popularised by Peters and Waterman (1982)[96].

3.2 The McKinsey 7 S model, a framework for the the analysis of the new product organisation.

The McKinsey 7 S model was popularised by Peters & Waterman (1982)[96], and Pascale & Athos (1981)[95]. Both these authors used the model to analyse whole organisations, but as Johne & Snelson (1987)[62] pointed out there is no reason why the postulated factors should not be applied at the task group or business unit level, hence their application to the new product development organisation.

The seven Ss are essentially seven factors that make up the organisation, they include, strategy, structure, systems, style, staff, skills, and shared values. Pascale & Athos broke these down into the "hard" and "soft" Ss.

figure 3.1 The "hard" and "soft" Ss



By referring to the "hard" Ss, Pascale and Athos (1981)[95] intended to convey these organisational aspects as being easier to understand, define or grasp. Of the three "hard" Ss, strategy refers to a company's plan of action that it uses to allocate resources. Structure refers to the way in which a firm is organised in terms of the lines of authority. Systems describe the regular procedures such as meetings routines and reports, used to transfer and coordinate information as it flows through the company. Within the company, the "hard" Ss are often documented as they are the most familiar and certainly the easiest to define, analyse and control. Organisational structures often exist in the form of charts showing clearly the lines of responsibility. Strategies are often documented and passed around various managers to ensure coordination of individual departmental plans. Systems exist in the form of procedures or guidelines.

The "soft" Ss are not so easy to define. Staff refers not to the numbers of staff, or staff in a line sense, but the characteristics of the people who make up the organisation. They are "computer buffs", "scientist types", "engineering types" or graduates. Skills describe the qualities that the organisation and its key personnel need in order to follow out the strategy. Style refers to the behaviour of managers and executives within the firm. Shared values (referred to by Pascale and Athos as superordinate goals) are the guiding views and concepts that are accepted as part of the organisation's culture. The "soft" Ss because of their nature are rarely defined within the organisation,

they are underlying themes that often get overlooked. Pascale and Athos (1981)[95] commented that they are however as important, if not more important than the "hard" Ss.

table 3.2 The seven Ss (Pascale & Athos(1981)[95])

THE SEVEN Ss	
Strategy	Plan or course of action leading to the allocation of a firm's scarce resources, to reach identified goals.
Structure	Characterisation of the organisation chart (ie. functional, decentralised).
Systems	Procedurally reports and routinised processes such as meeting formats.
Staff	"Demographic" description of important personnel categories within the firm (ie. engineers, entrepreneurs, B.Sc's etc.)
Style	Characterisation of how key managers behave in achieving the organisation's goals; also cultural style of the organisation.
Skills	Distinctive capabilities of key personnel or the firm as a whole.
Shared Values	The significant meanings or guiding concepts that an organisation imbues in its members

(Pascale & Athos (1981)[95])

Johne & Snelson (1987)[61] adapted the McKinsey 7 S framework in order to analyse the process of innovation. The framework has been used in a similar way as an investigative and analytical tool in this research. Within the new product development organisation the 7 Ss are defined as

follows:-

Strategy The new product development strategy and long term plan. Those goals and objectives which define the type of new products to be developed, the resources needed, the markets to be pursued, and the technologies to be adopted.

Structure The structural organisation of new product development, showing the lines of authority and responsibility.

Systems The routine procedures and control mechanisms for coordinating and communicating information flow during the development of new products.

Staff The qualities of key personnel within the new product development process.

Style The characteristics of key managers involved with the new product development process.

Skills The specialist knowledge and techniques needed to execute new product development tasks.

Shared Values Those guiding concepts or values that

give direction to staff involved in new product development.

As both Peters & Waterman (1982)[96] and Pascale & Athos (1981)[95] pointed out, the seven Ss are strongly interlinked. Strategy is a key part of the model as this determines to a large extent the structure, systems and skills required to make the organisation effective. The staff are essential to satisfy the skills requirements and control the systems. In turn these staff need to be managed and a certain management style will result. The shared values make up the culture of the organisation and are found throughout the organisation.

Pascale and Athos described the purpose of the McKinsey 7 S model as being an analytical tool to help make sense of the complexity of organisations. The model simplifies the various aspects of the organisation. Using the McKinsey seven S model, each aspect of the organisation is discussed in more detail during the rest of this chapter.

3.3 New product strategy

Many authors have strongly supported the idea that new product development should be driven by corporate strategy (Crawford (1983)[35], Twiss (1986)[141], Saren (1987)[122]). Booz Allen & Hamilton (1982)[13] revised their earlier interpretation of the new product process to include strategy. They found that a well defined new product strategy, itself driven by the corporate strategy and objectives should be at the core of any company's approach to new product development. New product strategy links the

new product process to the company's objectives. The new product strategy should provide guidelines for decision making throughout the new product development process. For example, it should provide a focus for idea and concept generation as well as guidelines for establishing appropriate screening criteria (Booz Allen & Hamilton(1982)[13]). Essentially the purpose of developing a new product strategy is to define the strategic role new products will play in fulfilling corporate objectives.

The choice of a particular type of new product strategy will vary depending on the company and the circumstances. It may often be the case that companies use different strategies for different products so as to provide a balanced portfolio. Indeed Booz Allen & Hamilton found that some successful businesses assigned specific roles for individual new product developments.

McDonough (1986)[77] listed five alternative new product strategies, first to the market, second to the market, "me too", "me better", and quick response. He went on to discuss that each of these strategies varies along three dimensions:

1. The importance of rapidity of response; for some products the difference between success and failure is determined by how quickly the product reaches the market.
2. The degree of innovation desirable.
3. The amount of prior information the firm has about the technology to be used.

Nystrom (1979)[93] classified a company's business strategy as either positional, with the emphasis on

achieving efficiency in present products, or entrepreneurial where the emphasis is on developing new business. When discussing new product strategies Nystrom proposed four types, two proactive and two reactive strategies:

1. **Broad span leader**; where a company has leading products in several market segments.
2. **Narrow span leader**; where a company is a leader in one market segment.
3. **Reactor**; where a company responds (often very quickly) to other company's successful product launches.
4. **Responder**; where a product is developed (usually with reluctance) in response to competitive pressure.

After a study of product innovation strategies, Cooper (1985)[30] concluded that new product performance and strategy are closely linked. Cooper classified five alternative strategy scenarios:

1. **Technology driven strategy**; involving high technology, innovative and based on state of the art developments. These strategies are technologically driven with a non-market orientation.
2. **Balanced strategy**; where new products are technologically sophisticated and innovative, combined with a strong degree of product fit, focus and market orientation.
3. **The technologically deficient strategy**; where new products are low technology, "me too" low risk

efforts relying on mature technologies.

4. **The low budget conservative strategy**; with low R&D spending and a "stay close to home approach".
5. **The high budget diverse strategy**; a high R&D budget with an unfocused and diverse approach to new product development.

Cooper analysed these in terms of their performance and effect on the chances of new product success, the results of this analysis are contained in table 3.3

table 3.3 New product strategy performance (Cooper (1985)[30])

Strategy	Performance
Balanced	By far the strongest performance
Low Budget Conservative	Positive results, good success rate and profitability but low impact on company
Technologically driven	Moderate results: High percentage sales of new products, but low success rates; poor profitability and fell short of programme objectives.
Technologically deficient	Very poor performance
High Budget, Diverse	Very poor performance

Strategy is regarded by many as the domain of senior management (Johne & Snelson(1987)[63], Cooper(1985)[31], Randall (1980)[102]). It is often the case however, that technological and marketing specialists have a clearer view of technical and market developments than their senior managers. Many authors have stressed the importance of keeping abreast of product technologies. However both Cooper's analysis, and Souder's (1987)[132] work on strategy has showed that strategies based solely on technology do little to guarantee success. The more successful strategies are balanced strategies which seek to marry technological sophistication with the needs of the marketplace.

3.4 New product development organisation structures

Structure is one of the most obvious of the seven Ss. It is by far the easiest to define and probably the easiest to change. Souder (1987)[132] wrote "structure is perceived and interpreted by employees as a basis for their choice of behaviour. Having the "right" organisational structure may not be suffice to stimulate behaviours that achieve innovation. However structures that are not based on innovative organising principles will discourage innovation".

Souder classified four generic types of structure, each having its own advantages and disadvantages. Souder found that the type of structure varied depending on whether the company was proactive or reactive. The type of structure was also found to depend on the level of innovation required.

Clearly therefore a company's new product strategy will be a major determinant of the structure required.

table 3.4 Contingent conditions for each type of Organisation Structure (Souder(1987)[132])

	Market and Technical Environments	
Level of innovation desired	Stable	Dynamic
None	Type I	
Incremental	Type II	Type III
Radical		Type IV

The organisation structure types I & II were found to function well under stable environments and are based on classical organisational principles. Types III and IV were found to be needed to handle new product organisations in dynamic environments.

Considerable attention has been given to identifying the ideal formal structures needed for the day to day management of the new product development process. Benson & Chasin (1976)[10], Souder (1987)[132], and other authors have stressed that no one organisational structure is best, rather that different organisational mechanisms are appropriate to different types of new product developments, companies and products.

In their survey on new product development, Booz Allen

& Hamilton (1982)[13] found that organisational structures used by companies fall into two general categories. Those with free standing or autonomous units (ie. inter-disciplinary teams, separate new product departments, venture groups, etc.) and those with functionally based units that are part of existing planning, marketing, R&D, or engineering departments. It was also noted that over half the companies surveyed used more than one type of structure, and over 75% tied the choice of organisational structure into product requirements.

It is often the case that companies keep radical new product activities separate from incremental innovations and many writers have emphasised the need for this (Johne (1984)[61]). Organisations are often faced with the choice of making new product development a separate function isolated from other company activities or passing the development from department to department. New product managers are often faced with the dilemma of trying to achieve both greater specialisation and more effective coordination. This problem is not new. Lawrence and Lorsch (1964)[74] concluded; "managers interested in improving their record with new products must recognise two important organisational ingredients of success.

1. Specialists need to be clearly oriented toward their individual tasks and able to work in organisational structures which are conductive to task performance.
2. There needs to be an effective means of coordinating departments which permit specialists with diverse knowledge and orientations to work together."

In order to satisfy these requirements, in recent years, companies have established coordinating departments across functional groups. This type of management is often to referred to as matrix management. In such organisations staff involved in new product development often have two lines of responsibility, one to his own departmental head, and one to the new product coordinating department. If not a carefully controlled environment this can often lead to conflict.

Separating new product development from the day to day company activities has benefits, but it also creates problems of isolation especially between development, the marketplace, and manufacturing (Johne(1984)[58]). Such a breakdown in communication could prove disastrous for the chances of success of the product. The alternative of passing the development from department to department presents problems of coordination and control. Tushman & Nadler (1986)[139] put emphasis on innovative organisations using linking mechanisms to ensure that the different components of the organisation are coordinated into a workable whole.

In recent years the flexibility of new product development organisation structures is becoming a key issue (Souder (1987)[132]). Different product may require different structures. Companies in general are placing less emphasis on formal structures and more emphasis on looser, freer forms of structuring. Peters and Waterman (1982)[96] found that a loose / tight approach was strongly associated with success.

The organisation is the backbone of any company's approach to new product management. Responsibility for the structure rests with senior management. Organisations rarely function exactly as described in any organisational chart. The informal organisation is also very important, (Johne (1985)[59]). This informal organisation is to a large extent covered by the factors of style and shared values.

3.5 New product systems

There are many coordination and control processes suited to managing the innovation process. However the extent to which these are applied is a matter of contention. Formalisation of the new product development process to ensure efficiency can have the disadvantage of stifling creativity and constraining innovation. Many authors have stressed that the innovation process by its nature is not suited to formalised procedures and control, Rickards (1985)[102], Quinn (1986)[101]. Johne (1987)[60] commented "strict formal control will stifle creativity and trial and error experimentation which is an essential element of innovation. Alternatively leaving innovation to develop in an unfocused way may increase the cost and complexity of the process. It would seem more appropriate that companies apply systems as tools, with different emphasis at different stages during the new product development process. Generally, during the early stages these controls should be loose. As the development progresses and more capital is allocated tighter controls are needed to avoid costly changes, and meet launch

dates, and to prevent designers continuing to perfection. Johne (1984)[57] demonstrates how innovators have come to terms with both flexibility and formality.

Many systems exist to help control the new product development process. The most common systems are those those that describe the new product development process itself, (Booz Allen & Hamilton (1982)[13], Crawford (1983)[35], Cooper (1983)[29]). Companies need to tailor such work to suit their own new product process. Indeed many companies will develop their own based on experience. These systems in effect describe the process of new product development. Other systems of a similar nature deal with aspects of the development process such as the selection of new products from ideas (Merryfield (1978)[86]) or decision support for new product development (Choffray and Lillien (1982)[20]).

Might (1984)[87] examined the effectiveness of project control systems, based on a study of 103 development projects. He found that simply because a control system worked well on one project this did not mean it would work well on another. Care needs to be taken and consideration given to the specific situation in which any control system is used. Recognising the interactions between control methods and situational conditions by project managers has a crucial impact on the success of the product.

3.6 Skills needed for the new product development organisation

The skills required for new product development will

vary tremendously throughout the process. Johne & Snelson (1987)[61] reviewed these skills across the whole of the new product process. The skills required were analysed using Crawford's model of the product innovation process (1983)[35]. Based on the model, the six key areas requiring skills were identified as; new product planning, idea generation, screening and evaluation, technological development, market appraisal, and launch. This list clearly shows the variation in the skills required to develop a new product. In order to draw these skills together a large amount of teamwork will be needed, along with coordination and communication skills (Takeuchi & Nonaka(1986)[135]). The need for such obvious skills must not be overlooked. New product development skills need to be clearly identified and developed within the organisation. Many skills too will depend on experience borne of years of working in the new product development environment.

3.7 New product development staff

The type of staff involved in new product development will to a certain extent be determined by the skills required. The nature and characteristics of the individuals is a different matter. There are certain key staff roles that need to be fulfilled. As already discussed the presence of a key individual is factor found to important in the chances of new product success (Langrish (1972)[70], Rothwell (1977)[113]). Kirton's (1980)[69] identified two distinct personalities among people in general. Through a detailed

questionnaire he was able to class people as either innovators or adaptors. Within new product development identification of such personalities would be an advantage to ensure staff are suited to their tasks. Staff with innovative natures will be needed early on in the development, during the creative stages. Later, a more persistent and detailed approach is needed. Here the skills of an "adaptor" are required who can take an idea and make it work in practice. Belbin (1981)[7] in his work on management teams demonstrated too that some people are much more suited to routine work where as others thrive on creativity. Creative people may not be suited to the painstaking tasks of detailed finishing work. The right mix of people is also an essential part of successful innovation in order to achieve the factors associated with success.

Roberts (1977)[107] shows certain staff roles will be needed if innovative ideas are to be generated and developed. A creative scientist is needed to originate the idea, whilst an entrepreneur or project manager are needed to promote and coordinate the development of the product.

Little work has been done on the psychological qualities of individuals who work in the innovative process. Yet the people who make up the new product development team are key to its success. Their attitude and the mix of the people involved will be critical to such factors as communication, even if the best structure and systems are available.

3.8 Management style in the new product development process

John & Snelson (1987)[61] pointed out that an organisation's sociocultural behaviour is as important as its structural configuration. The style that exists within an organisation will depend on a multitude of factors (Handy (1985)[47]). An organisations style will be strongly influenced by its management.

Many studies have shown that a crucial factor in successful new product development is top management support (Rothwell (1977)[113], Booz Allen & Hamilton (1982)[13], Moore (1984)[88]). Top management support is essential for the success of new products. Many studies stress the importance of support for innovation, and an open flexible company attitude (Randall(1980)[102]). This does not need to involve senior managers making all the key decisions indeed some studies have shown that over involvement by senior management can cause delays and upset the innovation process (Maidique and Zirger(1985)[82].

3.9 Shared values

The seventh S referred to by Peters and Waterman (1982)[96] as shared values, and Pascale and Athos (1980)[95] as superordinate goals, is probably the hardest to define and measure. Defined by Pascale and Athos (1980)[95], as "the significant meanings or guiding concepts that an organisation imbues in its members". This definition is very

similar to those given for an organisation's culture. In effect the shared values represent the culture of an organisation. Handy (1976)[46] referred to culture as a "feeling of a pervasive way of life, or a set of norms". Handy goes on to describe four different types of culture based on Harrison's (1972)[48] earlier work on organisational ideologies. These four type of culture are defined in terms of power, role, task and person cultures. The theory is, that any organisation is made up of a mix of any of these four types of culture.

The power culture is typically based around a central power source, where control is dominated by a selection of key individuals. Such an organisational culture works on precedent, anticipating the decisions of the key personnel. There are few systems and little bureaucracy. Conversely the role culture is bureaucratic by nature. It works on logic and rationality, the emphasis being on job definitions, positional power, and not the individual. The role culture depends on a stable environment and is slow to perceive the need for change. The task culture is generally structured in a matrix form. Here the emphasis is on getting the job done. This culture is very adaptable and thrives on speed of reaction and teamwork. Control is difficult, it is the product that is all important. Finally, the person culture relates to an individualistic type of culture. Here the individual is all important, such a culture is rare in industry.

Most organisations will be mix of these four organisational cultures. There is no one best type, each

will have its own positive and negative aspects. There are numerous factors that influence the type of culture present in an organisation. According to Handy (1985)[47] these include; history and ownership, size, technology, goals and objectives, the environment, and the people.

It is questionable as to whether culture can be directly controlled as it does not seem practical to adapt or change a culture quickly. Culture will be the last of the seven Ss to be affected by changes to the other Ss. Changes to structure, strategy, systems and so on will eventually affect the culture.

Again the type of culture best suited to new product development will vary throughout the process. At an early stage creativity is required. For the majority of the developments a task culture is needed where all effort is concentrated on the product. Once the product is in manufacturing, a steady state, role type culture is required to ensure a continuous supply of quality products. A common characteristic for all levels, and at all stage in the development process is recognition of the need for change (Souder (1981)[131], Tushman & Nadler (1986)[139]).

3.10 Summary and conclusions

Organising for new product development is a complex problem dictated by the complexity of the process itself. The McKinsey seven S model provides an excellent framework for analysing the new product development organisation.

As any new product passes through the various stages of

development the optimum requirements for each of the seven Ss will change. In order to increase the chances of new product success, the new product development organisation needs to be continually managed and adapted to meet its optimal configuration.

Control of the seven Ss is also complex. It is envisaged that the "hard" Ss; strategy, structure and systems, will be tackled first as they are by far the easiest to alter. These "hard" Ss are well documented in the literature compared to the "soft" Ss. The "soft" Ss, such as style and shared values, however may often get overlooked. Both Peters & Waterman(1982)[96] and Pascale & Athos(1980)[95] have proven the effectiveness and value of the McKinsey seven S model. Any organisation is made up of a number of interrelated factors and these interrelating factors are described simply through the seven S model. If a company is to change its organisation, it needs to ensure that it changes all organisational aspects. It is not reasonable to change just the strategy and expect the rest to follow. The seven S model is ideal for ensuring all organisational aspects are considered during the change process. In terms of responsibility for change, Johne & Snelson (1987)[62] pointed out that senior management must supply the vision and set the operating tone for the business. Middle management must be allowed to follow through with the specialist skills.

As new product development spans most departments within the company the importance of a clear strategy and communication of this strategy through those responsible, is

vital to a successful organisation. Cooper (1985)[31] concluded that new product strategy and performance are strongly linked. is not surprising when it is clear that strategy drives all other aspects of the new product organisation.

Throughout the new product development process there are tremendous conflicts, risk verses no risk, stable verses dynamic cultures, manufacturing verses research, informal verses formal. An effective organisation needs to draw all these conflicting aspects together and direct them to the company's advantage.

4. THE RESEARCH METHODOLOGY

4.1 Introduction

Three separate research methodologies were used to examine in detail how companies improve the process of innovation. The choice of these methodologies arose for a number reasons, the details of which are discussed individually in later chapters. The methodologies were:-

(i) An initial survey, intended to cover a large sample of UK engineering companies.

(ii) A series of case studies based on selected companies from the initial survey.

(iii) A detailed case study / experiment carried out in cooperation with the sponsoring company.

This chapter discusses the choice of population, the development of the research methodologies and the scope of the research.

4.2 The research population

A recent British Institute of Management (BIM) survey (Randall (1982)[102]) covering a broad cross section of British manufacturing industry, estimated that 94% of companies had launched at least one new product within the last three years. As already discussed, the majority of companies will need to develop products on a regular basis in order to survive. The number of new products developed will vary greatly depending on the definitions that are

taken for "new" and "product". A product, for example, could range from a computer to a type of insurance policy and comparison with organisations developing such products would be unrealistic. Clearly therefore a population had to be chosen that would restrict the size of the sample to a manageable number. It was equally important to ensure that the products developed were of a similar nature, thus allowing effective comparisons and conclusions to be drawn.

The sample population consisted of companies that were from the engineering sector, resident in the UK., and employing more than 100 employees. The factors influencing the selection of this population were geographical limits, industrial classification and company size.

4.2.1 Geographical limits

The population included only companies based within the United Kingdom. This presented a large population within easy access, and with no language or communication problems. An international population (ie. including companies from the US or Europe) could have introduced bias to the results if not carefully controlled. Such a population would have added significantly to the costs and time scales involved.

4.2.2 Industrial classification

Companies in the population were restricted to the engineering sector, as defined in the Standard Industrial Classification (see appendices III and IV). The following

"classes" of companies were included in the population:

table 4.1 Standard industrial classifications

SIC Class	Type of Company
32	Mechanical Engineering
33	Office Machinery & data processing equip.
34	Electrical and Electronic Engineering
35	Motor Vehicles and parts thereof
36	Other transport equipment
37	Instrument Engineering

The main reasons for limiting the population in this way were to ensure that the results could be effectively compared and valid conclusions drawn. The engineering sector was chosen for a number of reasons:

1. The sector is likely to develop more new products in a much shorter time span than any other sector.
2. The type of new products developed are relatively easy to define, identify and quantify.
3. The engineering sector provides a large population from which to choose an appropriate sample.

Other factors influencing the choice of the engineering sector as an appropriate population included the CASE sponsoring company, (Delco Electronics Overseas Corporation) the author's background and sponsorship from the SERC (Science & Engineering Research Council).

4.2.3 Company size

The population included companies with more than 100 employees. It was felt that companies smaller than this would not have a significant new product development capability. In the case of extremely large companies with autonomous divisions it would be unrealistic to consider the whole company as one. Thus large autonomous divisions were taken as individual companies.

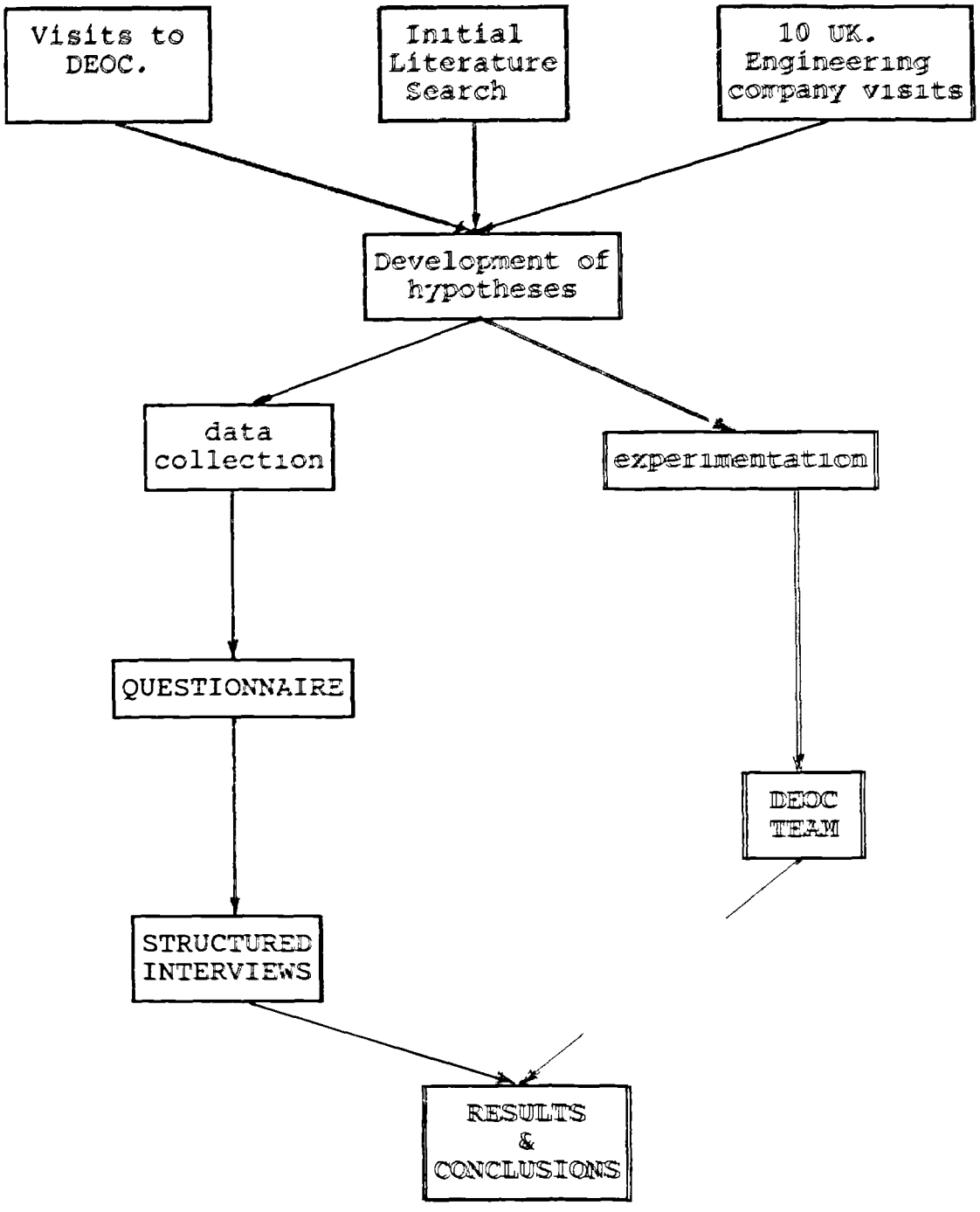
4.3 Development of the research methodologies

The choice of research methodologies grew from a combination of the literature review, the initial objectives, the influence of the CASE sponsoring company, and a series of pilot interviews with key personnel from UK engineering companies. An outline diagram showing how the research methodologies progressed is given in figure 4.2.

4.3.1 The initial objectives

Initially it was envisaged that the research would take the form of a survey to identify the factors associated with new product success and failure. However after several months, it became clear that the problem was not one of identifying what made a new product successful, but one of applying the findings of previous research. Initial literature reviews suggested there was ample evidence of

figure 4.2 Development of the research



what made a new product a success or failure. At the same time initial pilot visits indicated that few managers in industry had heard of the research, let alone were applying the results.

4.3.2 The CASE sponsoring company

The research project was initiated in 1985 as a CASE studentship to be carried out in collaboration with Delco Electronic Overseas Corporation (DEOC). DEOC (a subsidiary of General Motors) is based in Kirkby on the outskirts of Liverpool and the company employs in the region of 2000 people. The company manufacture instrument clusters and fuel pumps for the Automobile industry. The company develops in the region of five new products annually.

The management at Delco felt they had a problem in managing the new product development process and reacting effectively to a constantly changing environment. DEOC were having problems meeting launch dates and financial targets for their individual product developments. In short they were not meeting their own success criteria. The first 6 to 12 months of the research were spent researching the problems Delco perceived, in comparison with the UK. engineering industry as a whole and the literature on product innovation. This involved a series of interviews and discussions with new product staff, along with attendance at new product meetings.

4.3.3 Early company visits

A series of pilot interviews / discussions were carried out with key new product personnel in a variety of UK. engineering companies (see appendix VII). The objective of these visits was to get a "feeling" for the problems facing new product managers in British industry. These discussions showed little evidence of manager's awareness of the research into successful innovation.

Two pilot case studies were also carried out. These involved "in depth" interviews with new product staff. The objective of the case studies was to get an initial look at how companies organise for new product innovation, the systems they use, and the problems they were facing.

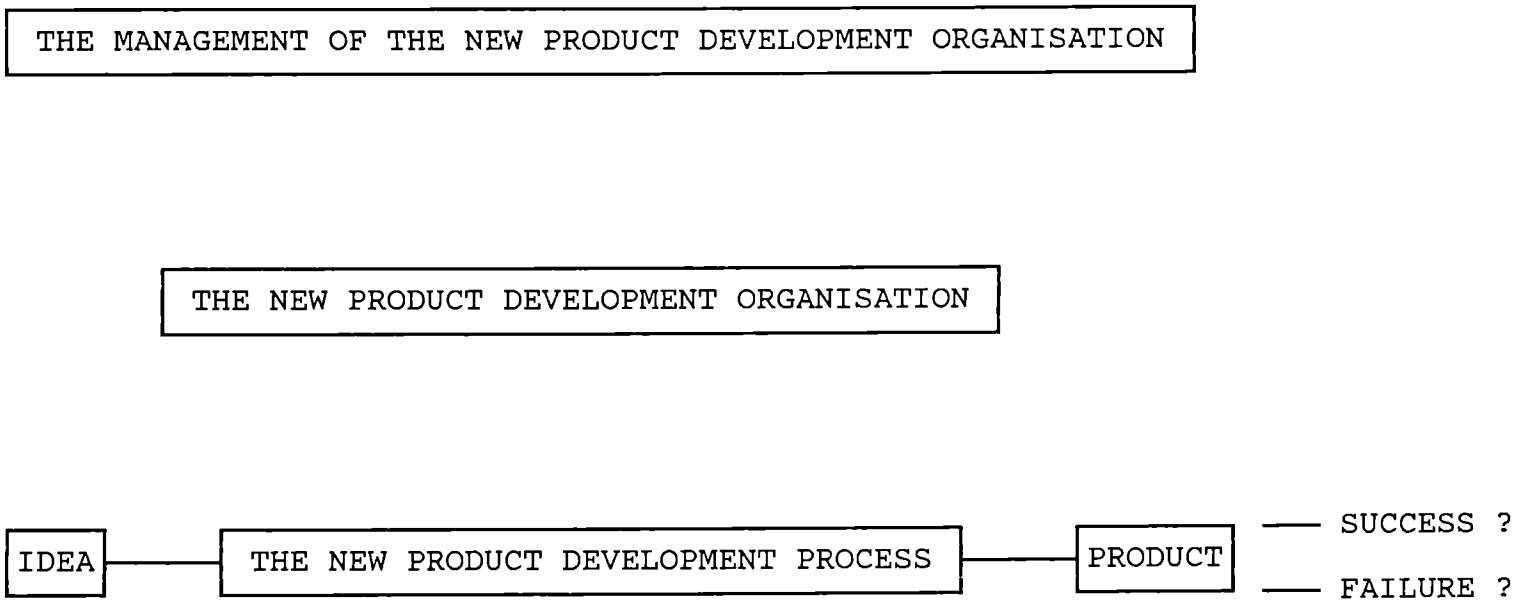
4.4 Scope of the research

It became clear that the main research problem was based around the question of how companies could improve the process of new product innovation. In order to structure the research a simple model was drawn up based on the literature review. The aim of the model was to help define more clearly the scope of the research.

The model breaks down new product development into three levels;

Level I, The new product development process. This level concerns the actual development of the product itself. Generally initiated by an idea and ending in product

figure 4.3 Basic model of the research



launch, the process can be viewed in a variety of ways as discussed in section 1.4. Once launched, the product will become either a success or a failure. This level is the dominated by technicians, draftsman, engineers and junior management.

Level II, The new product development organisation. The success of the new product development process, and the eventual product depends to large extent on the NPD organisation. Level II reflects the actual new product organisation in terms of its strategy, structure, systems management style, people, culture and skills. In general this level is controlled and influenced by the middle management.

Level III, The management of the new product development organisation. This level does not refer to the management of new product development. It concerns the management of the NPD organisation. This is the level where decisions for changes will be made to the new product organisation, for example a new structure, or strategy. It is an area often hidden within the company, and very much the domain of senior management.

The aim of the model was to build the many aspects of new product development and organisational change into one coherent picture. It was not the objective of the research to develop an accurate model, and time was not available to validate it thoroughly. However a model was essential in order to structure the research. No models were found to be available from the literature, again indicative of the lack

of research in this area.

In order to cover the questions raised by the model and develop the research fully it soon became clear that one type of survey or a series of case studies would not provide sufficient information. A combination of methodologies was required.

The alternative of researching in detail through one particular aspect was considered, but this would have reduced the scope of the research considerably. It was felt that a combination of data collection and experimentation would provide a sound and complementary basis for the research.

4.5 Design of the Research

The research methodologies chosen can be broken down into two broad areas;

(i) Data collection and analysis

(ii) Experimentation

The data collection took the form of a questionnaire to a large sample of UK. engineering companies followed by more detailed structured interviews with a smaller number of selected respondents. Details of the methodologies used and the results obtained are discussed in chapters 5, 6 & 7.

The experimentation involved the setting up of a team within the sponsoring company to test a methodology for improving the companies new product innovation process. This is discussed in detail in chapter 8.

4.6 Time limitations

With the data collection methodologies only a cross sectional study was possible due to time constraints. A longitudinal study of the innovation process and the effects of change over time was not possible as the nature of the innovation process would have meant considerable time being tied up.

4.7 Validation

Opportunity was taken to test the validity of the research methodologies and findings with "expert" audiences. The following conference papers were presented:

> Improving the Chances of New Product Success, 5th. International Conference on Innovation Adaptation and Growth, Brighton, August 1987.
>
> Improving New Product Success through Organisation Development, IEEE Conference on Management and Technology; Management of Evolving Systems, Atlanta, October 1987.

5. PLANNING THE INITIAL SURVEY; THE POSTAL QUESTIONNAIRE.

5.1 Introduction

The need for a survey became clear as the literature and initial industrial visits showed little evidence of how managers had attempted to improve the process of innovation. Despite substantial research into the process of innovation, and the recent surge of interest in organisational change, there is surprisingly little work that encompasses both aspects. Few empirical studies have considered how companies change their organisations to improve the process of innovation. Of the research studies covered in chapter two, for example, none discussed in detail how the results obtained could be (or have been) applied in practice. No significant literature was identified that showed how organisations changed to improve their chances of new product success. Similarly no literature was found that described the awareness of managers to, or the application of, previous research into the success and failure of new products.

From an industrial perspective, initial meetings with new product managers (see appendix VII) tended to suggest that few industrialists were aware of key research studies into new product success and failure. In discussions with fifteen new product managers, only two had heard of the work, and neither had made any attempt to apply the results. With failure rates high, managers in their role will make every attempt to improve the chances of new product success,

be this of a conscious or unconscious nature. The aim of the survey therefore, was to provide information on how companies did improve the chances of new product success.

Due to the nature of the information required, and the lack of previous research, it was decided that two surveys would be necessary. The initial survey would involve a large sample, and aim at identifying general trends in new product management and change. The second would focus in more detail on how successful companies had changed to improve their chances of new product success.

In order to make the best use of time and resources any survey would need to be carefully planned and carried out. It was anticipated that the following stages would be necessary in carrying out the initial survey:

1. Definition of the aims and objectives,
2. Identification of the population,
3. Choice of an appropriate method for collection of the data,
4. Analysis of the information.

This chapter discusses the planning of the initial survey, and considers the above aspects in detail. The initial survey took the form of a postal questionnaire, a copy of which can be found in appendix VI.

5.2 Objectives of the survey

Moser and Kalton (1971)[89] suggested that the methodological problems of surveys fall into three main categories: from whom to collect the information, what

methods to use for collecting it, and how to process, analyse, and interpret the results. Before any of these planning problems can be tackled it is important to define clearly the objectives of the survey, and the type of information required.

The initial survey had two major objectives:

1. To obtain information relating to how companies change and adapt their new product development organisation and to identify how aware key NPD managers are to research into the success and failure of new products.
2. To identify companies suitable for further, more detailed study.

This information was needed to further the research objectives and test the hypotheses developed.

5.2.1 The information required

There is little published information available on the methods companies are using to improve their new product development processes, the management of new product development and the associated organisation. Consequently the survey intended to provide a broad measure of general trends rather than focus on specific changes or specific parts of the NPD process.

Based on the conceptual model described in chapter 4 the information required from the questionnaire is detailed below. (The data described in (6) and (7) was needed primarily to set the rest of the information in context.)

(1) An outline of current methods and practices used to manage the process of new product development.

(2) The types of changes made recently to the new product organisation, in terms of:

Structure

Strategy

New product procedures or guidelines

Screening and evaluation of new products

Training and people development aspects

(3) The awareness and application by managers of the research studies into the success and failure of new products.

(4) The use of and emphasis placed on new product procedures and guidelines.

(5) How companies define and measure new product success

(6) The type of products developed in terms of number, lead times, newness, etc.

(7) The type of company in terms of size, type of manufacture and activities on site.

The accuracy aimed for was as high as possible, however due to the type of information being collected difficulties were anticipated in quantifying the results. The nature of

the research topic itself is quite subjective and as discussed earlier there are few clear definitions. The survey intended to cover general aspects of new product development, as opposed to focusing on specifics.

5.2.2 Identification of companies for further study

It was envisaged that much of the information required, especially on the "softer" organisational and people aspects would be quite subjective. A detailed examination of how a company had changed its new product development organisation in such detail would be best obtained through the use of structured interview techniques.

It was the intention of the initial survey to cover the broader aspects of change over a large number of companies. The practicalities of using the interview method for such a survey would mean considerable time wastage at companies where no significant changes had occurred. Clearly the ideal situation would be to examine only companies which had made constructive efforts to change. According to earlier hypotheses few companies would actually come into this category. It was decided therefore that the initial survey would provide a useful tool with which to identify companies for further and more detailed study.

Resources available to carry out the survey included the author, various grants for travel and financial assistance and support from the SERC and the department of Industrial Studies, Liverpool University.

5.3 Coverage of the survey

With the objectives defined, the next stage involved establishing the population to be covered. The survey population consisted of companies that were resident in the U.K. from the engineering sector and had more than 100 employees. The factors influencing the selection of this population were geographical limits, industrial classification and company size. The reasons for choosing this sample are discussed in section 4.2.

5.4 Method of data collection

Moser and Kalton (1971)[89] suggested four possible methods of data collection:-

observation,
desk work (documentation),
mail questionnaires,
interviews.

The choice of method selected depends on the type of population, the size of the sample, the subject area to be covered and the results required.

The population of engineering companies registered in the UK. (with more than 100 employees) was found to be in excess of 1200. To ensure responses from the whole of this sample was beyond the capabilities of this research, and the resources available. It was felt that responses from a random sample of 10% of the population would provide a sound

basis for the study.

By far the most appropriate method for collecting this data is through the use of a postal questionnaire. In the region of 120 responses were required. Some studies have concluded that response rates of over 80% can be achieved for postal questionnaires, these studies however are dated and do not take into account the popularity of the method in recent years. Also due to the difficulty in identifying the respondents it was felt that in order to achieve 120 responses in the region of 500 target companies would be required. The method was also chosen due to its relatively low cost and the speed with which it can be carried out. It allows respondents to make more considered responses, with consultation of records if necessary.

The questionnaire technique does however have certain problems with its use. The method can only be used when the questions are straight forward and simple. Questions need to be designed with clarity so that they can be easily understood. The majority of answers have to be accepted as final as there little opportunity to check the validity of responses by observation. One cannot be sure that the right person has answered the questionnaire, and in some cases the respondent may not have the information required. The main problem, however, with most mail surveys is that of obtaining a sufficient response rate.

5.4.1 Improving the response rate

Non response is a problem, not only because it

decreases the sample size, but also because non respondents may differ from respondents, and thus introduce bias into the sample. Checks can be made on the representativeness of the sample, but the best way to avoid bias is to reduce non response to a minimum. In order to overcome the disadvantages of the mail questionnaire it is important to consider the problems in detail during the planning stage.

According to Jolliffe (1986)[64] there are two main reasons why non response occurs, failure to contact the sample respondents, or refusal of the sample members to participate in the survey. Both these aspects were considered during the planning stages and steps taken to overcome the problems.

5.4.2 Contact with the respondent

With the type of population covered, non contact could occur on two levels, non contact with the company itself, or non contact of the potential respondent within the company. Non contact with the company could result from an incorrect address. It is therefore important to use an accurate and up to date sampling frame, in case the company has moved, or gone out of business.

Identification of the respondent within the company is also very important. In the initial survey the information required is best supplied by the manager responsible for new product development. However the title given to these managers will vary and could include descriptions such as Technical manager, Research and Development manager, New

Product manager and so on. It was essential that the questionnaire reached the correct respondent, this was achieved by addressing the questionnaire to the Managing Director asking him to pass the survey on to the appropriate manager. Although this methodology probably increased the chances of non response it provided a better method than direct mailing to another management title which may not have existed.

5.4.3 Overcoming the possibility of refusal

Refusal of a potential sample member to participate in a survey could be because the time of contact is inconvenient for him, or he may lack interest in the subject matter of the survey or he may resent the intrusion into his privacy. Jolliffe (1986)[64] argued that there will always be a certain number of "hard core" refusals, no matter what approach is used to obtain information. There are numerous reasons why the respondent may refuse to participate in the survey, and it is important to examine these and reduce them to a minimum.

Scott (1961)[127] suggested that the following factors affect response rate; length of questionnaire, sponsorship, the enclosure of a return envelope, the accompanying letter, the day and date of dispatch, anonymity, format, layout method of reproduction, and follow up of non respondents. In a more recent article, Kanuk and Berenson (1975)[68] reviewed a number of empirical studies and found response rates to be affected by a number of factors. These factors were taken

into account and the following provisions were made to increase the response rate:

(a) Questionnaire length

Common sense would suggest that the length of the questionnaire will affect the response rate. However research evidence does not support this view. There are few guidelines to suggest what the optimum length might be. The questionnaire was made as concise as possible, although this was difficult due to the amount of information required. It was thought that some respondents could anticipate the time taken to complete the questionnaire as being far too excessive. In order to over come this problem it was clearly stated in the accompanying letter how long it should take the respondent to complete. Questions were carefully worded so as to avoid ambiguity. The size of the questionnaire was reduced to 15 pages and 41 questions.

(b) Survey Sponsorship

Official support of some kind has been shown to increase the response rate. Thus the accompanying letter to the questionnaire was made on "University of Liverpool" headed stationary.

(c) Return envelopes

In order to make the respondents life as easy as

possible, and increase the response rate, a return envelope was included with the questionnaire. Although Scott (1961)[127] suggested that prepaid postage would also increase the response rate, it was felt that the extra cost of this compared to its effect would not be worthwhile.

(d) Personalisation and the Covering letter

A copy of the accompanying letter can be found in appendix V. The letter was made as brief and precise as possible. Each letter was dated, and sent with an impersonal address (Dear Sir). Any other method would have been costly due to the sample size and, since Scott (1961)[127] found that the content of the letter was very much more important than its "trappings", it was not felt necessary to be more personal. The letter included a general statement of the purpose of the research, a request for assistance, and an assurance of confidentiality. The letters were reproduced by photocopier and each one was individually signed.

(e) Anonymity

It was not possible to guarantee anonymity as it was necessary to be able to identify respondents for possible follow up interviews. The assurance of confidentiality was given both on the questionnaire itself and in the accompanying letter.

(f) Format, layout and method of reproduction

It is difficult to estimate which is more damaging to the response rate, a crowded layout or layout which covers a large amount of paper. Scott (1961)[127] suggested that it is better to spread the questions out. Therefore questions were well spaced and plenty of room was left when a written answer was required. Space was also left at the end of the questionnaire for additional comments.

The response brackets, and numbers were always positioned on the far right hand side of each page, so as to speed up completion. The respondent simply had to circle the appropriate response.

There is little evidence to suggest that an increase in response rate can be achieved through printing the questionnaires as opposed to duplicating them. Therefore to avoid high costs, reproduction was made by photocopier. This allowed a large number of good copies to made in a reasonably short space of time, at a lower cost.

(g) Follow up of non-respondents

Both Scott (1961)[127] and Kanuk & Berenson (1975)[68], found that the use of follow up letters and reminders increased the response rate. In the initial survey however, the cost of follow up letters would have been significant due to the size of the survey. Also, because it was not possible to identify the exact respondent in any one company, follow up letters would have to be mailed for a

second time to the managing director. If the questionnaire had already been passed on to the appropriate respondent, (for example via his secretary) the managing director might not be aware of the survey. It would have been necessary therefore to send further copies of the questionnaire, and the expense of this for the increased response could not have been justified.

(h) Telephone queries

Although not mentioned in the literature, a telephone number where the respondent could ring the author to query various aspects of the questionnaire was also provided. It was felt this would increase response rate even if the respondent did not need it.

5.4.4 Sources of error

Errors can occur at almost every stage of the survey process, Jolliffe (1986)[64] classed these as either sampling or non sampling errors. Sampling errors could occur through an incorrect sampling frame, or the selection of a sample from the sampling frame. Non sampling errors will in the main be response errors, but could also include errors made during analysis. During the planning stage it is important to anticipate possible sources of error so as to minimise them.

(a) Sampling frame errors

Moser and Kalton (1971)[89] identified four basic types of sampling frame error. Firstly missing elements, these can occur due to an inadequate definition of the sample or the sampling frame being incomplete. If elements of the population are missing this can be a serious defect especially if the elements are of the same specific type.

The second type of error can arise through clusters of elements represented as one element. Many large companies in the UK. come under one name yet the divisions themselves may be autonomous business units. It is important to select a sampling frame which breaks down large companies into their respective business divisions.

Thirdly, problems can arise due to blanks or foreign elements. Companies may have moved on or gone out of business and thus, may not be part of the frame. Finally it important to ensure that there are no duplicate listings of companies.

In order to overcome all the above problems it was important to select a comprehensive and up to date sampling frame. The sampling frame chosen was obtained through Huddersfield Polytechnic's outside organisation file (computer database). The frame was supplied in the form of pre-printed, self adhesive labels.

(b) Sampling errors and the design of the sample

Various methods are available for the selection of

elements from a sampling frame. For accuracy it is important that each element has an equal chance of selection. In the initial survey a mixed form of sampling was employed. Within each class companies were randomly selected. However for the sector as a whole a greater number of questionnaires were sent to those companies in SIC classes that were more likely to develop greater numbers of new products. This type of design was chosen for several reasons. To have effectively covered all the classes would have involved sending out a large number of questionnaires, significantly increasing the cost. At the same time covering only one or two of the engineering classes left too narrow a focus. A better quality of response was expected from companies in classes 33 - 37 as it was felt that these sectors would develop more new products. (Subsequent analysis of this assumption proved it to be valid.) Thus a higher proportion of the questionnaires were sent to these companies.

(c) Response errors

Response errors could occur through mis-interpretation of questions or mistakes in completing the questionnaire. Again, in order to minimise errors, it is important to ensure that the questionnaire is laid out in a clear manner with no ambiguities. Where possible the questionnaire used coded answers and only in a few cases were written answers required. It was also anticipated that possible sources of error could occur in the tabulation and analysis of data. In order to avoid such mistakes, checks were built into the

computer programme.

5.5 Analysis of the information; the design and administration of the questionnaire

5.5.1 The framing and arrangement of questions

Berdie and Anderson (1974)[11] commented that writing a good question is probably the most difficult task involved in a survey. Clear communication is essential to avoid confusing interpretations and errors in the resultant data. Various types of question format are available, among the most common being:-

- Yes / No questions
- open ended, or essay questions
- "fill in the blank" questions
- multiple choice questions
- ranking questions

Open ended and "fill in the blank" questions were kept to a minimum due to the size of the sample. Had such questions been included, analysis of the questionnaire by computer would have been difficult.

5.5.2 Pretesting and piloting the questionnaire

During the design stages it was felt that the questionnaire should be thoroughly tested. Pre testing involved sending the questionnaire to a sample of respondents similar to those targeted. Questionnaire experts

were also asked for their constructive criticism's. Over 50 pilot questionnaires were sent out involving five versions of the questionnaire. Possible respondents were identified through advertisements in engineering and management journals. A test analysis was also set up.

The results from the pilot questionnaire led to considerable changes in the format and layout of questions, and the structure of the questionnaire. Improvements were made in the clarity of questions to avoid ambiguities.

5.5.3 Targeting of the respondents

Due to the difficulty of identifying specific respondent's names or titles, all questionnaires were addressed to the Managing Director. A covering letter detailed the aim of the questionnaire and asked the managing director to forward it to the appropriate person within the company.

5.5.4 Processing and analysing the data

The questionnaire was sent out in batches of fifty over a three week period during March 1987. Of the total replies received the majority were returned within two months. When the questionnaires were returned they were checked for missing values or obvious errors. Questionnaires with significant amounts of information missing were discarded. Where only a few key questions were missing, where possible the respondent was contacted by phone.

The questionnaire was analysed with the on Liverpool University's IBM 3083 mainframe computer using the software package SPSSX (Statistical Processing for the Social Sciences, version X). This package was chosen as it was readily available and ideally suited to the analysis of questionnaire data.

Answers to open ended questions were dealt with separately (using dBASE III, a PC. database package) but as the questionnaire had few of these the majority of the questionnaire results were analysed through the SPSSX package. Response errors and blanks were carefully recorded as such so as to obtain accurate results. The data was typed in by the author. Various "check" digits were employed to ensure the data did not get out of synchronisation. The SPSSX programme allowed the generation of all types of information including frequencies, cross tabulations and statistical tendencies.

5.6 Summary

The initial survey was intended to examine; the key issues associated the new product development, how managers had attempted to improve the process of NPD, and their awareness to the factors associated with new product success and failure. The survey was also intended to identify companies suitable for more detailed research.

The method selected was that of the postal questionnaire. Careful planning was needed to ensure a good

response rate and a valid set of results. The eventual response rate was 27% and the results clearly showed that the detailed planning had been worthwhile.

6. RESULTS FROM THE INITIAL SURVEY

6.1 Introduction

A total 558 questionnaires were sent out to a broad selection of engineering companies. From this target sample, 156 questionnaires were returned of which 149 were acceptable. This gave an overall response rate of 27% representing well over 10% of the total population. This response rate was considered to be satisfactory. Responses with substantial amounts of data missing were discarded. Queries regarding answers to small numbers of questions were dealt with by telephoning the respondent. The majority of replies were received within 6 weeks, and these questionnaires were dominated by electrical and mechanical engineering companies. The results were analysed on the University's mainframe computer using the statistical analysis package SPSSX. This chapter describes and discusses the results of the initial survey in detail.

6.2 Description of the sample

6.2.1 The respondents

The questionnaire was addressed to the managing director of each company, with a covering letter asking him to forward it to the appropriate respondent. The final analysis showed that the majority of questionnaires were completed by a director or manager responsible for new

product development. A breakdown of the type of respondents is given in table 6.2.1.

table 6.2.1 Type of respondent

	% companies
	(N=149)*
- Managing Director	32.2%
- Director or manager responsible for new product development	60.4%
- Other director, or new product manager	7.5%

It was generally found that in the smaller companies the managing director himself completed the questionnaire. In most cases the respondent was in a position to answer accurately the majority of the questionnaire.

It is important to recognise that the majority of questionnaires have been completed by senior managers. This fact is especially relevant when considering questions regarding the role of senior management as some of the replies could be biased.

* The figure "N" refers to the number of respondents answering a particular question, where this figure does not add up to 149, this is due to missing values on some of the questionnaires. Questions that are mutually exclusive, may not add up to exactly 100% due to rounding.

6.2.2 Type of company

The range and type of companies represented in the sample are listed in table 6.2.2. This analysis is in terms of the respondent's own classification of the particular company represented, and not that of the sampling frame.

table 6.2.2 Type of company

	% companies
	(N=149)
Metal Goods	3.2%
Mechanical Engineering	19.6%
Office Machinery & Data Processing equipment	5.1%
Electrical and Electronic Engineering	29.1%
Motor Vehicles and parts thereof	8.2%
Other Transport	5.7%
Instrument Engineering	7.0%
(Other engineering	22.2%)

A broad cross section of engineering companies were represented in the sample. The survey was dominated by responses categorised as electrical & electronic or mechanical engineering companies. This was expected as these companies in turn dominate the engineering sector itself. It was the intention of the questionnaire to examine companies from the sector who were likely to develop a greater number

of new products, this is reflected in the high percentage of respondents from the electrical and electronic engineering sector relative to the the sampling frame which is dominated by mechanical engineering companies.

From the 22.2% of responses that did not class themselves as part of the first seven sectors (ie. those who selected "other"), no significant industries emerged that could be added to the classification. Responses marked as "other" were generally of companies that were of sub categories of the original seven sector categories.

6.2.3 Company size

Company size was measured in terms of the number of employees and the annual sales turnover. The range of company sizes in terms of the number of employees is shown in table 6.3.2.

table 6.2.3 Number of employees

	% companies
	(N=149)
Less than 200	28.7%
200 to 499	18.2%
500 to 999	18.8%
1000 to 9999	24.5%
More than 10,000	9.8%

A small number of companies with less than 100 employees were included in the sample, although these were excluded from the target population, the number of employees was considered near enough to merit inclusion. Company size was also measured in terms of annual sales turnover (see table 6.2.4) again, a wide range of companies were included in the sample.

table 6.2.4 Annual sales turnover

	% companies
	(N=149)
Less than £ 5.0 M	23.0%
£ 5 M to £ 9.9 M	11.1%
£ 10 M to £ 24.9 M	20.7%
£ 25 M to £ 99.9 M	22.2%
£ 100 M to £ 999.9 M	14.8%
More than £ 1000.0 M	6.7%

In general the questionnaire responses represent an accurate and well balanced cross section of the UK. engineering industry. A wide range of engineering companies are represented in terms of engineering sector, number of employees and annual turnover.

6.3 Effort on new product development

The questionnaire measured the effort spent on new

product development in three ways. Firstly in terms of the number of new products developed. Secondly in terms of the sales turnover of products developed in the last three years, and finally in terms of the percentage of sales turnover spent on research and development.

6.3.1 Number of new products developed

Two companies in the sample had developed no new products during the previous three years. One company estimated that over 200 new products had been developed and launched in the same period. The average (median) number of new products developed was found to be 5. The numbers of new products developed was broken down into the groups described in table 6.3.1.

table 6.3.1 Number of new products developed and launched within the last three years.

	% companies
	(N=145)
Less than 3	20.8%
3 to 5	26.2%
5 to 10	24.2%
10 to 20	22.8%
More than 20	6.0%

mean = 8.06, mode = 3.00, median = 5.00

The levels of new product activity varied across the engineering sectors. In general it was found that mechanically based companies developed fewer new products than their more high technology, electrical and electronic based counterparts. Only 39% of mechanical engineering companies had developed more than 10 new products within the last three years. This is to be compared with to the electrical and electronic sector where over 60% of the companies questioned had developed more than 10 new products. The results here clearly support the view that companies from the high technology sectors develop more new products.

6.3.2 Sales turnover generated by products developed within the last three years

A more realistic measure of new product effort is the contribution that new products developed and launched within the last three years have made to the annual sales turnover.

table 6.3.2 New products as a % of sales turnover

	% companies
	(N=145)
Less than 5% of turnover	25.5%
5 to 9.9% of turnover	10.7%
10 to 19.9% of turnover	18.1%
20 to 50% of turnover	31.5%
More than 50% of turnover	14.1%

Again there were significant differences across the engineering sectors. Companies from the electrical engineering and office machinery classes were found to have a much greater percentage of annual sales turnover made up of new products. Over 54% of electrical engineering companies estimated that more than 20% of their turnover included products that had been developed within the last three years. Only 35% of mechanically based companies fitted into this category.

6.3.3 Percentage of turnover spent on research and development

The final measure linked to new product effort was a measure of the percentage of turnover spent on research and development. Ideally this measure would have included all new product development costs, but as the process is spread across a number of departments so will be the costs, and because of this it was anticipated that few companies would have such information.

The average percentage of turnover spent on R&D across all sectors was found to be 4.51%. These results were found to be very similar to those obtained by Randall (1980)[102]. It is well worth noting, as Randall commented, that what is important is not how much money is spent on R&D, but how efficiently the money is spent.

table 6.3.3 Percentage of turnover spent on research and development

	% companies
	(N=144)
Less than 1%	10.1%
1.0% to 1.9%	15.4%
2.0% to 2.9%	8.7%
3.0% to 3.9%	14.1%
4.0% to 4.9%	14.1%
5.0% to 5.9%	20.2%
Greater than 5.9%	17.4%

mean = 4.5, mode = 4.00, median = 5.00

6.3.4 Lead times for the development of new products

The "lead time" refers to the time taken to develop the product as measured from the initial concept through to the launch of the new product. Respondents were asked to give the average time they would expect for development.

The average lead time for the development of a new product was found to be 20.8 months. Lead times ranged from a minimum of 1 month to a maximum of 5 years. Surprisingly no significant differences were apparent between the different sectors in terms of the time taken for the development of new products. The average lead times for development are listed in table 6.3.4.

table 6.3.4 Average lead time for development

	% companies
	(N=145)
Less than 12 months	35.6%
1 to 2 years	38.9%
2 to 3 years	20.1%
3 years or more	5.4%

6.4 New product success

6.4.1 Definitions of new product success

Respondents were asked to define exactly what their company regarded as a successful new product. These definitions are summarised in table 6.4.1

table 6.4.1 Definitions of new product success

	% of companies
	(N=149)
- Achieves the expected profit	46.6%
- Achieves the expected market sales or market share	36.9%
- Meets the required quality standards	19.5%
- Is delivered on the specified launch date	9.4%

Achieving the expected profit, and obtaining the targeted market share were by far the most common definitions used.

Respondents were also asked how often they reviewed their products to see if they had met the success criteria specified.

table 6.4.2. Frequency with which companies reviewed their new products to see if they had fulfilled the success criteria:

frequency	% companies
	(N=149)
Never	2.1%
Hardly ever	5.5%
Occasionally	22.6%
Often	41.8%
Regularly on a monthly basis	28.1%

6.4.2 Success and failure rates of new products

Each company was asked to estimate the percentage of new products developed that met the success criteria they had outlined. The products considered included only those that had passed through the commercialisation stage and did not include developments cancelled prior to launch. The average success rate was found to be 64.3%. Effectively, over one third of the new products launched did not meet their target success criteria.

table 6.4.3. Success and failure rates

Success rate	% of companies
	(N=149)
less than 50% of products successful	30.2%
50% to 80 % of products successful	38.4%
more that 80% of products successful	31.5%

Respondents were also asked to estimate the percentage of research and development expenditure that was spent on products cancelled prior to introduction. The companies in the survey estimated that 18.2% of R&D turnover went on products that were cancelled prior to reaching the market.

table 6.4.4. Percentage of R&D expenditure spent on products cancelled prior to launch

	% of companies
	(N=149)
less than 20%	63.1%
20 to 50 %	28.9%
greater than 50%	8.1%

6.4.3 The costs of new product failure

Using the above figures, combined with the turnover from each company, the total amount of money each company

spent on new products that were cancelled prior to launch was calculated. The results gave an average of £1.74 million per company (compared to an average company turnover of £200M). These figures vary significantly depending on the actual average taken (mean, median or mode). Table 6.4.5 lists these averages.

table 6.4.5. Costs of new product success and failure

(N=115)	mean	median	mode (number)
£ million spent on new products cancelled prior to product launch	£ 12.6 M	£ 0.98 M	£ 0.0 M (8)
£ million spent on new products that fail after launch	£199.7 M	£ 0.06 M	£ 0.0 M (20)
(for a company with) Annual Sales Turnover	£216.3 M	£19.0 M	£13.0 M

In total, the companies questioned in the survey spent £199.7 million, within the last three years, on products that were cancelled after launch. These figures account for 115 out of the 149 companies surveyed as many companies either did not have the required information or declined to respond for reasons of confidentiality.

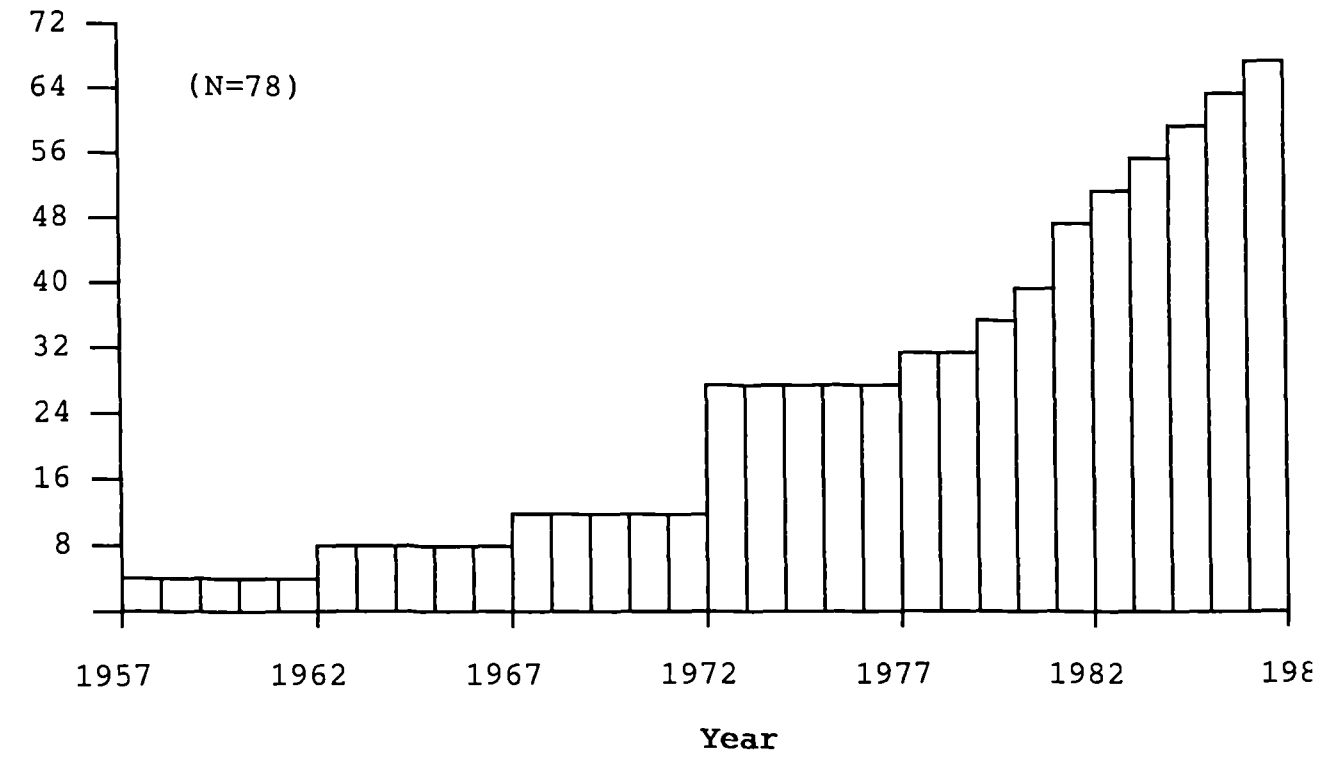
It would be unreasonable to expect any company not to waste some of its R&D money. If no mistakes were made it is likely that no risks would be taken. However careful control is needed to ensure that costs do not get out of hand. A similar case can be argued for products that fail after launch.

6.5 The organisation and control of new product development

6.5.1 Use of new product procedures or guides

Over half of the companies questioned (78 companies) were found to use some form of new product guide or checklist to help control their new product development process. The majority of companies estimated that these were followed "fairly closely" in practice. The majority of these new product procedures were relatively new to the companies involved, as demonstrated by figure 6.5.1.

figure 6.5.1 Number of companies with new product procedures or guides 1957 to 1987.



A extrapolation of this graph would tend to suggest that by the mid nineties the majority of companies will have new product guides or procedure of some kind. The results showed that currently, only 33% of companies from the mechanical sector used a formal procedure compared to nearly 60% of electronic based companies.

Only two companies out of whole sample had a new product procedure that had been in use for more than 20 years. Companies were also questioned regarding the origin of their new product procedure.

6.5.2 Origin of new product procedures or guides

Respondents were asked where their new product procedure or checklist had originated from. By far the majority of cases showed that new product guides have originated through experience. It was found that in only one company had based its new product procedure on literature describing new product process models. A list of the various origins is given in table 6.5.2.

table 6.5.2 Origin of the new product procedure

	% of companies (N=68)
- From experience; as a result of development problems and mistakes.	55.7%
- From experience; in anticipation of development problems and mistakes.	28.6%

- Through a key person or individual.	25.7%
- From another company, through a key individual.	17.1%
- From a book or journal detailing a new product procedure.	1.4%
- Through a committee or team set up to improve the new product development process.	37.1%

6.6 The management of new product development

6.6.1 Approach used to manage new product development

Companies were questioned as to the approach they used to manage the development of new products. In order to ensure all possible approaches were covered this question was based on Souder's (1987)[132] analysis of the approaches used to manage new product development.

table 6.6.1 Approach used to manage the development of new products

	% of companies (N=137)
New Product department: responsible for integrating R&D and Marketing efforts, mainly integrators and expeditors.	5.8%
Product Committee or Team: used to coordinate inter-disciplinary effort.	34.3%

Commercial Project Manager: an individual from Marketing, appointed to manage a new product development team.	7.3%
Technical Project Manager: an individual from R&D, appointed to manage a new product development team.	21.2%
Commercial Line Management: a top level Marketing executive has sole authority and responsibility for carrying out the project.	2.2%
Technical Line Management: a top level R&D executive has sole responsibility for carrying out the project.	7.4%
Commercial one man show: a Marketing person initiating and monitoring the development work.	2.9%
Technical One-Man show: an R&D person initiating and monitoring the development work.	2.2%
An R&D - Marketing Dyad: a strong personal alliance between an R&D individual and a Marketing individual.	14.6%

The most popular methods of organising for new product development appear to be based around the use of teams. A significant number of product developments were found to be controlled by technical project managers. This method however has been found by some studies (Souder(1987)[132], Cooper(1983)[29]) to lead to failure.

6.6.2 Responsibility for new product development

In over 60% of the companies questioned responsibility was found to be transferred during the course of the new product development process. It was more likely that mechanically based companies would transfer responsibility.

6.6.3 Awareness of new product strategy

Respondents were questioned as to how aware various management levels involved in new product development were to the companies new product strategy.

table 6.6.2 Policy towards the awareness of company strategy and new product objectives and goals

Group aware	% of companies
	(N=134)
Senior management	89.6%
Middle management	43.3%
Technical staff	32.1%
Supervisors	17.9%
Shop floor or equivalent	11.2%

As one would expect, the majority of senior managers are well aware of the company's strategy. What is surprising is the low levels of awareness of middle management and technical staff to the company's strategy.

6.6.4 New product strategy

Out of the total sample, just less than half (49.7%) of the companies felt that they had a clearly defined new product strategy.

6.6.5 Senior management involvement in new product development

By senior management the questionnaire referred to those managers of board level status. Table 6.3.3 shows senior management's involvement with NPD.

table 6.6.3 Senior management's involvement in the new product development process

	% of companies
	(N=136)
- Ensuring that the new product strategy and long term plans are implemented.	53.7%
- Provide support and encouragement but do not get involved any decisions that are part of the new product development process.	18.4%
- Involved with key decisions only at critical stages in the project.	43.4%
- Involved in decision making on a day to day basis.	18.4%

It was found that the majority of managers were strongly involved in key decisions and strategy considerations. Only a small number of managers felt their role was to provide support and encouragement only, and not get involved in the decision making process at a lower level.

6.7 Improvement of the new product development process

By far the majority of managers, 86.6%, felt that the new product development process and its management needed improving. Conscious effort to improve the new product development was greater among the high technology companies. It was found that 87% of electronic based engineering companies felt they made continual conscious effort to improve the process, compared to 75% for mechanically based companies. However, when asked how effort to improve the process of new product development had been directed, supporting evidence of significant improvements were not visible from the questionnaires.

6.7.1 Responsibility for improvements to the new product development process

Respondents were questioned as to who within the company was responsible for identifying new ideas and changes to the new product development process. These results are presented in table 6.7.1.

table 6.7.1 Responsibility for identifying new ideas and changes to the new product development process

	% of companies
	(N=147)
Senior management	68.0%
New product staff	23.8%
Review system/committee	25.9%
A specified individual	6.8%

The majority of respondents indicated that senior management were responsible for identifying changes to the new product process. Only 24% of companies however, viewed this responsibility as part of the role of their new product staff.

6.7.2 Types of changes made to the NPD process

Companies were questioned as to what type of changes were made to improve the process of new product development.

By far the majority of changes were found to involve changes to the organisational structure. The other key areas included changes to the strategy and systems. Few changes looked at the organisational culture or similar aspects of change. Many of the companies, 40.9%, said there were plans for future changes to the new product development process.

table 6.7.2 Type of changes made to improve the new product development process or its management.

	% of companies (N=147)
- Alterations to the new product strategy	39.8%
- Improved Screening and evaluation of new products	38.2%
- Changes to the organisational structure	65.0%
- Changes to the new product procedure	36.6%
- Other	8.1%

6.8 Awareness of research into new product success and failure

6.8.1 Factors associated with success and failure

Respondents were firstly asked to indicate the factors they felt contributed to the success of new products. They were asked to present these in order of the three most important factors.

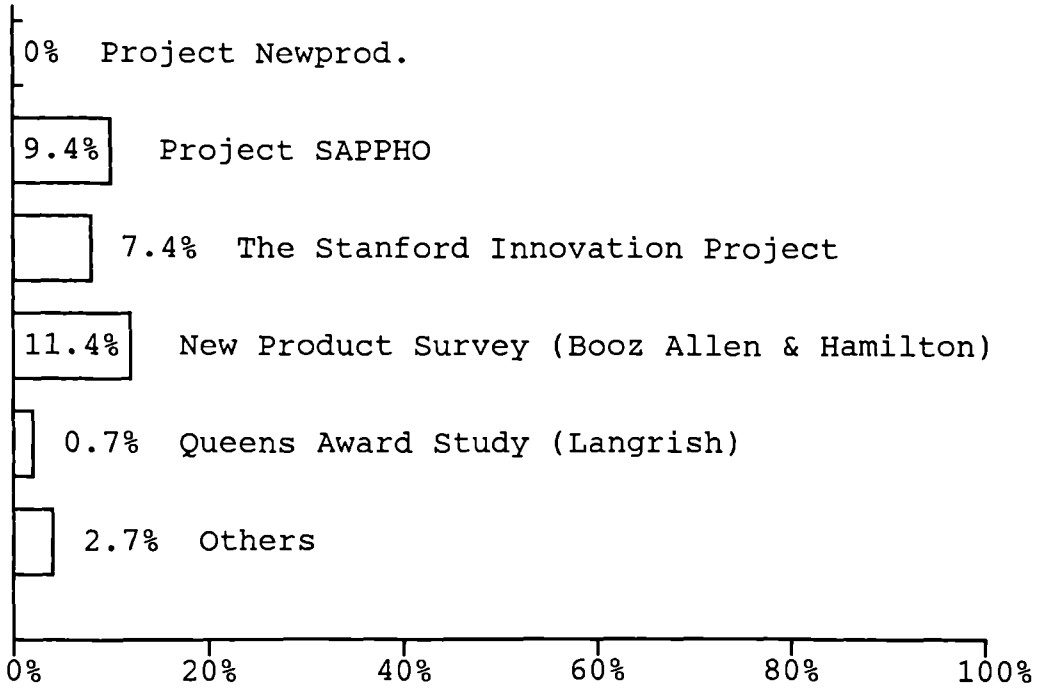
table 6.8.1 Factors contributed most to the success of a new product

(N=147)	% responses ranked 1st.	% responses ranked 2nd.
A detailed understanding of the market combined with a strong marketing effort.	38.7	22.5%
A unique and superior product, that clearly meets user needs.	20.4%	7.2%
A good specification and clear planning during the initial stages.	14.1%	29.7%
A key individual (product champion) to "push" the development through.	8.5%	5.4%
A strong understanding of the technology involved, and an efficient development process.	4.2%	23.4%

6.8.2 Awareness of new product research.

One of the key questions in the survey related to how aware new product managers were of the research studies carried out into new product success and failure. The key studies were listed and respondents were asked to indicate which studies they were familiar with. In total only 6.7% of the respondents had studied some of the above work in detail and only five companies (3.4%) had attempted to apply the results of the research or other studies in some way.

table 6.8.2 Percentage of managers who had heard of the research into new product success and failure.



6.9 Summary and conclusions

The questionnaire, as intended, covered a broad spectrum of engineering companies. A total of 149 companies were included in the sample, giving a response rate of 27%. The replies were dominated by electrical and mechanical engineering companies, with a deliberate bias towards the higher technology engineering companies. The majority of responses received were from director level.

The importance of new product development was clearly demonstrated through the level of effort companies are putting into the process. Only two companies out of the sample of 149 had not developed any new products within the last three years. On average companies had developed 5 new products within the last three years. In over 50% of the companies surveyed, 20% of their current sales turnover was made up of new products that had been launched within the last three years.

Across the engineering industry as a whole it was found, as expected, that the high technology companies tended to develop more new products than their low technology based counterparts.

The need to improve the process of new product development was demonstrated through the low success rates. The cost of failure is high. It was estimated that for the sample of 149 companies nearly £200 million has been spent on products cancelled within the last three years. Companies estimated that 18.2% of R&D expenditure was wasted on products cancelled prior to launch. On average this equates

to 0.82% of a company's annual turnover, a significant figure for any company to waste. These figures too, do not take into account products that have failed after launch, only those cancelled prior to introduction.

The success rate of the products after launch was found to be 64.3%. This is typical of many previous studies (Crawford(1983)[35]) and supports Crawford's conclusion that there has been little change in the success rate in recent years.

Most companies defined new product success in terms of achieving the required profit. This is to be expected as one of the main reasons for a company's existence is to make money. Few companies seemed to regularly review their new products to see of they had achieved the success criteria outlined. Companies described such reviews as being carried out "often". It is unlikely that a company would take such an attitude to its monthly balance sheet.

Over half of the companies surveyed used some form of new product guide to control their new product development process. This was most notable again, amongst the higher technology companies. The trend in the use of new product guides would tend to suggest that by the mid nineties over 80% of companies will use some form of new product guide or procedure. This clearly indicates that companies are beginning to take the process of new product development much more seriously.

It was interesting to note the origin of the new product procedure. Only two companies had based their procedures on articles or papers outlining new product

processes. By far the majority of companies based their systems on experience gained through previous mistakes. Some authors have argued that mistakes have to be made (Maidique & Zirger(1985)[82]). Equally there is an argument for making use of research factors that in effect summarise the most common mistakes companies make in the NPD process.

The two most popular approaches to managing new product development were, the use of a new product committee or team, and the use of a technical project manager. This first approach has proved to be a successful method of managing new product development. The second however, as both Souder (1987)[132] and Cooper (1985)[31] comment has showed it is far from ideal. The complexity of the process makes the use of team essential in most cases to coordinate the process.

In less than half the companies surveyed middle management were aware of the new product strategy. In the majority of cases senior management viewed their role as one of setting and ensuring that the company's new product strategy and long range plans are implemented.

The majority of managers agreed that the process of new product development needs improvement. Indeed over 80% said that continual changes were being made. Little evidence was found to back up significant or structured changes. In terms of the types of changes being carried out, by far the majority were found to be changes to be related to the new product structure, strategy or systems.

In over 68% of the responses, senior managers saw it as their own role to identify new ideas and changes to the new product development process. Yet as these same managers had

indicated earlier very few were involved with NPD decision making on a day to day basis.

Perhaps one of the most significant results from the questionnaire was the awareness of new product managers of the research into new product success and failure. By far the most popular work was that of Booz Allen & Hamilton (1982)[13]. However only one in ten managers had heard of this work. No managers had heard of Cooper's(1979)[26] research. Out of the entire sample, only five companies had made any attempts to apply the research.

Overall there appears to be no structured or common approach to the management of new product development. This is especially true compared to other areas of management such as finance or manufacturing. New product development is not a clearly defined or well managed area.

It is also questionable whether the research into new product success and failure is worthwhile if companies are not applying or taking benefit from the results. Researchers must take careful note of how their research findings can be applied. Industry too must find the time, ability and resource to apply the research findings.

7. THE FOLLOW UP SURVEY; THE STRUCTURED INTERVIEW.

7.1 Introduction

From an early stage it was clear that the more detailed information on how companies change their new product development organisations would be best obtained through the use of structured interviews. This choice of method of data collection was essential as the type of questions being asked did not generate categorical responses. The detail required was not at all suited to the questionnaire technique. The questionnaire allows little opportunity to explain the key issues. A structured interview allows the researcher to clearly explain the question and hence ensure he is obtaining an accurate response.

The aim of the structured interviews was to examine the type of changes being made to new product development organisations. The McKinsey seven S model (Peters and Waterman (1982)[96]) was used as a basis for the interview to ensure changes to all aspects of the NPD. organisation were examined. The structured interviews were analysed and written up as case studies contained in appendices XIII to XXII. This chapter discusses the planning of the interviews, the methodology used, and the subsequent results.

Originally it was the aim of the structured interviews to focus on companies that had attempted to apply the research factors (associated with new product success) in a planned programme of change. The aim was to compare these companies against a sample that had made unplanned changes

based on experience. After analysing the questionnaire survey, four companies were identified that had attempted to apply the research. Of these, only two companies had done so using a planned programme of change. It was therefore not practical to make the intended comparison.

7.2 Planning the structured interview

As with a questionnaire, careful planning of a structured interview is needed to ensure a good response rate and good quality information on which to draw valid conclusions.

7.2.1 Aims, objectives, and the type of information to be collected.

The main aim of the interviews was identify how successful companies adapt and change their new product development organisations. In effect, the main objective was to examine in detail the management of the NPD. organisation. Other objectives were, to give a clearer insight into how companies defined new product success, and to confirm and backup the questionnaire results.

It was envisaged at an early stage that the eventual results would be written up as case studies. This was due to the nature of the information being collected. A structured interview schedule was essential to ensure a consistent approach across each of the companies visited. The information required included:-

1. The type of NPD. organisation at the time of the interview.
2. A clear definition of success / failure.
3. The type of past changes and their effects on the organisation.
4. How recent changes to the NPD. organisation had been decided upon and implemented.
5. A measure of new product performance.
6. Additional company details.

The organisation was examined on the basis of the McKinsey seven S model. This was used to ensure all aspects of the organisation were covered. Thus the NPD. organisation was examined in terms of its strategy, structure, systems, management style, shared values, staff and skills. It was envisaged that difficulties would be encountered collecting information regarding some of the seven S's, especially the "soft" S's. Again this emphasised the importance of using the interview technique.

7.2.2 Sample selection

Companies were selected from the initial survey respondents, on the basis of their questionnaire replies. Companies selected were required to have the following characteristics:-

1. Recent changes had been made to the company's NPD. organisation.
2. The company was successful and one of the leaders in its particular market.

3. The company was successful at developing and introducing new products.

From the above criteria it can be seen there was an intentional bias in the sample selection. Thus the structured interview sample was biased compared to the original population. Since the purpose of the study was to examine change, there seemed little point in including companies that had made no changes. It is important to recognise this bias towards successful companies when considering the results.

It was important to ensure that the appropriate respondents were of a sufficient status within the company to provide the information required. It was envisaged that responsibility for changing the new product organisation would rest with senior management and it was essential that the interviews were carried out at this level and at a common level across the different companies. Ten companies were chosen for the follow up survey.

7.2.3 Design of the interview schedule

To ensure consistency between the company visits an interview schedule was designed. The schedule was broken down into three separate sections (see appendices IX, X, & XI). The aim of the schedule was to give a consistent structure to the interviews. It was not intended as a rigorous series of questions, more as a guide, allowing the discussion to focus on specific areas important to that particular company. The three sections were:-

1. **New product performance.** This section was intended to give a detailed measure of the actual success of new products within the company and their impact on company sales and profitability.
2. **Change and new product development.** This section contained the bulk of the interview questions. It aimed to examine more closely recent changes that had been made to the NPD. organisation. To achieve this it was first necessary to look carefully at the present organisational structure within each company.
3. **Additional information.** This short supplementary section was intended to collect additional company information required to make an effective company comparison.

The bulk of the structured interview was contained in "Change and new product development" (section 2 above, and appendix X). This section was designed to examine the organisation and any recent changes in detail. The questions themselves, as in the questionnaire, were strongly based on models and concepts drawn from the literature.

The interview was broken down into seven main sub sections on each of the seven S's (strategy, structure, systems, style, staff, skills and shared values). These sub sections were designed to examine the current organisation, followed by questions relating to change in that particular organisational factor. For example, the section on strategy examined the organisation's current new product strategy and

then questioned the changes that had been made to it within the last three years.

The interview schedule was tested within the sponsoring company and on several staff members of the department of Industrial Studies, Liverpool University. The aim of these pilot runs was to evaluate the layout and ensure all aspects of the new product organisation and change were covered.

7.2.4 Arranging the interview situation

Gorden (1975)[44] noted that establishing the correct interview situation is crucial, the first contact with the respondent through to the opening question needs to be carefully planned. What the interviewer says during this period will set the tone of the interview and affect the communication and the responses given.

Ten companies were targeted for the structured interviews. With the respondents previous response and interest in the research area it was felt that non response would not be a problem. The majority (but not all) of companies had also indicated they were willing to take part in further research.

Initial contact with the respondent was established by letter (see appendix VIII), explaining the purpose and nature of the interview, together with a set of the results from the initial survey. These letters were then followed, approximately one week later, with a telephone call. The aim of the phone call was to explain the purpose of the follow up survey in more detail and arrange a suitable date for the

interview. This method of contacting and arranging the interviews assured a 100% acceptance rate.

All interviews were held at the location of the company in question at a time convenient to the respondent. Gorden (1975)[44] proposed eight factors that should be considered prior to reaching the interview situation. These were taken into account during the planning stages and the following provisions made to ensure an ideal atmosphere.

(a) The interviewer's introduction

In the initial introduction it is important that the interviewer's role is clearly communicated to the respondent. Introduction was by name, and in a manner intended to convey competence and warmth.

(b) Sponsorship

It was made clear that the research was being sponsored by the department of Industrial Studies, Liverpool University and the SERC. Although none of the respondents were in direct competition with the DEOC, DEOC's sponsorship was not referred to. It was felt that DEOC's relationship with the interviewer might have been misconstrued, and consequently affect the responses given.

(c) Explaining the purpose of the interview

The purpose of the interview was explained in such a

manner that the respondent could account for all the types of questions being asked. Details of the research were given including the initial stages and findings from the mailed questionnaire. The research was presented in a brief, logical manner. It was made clear that the interview was the final stage in the research. The various parts of the interview schedule were explained, and the type of information that each sought. Estimated times for completion were also discussed.

(d) Explaining the selection of the respondent

The selection of the respondent was discussed; companies chosen were told how they were selected from their questionnaire responses. This was also useful in confirming to the interviewer that a correct judgement in the selection had been made.

(e) Offering feedback and results

The use of an extrinsic reward has proved a facilitator of communication. Consequently a copy of the results were offered in return for taking part in the interview.

(f) Providing anonymity, and assuring confidentiality

The type of information sought, the location of the interview (at the respondent's company) and the initial contact, meant it was not possible to give the the

respondent anonymity. Confidentiality, however, was assured. In some cases it was envisaged that the respondent may ask for a confidentiality form to be signed. This point was anticipated and offered if the respondent asked. Reassurance at this point was considered a vital point in setting the tone for the interview, and a key lesson learnt from the pilot interviews.

(g) Recording the interview

The structure of the interview form provided ample space for note taking. Again, out of courtesy, the respondent was asked if he objected to the interviewer taking notes during the course of the interview.

(h) Planning the opening question

Gorden (1975)[44] suggested that several alternative opening questions are advisable, depending on the initial atmosphere. He commented that the importance of the opening question is too great to leave to caprice, yet at the same time it should not be rigidly determined. In the layout of the schedule it was felt that the respondent would notice some thing wrong if any question other than the first was selected. Again the usefulness of having the schedule in three parts allowed the interviewer to select either section to "break the ice" if necessary.

7.2.5 Interviewing strategy and tactics

Each interview followed the interview schedule as described in section 7.2.3 (see also appendices IX, X, & XI). The schedule was intended as a guide, and not a series of questions to be rigorously followed. Where necessary additional questions were added "ad-lib" during the course of the interview as a form of probing to meet the informational objectives.

The points of anonymity and confidentiality were stressed in order to facilitate communication. Gaining access to the required respondent was not found to be a problem. However keeping his interest over the length of the questionnaire was a problem. This was overcome by allowing the discussion to expand in areas of interest to the respondent and jumping ahead in sections where no changes had been made and the questions were not relevant. The interview was designed to last no longer than two hours. Although in some cases it was expected that the discussions would go on longer.

Notes were made on the schedule itself in the spaces provided, or on paper attached on the back.

7.2.6 Analysis of the results from the structured interview.

Results from the interviews were written up in the form of case studies (appendices XIII to XXII). Each of the case studies included a company description, followed by details

of recent new product performance. The bulk of the case study, as in the interview discusses each of the seven S's and the associated organisational changes. Each case study was written up independently before any conclusions were drawn for the study as a whole.

7.3 The structured interview results

7.3.1 Introduction

Ten interviews were carried out during February and March 1988. The interviews all went according to plan, most lasting in the region of two to three hours. In each case the interview was fully completed, and in over half of the companies a substantial amount of additional information was received relating to specific products, and changes within the company concerned. It was clear from the information obtained that the structured interview had served its purpose and examined all possible changes to the new product development organisation. The respondents were all of a senior level within the companies questioned, and were well placed to answer the questions. The majority of answers were of a qualitative nature. Numerical information eg. success rates, although measured to ensue comparability, was not the concern of, nor analysed in any detail in this chapter.

One case study was however discarded after writing up as it was felt not to be relevant compared to the rest of the sample. The company was originally selected because of its

indicated attempts to apply the results of a research study. During the interview it emerged that the research had confirmed rather than changed its way of thinking. The company's products were also not compatible with the rest of the sample, with innovations being more of a process rather than product in nature. Much of the work was contractual, and the company did not have significant new product development effort. Consequently the results were discarded, the case study however is included for comparison in appendix XXIII.

7.3.2 The companies

The final sample included a range of mechanical, electrical and electronic engineering companies. In terms of company size, all companies had more than 100 employees, as in the questionnaire. Company turnovers in the sample ranged from £5 million to £2 billion. The companies in terms of their product, turnover and number of employees are described in table 7.3.1.

table 7.3.1 The companies.

COMPANY	PRODUCT	TURNOVER £M	NUMBER OF EMPLOYEES
1	Articulated Dump Trucks	60	600
2	Electro optical products	90	2,300
3	Electrical heating elements	5	200
4	Industrial Gases	2000	32,000
5	Computer inform-ation systems	1500	20,000
6	Four wheel drive vehicles	500	8,000
7	Heavy duty diesel engines	40	900
8	Gas turbine engines	2000	42,000
9	Life Science Instrumentation	15	300

This range of companies gave a good broad sample of successful engineering companies, with different and varied approaches to new product development. The sample represents a broad cross section of UK. engineering companies, in terms of size, product, and effort spent on new product development. Table 7.3.2 examines the effort companies put in to new product development.

table 7.3.2 Effort on new product development

COMPANY	PRODUCT	Number of new products developed 1983 - 1988	% of sales T/O made up of new developed 1985 - 1988	Number of employees involved with NPD.	% of turnover spent on research & development	Typical lead time for new product development
1	Articulated Dump Trucks	6	60%	35 (6%)	3.5%	18 months
2	Electro optical products	5	30%	200 (9%)	5%	5 years
3	Electrical heating elements	1 (3)	6%	11 (6%)	2%	12 months
4	Applications of Industrial Gases	10	30%	300 (10%)	2%	24 months
5	Computer inform-ation systems	200+	70%	2000 (10%)	9%	12 months
6	Four wheel drive vehicles	5	2%	800 (10)%	5%	4 years
7	Heavy duty diesel engines	0	0%	50 (6%)	3%	10 years
8	Gas turbine engines	4	0%	2000 (5%)	7%	5 years
9	Life Science Instrumentation	5	10%	45 (15%)	6.5%	24 months

As can be seen from table 7.3.2 the range of effort expended on new product development varies across the companies surveyed. As expected, the higher technology companies in general expend much more effort than their low technology based counterparts.

7.3.3 New product success

Companies were questioned in detail regarding their perceptions of new product success. Only three companies out of the nine interviewed included within their definitions an acknowledgement that success involved meeting customer needs. These companies defined success as either "achieving user acceptance" or "meeting the requirements of the customer". Despite the fundamental importance of meeting customer needs, six companies did not include any reference to the customer in their definitions of success. Meeting customer needs can be measured in terms of the product's impact and acceptance within the marketplace. Meeting the needs of the customer is strongly associated with achieving a minimum level of sales or a certain market share. A good product will meet customer needs and sell well. Both the level of sales and market share were found to be key measures in over half of the companies interviewed.

Profit and the commercial performance of the product were underlined by all the companies in the survey. All the interviewees commented that profit was prime of importance followed closely by market share or the achievement of a certain level of sales. Apart from possible tactical sales,

it was strongly believed that every product must make a profit, and as such profit was by far the most commonly cited factor in the definitions of new product success.

Most companies felt that profit was distinct from other measures such as product performance, quality, reliability and delivery on time. The general consensus appeared to be that factors such as product performance, quality, delivery on time were a prerequisite to achieve the required level of sales. Achieving the required level of sales should then generate the required profit.

No accurate or quantitative measures of new product success were found in any of the companies interviewed. The lack of a clear measure was also reflected when companies were asked about their success rates. All the companies gave estimates. It seems that there is little accurate quantitative data on company's individual new product success rates. To a large extent this is a result of no clear product success definitions. Clearly, success will vary depending on how it is defined. Such definitions are vital as part of the new product development process.

Two companies defined success as meeting the performance targets and requirements laid down during the early stages of development. Such measures included cost and performance objectives. These types of definitions, and measures of success, clearly relate to only the performance of the product development programme itself. One company had a useful measure of development efficiency which was in terms of the total sales achieved against the resources available. That is, sales per man year of development

effort.

The time at which success is measured was found to be of crucial importance. Two companies clearly showed that products that had initially, been classed as failures, had at a later date become very successful. This clearly demonstrates that true product success can only be measured over the life of a product, and that the development and management of the product after launch is crucial to the profitability of the company.

7.3.4 New product development organisations and organisational change

The case studies were examined in detail across each of the 7 S's that make up the organisation. Key factors relating to the current organisation are summarised in tables 7.3.3 and 7.3.4. These are followed by tables 7.3.5 and 7.3.6 which describe recent changes to the new product organisations.

The fact that each company was successful was reflected in the practices found across the case studies. From the organisations studied, several aspects stood out where significant changes had occurred. These included:

1. A trend towards much more customer oriented organisations with more emphasis on marketing.
2. The introduction of new product procedures and a general tightening of rules and procedures.
3. An increased emphasis on teamwork and teamwork training.

table 7.3.3 New product development organisations;
Key factors relating to the hard S's Strategy, Structure and Systems.

COMPANY	PRODUCT	NPD. STRATEGY	NPD. STRUCTURE	NPD. SYSTEMS
1	Articulated Dump Trucks	To remain market leader and be first to the market.	Engineering led	Outline NPD. procedure also, use of CPA. and PERT.
2	Electro optical products	First to the market, a broad span leader in several markets	Engineering led	Review procedure providing loose outline.
3	Electrical heating elements	Leader in one market segment	Small, functional structure	No NPD procedure Use of CPA.
4	Industrial Gases	Broad span leader and first to the market	New products dept. for each company division.	No NPD. procedure Key NPD. measures
5	Computer Information Systems	Broad span leader with the aim of becoming No.1 choice in markets	Business centres each with NPD facilities, linked to NPD dept.	Phase review process ie. reviews at specific stages during NPD.
6	Four wheel drive vehicles	Leader in one market segment	NPD. department to coordinate and track NP. developments.	NPD. procedure, use of network analysis & computer software
7	Heavy duty diesel engines	Leader in one market segment	Conventional	NPD. procedure provid -ing a loose outline for developments.
8	Gas turbine engines	Market leader	NPD. engineering led with corporate engin- eering department.	Broad based NP. proce- dure tailored for individual NP's.
9	Life Science Instrumentation	Leader in one market segment	Small functional Co. with responsibility for NPD. transferred	Use of NP. procedure following specific development path

table 7.3.4 New product development organisations; Key factors relating to the soft S's Style, Skills, Staff, and Shared Values.

COMPANY	NPD. STYLE	NPD. SKILLS	NPD. STAFF	NPD. SHARED VALUES
1	Entrepreneurial with strong management involvement in NPD.	Heavy engineering, good generation of new product ideas.	Small company atmosphere, many "all rounders"	Typical power culture centred around a key individual.
2	Mixture of paternal "old guard" style & involved leadership	Strong R&D skills	Mixture of graduates and loyal Co. workers	Mixed old and new styles, bureaucratic "role type company"
3	"hands on", open and democratic with an element of autocracy	Low development tech -nology, "state of the art" production	Low emphasis on teamwork, small Co. atmosphere	High degree of open-ness and trust
4	Aggressive "hands on" style	Low emphasis on R&D - will "buy" in the necessary skills	Many professionals & specialised skills	Key individuals, risk averse and smug.
5	Extensive senior man-agement involvement and support	Strong R&D skills, many brought in from university contacts	High proportion of graduates, and high management turnover	"British" and inward looking, but need for change well recognised
6	Management involve-ment and support	Ranges from cutting edge to low tech., emphasis on teamwork	Many graduates, and specialist engineer-ing types.	Mixed old and new culture. Key individ-uals play a key role
7	Autocratic style revolving around key individuals	"State of the art" manufacturing equipment	Many apprentices, staff turnover low.	Environment slow to change. People seem to be mistrustful
8	Senior management have high visibility & in constant touch	Strong technological skills base, with emphasis on teamwork	Strong recruitment drive for graduates to work in NPD.	Cost conscious, expert power is the main source of power
9	Little senior manage-ment in NPD, elements of bureaucracy.	Specialised skills required for specific markets	Emphasis on profess-ional specialised technical abilities	Family based atmos-phere and abilities.

table 7.3.5 Recent changes to the new product development organisations; Key changes relating to the hard S's Strategy, Structure, & Systems.

COMPANY		NPD. STRATEGY	NPD. STRUCTURE	NPD. SYSTEMS
1	Articulated Dump Trucks	Change from an entrep-reneurial strategy to a positional one.	Increase of technical resource and reinforc-ing of organisation.	Introduction of NPD. procedure two years ago
2	Electro optical products	Change from technology push to a customer driven policy.	Strengthening of the sales and marketing functions.	A general tightening of the rules and procedures.
3	Electrical heating elements	Company is becoming more market driven.	NO functional changes to the structure	Improved coordination through NPD meetings
4	Industrial Gases	Change towards greater market diversification	NO major changes to the structure	More formalisation tightening of rules and procedures
5	Computer Information Systems	Change towards a much sharper customer focus	Change from functional organisation to the use of business units	Introduction of the phase review, + a tigh-tening of rules etc.
6	Four wheel drive vehicles	NO major changes only detailed alterations	NO major changes	Implementation of computer controlled project management
7	Heavy duty diesel engines	NO recent changes	Appointment of a speci-fic new product manager	Plans to formalise information transfer
8	Gas turbine engines	Towards improved product performance & meeting needs of the customer.	New department looking purely at "new" new product developments	Changes to ensure tighter resource mana-gement, & rules etc.
9	Life Science Instrumentation	Organic growth of the company and growth though acquisitions	Expansion of structure jobs becoming more formalised & narrow	Introduction of new product procedure & tightening of rules.

table 7.3.6 Recent changes to the new product development organisations; Key changes relating to the soft S's Style, Skills, Staff, and Shared Values.

COMPANY	NPD. STYLE	NPD. SKILLS	NPD. STAFF	NPD. SHARED VALUES
1	Loss of entrepreneur-ial spirit to become more professional.	Development of proj-ect oriented skills for coordination.	Training for and recruitment of CAD. skilled staff	Little change, but towards a more disciplined workforce
2	From an authoritarian line management to a more "involved" style	Acquiring of more marketing and team work skills.	Recruitment of mark-ing specialists	Change from authorit - arian approach to a more involved style
3	From complacency and stagnation to dynamic and fast moving	More emphasis on marketing	Entire new manage-ment team	From an individualis-tic approach to a more open & risk taking Co.
4	More emphasis on management support & new product tracking	"Buying in" of specialist skills as and when required	NO recent changes	"Putting the customer FIRST" a company wide training programme
5	More openness, more cooperation and more participation	Development of Mark-eting skills and systems capability	NO recent changes	NO recent changes
6	Change from a react-ion to failure to one of building on success	Development of CAD, electronics and also teamwork skills	NO recent changes	High degree of open-ness and trust developing
7	NO recent changes	Major improvements to production skills CADAM, FMS etc.	NO recent changes	Need for change not strongly accepted. NO major changes.
8	NO recent changes	Development of CAD, electronics and manufacturing skills	NO recent changes	NO significant changes
9	Change to a more professional organisation	Significant skills bought in due to organic growth of Co.	Major introductions of new staff to sati--sfy organic growth	Gradual change to a more dynamic Co.

4. The move to a more democratic, professional and supportive management style.

Each of the organisational aspects covered is discussed individually using the McKinsey model seven S model.

Strategy

All the companies were found to be leaders in at least one market segment. Strategies were all positive, and dominated by "entrepreneurial" type approaches, as opposed to positional. There is clear link between entrepreneurial strategies and effort put into new product development. The three companies with positional strategies were characterised by long lead times, a low number of new product developments, and a low percentage of sales made up of new products developed within the last three years. The majority of strategies appeared to be of the successful "balanced" type as identified by Cooper (1980)[27] apart from one case which was clearly a "low budget conservative" type of strategy.

Probably the most significant change in the new product strategies appears to be towards meeting customer needs. The trend is one of a much sharper customer focus with more emphasis on marketing. Two companies indicated that no significant changes had occurred to their NPD. strategies. In both cases the companies were low technology, long lead time companies.

Structure

The structures used by the case study companies were found, as expected, to vary significantly. In four companies new product development was under the control of the engineering departments. According to the literature, this factor has been found to be detrimental to the success of many companies new product development programmes. These engineering led companies tended to be associated with longer product development lead times. The smaller companies had much simpler and more conventional organisational structures. Four of the larger companies used some form of new product department, and the responsibility of these varied from simple tracking to the full development of the products.

Changes to the structures varied across the cases. Three companies had undertaken no major changes. Two of the larger companies had altered their organisations to mimic smaller organisations through the creation of business centres. The idea behind this philosophy being to achieve a more open, team orientated type atmosphere of small organisations whilst at the same time retaining the efficiency and skills of the large organisation.

Systems

Only two companies did not use new product procedures. The majority did and these varied from the provision of rough outlines to detailed guides. There was considerable emphasis on a carefully planned approach and most companies used some form of critical path analysis to ensure efficient

development programmes. At the same time companies appeared not to over formalise the procedures nor to put too much emphasis on them.

Perhaps the most striking changes across the case studies have been the recent increased formalisation of systems. All companies were found to have made changes to their systems. Four had introduced, or rewritten their new product procedures. In all cases there appeared to be a trend towards a general tightening of rules and procedures.

Style

The management style of the companies was very mixed and ranged from a very autocratic style in one case, to several very open and democratic management styles. The open "hands on" management styles were clearly linked to companies with substantial new product development effort, and low development lead times.

The changes in management style indicated a move towards a more open and supportive management. The companies making up the case studies were aiming to become more professional in all aspects of management. Authoritarian line type managers are being replaced by more professional democratic type managers.

Skills

The factors of skills and staff were found to be very closely interrelated. Skills proved a difficult aspect of the organisation to measure. The types of skills required by the companies varied and were generally matched to the

company's products. There appeared to be either no commitment, or a strong commitment to research and development skills, again in accordance with the requirements of the organisation, and new products. Efficient use of skills is a key aspect in the running of an efficient NPD organisation. The larger companies placed a great emphasis on teamwork, yet smaller companies found no need for this conscious effort due to their small size, and "family" type atmospheres.

Three companies had made specific aims at improving the marketing ability of their staff. The majority of the larger companies had invested in teamwork training. Most of the companies saw the development and introduction of computer aided design as a major step forward to improve their NPD skills base.

Staff

Smaller companies tended to recruit less, and promote more from within. The larger companies however appeared to attract more specialist skills and graduate training programmes.

Major changes in staff occurred in only two companies and in both cases these have been marked by a significant growth and improvement in the companies performance. In one case the entire management board was replaced which led to a significant improvement in the company's ability to produce new products.

Shared Values

As with style, the shared values of each case company, varied tremendously. One prominent factor was the role of key individuals. Changes to shared values appear to be low in effort and emphasis and showed mixed and varied approaches.

The hard S's show definite trends and similarities, the soft S's vary significantly across the companies. It is interesting to note that in certain cases the larger the companies directed structures and resources to mimic the smaller companies. This was especially noticeable with aspects such as teamwork which comes naturally to small companies and where training is not required.

7.3.5 Basis, implementation and management of the changes

In seven out of the nine companies, the driving forces that pushed the changes have been as a result of recognition of the need to change in order to survive. Out of the other two changes, one was driven from a complete change in the management team, the other due to significant growth in the company. A summary of the implementation and management of change can be found in table 7.3.7.

table 7.3.7 New product development organisational change

COMPANY	PRODUCT	DRIVING FORCE BEHIND THE NPD. ORGANISATIONAL CHANGES	IMPLEMENTATION OF THE CHANGES	TYPE OF CHANGES
1	Articulated Dump Trucks	Company growth, and the need to become more professional, and less risk taking.	Senior managers within the organisation	LEGISLATED
2	Electro optical products	Recognition of the need to change in order to survive.	The whole organisation through total quality management	PLANNED
3	Electrical heating elements	Replacement of the management team; new ideas & change	Senior management within the organisation	LEGISLATED
4	Industrial Gases	Recognition of need to improve marketing ability in order to compete more effectively.	Senior management within the organisation	LEGISLATED
5	Computer Information Systems	Stemmed from strategy and recognition of the need to change in order to survive	Driven from senior management and board level	PLANNED
6	Four wheel drive vehicles	Increased competition and recognition of the need to change	Driven from senior management and board level	LEGISLATED
7	Heavy duty diesel engines	Development of new tech. in the production area, essential for company survival	Totally controlled from board level, and in most cases from the Managing Director himself	LEGISLATED
8	Gas turbine engines	Increased competition and the effects of privatisation	Senior Management at board level	LEGISLATED
9	Life Science Instrumentation	Organic growth of the Co. and the need to make better use of the resources	Directed through Senior Management	MANAGEMENT TURNOVER

Reddin (1970)[103] categorised change in three ways; legislated change, management turnover, and planned change (see section 8.2.2). From the case studies, six of the changes were categorised as "legislated" change and one "management turnover". The remaining two companies classed their changes as "planned". One of the planned changes was in fact based on the McKinsey seven S model and the other involved a total quality management (TQM) programme.

Both the companies that followed the planned changes had attempted in some way to change all seven S's. However none of the companies felt they had managed their effort on change equally across the seven S's. The majority of changes to shared values were by default and as with most of the soft S's, evidence of planned change was lacking.

The mechanically based companies with long lead times were found to have made the least changes across the seven S's. Planned changes were in much greater evidence for the hard S's with the soft S's changing mainly by default. Changes appeared to stem from changes to the strategy followed by structure and systems, with the soft S's taking up the rear.

All changes were identified and driven from senior management, only in one case was substantial support and involvement of the managers and staff sought. After careful questioning, it was found that none of the companies had based their improvements to the new product process on the key research studies into new product success and failure.

7.4 Summary and Conclusions

The companies were chosen because of their success in new product development. The interviews were of a high quality due to the respondents position, and the detailed schedule. The quality of the information obtained was further enhanced in some companies as the opportunity to talk to more than one person was available. The driving forces for the changes in the case study companies were, in the main, as a result of increased competition, and a recognition of the need to change.

7.4.1. New product success

No comprehensive measures of success were found during the study. In defining success only two of the companies included reference to meeting their customer's needs. A clear definition of new product success is a starting point and measure for future successes. In the literature many authors have gone to great pains to point out the importance of the customer, yet this is not recognised in appropriate definitions in industry.

In order to be successful a new product must meet customer needs. This has been emphasised many times in the literature yet does not seem to be of prime importance within the industry. Perhaps it is a factor so obvious that it often gets overlooked.

Achieving the required profit is also a key measure in

the success of a product. Profit is clearly at the end of the chain of events and driven by product performance. Profit is rightly considered as one of the prime factors. Having said this however, profit is a result of getting everything else right, and is the last measure in the chain of success.

New product performance covers a multitude of factors that will differ from product to product. Measures of performance include; number of service claims, product life, product sales. Other factors such as, meeting the required quality standards and delivery on time relate to the performance of the new product development programme. This clearly distinguishes two different measures of success, firstly the success of the development programme, and secondly the success of the product itself.

It is important to note that the success of a particular product clearly depends on the stage at which it is measured during the product's life cycle. This thesis has concentrated on measuring success after product launch. The success level will vary depending on the life of the product. The time at which success is measured is crucial, at launch, development success can be measured. Only at the end of manufacture can the overall product success be calculated.

It is interesting to note that if measuring profit and profit alone, every product will have a cut off point at which it becomes a success and makes a profit for the company. There will be a point in time when the product is not successful, and where the sale of one more product will

make it a success. Some companies may not achieve that level of sales. Others may spend so much on manufacturing, promoting and selling a product that achieving the goal of product success is not possible. There is also the possibility that with a successful product, the sale of one more product may make it a failure. What was clear from all the interviews and the questionnaire was that no company accurately measured this, and only one expressed the need for such a measure. Again the complexity of the process may account for the lack of accurate measures. Yet as a starting point if companies are to improve the chances of new product success they need to know how successful each individual new product has been.

New product success needs to be measured against initial plans and objectives. Products need to be reviewed against such plans at regular intervals. The success of a product should be tracked throughout its life. Without such detailed measures, companies could believe a product is successful when in fact it is a failure. This could easily lead to misuse and misdirection of resources.

7.4.2 Change and new product development

Only two companies out of the nine used planned programmes of change to improve their NPD process. No changes were identified that were based on key success factors.

In three companies new product development was under the control of the engineering department. This factor has been found to be detrimental to the success of many

companies, however in two of the companies interviewed there was evidence of substantial integration with other departments.

In terms of the types of changes being made to NPD organisations, companies are clearly recognising the importance of marketing skills, and the need to recognise customer needs. Three companies emphasised the importance of marketing in successful new product development. It is clear that this function cannot be divorced from the new product development process. Efforts must be made to carefully integrate it with the development side of the organisation.

The majority of changes appear to be legislated changes, initiated by senior management. Only two of the companies questioned were found to be making planned organisational changes. The rest were found to be based on the attitudes and beliefs of senior management.

8. APPLICATION OF THE RESEARCH FACTORS ASSOCIATED WITH NEW PRODUCT SUCCESS; A CASE STUDY

"Management systems tend to assume there will be no change, and basic organisational theories ignore project work. A firm's technological adaptability depends heavily on how a firm's organisation structure modifies itself".

(Hawthorne 1978)

8.1 Introduction

The final methodology used in the research involved "experimental" work carried out in collaboration with the sponsoring company. The company's perceived problems in NPD were instrumental in determining the research objectives. In effect the research, and the methodology developed, were inextricably linked.

The aim of this part of the research was to develop and test a practical methodology that could be used to improve the product innovation process. This methodology was designed to take advantage of previous research into new product success and failure. It aimed at applying the factors identified as being associated with new product success through a planned process of change. This experimental study was written up in the form of a case study and is contained in appendices XXIII to XXX.

The case study was carried out with Delco Electronics Overseas Corporation (DEOC) over an eighteen month period between late 1986 and March 1988. DEOC employ around 2000

people and are based in Kirkby on the outskirts of Liverpool. The company is part of the US based General Motors corporation, and is involved in the manufacture of instrument clusters, fuel pumps and other components for the automobile industry.

During the mid eighties the management at DEOC recognised that in order to continue reacting competitively improvements to the NPD process were essential. Indeed this was one of the main reasons for the initiation of the CASE research studentship. DEOC were experiencing problems in meeting delivery dates and cost targets for their new products. In effect they were not meeting their own success criteria. DEOC formed an ideal company on which to test a methodology aimed at improving new product development. This chapter describes the development of the methodology and the lessons learnt during its application in the sponsoring company.

8.2 Development of the methodology

The methodology itself was developed towards the end of the first year of the research when it became apparent that no clear methodologies had been developed or proposed in the literature. The research had already established that a key problem at the present time was not one of identifying what made a new product successful but more one of applying the results of previous research. An outline of the proposed methodology was briefly discussed in the first year proposal report. This was refined during the case study in line with

the research findings. There was considerable input to the work at the early stages but as the methodology was intended to be free standing, involvement changed from the presentation of ideas in an educational role to a "fly on the wall" approach towards the end of the case study. A copy of the case study can be found in appendix XXIII.

8.2.1 Current methodologies aimed at improving new product development

The literature survey (section 1.3) and the results from the questionnaire survey (chapter 6) clearly show that new product failure rates remain high. In the questionnaire sample over one third of the new products developed failed. A significant number of products were also cancelled prior to product launch. As we have already discussed, not all the money invested in these failed, and cancelled, new products will be wasted. Valuable lessons may be learnt and experience gained that could pay dividends for the company in years to come. Clearly however there is considerable scope for improvement. This belief is supported by the fact that the vast majority of respondents to the questionnaire agreed that there is a definite need to improve the new product development process and its management.

The results from questionnaire also showed that only a small number of managers know of the research into new product success and failure. Of those that are aware, few have made attempts to apply the results of the studies. Companies are keen to improve their chances of new product

success and the management of their NPD programmes. Many companies in the questionnaire sample indicated that changes had been made. However the majority of these appear to be minor changes and almost subconscious in nature. Little evidence was found to suggest structured and comprehensive change programmes. Since the vast majority of these improvements have not been based on the research into new product success, it may be concluded that the changes made have arisen from experience.

Johne (1987)[60] commented that experience is a great teacher. It can also be said that experience is gained by making mistakes. In today's rapidly changing environment companies cannot afford to make many such mistakes.

It was also noted from the questionnaire that most of the current changes arise from, and are controlled by, senior management. These changes result in alterations to the organisation mainly in terms of its structure, strategy and systems. It appears that these hard S's (as defined by Pascale and Athos (1981)[81]) are tackled much more readily than the soft S's.

Suggested methods of applying research into new product success and failure were discussed in chapter 2.2.5. It was concluded that these were far from ideal. Assuming managers are aware of the research, and the need to improve the process of NPD, how can they best apply the results?. Despite the number of research studies into new product success and failure few clear methodologies have been suggested to apply the work.

One of the reasons for the lack of awareness and the

lack of application of this research is probably due to the way in which the results have been presented. Indeed the fact that there is no clear method of application will reduce its chances of being diffused across industry. It is also likely that if a method did exist that could guarantee to improve the chances of new product success then there is fair chance that this would have been commercially exploited by consultants, and companies alike.

Clearly companies should benefit from applying the attributes associated with new product success. The factors should improve the development process, the product's performance, and its chances of success once launched. Cooper (1983)[29] highlighted the lack of application as a major problem, and proposed the redesign of a company's new product development process into the form of a model that took into account the research findings. In an earlier paper Cooper (1978)[24] suggested that an effective strategic plan is essential. Other authors have suggested different methods to applying the research findings. Rubenstein (1976)[119] suggested changes to the new product policy. Souder (1987)[132] presented ten guidelines for managers involved in new product development. More recent work by Arleth (1987)[3] has led to the development of Dan Prod. a methodology aimed at scoring new product projects during their early stages of development to calculate the percentage chance of their success. For the majority of the studies however, including SAPPHO and the Stanford Innovation project the results have been presented as lists of key findings.

Of the methodologies that have been suggested all will

improve the chances of new product success but these improvements will be limited for the following reasons:-

1. They do not take into account all the aspects of organisational change that will have to occur if the factors are to be successful.
2. The methods that have been presented are in effect "one off" solutions, that is they are not continuous and an indefinite part of the organisation. Thus they do not account any future changes that will affect the new product development process once the solution has been implemented.
3. They focus on only one aspect of the new product development process, and do not give a company wide, balanced view.
4. Companies may not have an organisational structure or culture that will allow suggested improvements and changes to be implemented easily.

8.2.2 Organisational change

One of the first and most fundamental assumptions made is that if any company is to consciously improve the chances of its new products being successful, it will undoubtedly have to make changes to its new product organisation.

In an analysis of the different methods through which companies change, Reddin (1970)[103] commented "it is increasingly apparent to all that organisational change is a requisite for organisational improvement", he went on to say that "planned change is likely to be much more effective

than unplanned change". Organisational change is inevitable to improve the process of new product development.

As discussed in chapter 3 the new product organisation can be regarded as a single entity. However as changes are made to new product organisation, these will affect the company and the organisation as a whole. Thus any changes need to be considered carefully in line with the corporate strategy.

Reddin (1970)[103] described three generally accepted methods used to change an organisation; management turnover, legislated change and planned change. Management turnover involves changing key people within the organisation. This is an extremely effective method if senior management have sufficient power resources, and a clear picture of where the organisation needs to go.

With legislated change Reddin is referring to edicts from the top, or from outside the organisation. Such changes are often less effective than management turnover as it is often difficult to justify them especially if there have been few changes in the past, and the organisation is currently operating in a reasonably efficient manner. The results of the structured interviews (chapter 7) showed that by far the commonest form of change was in fact legislated change.

The third and relatively new method comes under a variety of names including planned change, organisation development, and organisational effectiveness. Such change methods are characterised as long range programmes of change. They aim to move an organisation from one level of

effectiveness to a higher one. These programmes often involve an external consultant and are based around some form of model. The basic philosophy behind such change programmes is to get managers within the organisation to look at themselves and their organisations from a different angle and to make changes in a planned direction. The most common term for such programmes was found to be organisation development (OD.) and the use of this intervention strategy became a major part of the methodology.

8.2.3 The new product development organisation and change

New product development programmes are at the forefront of the change process. They are affected by changing customer wants and needs, increased competition and new technological developments. Application of attributes associated with success will also involve change. It is essential therefore that any method of improving new product programmes takes into account factors that will influence the success of these changes. The whole approach of improving new product programmes must be balanced, coordinated and planned. Managers must create an atmosphere and a culture surrounding new product development activities that is innovative and conducive to change. At the same time companies must strive to keep the steady state aspects of the culture that are required by activities such as manufacturing, and other operational and service functions.

Changes that are made must be carefully managed, and

diffused through the organisation. The information on which they are based must give an accurate perception of the current problems and shortfalls of the new product development programmes. It is essential that any changes identified can be properly implemented. During the change process companies need to consider carefully the effects of change on the people involved.

In a classic paper on how to deal with resistance to change, Lorsch & Lawrence (1965)[75] concluded that the real problem is not the technical change, but the human factors that accompany technical innovations. Involvement and participation are important when implementing changes. Consequently the approach management take in achieving that participation is crucial. People are the key links in any organisation and their opinions should form a major part of any changes.

From the above discussion it can be concluded that there are certain characteristics that any methodology must have to improve the management of new product programmes and the chances of new product success. Any method attempting to improve the NPD process must allow:-

1. The cultivation and development of appropriate attributes. This will allow the attributes associated with success to be developed and the factors associated with failure to be removed.
2. Continuous changes to be made, allowing the new product programmes and the organisation to react incrementally in line with changing environmental and customer needs.

3. A balanced approach that considers developing all aspects of the organisation as a whole, rather than concentrating on one specific aspect.
4. An approach that carefully considers the problems associated with change and involves people who work within the organisation, who will be affected by any changes.

This research puts the view that if new product failure rates are to be reduced, and the chances of new product success improved, the most effective way to create all of the above conditions is through using a planned programme of change, such as the technique of organisation development.

8.2.4 Organisation development.

Organisation development (OD.) as defined by Luthans (1981)[76] is a "systematic way of managing change". Bennis (1969)[8] gave a more detailed description, and referred to OD. as "a response to change; a complex organisational strategy intended to change the beliefs, attitudes, values and structure of organisations so that they can adapt to new technologies, markets and challenges and, the dizzying rate of change itself". In the context of this thesis, organisation development is a planned process of change, designed to help the organisation create a structure and culture that will allow it to achieve its strategic goals and objectives.

Woolhouse (1983)[147] said that there is a need for organisation development in many situations and out of four

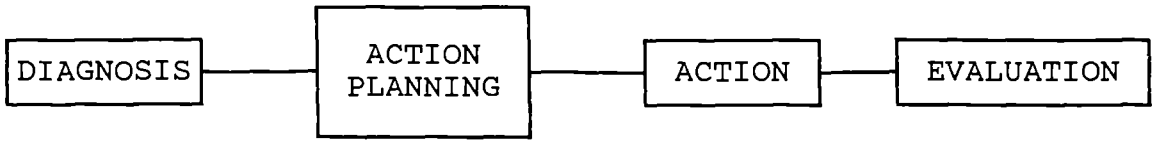
situations he puts forward as needing OD., the following three are directly relevant to new product development:-

1. Allowing existing organisations to adapt more easily to changes in the environment.
2. Where the organisation is failing to accomplish its objectives in terms of output, quality or profitability and where the nature of the organisation is limiting the performance of those who work in it.
3. Where the adoption of new technology, systems or methods requires corresponding changes in the organisation for proper implementation.

From the above it can be seen that OD. is an ideally suited method for the improvement of new product programmes as:-

1. New product programmes must react to changes in the environment, such as outside technology advances, changing customer needs and more aggressive competition.
2. The organisation may be failing to achieve the level of new product success and the new product organisation and management itself may be limiting the chances of new product success.
3. The adoption of new product technology and the development of systems and methods are essential to efficient new product development.

In its basic form OD. is regarded by most practitioners as a four stage process:-



Every company is unique and must shape the process to fit in with its own culture and structure. Organisation development is an ideal technique with which to apply the factors associated with new product success. It is this organisational change methodology that was used within DEOC.

Organisation development is usually controlled by a team, generally multi disciplinary in nature. As the technique involves a considerable amount of team work it is important to carefully choose, establish and develop the team. This is especially important when considering the development of the new product organisation, due to the broad range of disciplines and people represented. No one person would have the skills and knowledge required identify the problems, analyse them and propose new organisational directions to solve them. Such a task would be best accomplished by a team. Therefore the first stage in any use of the OD. is to develop an effective and useful team.

8.2.5 A framework for analysis of the new product development organisation, and application of the factors via organisation development.

Previous research methodologies have concentrated on only single aspects of the new product organisation, such as the structure or systems used. A balanced approach is

required so that the attributes needed for success can be applied across the whole new product development organisation. There are certain organisational areas within the company where the research into new product success and failure would have a significant impact.

Initially it was envisaged that the following areas would all need careful analysis in terms of correct diagnosis of the problems and subsequent action. It was later decided that the most appropriate way forward was to use a proven model that covered all aspects of the organisation.

(a) New product development procedures, activities and skills.

The process a company goes through to develop a new product will vary depending on the type of products it markets. Many companies today use a new product procedure, or guide, to control this process. In applying the attributes, companies will need to take a close look at their procedures, compare this with the attributes, and if problems and differences exist, alter the procedure or guide accordingly. This process of comparison also needs to include the individual development activities and skills such as screening and evaluation, design, prototype testing and so on. Companies need to be able to compare the attributes with current problem areas and see if improvements can be made.

(b) The organisation and management of new product development programmes.

Many companies continually adjust the way in which they organise their new product development activity. Hawthorne (1978)[49] summarised the problems of managing this constantly changing situation. "Management systems tend to assume there will be no change, and the basic organisational theories ignore project work. A firm's technological adaptability depends heavily on how a firm's organisation structure modifies itself". New product development programmes are in effect a series of projects. This constant stream of project work demands a different organisational structure to other areas within the company, yet at the same time it needs to interrelate with these other areas. From the questionnaire results it can be seen that changes made in this area were by far the most common. Research too, has looked at the best ways to organise for new product development. Souder (1987)[132] identified seven organisational qualities that characterised the most innovative firms. Johne (1984)[58] looked at the types of structure used by experienced product innovators. Companies need to use this research, and the attributes associated with success to identify the characteristics required by their own organisation.

The management of new product programmes also needs to be improved, this will include the techniques used and the managers themselves. Too often the development of the people in terms of their interpersonal and management skills gets overlooked. The people involved in new product development

are crucial to a programme's success, their development should be a priority. Management development and training has a key role to play in developing the management style that has been associated with success.

(c) The new product strategy.

The strategy that a company chooses for its new products provides the vision for its future development and growth. Booz Allen & Hamilton (1982)[13] emphasised the need to make a strong, long term commitment to support innovation and new product development. They argued that a company specific approach should be implemented, driven by corporate objectives and strategies.

The development of a sound long term new product strategy is critical. Companies need to consider the attributes associated with success, identify those relevant to themselves and build these into their new product development programmes.

Development and cultivation of the attributes in these three areas needs to be carefully coordinated and planned. A balanced approach is needed that will ensure improvements are carefully considered and applied across the whole organisation. The results from the questionnaire showed that companies currently focus their change efforts on the organisational structures. There are more aspects to an organisation than just its structure. Today for example

there is a large amount of literature on culture and its importance in the success of companies. However during the questionnaire survey no companies reported any attempts to change and improve their culture.

As the research progressed it became clear that only a proven model would ensure that all aspects of the organisation were covered during the diagnosis and analysis stages. It is important to consider changes to the organisation in a balanced way. This would be best achieved using an existing organisational framework or model that covered the above aspects. Recently Johne (1987)[63] used the McKinsey Seven S model (popularised by Peters and Waterman (1982)[96]) as a framework for examining the new product organisation. This framework makes an ideal tool that managers can use to apply the factors associated with new product success. Any actions then taken to move the organisation to a higher level of efficiency should ensure that all organisational aspects move in the same direction.

8.2.6 The McKinsey seven S framework

The McKinsey 7 S framework is discussed in detail in chapter 3. Everyone involved in new product programmes will have a role to play in applying the factors and solving current new product development problems. The application of the attributes will require change. These changes will affect the strategy, the organisational structure, the management, the procedures and the activities involved in new product development programmes. The organisation needs,

in effect, to manage and change the whole organisation of the company.

The McKinsey 7 S model provides a framework across which to combine the techniques of organisation development and the factors associated with new product success and failure.

8.3 Implementing the OD. process

In theory OD. seems an ideal method to apply the factors associated with new product success. In practice a number of additional considerations are essential to make the process work.

8.3.1 Choosing the team.

New product development is such a complex process that only those involved continually with new product development will have the detailed knowledge of every day problems and activities. The most effective way to implement OD. is to draw on these skills through a multi disciplinary team made up of people involved in the new product development process. The team should also include senior management especially managers involved in developing the long range plans and strategy for the company.

8.3.2 Developing the team.

It is not reasonable to expect a group of individuals who have not worked together as a team before to come together as a team and work effectively immediately. With the team chosen, one of the first priorities will involve the development of the team itself. This will be best achieved through an "off site" team building programme, away from the pressures and interruptions of work. The objective of the programme being to build the team into a cohesive unit with a basic understanding of OD. principles, and the team's own role in improving the management of new product programmes.

8.3.3 Diagnosis of the "real" problems

With the team established and conversant with organisation development techniques. The first task will involve clear diagnosis of the problems. Some form of guide or measure is needed to ensure a fair comparison. The diagnostic stage is essential to identify the real problems facing new product development. Baker and Gorman (1976)[4] conclude that this diagnostic stage is the key to OD. effectiveness. It is at this stage that the team need to draw on the research into new product success and failure, and involve people from all over the organisation. It is also essential that the team identify the real problems facing new product development, and not just those as perceived by individual departments, executives or

managers.

In order to perform the diagnostic stage effectively the team needs to collect information. This will come from several sources. These sources need to include:-

1. The factors associated with the success and failure of new products.
2. Key executive perceptions of the problems.
3. The teams own particular experiences.
4. The views of other managers and staff involved in new product development programmes.
5. The views of customers and suppliers.

This information needs to be carefully collected and a variety of methods can be employed. The attributes associated with success can be introduced gradually to the team, through presentations, team building sessions and the use of outside agencies.

8.3.4 The new product survey.

In order to help collect the above information a questionnaire survey was developed to aid the team. This survey has the dual advantage that as well as introducing the company to the attributes involved in new product development, it also provides a comparison with the company problems and the attributes associated with success.

The survey was developed as part of the research, and is based on the attributes outlined in chapter 2.

The questionnaire survey is designed with five sections each representing one of the attributes associated with

success. In each section there are in the region of eight qualities that have been associated with new product success. The idea of the survey is that members of the organisation respond by either agreeing or disagreeing (on a scale of one to five) that a particular quality is present inside the organisation. In this way the survey has the double advantage that it makes people aware of the research findings (education) and, at the same time, provides the team with a sound database on which to base the action planning stage. Key problem areas can be followed up in more detail using interview and discussion sessions with the team.

8.3.5 Action planning, implementation and evaluation

With a thorough diagnosis completed the team can move on to decide on the appropriate form of action. This action planning stage needs to be carefully thought out so that if possible it involves the people who will be affected by the changes. It is at this stage that the McKinsey seven S model plays an important role in coordinating the organisational changes. It is essential to use some form of model to ensure that changes to all parts of the organisation are made effectively and carried out in parallel. Changing just the structure, for example, may have little effect if the management style appears to be going in a different direction.

With clear definitions of the problems the team can

break these down and solutions suggested through "brainstorming" techniques. Based on the McKinsey Seven S model these solutions will fit into place and confirm again that the problem has been examined effectively.

During the action stage, changes will be made gradually and tested. Modifications may be necessary to ensure the success of the programme. It is important that the team monitor, coordinate and measure these changes to ensure they are carried out as intended. In some cases it may be the action requires further diagnosis of a problem area.

Finally an evaluation stage should review the programme against the criteria agreed at the outset. This will allow any improvements to be measured, and any further action to be planned.

8.4 The practical application of the methodology in DEOC

The methodology described was successfully tested within DEOC. A full description of the case study can be found in appendices XXIII to XXX. In terms of the practical application of the methodology, numerous results, conclusions and observations were made. This chapter describes these results and conclusions.

8.4.1 Senior management support

Top management support was essential throughout the development, introduction and application of the OD. methodology. Senior managers clearly recognised the need to improve the new product development process.

Achieving this management support was crucial to the success of the methodology, especially during the early formative stages. In the case of DEOC this initial support was obtained in a two ways. Firstly through priming the key executives as the methodology developed and secondly through a presentation on the intended methodology to the whole executive board. The support of the board was essential due of the significance of the methodology and especially as most departments are involved to some extent with NPD.

Management support for the team was required not only financially, support was mainly required for the methods used, and the recommendations proposed from the results.

This support was achieved through a regular dialogue of communication consisting of presentations and discussions. Within DEOC no formal requirements to report back were imposed by the executives. This generated a relaxed reporting atmosphere with few deadlines, allowing the team to work at its own pace. The presentations were held on average about every four months, as and when required.

Support is finally required as the recommendations are progressed. This was the point reached at the end of the research project and no results are available on the success of the recommendations. This action stage however is the

most crucial and the hardest to complete. It is at this point that the team cannot work alone, they must have the total support of the senior managers. A committed strong management team that is willing to divest its power is crucial.

8.4.2 Implementation through a team

The second crucial element in making the OD. process work was through the team itself. The team was essential to coordinate the work and draw on different experiences within the company. The team was effectively a catalyst to promote planned change within the organisation. The team was carefully selected and represented a range of disciplines and management levels.

The teamwork development course brought the team together effectively, allowing them time (away from the company) to analyse their objectives. The only criticism of the course was that it was not held soon enough. Ideally such a teamwork development course should initiate the OD. process.

The regular "off site" meetings also proved useful in allowing the team time to consider all the various aspects associated with its role. In the company itself meetings were held on a weekly basis. Team members often found it difficult "switch off" from the day to day activities. Occasionally attendance was a problem. Often team members found it difficult to find time for meetings and interruptions were inevitable. The "off site" meetings proved

a huge success, allowing the team time to concentrate on its objectives. These sessions, held approximately every two months, were good motivators for the team and were always well attended.

8.4.3 Use of an external advisor

Although not essential to make the OD. process work the availability of an independent external advisor was important for a number of reasons. Apart from the input in terms of the OD. methodology and the factors associated with new product success and failure the external advisor was found to provide a focus for the team. The advisor was also useful in providing independent and unbiased opinions.

8.4.4 The successful product innovation survey

The successful product innovation questionnaire proved an essential "tool" with which to analyse the organisation. Clear diagnosis and definition of the problems helped substantially in identifying the appropriate recommendations and changes.

The questionnaire provided a method through which people could voice their opinions regarding the new product organisation. This involvement would help at later stages when recommendations were being implemented. It was interesting to note that during the analysis of the questionnaire survey from DEOC, that senior manager's perceived only around half the problems identified by middle

managers. This clearly showed that the expertise regarding the problems faced in NPD was spread around the middle management function and to some extent the senior managers were out of touch with the many of the problems.

The survey was sent out only to people within the DEOC organisation. It would have been useful too, to obtain the critical opinions of customers and supplies. This was intended, but after the results from the internal questionnaire the team decided to leave an expansion of the survey until a later date.

8.4.5 Publicity for the team in its objectives

As well as the publicity obtained through the successful product innovation survey, the team felt it was important to "sell" its own image. During the early stages few people with the company had heard of the team or its goals. Consequently presentations were given to as many managers as practically possible. This communication was also obtained through the "core brief" and the "Kirkby Comment", two internal news letters. Good communication with the people in the organisation was crucial in obtaining the support of various members of the organisation especially during the questionnaire survey and the implementation of the recommendations.

8.5 Summary and Conclusions

Organisation development was found to be an ideal technique for identifying the problems and developing effective recommendations to improve the chances of new product success. Essentially the methodology is a combination of the attributes associated with new product success, organisation development, the McKinsey Seven S model, and effective teamwork.

The methodology allows companies to cultivate and develop the attributes that have been associated with new product success. Good effective diagnosis of the problems is crucial. Within Delco it was noted that each group surveyed with regard to new product development had differing views as to what the problems were. The most striking difference in the perceptions was between senior management (ie. the executives) and the middle management staff. The executives perceived far fewer problems than any other group of managers. This fact alone adds tremendous weight to the idea that the whole process of identifying the change is one that should involve more managers at a lower level in the organisation. From the diagnostic stage a clear view as to the action required was formed.

The results from the application of the methodology in DEOC, highlighted five key areas. These were;

1. Strong management support throughout.
2. Good effective teamwork.
3. Clear diagnosis and definition of the real problems affecting NPD, based on the factors associated with

success and failure.

4. The use of an external advisor.

5. Good communication with the company as a whole.

The OD. process itself is continuous and should be incorporated as part of the organisation. In this way it will allow companies to progress, in line with their new product strategy, an effective approach to the management of change.

9. DISCUSSION AND CONCLUSIONS

9.1 Introduction

This research has investigated the process of product innovation with reference to how companies adapt and change their organisations to improve the chances of new product success.

Initially, careful analysis of the literature identified five key attributes that were found to be strongly associated with new product success. This analysis was followed by a survey of 149 UK engineering companies that identified general trends and attitudes in the management of new product development. The survey clearly showed a definite lack of awareness amongst managers of previous research studies that have identified the factors associated with new product success. The majority of managers involved in the survey agreed that the process of new product development needed improvement, yet evidence of constructive and planned change to new product development organisations was was found in only 5 out of 149 companies surveyed.

Further analysis through a series of structured interviews showed that the majority of changes were based on experience and were in fact legislated changes. Few organisational changes were classed as "planned changes".

A methodology to improve the process of new product development was developed and tested within the sponsoring company. This methodology combines the five key attributes

associated with new product success with a planned programme of change. The methodology was successful in identifying problems associated with new product development and stimulating change. The methodology was developed to be transparent and there is no reason to suggest that it could not be applied to any new product development process in any engineering or manufacturing environment.

This chapter discusses the main conclusions from the research, drawing together the results from the three methodologies used. The research has covered a subjective and difficult subject area, dogged by poor definitions and a lack of previous research. Areas for further research are discussed at the end of this chapter.

9.2 The importance of product innovation

Innovation encompasses the whole process through which new ideas, incremental or radical are conceived, diffused and successfully exploited. Product innovation involves the creation and introduction of new products, it is the process through which an idea is translated into a physical product. New product development is in effect the process of product innovation and concerns all aspects of that process from idea generation and technological development to the successful marketing and commercialisation of a new product.

The literature survey, the questionnaire, the

structured interviews, and the work in Delco have all strongly underlined the importance of product innovation. Product innovation is crucial to the long term survival of manufacturing industry. A point clearly reflected by the fact that nearly 50% of companies in the initial survey estimated that more than 20% of their company's annual sales turnover came from products launched within the last three years.

Many authors have shown that the rate of technological change is greater than ever before (Hawthorne(1978)[49]). Booz Allen and Hamilton(1982)[13] estimated that the rate of new products developed would double within the next five years. Clearly as the rate of new product development increases so will the percentage of annual sales turnover made up of new product developments. This again underlines the increasing importance of product innovation.

9.3 The research into new product success and failure

The research into new product success and failure has clearly identified the factors associated with new product success. Despite the number of research studies no one study or review was found that accurately summarise the research as a whole. Consequently a detailed analysis of the studies was carried out through which five key attributes were identified as being strongly associated with new product success. These five attributes were;

1. A unique and superior product that clearly meets customer wants and needs.

2. Good communication and coordination.
3. Proficiency in technological activities.
4. An open minded, supportive and professional management.
5. A good market knowledge and strategy.

These five key attributes formed the basis of the successful product innovation questionnaire. This was used within this research to compare a company's own organisation with the researched factors.

9.4 The lack of awareness and application of the research into new product success and failure

The initial survey showed that few new product managers were aware of the research into new product success and failure. The most popular studies were found to be project SAPPHO (Rothwell(1974)[111]) and a new product survey by Booz Allen & Hamilton(1982)[13]. Even in these cases, only 10% of the managers responding to the questionnaire had even heard of the work. In terms of application of the work only 5 companies out of the 149 surveyed had made attempts to apply the findings.

If a company is to improve its chances of new product success it will need a knowledge of the factors associated with successful innovation. This knowledge, in general, appears to be gained through experience, often by making mistakes. It would be more logical to make use the researched factors, which have been built up through analysing the experiences and mistakes of large number of

companies. Companies need to take the research findings and change their organisations to cultivate those factors required.

One basic problem is getting managers aware of the research in the first place. As the results from the study have shown few managers are aware of the research into new product success and failure. There is a distinct communication problem if this research is not finding its way back into industry. It is important therefore that any further academic study into the factors associated with new product success and failure takes careful note of how the results can be applied in practice. The research needs to be oriented towards application and ease of communication.

9.5 New product failure rates

The need for conscious effort to improve the new product development process is underlined by the high failure rates. The results from the questionnaire showed an average new product failure rate of 35.7%. This figure compares very closely to an average failure rate of 33.4% found by Crawford (1983)[35] in his study of other research into new product success and failure. These results suggest that there has been little improvement in the success rates in recent years. If there is no change in the failure rate, as the rate of new product development increases so will the total number of new products that fail, again demonstrating the need to improve the product innovation process.

What is probably most striking about new product

success / failure rates, is the lack of an effective measure. The structured interviews clearly showed that definitions of new product success are unclear. Few companies showed evidence of a clear effective measure of individual product success. In only two out of nine cases did companies include reference to meeting customer needs in their definitions of success. A measure of new product success is fundamental to ensuring a successful product, and giving direction to long term improvements.

9.6 Change and new product development

In the majority of the structured interviews change was stimulated by a recognition of the need to change as a result of increased competition. It was found that less than 5% of the companies in the research are approaching the process of changing their new product development organisations in a planned way. Most managers appear to be changing aspects of the organisation that are easy to change. It was found that, in general, senior management were making changes to the "hard" S's (strategy structure and systems) with few companies carefully considering changes to the softer S's (management style, staff, skills and shared values). This was apparent both in the initial survey and the structured interviews.

The majority of changes in the structured interviews were found to be legislated changes. These legislated changes were made despite senior managements own admission that they were not involved in new product development on a

day to day basis. Reddin (1970)[103] commented that legislated change was effective only if the management had a clear picture of where the organisation should go.

The results from the application of the methodology in DEOC clearly showed that senior management only perceived half the problems identified by middle management. It is clear that those managers and specialists controlling the day to day process will have a much clearly picture of the problems associated with new product development and methods through which those problems could be solved. Good communication between the various management levels is essential, and any change process needs to draw carefully on the experience of the whole organisation.

9.7 The methodology for application of the research factors in practice

The methodology for applying the research was effectively a combination of the attributes associated with new product success, organisation development, effective teamwork and the McKinsey 7-S model. It was also found to be important that there was a key individual within the company who understood the process of organisation development, and was in a position to win the support of the senior management. Key individuals are essential develop the methodology and stimulate change.

The new product success and failure questionnaire developed, provided an effective measure to compare the factors present in the company's new product development

organisation with those identified through the research. It allowed DEOC to quantify their own new product development organisation, compared to the research, and at the same time familiarise their staff with the research and make them think carefully about the problems associated with the product development. The space left for comments proved very useful as by the time respondents reached this section, they had a clear picture of the objectives of the questionnaire.

The use of a planned programme of change, through organisation development ensured careful analysis of the new product development organisation. The OD. process drew on the experience of the organisation as a whole, rather than the opinions of a few senior managers.

The initial team development course was essential to bring the team together in an effective manner. "Offsite" meetings too, were found to be crucial to allow the team to escape from the day to day pressures and constraints of the company. The use of the 7 S model was a vital tool in breaking down the results and analysing the organisation.

Although the methodology developed was tested in only one company, there is no reason why such a methodology should not be transparent across a range of industries. From the study within DEOC five key areas were found to be crucial to the success of the methodology, these were:-

1. Senior management recognise the need to improve the process of new product development and provide strong support throughout the development of the methodology.
2. Good effective teamwork.

3. Clear diagnosis and definition of the real problems affecting new product development, based on the factors associated with success and failure.
4. The use of an external advisor.
5. Good communication and publicity for the methodology with the rest of the company.

9.8 Further research

The importance of product innovation in the role of wealth creation and improving the quality of life, makes it a subject worthy of academic study. The subject areas linked to the management of new product development provide a rich and varied source for further research. However it is a difficult area to research due a lack of clear definitions and the subjectivity of the area itself. There is a definite need to improve the process of product innovation and reduce new product failure rates. It is important that researchers bear this in mind, and give careful thought to how their results can be applied. Three areas for further research have been identified:

1. A further study into the factors associated with new product success and failure.
2. The development of a comprehensive measure of new product success.
3. Further development of the methodology to improve the process of new product development.

There would be substantial benefits in linking these

three research proposals together.

9.8.1 The factors associated with new product success and failure

It is nearly a decade since the last major study on new product success and failure was carried out. There is still scope for a clearly defined and comprehensive survey. This is demonstrated by the fact that no one study has identified the factors shown through the research as a whole. In order to be a comprehensive and successful study it should compose of the following characteristics:

1. It should be based on the previous research, all the possible factors previously identified as being associated with new product success should be listed and broken down into appropriate groups.
2. It should be based on a large and structured sample of manufacturing companies from one country.
3. It should take the form of a success verses failure comparison.
4. It should be based on careful definitions, especially:
   - new product success / failure
   - the "newness" and type of the products studied
5. The methodology used should ideally be of a structured interview format, as the research does not lend itself easily the questionnaire technique.

9.8.2 The measurement of new product success

A crucial area for research would be in the development of a measure of new product success. A measure of product success is crucial. If companies are to improve they must have some means of measuring their improvement. Ideally such a success measure should be computer based.

A measure would need to take into account all the factors associated with new product success, including financial return, product performance, quality, initial objectives and most importantly the meeting of customer needs. These would need to be measured at regular intervals throughout the life of any product development as success will vary depending at what stage it is measured. A clear distinction is needed between new product success and success of the product development programme. Research is needed to examine the link between the two. Do successful development programmes lead to successful new products?. Clearly one would expect so as unsuccessful development programmes lead to failure. Ultimately the success of any product is dependant on the customer.

The use of computers in the role of new product development has so far been limited. Today there are numerous project management packages available, however because of the variety of new product development programmes few are of substantial use to the new product manager. One area where strong possibilities for development lie is in the use of expert systems. Such a system could be developed as an aid to the management of new product development

programmes. If this was linked to a measure of new product success, it would provide a useful tool for both the project manager and the company as a whole.

9.8.3 Further development of the methodology to improve new product development

The methodology developed in DEOC proved successful and there is no reason to suggest that this will not work in other industries. There is considerable scope for developing this work further. Firstly by developing and testing the model proposed in this research. Secondly by testing the model and the methodology in a range of manufacturing companies and thirdly by developing it into a "package" so that it can be communicated and used across a range of manufacturing industry. In effect the methodology needs to be developed into a "package" that can be quickly absorbed and understood by companies. Such a package would benefit strongly from the inclusion of a success measure.

The importance of good teamwork both in the OD. methodology and within the process of product innovation itself also presents an area for further development. The work of Kirton (1976)[69] and Belbin (1981)[7] in identifying distinct personalities associated with certain people and team skills is an area ripe for further exploration. The variety of skills required within the new product development process and personalities present must seriously affect the outcome of new product development programmes. Research into how a mix of people can be analysed and

improved based on personality assessment techniques would be of great practical benefit to employers and personnel departments in selecting the right mix of people to work on a particular new product development. This would also be of benefit during the selection of an appropriate organisation development team.

9.8.4 Combining the suggestions for further research

The suggestions for further research should ideally be drawn together as they are all strongly interlinked. Such a research project would form a long term study into successful product innovation. The study would form the basis of several research projects interlinked over a substantial time period.

The research programme would have to commence with the development of an accurate measure of product success, carried out in parallel with an updated study to identify and verify the factors associated with new product success. The main study would incorporate this research and should involve in the region of 20 companies over a five year period. The success of each product developed being measured at regular intervals. Regarding development of the methodology, ten companies randomly selected from the sample would use the OD. methodology. The remaining ten companies would use no methodology, these would be left to develop improvements based on experience. In effect these ten companies would form the control sample. All improvements

and how they arose would need to be carefully documented.

Such a study would need to convince ten companies to implement the organisation development methodology. In order to achieve this the methodology would need to be drawn together into a "package" to persuade management to set up the team. Key parts of this package would involve presentations on the research studies, the success / failure comparison questionnaire, and the developed measure of product success.

Aspects such as the teamwork training and the use of "offsite" facilities for all ten companies could be provided by an external organisation such as the University and would provide an ideal sample to examine the teamwork aspects associated with product innovation.

A cross comparison of the companies after a five year period would be an exciting prospect. The work could form the basis of a number of Ph.D's. The first being the development and testing of a suitable success measure, this would also have to be tied in with the selection of a suitable sample.

Further research into the process of product innovation is vital if UK manufacturing companies are to compete effectively in a global environment. As has been clearly pointed out by Baren et al (1986)[5], successful product innovation cannot be left to chance, it must be carefully managed and controlled to be exploited. Likewise, improvements to the product innovation process cannot be left to chance, they too must be carefully managed and driven to

ensure success.

New products are at the forefront of the change process. Changing customer wants and needs are forcing companies to change their product ranges to meet new customer requirements. The resultant change in products will alter the company's strategy. As the strategy changes so must the organisation so that it can meet the new strategy. New product development is at the front of the change process. It is important that management recognise this, as decisions regarding new products will affect the success of the company in years to come. Overall company success depends on getting everything right, including manufacturing finance, and marketing. Success in any one of these areas however, is worthless without successful new products.

REFERENCES

REFERENCES

1. Abetti P.A. & Wacholder M.H., (1979), The process of technological innovation and its application to the RPI incubator program, Rensselaer Polytechnic Institute.

2. Albala A., (1975), Stage approach for the evaluation and selection of R&D projects, IEEE transactions on engineering management, Vol. EM-22 No.4, November 1975.

3. Arleth J.H., (1987), Dan Prod; A model of assesment of new product ideas and projects, Innovation, Adaptation and Growth, (edited by R.Rothwell & J.Bessant), Elsevier, Amsterdam.

4. Baker H.K and Gorman R.H., (1976), Diagnosis; the key to OD. effectiveness, Personnel Journal, (October 1986).

5. Baran S., Zandan P. & Vanstron J.H., (1986), How effectively are we managing innovation?, Research Management, Vol XXIX, 1, pp 23-25.

6. Barclay I. & Benson M.H., (1987), Improving the Chances of New Product Success, Innovation, Adaptation and Growth, (edited by R.Rothwell & J.Bessant), Elsevier, Amsterdam.

7. Belbin R.M., (1981), Management teams; why they succeed or fail, Heinemann, London.

8. Bennis W.G., (1969), Organisation development: its nature origins and prospects, Addison Wesley, New York.

9. Benson M.H. & Barclay I., (1987), Improving New Product Success through Organisation Development, Proceedings of the IEEE Conference on Management and Technology, Management of Evolving Systems, Atlanta.

10. Benson G. & Chasin J., (1976), The structure of new product organsiations, AMACOM, New York.

11. Berdie D.R., & Anderson J.F., (1974), Questionnaires: Design and Use, The Scarecrow Press inc., Metuchen, N.J.

12. Bergen S.A. & Miyajima R., (1986), Productivity & the R&D / Production interface in Japan, R&D Management 16,1, pp 15-24.

13. Booz Allen & Hamilton, Inc (1982), New Product Development in the 1980's, Booz Allen & Hamilton, New York.

14. Bright J.R, (1964), Research, Development and Technological Innovation; An Introduction, Richard D. Irwin, Illinois.

15. Burgelman R.A., & Maidique M.A., (1988) Strategic management of Technology and Innovation, Irwin, Illinois.

16. Calantone R. & Cooper R.G., (1979), A discriminant model for identifying scenarios of industrial new product failure, Journal of the Academy of Marketing Science, Summer 1979, 163-183.

17. Calantone R. & Cooper R.G., (1981), New Product Scenarios: Prospects for Success, Journal of Marketing, Spring 1981, 48-60.

18. Carter C.F & Williams B.R, (1957) Industry and Technical Progress, Oxford University Press, London.

19. Centre for the study of Industrial Innovation, (1971), On the Shelf, A survey of Industrial R & D projects abandoned for non technical reasons, Centre for the study of Industrial Innovation, London.

20. Choffray J.M., & Lilien G.L., (1982), DESIGNOR; A Decision Support Procedure for Industrial Product Design, Journal of Business Research, 10, pp 185-197.

21. Cochran B., & Thompson G.C., (1964) Why New Products Fail, The Conference Board Record, October 1964, 11-18.

22. Cohn S.F., & Turyn R.M., (1980), The Structure of the Firm and the Adoption of Process Innovations IEEE Transactions on Engineering Management, Vol. EM-27, No. 4, November 1983.

23. Cooper R.G., (1975), Why New Industrial Products Fail, Industrial Marketing Management 4, 315-326

24. Cooper R.G.,(1978), Strategic Planning for Successful Technological Innovation, The Business Quarterly, Spring 1978.

25. Cooper R.G., (1979), Identifying Industrial New Product Success: Project New Prod, Industrial Marketing Management 8, 124-135.

26. Cooper R.G., (1979), The Dimensions of Industrial New Product Success and Failure, Journal of Marketing, Vol 43 (Summer 1979), 93-103.

27. Cooper R.G., (1980), Project New Prod: Factors in New Product Success, European Journal of Marketing, 14,5/6, 227-291.

28. Cooper R.G., (1981), The Myth of a Better Mousetrap: What makes a New Product a Success? Business Quarterly, Spring 1981, 69-81.

29. Cooper R.G., (1983), A Process Model for Industrial New Product Development, IEEE Transactions on Engineering Management, Vol. EM-30, No. 1, February 1983.

30. Cooper R.G., (1985), The performance Impact of Product Innovation Strategies, European Journal of Marketing, 18, 5 pp 5-53

31. Cooper R.G., (1985), Overall Corporate Strategies for New Product Programmes, Industrial Marjeting Management, 14, pp 179-193.

32. Cooper R.G., & Kleinschmidt E.J., (1986), An investigation into the New Product Process; Steps, Deficiencies and Impact, Journal of Product Innovation Management, 3, pp 71-85.

33. Crawford C.M., (1979), New product failure rates, facts and fallacies, Research Management, Vol. 22, pp 9-13.

34. Crawford C.M., (1980), Defining a charter for product innovation., Sloan Management Review, Fall, 1980, pp 3-12.

35. Crawford C.M., (1983), New Products Management, Richard D.Irwin, Illinois.

36. Drucker P.F., (1973), Management; Tasks Responsibilities, Practices, Harper and Row, New York.

37. Drucker P.F., (1985), Innovation and Entrepreneurship, Pan Books, London.

38. Edge G., (1985), Britain's Innovation trap, Management Today, November 1985.

39. Foster R., (1986), Innovation; the attackers advantage, McKinsey & Co., New York.

40. French W., (1974), The personnel management process, Miflin, Boston.

41. Gerstenfeld A., (1969), Marketing and R&D, Research Management, Vol. XII, No.6 pp 409-412.

42. Gerstenfeld A., (1976), A Study of Successful Projects, Unsuccessful Projects and Projects in Process in West Germany, IEEE Transactions on engineering management, Vol. EM-23, No. 2, August 1976.

43. Gorden R.L., (1975), Interviewing: Strategy, techniques and tactics, Dorsey Press, Illinois.

44. Gorman L. & Mullan C., (1973), Human aspects of the management of technological change: a case study, Journal of Management Studies, February 1983.

45. Globe S., Levy G.W. & Schwartz C.M., (1973), Key Factors and Events in the Innovation Process, Research Management, July 1973, 8-15.

46. Handy C.B., (1976), Understanding Organisations, Penguin, Hamondsworth, Middlesex.

47. Handy C.B., (1985), The Gods of Management, 1985.

48. Harrison R., (1972), How to describe your organisation, Harvard Business Review, Sept-Oct 1982.

49. Hayes and Abernathy, (1980), Managing our way to economic decline, Harvard Business Review, July/August 1980.

50. Hawthorne E.P., (1978), The management of technology, McGraw-Hill.

51. Helriegel & Slocum, (1974), Management; A contingency approach, Addison Wesley, Massachusetts.

52. Hill C.T. & Utterback J.M., (1979), Technological Innovation for a dynamic economy, Permagon Press, New York.

53. Holt K., (1983), Product Innovation Management, Butterworths, London.

54. Hopkins D.S. & Bailey E.L., (1971), New Product Pressures, The Conference Board Record, June 1971, 16-24.

55. Hopkins D.S., (1981), New Product Winners and Losers, Research Management, May 1981, 12-17.

56. Houston M.J. & Ford N.M., (1976), Broadening the scope of Methodological Research on Mail Surveys, Journal of Marketing Research, Vol XIII, November 1976, 397-403.

57. Johne F.A., (1984), How experienced product innovators organize, Journal of Product Innovation Managament, 4, pp 210-223.

58. Johne F.A., (1984), The Organisation of High Technology Product Innovation, European Journal of Product Innovation, 18, 6/7.

59. Johne F.A., (1985), Industrial Product Innovation, organisation and management, Croom Helm, Beckenham, Kent.

60. Johne F.A., (1987), Innovate or die, Management Today November 1987.

61. Johne F.A & Snelson (1987), Product Policy and Development, An Annotated Bibliography, April 1987, Working Paper No. 86, The City University Business School, London.

62. Johne F.A & Snelson (1987), Success Factors in New Product Development, May 1987, Working Paper No. 87, The City University Business School, London.

63. Johne F.A & Snelson (1987), Product Development Practices In Large US and UK firms, October 1987, Working Paper No. 88, The City University Business School, London.

64. Jolliffe F.R., (1986), Survey Design and Analysis, Ellis Horwood ltd., Chitchester, England.

65. Kanter R.M., (1983), The Change Masters, Counterpoint, London.

66. Kanter R.M., (1984), SMR forum - the only hope for times ahead?, Sloan Management Review, Summer 1984.

67. Kantrow A.M., (1980), The Strategy Technology Connection, Harvard Business Review, July - August 1980.

68. Kanuk L. & Berenson C., (1975), Mail Surveys and Response Rates: A Literature Review, Journal of Marketing Research, Vol. XII, November, pp 440-53.

69. Kirton M.J., (1976), Adaptors and innovators: a description and measure. Journal of Applied Psychology, 61, pp 622-629.

70. Langrish J., Gibbons M., Evans W.G., & Jevons F.R., (1972), Wealth from Knowledge, Macmillan, London.

71. Leavitt H.J., (1978), Managerial Psychology, 4th. Edition, University of Chicago Press, Chicago.

72. Lorsch J.W., Lawrence P.R., (1965), Organising for Product Innovation, Harvard Business Review, Jan-Feb 1965, pp 109-122.

73. Lawrence P.R & Lorsch J.W, (1967), New Management Job: The Integrator, Harvard Business Review, November / December pp 142 - 151.

74. Lawrence P.R & Lorsch J.W, (1967), Organisation and Environment, Harvard Business Press, Boston.

75. Lin L.T.S., (1986), Tangible and Intangible reasons for new product failure, Monograph series, Vol 1., New Product Development, European Society for Opinion and Marketing Research, London.

76. Luthans F., (1981), Organisation behaviour, 3rd. Ed., McGraw Hill.

77. McDonough III E.F., & Kinnunen R.M., (1984), Management control of New Product Development Projects, IEEE Transactions on Engineering Management, Vol EM-31, No. 1, February, 1984.

78. McDonough III E.F., (1986), Matching control systems to Product Strategies, R&D Management 16, 2, 1986.

79. McTavish R., (1984), Approaching the New Product Organisation Problem, European Journal of Marketing, 18, 6/7.

80. Maidique M.A. & Zirger B.J., (1984), A Study of Success and Failure in Product Innovation: The case of the U.S. Electronics Industry, IEEE Transactions on Engineering Management, Vol. EM-31, No.4, November 1984, pp 192-203.

81. Maidique M.A. & Hayes R.H., (1984), The art of high technology management, Sloan Management Review, Winter 1984.

82. Maidique M.A. & Zirger B.J., (1985), The new product learning cycle, Research Policy, 14, 6, December 1985, pp 299-313

83. Mansfield E., (1968), Industrial Research and technological innovation, Longmans, London.

84. Mansfield E., (1971), Research and Innovation in the Modern Corporation, Macmillan, New York.

85. Marquis D., (1969), The Anatomy of Successful Innovations, Innovation, 1, November 1969, pp 28-37.

86. Merrifield B., (1978), Industrial project selection and management, Industrial Marketing Management, 7, pp 324-330.

87. Might, (1984), An evalluation of the effectiveness of project control systems, IEEE transactions on engineering management, Vol. EM31, No.3, August 1984.

88. Moser C.A. & Kalton G., (1971), Surveys Methods in Social Investigation, Gower Publishing Company ltd., Aldershot, England.

89. Moore R.A., (1984), Control of New Product Development in U.K. Companies, European Journal of Marketing, 18, 6/7, pp 5-13.

90. Myres D.D., (1984), Technological Innovation and Entrepreneurship from the human side, Engineering Management International, 2, pp 229-234.

91. Myres S. & Marquis D. (1969), Successful Industrial Innovations; A Study of Factors Underlying Innovation in Selected Firms, National Science Foundation Report No. NSF 69 17, May 69, Institute of Public Administration, Washington D.C.

92. Nadler D.A. & Tushman M.L., (1980), A model for diagnosing organisational behavior, Organisational Dynamics, Autumn 1980.

93. Nystrom H., (1979), Creatvity and Innovation, London, John Wiley.

94. Parker R.C., (1985), Going for Growth; Technological Innovation in Manufacturing Industries, John Wiley & Sons, Chichester.

95. Pascale R.G. & Athos A.G., (1981), The Art of Japanese Management, Penguin, Middlesex.

96. Peters T.J. & Waterman R.H., (1982), In Search of Excellence, Harper and Row, New York.

97. Pinchot III G.P., (1985), Intrapreneuring, Harper & Row, New York

98. Pugh D.S. et al., (1964), A Conceptual Scheme for Organisational Analysis, Administrative Science Quarterly, 8, pp 290-315.

99. Pugh D.S. et al., (1971), Organisation theory, Penguin, 1971.

100. Quinn J.B., (1979), Technological Innovation, entrepreneurship and strategy. Sloan Management Review.

101. Quinn J.B., (1986), Managing innovation: controlled chaos, The McKinsey Quarterly, Spring 1986, pp 2-21.

102. Randall G., (1980), Managing New Products, Management Survey Report No. 47, British Institute of Management, Reedprint, Winsor, Berks.

103. Reddin W.J., (1970), Managing Organisational Change, Industrial training international, March 1970.

104. Reed M., (1985), Redirections in Organisational Analysis, Tavistock, New York.

105. Rickards T., (1985), Stimulating Innovation; A Systems Approach, Francis Pinter.

106. Roberts E.B., (1987), Generating Technological Innovation, Oxford University Press, London.

107. Roberts E.B., (1977), Generating Effective Corporate Innovation, Technology Review, October / November, pp 27-33.

108. Ronkainen I.A., (1985), Criteria Changes Across Product Development Stages, Industrial Marketing Management, 14, pp 171-178.

109. Rosegger G., (1986), The Economics of Production and Innovation; An Industrial Perspective, Pergamon press, Oxford.

110. Rothberg R., (1976), Corporate Strategy and Product Innovation, Macmillan, New York.

111. Rothwell R., Freeman C., Horlsey A., Jervis V.T.P., Robertson A.B., & Townsend J., (1974), SAPPHO updated - project SAPPHO phase II, Research Policy 3, pp 258-291.

112. Rothwell R., (1974), The Hungarian SAPPHO: Some Comments and Comparisons, Research Policy 3, pp 30-38.

113. Rothwell R., (1977), The Characteristics of successful innovators and technically progressive firms (with some comments on innovation research) R & D Management 7, 3, 1977, pp 191-206.

114. Rothwell R., (1985), Project SAPPHO: A comparative study of Success and Failure in Industrial Innovation, Information Age 7, 4, October 1985, pp 215-219.

115. Rothwell R. & Bessant J., (1987), Innovation: Adaptation and Growth, Elsevier, Amsterdam.

116. Rothwell R. & Gardiner P., (1985), Innovation; A study of the problems and benefits of product innovation, The design council, London.

117. Rothwell R. & Zegveld., (1985), Reindustrialisation and Technology, Longman, Harrow.

118. Roy R., (1985), Design innovation and competitiveness from awareness to action, Design Studies, 6, 1, January 1985.

119. Rubenstein A.H., Chakrabarti A.K., O'Keefe R.D., Souder W.E. & Young H.C., (1976), Factors Influencing Innovation Success at the Project Level, Research Management, May 1976, pp 15-20.

120. Rubenstein A.H., & Ettlie J.E., (1979), Innovation among suppliers to Automobile Manufacturers: An exploratory study of barriers and facilitators R&D Management 9, 2, pp 65-76.

121. Saren M.A., (1984), A classification and review of models of the intra-firm innovation process, R&D Management 14, 1, pp 11-24.

122. Saren M., (1987), The role of strategy in technological innovation: A reassesment. Organisation Analysis and Development, ed. Mangham, I.L., John Wiley & Sons, Chichester.

123. Science Policy Research Unit, (1972), Success and Failure in Industrial Innovation, Centre for the Study of Industrial Innovation, London.

124. Scott C., (1961), Research on Mail Surveys, Journal of the Royal Statistical Society, A, 124, pp 143-205.

125. Shaw B.F., (1986), The role of the interaction between the manufacturer and the user in the technological innovation process. D.Phil thesis, University of Sussex.

126. Schmookler J., (1966), Invention and Economic Growth, Harvard University Press, Cambridge, Mass.

127. Schumpter J.A., (1939), Business Cycles, Vols. 1 & 2, New York.

128. Schott K., (1981) Industrial Innovation in the United Kingdom, Canada, and the United States, British North American Committee, London.

129. Shrivastava P. & Souder W.E., (1987), The Strategic management of technological innovations: A review and model, Journal of Management Studies, 24:1, January 1987.

130. Souder W.E., (1978), Effectiveness of Product Development methods, Industrial Marketing management 7 pp 229-307.

131. Souder W.E., (1981), Disharmony between R&D and Marketing, Industrial Marketing Management, 10, 67-73.

132. Souder W.E., (1987), Managing New Product Innovations, Lexington, Massachusetts.

133. Souder W.E., (1987), Encouraging Innovation in Large Corporations, R&D Management, May 18-22

134. Swords-Isheerwood N., (1984) The process of Innovation, a study of companies in , Canada, the United States, and the United Kingdom, British North American Committee, London.

135. Takeuchi H. & Nonaka I., (1986), The new new product development game, Harvard Business Review, Jan - Feb 1986, pp 137-146.

136. Thamhain, (1984), Engineering programme management, John Wiley & Sons, New York.

137. Tornatzky L.G. & Klein K.J., (1982), Innovation Characteristics and Innovation adoption - implementation: A meta analysis of findings, IEEE Transactions on Engineering Management, Vol. EM-29, No.1, February 1982.

138. Tushman M. & Moore W.L., (1982), Readings in the Management of Innovation, Pitman, London.

139. Tushman M. & Nadler D., (1986), Organizing for Innovation, California Management Review, Vol. XXVIII, No. 3, Spring 1986

140. Turner B.T., (1985), Managing design in the new product development process - methods for company executives, Design Studies, Vol.6, No.1, January 1985.

141. Twiss B.C., (1986), Managing Technological Innovation (3rd. edition), Pitman, London.

142. Twiss B.C., (1985), Non MSC Research and Initiatives in the field of Management Development for Technical Change, Manpower Services Commission, Sheffield.

143. Utterback J.M., (1971), The process of Innovation, a study of the Origination and Development of Ideas from New Scientific Instruments, IEEE Transactions on Engineering Management, Vol. EM-18.

144. Utterback J.M., (1971), The process of Technological innovation within the firm, Acadamy of Management Journal, March 1971, pp 75-88.

145. Utterback J.M., (1974), Innovation in Industry and the Diffusion of Technology, Science, Vol. 183, pp 620-626.

146. Utterback J.M., Allen T.J., Hollomon J.H., & Sirbu M.A., (1976), The process of Innovation in Five Industries in Europe and Japan IEEE transactions on engineering management, Vol. EM-23, No.1, February 1976.

147. Woolhouse J., (1983), The Gower Handbook of Management, Gower.

APPENDICES

LIST OF APPENDICES

Appendices part 1

APPENDICES PART 1

APPENDIX I

A summary of the research studies into new product success and failure

	STUDY AND AUTHORS	YEAR	FOCUS	SAMPLE SIZE	SAMPLE DESCRIPTION	COUNTRY OF ORIGIN	METHODOLOGY	FACTORS ASSOCIATED WITH SUCCESS OR FAILURE
1	Carter and Williams	1957	SUCCESS	269	firms	UNITED KINGDOM	Case Studies	1 High quality of incoming communication 2 A deliberate survey of potential ideas A willingness to: 3 - share knowledge 4 - take new knowledge on licence and enter joint ventures 5 A readiness to look outside the firm 6 Effective internal communication and coordination 7 High status of science and technology in the firm 8 A consciousness of costs and profits in the R&D departments 9 Rapid repalcement of machines 10 A sound policy of recruitment for management 11 An ability to attract talented people 12 A willingness to arrange for the effective training of staff 13 Use of management techniques 14 Identifying the outcome of investment decisions 15 High quality chief executive 16 Adequate provision for intermediate managers 17 Good quality of intermediate management 18 An ability to bring out the best of managers 19 Use of scientists and technologists on the board of directors 20 A readiness to look ahead 21 A high rate of expansion 22 Ingiunity in getting around material and equipment shortages 23 An effective selling policy 24 Good technical service to customers
2	Conference Board (Cochran and Thompson)	1964	FAILURE	87	firms	UNITED STATES	Questionnaire	1 Inadequate market anaysis 2 Product problems or defects 3 Higher costs than anticipated 4 Poor timing 5 Competition 6 Insufficient marketing effort 7 Inadequate sales force 8 Weakness in distribution
	Conference Board (Hopkins and Bailey)	1971	FAILURE	125	firms	UNITED STATES	Questionnaire	1 Inadequate market analysis 2 Product problems or defects 3 Lack of effective marketing effort 4 Higher costs than anticipated 5 Competitive strength or reaction 6 Poor timing of introduction 7 Technical or production problems
	Conference Board (Hopkins)	1980	FAILURE	91	firms	UNITED STATES	Questionnaire	1 Poor marketing research 2 Technical problems in design or production 3 Poor or improper timing
3	Myres and Marquis	1969	SUCCESS	567 121	innovations firms	UNITED STATES	Case Studies	1 Incremental innovations are important 2 Recognition of demand 3 Adopted innovations 4 Receptive climate to new ideas
4	Langrish	1972	SUCCESS	85	case studies	UNITED KINGDOM	Case Studies	1 Top person (in position of authority)

								2 Other key person 3 Clear identification of need 4 Realisation of potential usefulness 5 Good Cooperation 6 Availability of resources 7 Help from government sources
5	Globe, Levy, & Schwartz	1973	SUCCESS	8	key innovations	UNITED STATES	Case Studies	1 Recognition of technological opportunity 2 Recognition of need; market pull 3 Internal R & D Management 4 Management venture decision 5 Availability of funding 6 Technological Entrepreneur 7 In house collegues
6	Rothwell (Project SAPPHO)	1974	SUCCESS VS. FAILURE	43	"pairs"	UNITED KINGDOM	Case Studies	1 Had a much better understanding of user needs 2 Paid more attention to marketing 3 Performed development work more efficiently 4 Made more use of outside technology and advice 5 Had responsible individuals with greater authority
7	Rubenstein	1976	SUCCESS VS. FAILURE	103	projects, (6 firms)	UNITED STATES	Case Studies	1 Key individuals play a crucial role 2 Top management support 3 Improved communication
8	Gerstenfeld	1976	SUCCESS VS. FAILURE	32	projects	WEST GERMANY	Case Studies	1 Demand pull 2 Greater average effort 3 Strong project monitoring
9	Cooper (Project NewProd)	1979	SUCCESS VS. FAILURE	195	projects, 177 firms	CANADA	Mail Questionnaire	1 A unique or superior product 2 Strong market knowledge or efficiency 3 Technical and Production synergy and proficiency 4 A good product / company "fit" 5 Strong marketing communications and launch 6 Being in a large, growing, high need market 7 An economically priced product 8 Avoiding highly competitive dynamic markets
10	Maidique and Zirger	1982	SUCCESS VS. FAILURE	79 59 8	surveys questionnaires key innovations	UNITED STATES	79 Surveys 59 Questionnaire 8 Case Studies	1 Market knowledge gained through frequent customer interaction 2 Planning of the new product process 3 Coordination of the new product process 4 Emphasis on marketing and sales 5 Management support 6 The contribution margin of the product 7 Early market entry 8 Proximity of new product technologies and markets to existing strengths of the developing unit
11	Rothwell (review)	1977	SUCCESS & FAILURE	9	key research studies	VARIOUS	Literature Review	1 Good communication and effective collaboration 2 Innovation as a corporate wide task 3 Efficient development work 4 Careful planning and the use of management techniques 5 Quality of management, personnel policy and style 6 Marketing and user needs 7 After sales service and user education 8 Key individuals in greater poitions of authority

12	Booz Allen and Hamilton	1982	SUCCESS & FAILURE		fortune 1000 firms	UNITED STATES	Questionnaire	1 Product fit with market needs 2 Product fit with internal functional strengths 3 Technological superiority of product 4 Top management support 5 Use of a multiple step new product process
13	Souder	1986	SUCCESS	289	innovations	UNITED STATES	Case Studies	1 A high degree of understanding of technical problems and user needs 2 A high degree of fit between the technology and the company's level of expertise 3 A high quality of resources
14	Cooper (review)	1983	SUCCESS		key research studies	VARIOUS	Reviews	1 A strong market orientation 2 New product success is largely amenable to management action 3 A unique product with real customer advantages 4 A well conceived and properly executed launch 5 Internal communication and coordination
15	Peters and Waterman	1982	SUCCESS		US industrial companies	UNITED STATES	Case Studies	1 A bias for action, for getting on with it 2 Close to the customer 3 Autonomy and entrepreneurship, foster innovators and enrepren -eurs throughout the company 4 Productivity through people, respect for the individual 5 Hands on, value driven; leadership and management support 6 Stick to the knitting; stay close to the business you know 7 Simple form, lean staff 8 Simultaneous loose / tight properties
16	Lin	1986	FAILURE		Japanese new products	JAPAN		1 Poor product concept 2 Inferior product quality 3 Inapropriate product pricing 4 Underspending on marketing 5 Underestimating the competition 6 Unsupportive corporate structure 7 Inadequate use of marketing resources 8 Emotional decision making
17	Twiss	1986	SUCCESS		successful innovations	VARIOUS	Literature review	1 A market orientation 2 Relevance to the organisation's corporate objectives 3 An effective project selection and evaluation system 4 Effective project selection and control 5 A source of creative ideas 6 An organisation receptive to innovation 7 Committment by one or a few individuals
18	Centre for the study of ind- -ustrial innovation	1971	FAILURE		unsuccessful R&D projects	UNITED KINGDOM	Case Studies	1 Unattractive small market 2 Uncertainty with monopolistic buyers 3 Unattractive level of competition 4 Uncertainty with suppliers 5 Product obsolesence 6 Lack of marketing capacity or expertise 7 Faulty communications with associated firms 8 R & D cost escallation 9 Shortage of R & D resources

APPENDIX II

A breakdown of the factors associated with new product success and failure

GOOD COMMUNICATION AND COORDINATION

High quality of incoming communication	Carter and Williams
A willingness to:	
- share knowledge	Carter and Williams
- take new knowledge on licence and enter joint ventures	Carter and Williams
A readiness to look outside the firm	Carter and Williams
Effective internal communication and coordination	Carter and Williams
Good Cooperation	Langrish
Improved Communication	Rubenstein
Strong marketing communications and launch	Cooper (Project NewProd)
Good communication and effective collaboration	Rothwell (review)
Internal communication and coordination	Cooper (review)
Coordination of the new product process	Maidique and Zirger
Faulty communications with associated firms	Centre for the study of industrial innovation
Receptive climate to new ideas	Myres and Marquis
An organisation receptive to innovation	Twiss

A UNIQUE AND SUPERIOR PRODUCT THAT CLEARLY MEETS CUSTOMER WANTS AND NEEDS

A unique or superior product	Cooper (Project NewProd)
Product problems or defects	Conference Board (Cochran and Thompson)
Product problems or defects	Conference Board (Hopkins and Bailey)
Clear identification of need	Langrish
Realisation of potential usefulness	Langrish
Recognition of need; market pull	Globe, Levy, & Schwartz
Had a much better understanding of user needs	Rothwell (Project SAPPHO)
Demand Pull	Gerstenfeld
A unique product with real customer advantages	Cooper (review)
Poor product concept	Lin
An economically priced product	Cooper (Project NewProd)
Recognition of demand	Myres and Marquis
Product obsolesence	Centre for the study of industrial innovation
A high degree of understanding of technical problems and user needs	Souder

PROFICIENCY IN TECHNOLOGICAL ACTIVITIES

Made more use of outside technology and advice	Rothwell (Project SAPPHO)
Technological Entrepreneur	Globe, Levy, & Schwartz
Good technical service to customers	Carter and Williams
High status of science and technology in the firm	Carter and Williams
A consciousness of costs and profits in the R&D departments	Carter and Williams
Rapid repalcement of machines	Carter and Williams
Use of scientists and technologists on the board of directors	Carter and Williams
Technical or production problems	Conference Board (Hopkins and Bailey)
Technical problems in design or production	Conference Board (Hopkins)
Recognition of technological opportunity	Globe, Levy, & Schwartz
Technical and Production synergy and proficiency	Cooper (Project NewProd)
A good product / company "fit"	Cooper (Project NewProd)
Product fit with internal functional strengths	Booz Allen and Hamilton
A high degree of understanding of technical problems and user needs	Souder
A high degree of fit between the technology and the company's level of expertise	Souder

A high quality of resources	Souder
Inferior product quality	Lin

AN OPEN MINDED, SUPPORTIVE AND PROFESSIONAL MANAGEMENT

A sound policy of recruitment for management	Carter and Williams
An ability to attract talented people	Carter and Williams
A willingness to arrange for the effective training of staff	Carter and Williams
Use of management techniques	Carter and Williams
High quality chief executive	Carter and Williams
Adequate provision for intermediate managers	Carter and Williams
Good quality of intermediate management	Carter and Williams
An ability to bring out the best of managers	Carter and Williams
Top person (in position of authority)	Langrish
Other key person	Langrish
Internal R & D Management	Globe, Levy, & Schwartz
Management venture decision	Globe, Levy, & Schwartz
Performed development work more efficiently	Rothwell (Project SAPPHO)
Had responsible individuals with greater authority	Rothwell (Project SAPPHO)
Key individuals play a crucial role	Rubenstein
Top management support	Rubenstein
Management Support	Maidique and Zirger
Quality of management, personnel policy and style	Rothwell (review)
Key individuals in greater positions of authority	Rothwell (review)
Top management support	Booz Allen and Hamilton
Hands on, value driven; leadership and management support	Peters and Waterman
Careful planning and the use of management techniques	Rothwell (review)
New product success is largely amenable to management action	Cooper (review)
Productivity through people, respect for the individual	Peters and Waterman
Committment by one or a few individuals	Twiss
Strong project monitoring	Gerstenfeld
Planning of the new product process	Maidique and Zirger
Relevance to the organisation's corporate objectives	Twiss
An effective project selection and evaluation system	Twiss
Effective project selection and control	Twiss

A GOOD MARKET KNOWLEDGE AND STRATEGY

An effective selling policy	Carter and Williams
Inadequate market anaysis	Conference Board (Cochran and Thompson)
Insufficient marketing effort	Conference Board (Cochran and Thompson)
Inadequate sales force	Conference Board (Cochran and Thompson)
Inadequate market analysis	Conference Board (Hopkins and Bailey)
Lack of effective marketing effort	Conference Board (Hopkins and Bailey)
Poor marketing research	Conference Board (Hopkins)
Paid more attention to marketing	Rothwell (Project SAPPHO)
Strong market knowledge or efficiency	Cooper (Project NewProd)
Avoiding highly competitive dynamic markets	Cooper (Project NewProd)
Market knowledge gained through frequent customer interaction	Maidique and Zirger
Emphasis on marketing and sales	Maidique and Zirger
Proximity of new product technologies and markets to existing strengths of the developing unit	Maidique and Zirger
Early market entry	Maidique and Zirger
Marketing and user needs	Rothwell (review)

Product fit with market needs	Booz Allen and Hamilton
A strong market orientation	Cooper (review)
Close to the customer	Peters and Waterman
Underspending on marketing	Lin
Inadequate use of marketing resources	Lin
A market orientation	Twiss
Lack of marketing capacity or expertise	Centre for the study of industrial innovation
Unattractive small market	Centre for the study of industrial innovation

OTHER FACTORS

A deliberate survey of potential ideas	Carter and Williams
Identifying the outcome of investment decisions	Carter and Williams
A readiness to look ahead	Carter and Williams
A high rate of expansion	Carter and Williams
Inginuity in getting around material and equipment shortages	Carter and Williams
Higher costs than anticipated	Conference Board (Cochran and Thompson)
Poor timing	Conference Board (Cochran and Thompson)
Competition	Conference Board (Cochran and Thompson)
Weakness in distribution	Conference Board (Cochran and Thompson)
Higher costs than anticipated	Conference Board (Hopkins and Bailey)
Competitive strength or reaction	Conference Board (Hopkins and Bailey)
Poor timing of introduction	Conference Board (Hopkins and Bailey)
Poor or improper timing	Conference Board (Hopkins)
Incremental innovations are important	Myres and Marquis
Adopted innovations	Myres and Marquis
Availability of resources	Langrish
Help from government sources	Langrish
Availability of funding	Globe, Levy, & Schwartz
In house collegues	Globe, Levy, & Schwartz
Greater average effort	Gerstenfeld
Being in a large, growing, high need market	Cooper (Project NewProd)
The contribution margin of the product	Maidique and Zirger
Innovation as a corporate wide task	Rothwell (review)
Efficient development work	Rothwell (review)
After sales service and user education	Rothwell (review)
Use of a multiple step new product process	Booz Allen and Hamilton
A well conceived and properly executed launch	Cooper (review)
A bias for action, for getting on with it	Peters and Waterman
Autonomy and entrepreneurship, foster innovators and enrepren -eurs throughout the company	Peters and Waterman
Stick to the knitting; stay close to the business you know	Peters and Waterman
Simple form, lean staff	Peters and Waterman
Simultaneous loose tight properties	Peters and Waterman
Inapropriate product pricing	Lin
Underestimating the competition	Lin
Unsupportive corporate structure	Lin
Emotional decision making	Lin
A source of creative ideas	Twiss
Uncertainty with monopolistic buyers	Centre for the study of industrial innovation
Unattractive level of competition	Centre for the study of industrial innovation
Uncertainty with suppliers	Centre for the study of industrial innovation
R & D cost escallation	Centre for the study of industrial innovation
Shortage of R & D resources	Centre for the study of industrial innovation

APPENDIX III

Standard Industrial Classifications;
major divisions, 1980

Standard Industrial Classifications; major divisions

The standard industrial classification (SIC) is a categorisation of the industries that provide goods and services in the United Kingdom. The classification is produced by the Central Statistical Office and provides a useful framework for analysing the British economy.

The nine divisions are:

Division 0	AGRICULTURE, FORESTRY AND FISHING
Division 1	ENERGY AND WATER SUPPLY INDUSTRIES
Division 2	EXTRACTION OF MINERAL AND ORES OTHER THEN FUELS; MANUFACTURE OF METALS, MINERAL PRODUCTS AND CHEMICALS.
Division 3	METAL GOODS, ENGINEERING AND VEHICLE INDUSTRIES
Division 4	OTHER MANUFACTURING INDUSTRIES
Division 5	CONSTRUCTION
Division 6	DISTRIBUTION, HOTELS AND CATERING; REPAIRS
Division 7	TRANSPORT AND COMMUNICATION
Division 8	BANKING, FINANCE, INSURANCE, BUSINESS SERVICES AND LEASING
Division 9	OTHER SERVICES

APPENDIX IV

Standard Industrial Classification division 3; metal goods, engineering and vehicle industries (1980).

Standard Industrial Classification division 3; metal goods, engineering and vehicle industries

This study focused on division 3 (with the exclusion of class 31; Manufacture of Metal goods not elsewhere specified). Division 3 includes the following activities:

Class	Group	Activity
32		**MECHANICAL ENGINEERING**
	320	Industrial plant and steelwork
	321	Agricultural Machinery and tractors
	322	Metal working, Machine tools and engineers tools
	323	Textile Machinery
	324	Machinery for the food, chemical and related industries; process engineering contractors
	325	Mining machinery construction and mechanical handling equipment
	326	Mechanical power transmission equipment
	327	Machinery for the printing, paper,wood, leather, rubber, glass and related industries
	328	Other machinery and mechanical equipment
	329	Ordnance, small arms and ammunition

33	330	**MANUFACTURE OF OFFICE MACHINERY AND DATA PROCESSING SOFTWARE**
34		**ELECTRICAL AND ELECTRONIC ENGINEERING**
	341	Insulated wires and Cables
	342	Basic Electrical Equipment
	342	Electrical equipment for industrial use, batteries and accumulators
	343	Telecommunication equipment, electrical measuring equipment, electronic capital goods and passive electronic components
	344	Telegraph and telephone apparatus and equipment
	345	Other Electronic equipment
	346	Domestic-type electric appliances
	347	Electric lamps and other electric lighting equipment
	348	Electrical equipment installation
35		**MANUFACTURE OF MOTOR VEHICLES AND PARTS THEREOF**
	351	Motor Vehicles and their engines
	352	Motor Vehicle bodies, trailers and caravans
	353	Motor Vehicle parts
36		**MANUFACTURE OF OTHER TRANSPORT EQUIPMENT**
	361	Ship building and repairing

	362	Railways and tramway vehicles
	363	Cycles and motor cycles
	364	Aerospace Equipment manufacturing and repairing
	365	Other vehicles
37		**INSTRUMENT ENGINEERING**
	371	Measuring, checking and precision instruments and apparatus
	372	Medical and surgical equipment and orthopaedic appliances
	373	Optical precision instruments and photographic equipment
	374	Clocks watches and timing devices

APPENDIX V

Questionnaire covering letter

Mark Benson

1ENT OF INDUSTRIAL STUDIES P.O. BOX 147 LIVERPOOL L69 3BX TEL: 051 – 709 - 6022 EXT. 2357

27th. March 1987

IMPROVING THE CHANCES OF NEW PRODUCT SUCCESS

Dear Sir,

We are currently researching how companies improve their chances of new product success.

We would be grateful if you could assist us by filling in the enclosed questionnaire (which is totally confidential).

If it is not appropriate that you complete it, could you please pass it to the person responsible for new product development.

With thanks for your assistance.

Yours Sincerely

Mark Benson.

APPENDIX VI

The initial questionnaire survey

Confidential

IMPROVING THE CHANCES OF NEW PRODUCT SUCCESS

This questionnaire is concerned with how companies manage the development of new products. It examines how changes in the organisational structure and management of the development process influence the success of new products.

It is aimed at engineering companies from the Standard Industrial Classification; Division 3.

We estimate it will take in the region of 25 minutes to complete.

If you have any query please contact:-

Mark H. Benson
Department of Industrial Studies
Liverpool University
PO.Box 147, Liverpool, L69 3BX.

Tel: 051-706-6022 ext. 2357.

INTRODUCTION

Answering the questionnaire.

There are four types of question:

1. Dotted line.

Enter the appropriate number (or answer). If exact figures are not available estimates should be given.

eg. How many people are employed on your site? (.2100..)

2. Numbers to circle.

Please circle the appropriate number.

eg. How many new products did your company introduce last year?

(1)	Between 0 and 9	(1)
(2)	Between 10 and 19	2
(3)	Between 20 and 30	3

(the answer being 8)

3. Numbers to circle and rank.

If there are a set of brackets after the number, there could be more than one answer. If more than one choice is appropriate enter 1 against the first choice, 2 against the second and so on.

eg. How would you define a successful new product?

A successful new product is:-

(1)	one which achieves the expected **profit.**	1 (2)
(2)	one which meets the required **quality** standards.	2 ( )
(3)	one which is delivered on the specified **launch date.**	3 (1)

(in this example, the answer being launch date and profit in that order.)

4. Yes or No to Circle.

If the answer is Yes or No, please circle Yes or No

eg. Do you feel your new product development process needs improving? (Yes) / No

If there is not enough space feel free to write on the questionnaire itself.

Questionnaire No.

IMPROVING THE CHANCES OF NEW PRODUCT SUCCESS.

Name .....

Position .....

Company .....

Address .....

.....

Telephone .....

Please describe your involvement with new product development programmes.

.....

.....

SECTION ONE, The company.

1. Which of the following best describes your company's main area of business? If appropriate please rank.

(1)	Metal Goods	1	( )
(2)	Mechanical Engineering	2	( )
(3)	Office Machinery and Data Processing Equipment	3	( )
(4)	Electrical and Electronic Engineering	4	( )
(5)	Motor Vehicles and Parts thereof	5	( )
(6)	Other Transport equipment	6	( )
(7)	Instrument Engineering	7	( )
(8)	Other (please specify)		
	.....	8	( )

2. What are the company's main product lines?

.....

3. How many people are currently employed by the company:-

(1) As a whole? (.....)

(2) On your site? (.....)

4. What was the level of turnover achieved by the company in the last financial year? £.....

5. Indicate which of the following best describes the type of production carried out by the company. If appropriate please rank.

(1) One off 1 ( )

(2) Small Batch 2 ( )

(3) Large Batch 3 ( )

(4) Continuous or Mass 4 ( )

(5) Process 5 ( )

(6) Other (.....) 6 ( )

6. Of the orders received by the company please indicate the percentage in each of the following categories:

(1) Specials: designed and manufactured only against a firm customer order and to the customer's specification. .....%

(2) Repeats: made to an existing design after a firm customer order is received. .....%

(3) Standards: made to stock so that the customer is supplied "off the shelf". .....%

7. Indicate which of the following activities are carried out on your site.

(1) Marketing 1

(2) Research 2

(3) Product development 3

(4) Production development / Process development 4

(5) Manufacturing / Production 5

(6) Other Services eg. Finance, Personnel, Training etc. 6

(7) Other (please specify) 7

.....

8. Indicate the percentage of turnover that is spent on the research and development of new products. .....%

9. Is your new product development operation located centrally within the company, or does each division or unit have its own separate new product department.

(1) Product development is centrally located. 1

(2) Product development in each division. 2

(3) Question not relevant; whole company on one site 3

(4) Other (please specify) 4

.....

SECTION TWO, **The product(s)**

1. How many new (new to the company) products has the company developed and introduced in the last three years? (.....)

2. What percentage of current sales turnover is made up of products that have been developed and introduced in the last three years? .....%

3. What is the average lead time (in months) for the development of the product, from the initial concept to the start of production? (.....)

4. Do you produce:-

(1) A finished marketable product. 1 ( )

(2) A component for further assembly. 2 ( )

5. Approximately what percentage of the product (in terms of component cost) is manufactured by outside suppliers? .....%

6. Please indicate how "new" your new products are by entering the appropriate percentage against each of the following categories.

(1) Existing market, existing technology .....%

(2) Existing market, new technology .....%

(3) New market, existing technology .....%

(4) New market, New technology .....%

SECTION THREE

Control and organisation of the new product development process.

1. Do you have a new product guide, procedure or checklist? (if no please go to question 5) Yes / No

2. How closely is your new product guide, procedure or checklist followed in practice?

not used				followed very closely	
1	2	3	4	5	6

3. How many years have you been using a new product guide procedure or checklist? (.....)

4. How did your current new product guide, procedure or checklist originate?

(1) From experience; as a result of development problems and mistakes. 1

(2) From experience; in anticipation of development problems and mistakes. 2

(3) Through a key person or individual. 3

(4) From another company, through a key individual. 4

(5) From a book or journal detailing a new product procedure. 5

(6) Through a committee or team set up to improve the new product development process. 6

(7) Other (please detail) 7

.....

.....

5. How would you define a successful new product? Please rank in order of priority.

(1) One which achieves the expected **profit** 1 ( )

(2) One which meets the required **quality** standards 2 ( )

(3) One which is delivered on the specified launch date 3 ( )

(4) One which achieves the expected market sales or market share 4 ( )

(5) Other (please specify) 5 ( )

.....

.....

6. How often do you review each product to see if it has fulfilled the above (Qu.5) criteria?

(1) Never 1

(2) Hardly Ever 2

(3) Occasionally 3

(4) Often 4

(5) Every [....] months 5

If you do review your products regularly please briefly outline the procedure you use.

.....

.....

7. Please indicate the percentage of the new products (that have passed through the commercialisation stage) that meet the success criteria you outlined in question 5. That is; What percentage of your new products are successful? .....%

8. In your estimation what percentage of expenditure on R&D is spent on new products that are cancelled prior to introduction (to the market). .....%

9. Which of the following best describes the approach used by your company to manage the development of new products? If appropriate please rank.

(1) **New Product department:** responsible for integrating R&D and Marketing efforts, mainly integrators and expeditors. 1 ( )

(2) **Product Committee or Team:** used to coordinate inter-disciplinary effort. 2 ( )

(3) **Commercial Project Manager:** an individual from Marketing, appointed to manage a new product development team. 3 ( )

(4) **Technical Project Manager:** an individual from R&D, appointed to manage a new product development team. 4 ( )

(5) **Commercial Line Management:** a top level Marketing executive has sole authority and responsibility for carrying out the project. 5 ( )

(6) **Technical Line Management:** a top level R&D executive has sole responsibility for carrying out the project. 6 ( )

(7) **Commercial One-Man Show:** a Marketing person initiating and monitoring the development work. 7 ( )

(8) **Technical One-Man Show:** an R&D person initiating and monitoring the development work. 8 ( )

(9) **An R&D - Marketing Dyad:** a strong personal alliance between an R&D individual and a Marketing individual. 9 ( )

(10) Other (please specify) 10 ( )

.....

.....

10. Is the responsibility for the new product transferred during the course of a new product development programme, or is one person (or department) in charge throughout?

(1) One person in charge 1

(2) Responsibility transferred 2

11. Which levels of staff are well aware of company objectives and goals, in terms of strategic planning etc. If appropriate please rank in order of awareness.

(1) Senior management 1 ( )

(2) Middle management 2 ( )

(3) Technical Staff 3 ( )

(4) Supervisors 4 ( )

(5) Shop floor workers 5 ( )

(6) Everyone, including customers and suppliers 6 ( )

12. Please indicate which of the following best describes senior managements (board level) involvement in the new product development process.

(1) Ensuring that the new product strategy and long term plans are implemented. 1

(2) Provide support and encouragement but do not get involved any decisions that are part of the new product development process. 2

(3) Involved with key decisions only at critical stages in the project. 3

(4) Involved in decision making on a day to day basis. 4

(5) Other (please specify)

..... 5

.....

13. Do you have a clearly defined new product strategy? Yes / No

If yes, how is this communicated to staff involved in new product development? (please specify).

.....

.....

SECTION FOUR

Development and improvement of the new product management system.

1. Do you think the new product development process and its management needs improving? Yes / No

2. Are conscious efforts made on a regular basis to improve the new product development process? Yes / No

3. Who is responsible for identifying new ideas and implementing changes to the new product development process?

(1) Senior Management 1

(2) New Product Staff 2

(3) Review system/committee 3

(4) Development Team 4

(5) A specified individual 5

(6) Other (please specify) 6

..... 7

4. In the past three years which of the following methods, if any, have been used to improve the new product development process or its management? If none, state "None".

(1) Alterations to the new product strategy 1

(2) Improved Screening and evaluation of new products 2

(3) Changes to the organisational structure 3

(4) Changes to the new product procedure 4

(5) Other (please specify)

..... 5

5. Indicate which of the following training programmes you, or the staff in your company been on.

(1) New Product Management 1

(2) Project Management 2

(3) Technical training courses 3

(4) Management Development 4

(5) Quality Improvement 5

(6) Others (please specify) 6

.....

6. Who is responsible for identifying training needs?

(1) Personnel department 1

(2) Training department 2

(3) Individual departments 3

(4) Outside consultants 4

(5) Individuals themselves 5

(6) Other (please specify) 6

.....

7. Is your company involved with any organisation development or similar "change" programmes? Yes / No

8. Are there any plans for any future changes to the new product development process? Yes / No

If Yes (please outline)

.....

.....

SECTION FIVE

Research into the success and failure of new product development.

1. Please circle the factors that you feel contribute most to the success of a new product. If appropriate please rank.

(1) A good specification and clear planning during the initial stages.	1	( )
(2) A detailed understanding of the market combined with a strong marketing effort.	2	( )
(3) Good internal and external communications.	3	( )
(4) A unique and superior product, that clearly meets user needs.	4	( )
(5) An effective and well written new product procedure.	5	( )
(6) A strong understanding of the technology involved, and an efficient development process.	6	( )
(7) A well trained and proficient management and work force.	7	( )
(8) Strong support from senior management	8	( )
(9) A key individual (product champion) to "push" the development through.	9	( )
(10) Sufficient resources	10	( )
(11) Others (please specify)	11	( )

.....

.....

.....

2. Do you know of any of the recent research studies that have attempted to identify the reasons for the success and failure of new products. Please indicate if you have heard of any of the studies.

	Please circle the appropriate reply	
(1) Project New Prod.	Yes	No
(2) Project SAPPHO.	Yes	No
(3) Stanford Innovation Project	Yes	No
(4) Booz Allen & Hamilton	Yes	No
(5) Langrish	Yes	No
(6) Others (please specify)	Yes	No

.....

.....

3. Have you studied any of the above in detail? Yes / No

(if yes please specify)

.....

.....

4. Has your company attempted to apply the results of these studies, and if so using what techniques?

(1) Not applied 1

(2) Applied 2

Techniques used (eg. imposed, training, organisation development)

.....

.....

5. Please add any further comments that you feel may be useful.

.....

.....

.....

.....

Thank you for your assistance.

If you would like any further details of the project or the results of the study please indicate below.

(1) Further details 1

(2) Results 2

It is planned that the next stage of the project will involve a more detailed study of individual companies. This second phase will involve a structured interview lasting between one and two hours.

Would you be willing to take part in this second phase? Yes / No

APPENDIX VII

Initial industrial contacts

A list of the initial industrial contacts made during 1986

1. **Baker Perkins**, Peterborough. (19th. May 1986)

2. **Bentley Engineering**, Leicester. (20th May 1986)

3. **Caterpillar Tractor**, Leicester. (26th Sept. 1986)

4. **Delco Electronics**, Liverpool. (October 1985 onwards)

5. **GKN.**, Wolverhampton. (26th. May 1986)

6. **Grattan**, Bradford. (19th. June 1986)

7. **IBM**, Winchester. (23rd. May 1986)

8. **Land Rover**, Solihull. (25th. April 1986)

9. **Leyland Trucks**, Preston. (9th. April 1986)

10. **Renold plc.**, Manchester. (14th. May 1986)

11. **Rolls Royce**, Derby. (30th. May 1986)

12. **T.I. Research**, Hixton Hall. (21st. May 1986)

13. **Turner & Newall**, Rochdale. (12th. May 1986)

APPENDIX VIII

Structured interview cover letter

Mark H. Benson

'MENT OF INDUSTRIAL STUDIES P.O. BOX 147 LIVERPOOL L69 3BX TEL: 051 – 709 - 6022 EXT. 2359

15th. December 1987

Mr J.P.T Wilkinson
Automotive Division Director
Davy McKee (Sheffield) ltd.
Prince of Wales Road
Sheffield, S. Yorkshire.

Dear Mr Wilkinson,

Many thanks for completing the questionnaire on Successful Product Innovation earlier this year. In total I received over 150 replies, and these have proved invaluable to the research. I have enclosed a summary of the findings.

I have now reached the final stage of the research which will involve interviewing around twelve companies who appear to be making substantial efforts to improve the management of new product development.

From your questionnaire responses I feel that your company fits into this category and I would very much like to include it in the survey. Any information obtained will of course be treated with total confidentiality.

The interview itself is expected last in the region of two to three hours and ideally I would like to talk to the manager responsible for new product development, and possibly several product managers. In return I can offer you a copy of the results obtained, and if you like, a brief presentation on the results so far. (Two papers have already been written on the work.)

I am hoping to arrange the interviews between mid January and mid February. If you can help, please could you advise me of a convenient date and I will make arrangements to forward a copy of the structured interview, prior to our meeting. I have enclosed details of the type of information required.

I look forward to hearing from you.

Yours Sincerely

Mark Benson

APPENDIX IX

The structured interview schedule

Part 1; New product performance

TOTALLY CONFIDENTIAL

SUCCESSFUL PRODUCT INNOVATION

PART 1: STRUCTURED INTERVIEW

NEW PRODUCT PERFORMANCE

The aim of this section is to measure the success of new products, and their impact on company sales and profitability.

Name _____

Company _____

Mark H. Benson
Department of Industrial Studies
University of Liverpool,
Liverpool, P.O.Box 147,
L69 3BX ENGLAND

NEW PRODUCT PERFORMANCE

1. How does the company define a successful new product?

.....
.....
.....

2. Do you measure the success of individual new products?

Yes / No

3. Which of the following success criteria are **most** important to the company (rank):

		Rank
1.	Delivery on Time	( )
2.	Profit	( )
3.	Quality	( )
4.	Performance	( )
5.	Market share	( )
6.	Other	( )

.....

4. What percentage of your new products are successful?

.....%

5. What percentage fail, once they have reached the market?

.....%

6. What percentage are cancelled prior to introduction?

.....%

(Should total 100%)

7. What percentage of current sales turnover is made up of products that have been developed within the last 3 years?

.....%

8. Approximately by how much has your market share increased or decreased over the last 3 years?

.....%

9. Is the number of new products being developed increasing, remaining the same, or decreasing?

Increasing		Same		Decreasing
1	2	3	4	5

10. To what extent do new product development programmes meet the performance objectives:

Never	Sometimes		Often	Always
1	2	3	4	5

Comments / notes on product performance

.....
.....
.....
.....
.....
.....
.....
.....

APPENDIX X

The structured interview schedule

Part 2; Change and new product development

TOTALLY CONFIDENTIAL

SUCCESSFUL PRODUCT INNOVATION

PART 2: STRUCTURED INTERVIEW

CHANGE & NEW PRODUCT DEVELOPMENT

The aim of this section is to examine more closely any recent changes to the new product development organisation. The main objective of the section is, firstly to try and identify the type of effort put into improving new product programmes, and secondly to identify and evaluate different change methods.

This is the area with which the research is primarily concerned, how the need for change is identified, diagnosed, developed and actioned.

Name: _____

Company: _____

This research is being carried out by:

Mark H. Benson
Department of Industrial Studies
University of Liverpool,
Liverpool, P.O.Box 147,
L69 3BX ENGLAND

CHANGE WITHIN THE NEW PRODUCT DEVELOPMENT ORGANISATION

Using the McKinsey Seven "S" model* the aim of this section is to identify where changes have occurred in the new product organisation within the last three years.

Description of the model:

The McKinsey Seven "S" model is a useful framework through which to examine the organisation. The seven "S" model has been adapted to look at the new product organisation, and in terms of this structured interview the seven "S"s refer to:

Structure: How new product development (NPD) is formally structured within the company, i.e how NPD. fits into the organisation tree.

Style: The type of support given by, and characteristics of key managers involved in new product development.

Strategy: The new product development strategy and long term plan. Those goals and objectives which define the type of new products to be developed, the resources needed, the markets to be pursued, and the technologies to be adopted etc.

Skills: The specialist knowledge and techniques needed to undertake new product development activities.

Systems: Those coordination and communication mechanisms used to control and transfer information around the new product organisation. eg. the New Product Procedure.

* source: Johne and Snelson (1987), Peters and Waterman (1982) & Pascale and Athos (1981).

Staff: The qualities and development of key personnel needed for new product development.

Shared values: Those guiding concepts or values that give direction to the people involved in new product development.

*** source:** Johne and Snelson (1987), Peters and Waterman (1982) & Pascale and Athos (1981).

1. Where have the major changes been made to the new product organisation within the last three years?

For example: If the total changes made represent 100% please divide this percentage between the relevant S's so as to indicate where the effort (in terms of total cost) has been placed. For example if company X had made changes to its organisational structure, and its new product procedure, and a similar effort had been spent on each change, company X would divide the percentage up like so:

Strategy	
Structure	50%
Systems	50%
Shared Values	
Style	
Staff	
Skills	
	100%

STRATEGY [.....]

STRUCTURE [.....]

SYSTEMS [.....]

SHARED VALUES [.....]

STYLE [.....]

STAFF [.....]

SKILLS [.....]

2. In general who would you say is responsible for **identifying** changes or possible improvements to the new product development organisation and process?

.....
.....

3. In general who would you say is responsible for **implementing** changes or possible improvements to the new product development organisation and process?

.....
.....

4. In the last three years have any improvements to the new product development process or organisation been made through the application of:

4.1 Specific Consultancy Studies [ ]

4.2 Results or ideas from any of the following research studies:

Project SAPPHO (Rothwell) [ ]

Project NewProd (Cooper) [ ]

Stanford Innovation Project (Maidique) [ ]

New Products Survey
(Booz Allen & Hamilton) [ ]

Others ..... [ ]

4.3 Any other method [ ]

Details

.....
.....
.....
.....
.....
.....

The rest of the interview looks more carefully at these seven S's in terms of the organisation as it is now, and the kind of changes that have been recently made.

STRUCTURE

Structure: How new product development is formally structured within the company i.e how NPD fits into the organisation tree.

The structure of the NP organisation

1. Which department is responsible for controlling the development of a new product?

   Marketing department [ ]

   Engineering / Technical department [ ]

   New Product department [ ]

   Other ..... [ ]

2. Is the new product development unit totally self sufficient, or is it dependent on other functional units, with a matrix type structure for supportive activity?

   Self sufficient NPD [ ]

   NPD involves other functions (in a matrix type structure) [ ]

3. Are teams set up with the responsibility of developing new products, and coordinating the work across the various departmental boundaries? If yes, are these teams full or part time?

   YES / NO

FULL TIME / PART TIME

.....
.....

4. On what level are new product "needs" serviced, ie where is the NPD carried out?

Corporate (whole company)	[ ]
Divisional	[ ]
Product Line / Group	[ ]

5. Is it possible to have an outline or copy of the organisation "tree" showing how NPD "fits" into the organisation?

YES / NO

Changes to the structure

1. Have any significant changes been recently made to the **structure** of the organisation with the aim of improving the efficiency of NPD?

YES / NO

If NO go to Question 7

2. Why was it felt necessary to make these changes to the structure? and on what information were they based, (eg. experience, consultancy study, in house study etc.)

.....
.....

3. From where or who were these changes initiated?

.....
.....

4. What were the general trends in the changes? From what original structure to what new structure?

Original Structure .....
.....
New Structure.....
.....

5. How were the changes were made, and communicated to the organisation, who was involved and how successful they were?

Made: .....
.....

Communicated:.....
.....

Involvement: .....
.....

Success? .....
.....

6. Did these changes have any effect on any of the other seven S's?

Style	YES / NO
Strategy	YES / NO
Skills	YES / NO

Systems	YES / NO
Staff	YES / NO
Shared Values	YES / NO

What effect? .....
.....
.....
.....

7. Are there any plans for future changes to the organisational Structure?

.....
.....
.....
.....

STYLE

Style: The type of support given by, and characteristics of key managers involved in new product development.

The management style surrounding NPD.

1. How involved are senior management with NP development programmes?

Little Direct involvement eg. Reviewing monthly reports etc.				Extensive Involvement eg. daily chats with design engineers.
1	2	3	4	5

2. How do senior management (SM) keep in touch with the new product development? eg. through tracking, reports, formal meetings etc.

.....
.....
.....
.....

3. Would you say SM have an intimate knowledge of the NP's situation? What is the main kind of information they chase?

.....
.....
.....
.....

4. What key words would you use to describe the leadership style within the company?

.....
.....

Changes to the management style of NPD

1. Have any significant changes been recently made to the **management style** of the organisation with the aim of improving the efficiency of NPD?

YES / NO

If NO go to Question 8

2. Did these changes to the management style come about as a result of some other change to the organisation? If so what influenced the change in style.

.....
.....

3. Why was it felt necessary to make these changes?

.....
.....

4. From where or who were these changes initiated?

.....
.....

5. What were the general trends in the changes? From what original style to what new style?

Original Style .....
.....
.....

New Style .....
.....
.....

6. How were the changes were made, and communicated to the organisation, who was involved and how successful they were?

Made: .....
.....

Communicated: .....
.....

Involvement: .....
.....

Success? .....
.....

7. Did these changes have any effect on any of the other seven S's?

Structure	YES / NO
Strategy	YES / NO
Skills	YES / NO
Systems	YES / NO
Staff	YES / NO
Shared Values	YES / NO

.....
.....
.....
.....

8. How do you see future changes in the management style of the organisation?.

.....
.....
.....
.....

STRATEGY

Strategy: The new product development strategy and long term plan. Those goals and objectives which define the type of new products to be developed, the resources needed, the markets to be pursued, and the technologies to be adopted.

1. Which of the following best describes companies position in the market?

Broad span leader [ ]
(leader in several market segments)
Narrow span leader [ ]
(leader in one market segment)
Reactor [ ]
(response to successful competitors launches)
Responder [ ]
(reluctant response to competitive pressure)

2. Which of the following best describes company policy towards the market place?

First to the market [ ]
Follow the leader [ ]
"Me too" alternatives [ ]

3. How "new" are the new products your company develops. Approximately what percentage of your new products fit into each of the following categories?

Existing Market / Existing technology. [ ]
Existing Market / New Technology. [ ]
New Market / Existing Technology. [ ]

New Market / New Technology. [ ]

100%

4. Is the new product strategy positional, (ie. is the emphasis is put on achieving efficiency in present products) or entrepreneurial. (the emphasis put on new product and new business development)

Positional Entrepreneurial

2 3 4 5

5. Would you describe the main product technology you are involved in as still developing or mature?

Developing [ ]

Mature [ ]

Changes in the strategy and emphasis on strategy

1. Have any significant changes been recently made to the NP strategy, or the way in which the strategy is communicated to the organisation, with the aim of improving the efficiency of NPD?

YES / NO

If NO go to question 7

2. Why was it felt necessary to make these changes? and on what information were they based, (eg. experience,

consultancy study, in house study)

.....
.....
.....
.....

3. From where were these changes initiated?

.....
.....

4. What were the general trends in the changes? From what original strategy to what new strategy?

Original Strategy .....
.....
New Strategy .....
.....

5. How were the changes made, and communicated to the organisation, who was involved and how successful they were?

Made: .....
.....

Communicated: .....
.....

Involvement: .....
.....

Success: .....
.....

6. Did these changes have any effect on any of the other seven S's?

Structure	YES / NO
Strategy	YES / NO
Skills	YES / NO
Systems	YES / NO
Staff	YES / NO
Shared Values	YES / NO

.....
.....

7. Are there any plans for future changes to the Strategy.

.....
.....
.....
.....

SKILLS

Skills: The specialist knowledge and techniques needed to execute new product development tasks.

1. What level of technology do your new products employ?

Low Technology				High/Sophisticated Technology
1	2	3	4	5

2. How strongly orientated is the firm towards R&D.?

Little emphasis				Very strongly
1	2	3	4	5

3. How active is the firm in acquiring new **development** technologies?

Lacking				Proactive
1	2	3	4	5

4. How often do new products employ "state of the art" **product** technologies?

Rarely				Always
1	2	3	4	5

5. How active is the firm in generating new product ideas?

Lacking Proactive

1 2 3 4 5

6. How often do new products employ "state of the art" **production / manufacturing** technologies?

Rarely Always

1 2 3 4 5

7. Do new products usually "fit" in with the firm's **production** skills and resources?

Rarely Always

1 2 3 4 5

8. Do new products "fit" in with the firm's **R&D** skills and resources?

Rarely Always

1 2 3 4 5

9. Do new products "fit" in with the firm's **engineering** and development skills and resources?

Rarely Always

1 2 3 4 5

Changes in the NPD skills

1. Have any significant changes been recently made to the NP skills?

YES / NO

If NO go to Question 8

2. Why was it felt necessary to make changes to the level of skills required for new product development?

.....
.....
.....
.....

3. From where did the need to change the level of skills originate? (Did this change result from some other key change to the organisation?)

.....
.....
.....

4. What were the general trends in the changes?, and in what areas were more skills acquired?

.....
.....
.....
.....

5. What did the changes involve?

.....
.....
.....
.....

6. How were the changes made, and communicated to the organisation, who was involved and how successful they were?

Made: .....
.....

Communicated: .....
.....

Involvement: .....
.....

Success: .....
.....

7. Did these changes have any effect on any of the other seven S's?

Structure	YES / NO
Style	YES / NO
Strategy	YES / NO
Systems	YES / NO
Staff	YES / NO
Shared Values	YES / NO

.....
.....
.....

8. Are there any plans for future changes to the Skills required and used in NPD.?

.....
.....
.....
.....

SYSTEMS

Systems: Those coordination and communication mechanisms used to control and transfer information around the organisation. eg. the New Product Procedure.

1. What are the main systems or procedures used in the control of the new product development process:

.....
.....
.....
.....

2. Do you have a new product guide procedure or checklist?

YES / NO

3. How important is this for controlling new product development?

Loose outline for development.				Followed Rigidly.
1	2	3	4	5

.....
.....

4. Is it possible to have a copy or outline? YES / NO

5. Which of the following criteria are measured during and after the development of the new product, and how often?

Time tracking	( )	.....
Profit	( )	.....
Performance	( )	.....
Quality	( )	.....
Market share	( )	.....

6. How often do you cost out a product to see if it has achieved the financial performance objectives specified at early stages in the programme?

.....
.....

7. How often are the objectives set during the early stages reviewed for new product developments? (at what stages during the new product development)

.....
.....
.....

8. When do the controls start and how do they vary throughout the product development process? (in terms of responsibility and accountability etc.)

.....
.....
.....

9. Are any project management techniques used, such as PERT or CPM?

.....

.....
.....

10. Do you have computer controlled tracking systems? or other control systems monitoring new product development?

.....
.....

Changes in the new product systems

1. Have any significant changes been recently made to the NP systems used?

YES / NO

If NO go to question 10

2. How long have you had a new product procedure?

[ ] years

3. Why was it felt necessary to make changes to the systems you use to manage new product development?

.....
.....
.....
.....

4. Did these changes result from any other changes to the organisation?

.....

5. Have these changes resulted in a general tightening of rules controls and procedures or a relaxing of them?

Tightening				Loosening
1	2	3	4	5

6. From where were these changes initiated?

.....
.....

7. How were the changes made, and communicated to the organisation, who was involved and how successful they were?

Made: .....
.....

Communicated: .....
.....

Involvement: .....
.....

Success: .....
.....

8. What were the general trends in the changes, from what old systems to what new ones?

Old Systems .....
.....
New Systems .....
.....

9. Did these changes have any effect on any of the other seven S's?

Structure	YES / NO
Style	YES / NO
Strategy	YES / NO
Skills	YES / NO
Staff	YES / NO
Shared Values	YES / NO

What effect? .....
.....

10. Are there any plans for future changes to the Systems used to control NPD.?

.....
.....

STAFF

Staff: The qualities of key personnel needed to execute the new product procedure.

1. What kind of training programmes are run both in and out of the company?

.....
.....
.....
.....

2. Who is responsible for identifying training needs?

.....
.....

3. Who identifies and recruits the new product staff

Personnel department	( )
Individual departments	( )
Recruitment agencies	( )

4. What percentage of managers recruited are graduates?

.....%

5. Is there a structured Management Development programme in the company?

YES / NO

6. Is there a structured Organisation Development programme in the company?

YES / NO

7. What emphasis is there on teamwork and the use of teams within the company?

Low emphasis High emphasis

1 2 3 4 5

8. Do the company use any special team selection methods, and what emphasis is put on training?

.....
.....
.....

Changes with new product staff

1. Have any significant changes been recently made to the NP staff, training of NP staff, or selection of NP staff?

YES / NO

If NO go to question 8

2. Why was it felt necessary to make changes to the staff side of new product development?

.....
.....
.....
.....

3. Did these changes result from any other changes to the organisation?

.....
.....

4. From where were these changes initiated?

.....
.....

5. How were the changes made, and communicated to the organisation, who was involved and how successful they were?

Made: .....
.....

Communicated: .....
.....

Involvement: .....
.....

Success: .....
.....

6. What were the general trends in the changes?

.....
.....
.....
.....

7. Did these changes have any effect on any of the other seven S's?

Structure	YES / NO
Style	YES / NO
Strategy	YES / NO
Skills	YES / NO
Systems	YES / NO
Shared Values	YES / NO

8. Are there any plans for future changes to the Staff, or training etc. in NPD.?

.....
.....
.....
.....

SHARED VALUES

Shared values: Those guiding concepts or values that give direction to the people involved in new product development.

1. How would you rate the acceptance within the organisation of the need for change?

Need for change not accepted				Need for change accepted
1	2	3	4	5

2. How strong is the part played by key individuals in the organisation? such as product champions and intrapreneurs etc.

.....
.....
.....

3. How much certainty is there about job roles and assignments?

Uncertainty about roles				Roles and responsibility clearly defined
1	2	3	4	5

4. Do key people involved in the development of new products play more than one role, ie how much role flexibility is there?

People play one role only — People have multiple roles

1 2 3 4 5

5. What degree of openness and trust is there in the organisation?

High degree of openness & trust — Low degree of openness & trust

1 2 3 4 5

6. What key words would you use to describe the culture in your organisation?

.....
.....
.....
.....

7. Circle **any** of the following words or statements that best describe the culture in your new product organisation?

Central figure
Key individuals
Few rules and procedures
Power orientated
Expert power
Positional power is main source of power
Politically minded
Risk taking

Security & predictability
Matrix organisation
Team culture
Adaptable
Integration
Individualism
Stable
Many rules and procedures
Reacts quickly
Environment slow to change
Bureaucratic

Changes in the new product shared values

1. Have any significant changes been recently made to the shared values or culture associated with NPD?

YES / NO

If NO go to question 8

2. Did these changes result from any other changes to the organisation?, or was a direct effort made to change the shared values / culture?

.....
.....

3. Why was it felt necessary to make these changes

.....
.....
.....
.....

4. From where were these changes initiated?

.....
.....

5. How were the changes made, and communicated to the organisation, who was involved and how successful they were?

Made: .....
.....

Communicated: .....
.....

Involvement: .....
.....

Success: .....
.....

6. What were the general trends in the changes, from what old shared values and culture to what new ones?

.....
.....
.....
.....

7. Did these changes have any effect on any of the other seven S's?

Structure	YES / NO
Style	YES / NO
Strategy	YES / NO
Skills	YES / NO

Staff	YES / NO
Systems	YES / NO

.....
.....

8. Are there any plans for future changes to the Shared Values used to control NPD.?

.....
.....
.....
.....

APPENDIX XI

The structured interview schedule

Part 3; Additional information

TOTALLY CONFIDENTIAL

SUCCESSFUL PRODUCT INNOVATION

PART 3: STRUCTURED INTERVIEW

ADDITIONAL INFORMATION

This final part of the structured interview is concerned with additional information such as company size, turnover etc.

Name _____

Company _____

Mark H. Benson
Department of Industrial Studies
University of Liverpool,
Liverpool, P.O.Box 147,
L69 3BX ENGLAND

Respondent

1. Name: .....

2. Position: .....

3. Address: .....
.....
.....

4. Phone No. .....

Company

5. Name: .....

6. Main Area of Business: .....
.....
.....

7. Company Ownership:
UK ( )
USA ( )
Foreign ..... ( )

8. Company Size:
Annual Sales Turnover .....
ROC. .....%
Number of Employees .....

9. Growth rate of the industry:

Decline		Steady		Growth
1	2	3	4	5

New Product Development

1. How many new products have you introduced during the last 5 years? (.....)
   3 years? (.....)
   1 years? (.....)

2. What is the average lead time for new product development?

   (.....)

3. What percentage of sales turnover is spent on R&D?

   (.....)

4. Approximately how many staff are involved with new product development?

   (.....)

The Marketplace

6. How would you describe your markets in terms of growth?

Declining		Steady		Growing Rapidly
1	2	3	4	5

7. Are the markets are mass markets with many customers? or mainly industrial markets?

   Type of market & customer? .....
   .....
   .....

APPENDIX XII

Successful product innovation questionnaire

SUCCESSFUL PRODUCT INNOVATION QUESTIONNAIRE

Instructions.

The questionnaire is laid out as a series of qualities that have been found to be associated with new product success. Please indicate on the scale if you feel that the particular quality is present inside DEOC.

For example:-

	This quality is present in Delco Electronics.				
Qualities	Always	Often	Unsure	Seldom	Never
1. There is good effective communication between key internal groups.	1	2	3	4	5

In this case the respondent has indicated that, in his opinion, there is often good effective communication between key internal groups.

If you feel you cannot answer a particular question because it is not relevant or outside your experience please put a line through the response.

All answers will be treated with total confidentiality.

PRODUCT UNIQUENESS AND SUPERIORITY.

Qualities.	This quality is present in our company				
	Always	Often	Unsure	Seldom	Never
1. Our products have significant or unique advantages over competitors products.	1	2	3	4	5
2. Our products meet customer needs better than competing products.	1	2	3	4	5
3. Our products are unique and superior in the eyes of the customer.	1	2	3	4	5
4. The company has the technical and design skills necessary to develop unique and superior products.	1	2	3	4	5
5. Our products clearly meets customers needs.	1	2	3	4	5
6. Our designs are not "me too" designs that result from copying competitors ideas.	1	2	3	4	5
7. Our products are of a higher quality and more reliable than competitors products.	1	2	3	4	5
8. Our products are often highly innovative and new to the market.	1	2	3	4	5

COMMUNICATION AND COORDINATION.

Qualities.	This quality is present in our company. Always	Often	Unsure	Seldom	Never
1. There is good effective communication between key internal groups.	1	2	3	4	5
2. There is an efficient multi-disciplinary approach to the development of new products.	1	2	3	4	5
3. There is a systematic logical approach to the development of new products.	1	2	3	4	5
4. There are good communications with universities polytechnics and other technical and scientific institutions.	1	2	3	4	5
5. There is open and honest communication between individuals and departments.	1	2	3	4	5
6. There are extensive and regular communications to customers and suppliers.	1	2	3	4	5
7. Both internal and external communications are effective.	1	2	3	4	5

MARKET KNOWLEDGE AND PROFICIENCY.

Qualities.	This quality is present in our company. Always	Often	Unsure	Seldom	Never
1. Everyone involved in new product development has a clear understanding of user wants and needs.	1	2	3	4	5
2. A detailed market assessment is always undertaken early on in the development of a new product.	1	2	3	4	5
3. The sales department is well targeted and has a strong and aggressive sales policy.	1	2	3	4	5
4. A thorough study of customer preferences is undertaken during the initial stages of development.	1	2	3	4	5
5. Most people in the company have a good knowledge of the marketplace.	1	2	3	4	5
6. Market studies and the collection of market information play an important part in the development of new products.	1	2	3	4	5
7. There is an systematic approach to new product development that brings together the various groups involved.	1	2	3	4	5

TECHNICAL KNOWLEDGE AND PROFICIENCY.

Qualities.	This quality is present in our company. Always	Often	Unsure	Seldom	Never
1. The development of new products runs smoothly and is well coordinated.	1	2	3	4	5
2. There is a good "fit" between the resources available, and the new product development undertaken.	1	2	3	4	5
3. There is a high technical strength within the company.	1	2	3	4	5
4. Production knowledge and production strength is high.	1	2	3	4	5
5. The development of new products runs smoothly and is well coordinated.	1	2	3	4	5
6. The company has a strong reputation for quality and reliability.	1	2	3	4	5
7. The launch of the product into production is always a smooth and efficient activity.	1	2	3	4	5
8. Activities such as Prototype Development and Testing are well undertaken.	1	2	3	4	5
9. There are no design "bugs" in the product as it enters production.	1	2	3	4	5

MANAGEMENT AND PEOPLE QUALITIES.

Qualities.	This quality is present in our company. Always	Often	Unsure	Seldom	Never
1. The management is of a high quality, professional and well trained.	1	2	3	4	5
2. Senior management openly support new product development.	1	2	3	4	5
3. There is an innovative, creative and open atmosphere amongst all those involved in developing new products.	1	2	3	4	5
4. The management style could be described as progressive and open minded.	1	2	3	4	5
5. Management planning techniques (eg cost control procedures, production planning and sales forecasts, etc.) are efficient and effective.	1	2	3	4	5
6. Everyone is well aware of the new product strategy, and the long term goals and objectives of the company.	1	2	3	4	5
7. Key individuals play a key role in pushing new product developments through the company.	1	2	3	4	5
8. The company has the ability to attract talented and well qualified people.	1	2	3	4	5
9. The company has an effective training policy.	1	2	3	4	5

Please indicate the three major problem areas that you feel are facing new product development today.

1. .....

.....

2. .....

.....

3. .....

.....

Please make any comments you feel are relevant.

APPENDICES PART 2

APPENDIX XIII

Structured interview case study; company 1

ARTIX ltd

ARTIX ltd.

The company

Artix ltd, design and manufacture "off highway" articulated dump trucks (ADTs). The company employs 600 people and is based on the outskirts of Peterlee, Co Durham. It is a privately owned company with an annual turnover in the region of £ 60 M. The company was founded 15 years ago by D.J. Brown and was originally known as DJB trucks. The original company was formed when David Brown identified a market niche within the dump truck industry.

Today the company has one customer; Caterpillar. The major component parts, such as the engines, torque converters etc. are supplied by Caterpillar. Artix in turn design and manufacture the chassis, assemble the product and sell it back to Caterpillar, who market, distribute and sell the ADT through their own organisation. Consequently Artix's links with Caterpillar are very strong, to the point where it is almost a subsidiary operating company.

Artix's competitors include Volvo, Moxy and Komatsu. The industry as a whole is relatively mature, with the predicted growth rate in the US expected to go from £4.2B in 1986 to £4.5B in 1991, representing a increase of about 1.5% per year. The market segment particular to Artix (ADT's) however is growing by about 5% per year. The end users include companies involved in industrial earth moving equipment, mainly for the mining and construction industry.

New Product Performance

Artix is a unique case study in some ways as it relies entirely on one customer; Caterpillar. A successful product therefore is defined as one which keeps Caterpillar happy, thus ensuring continued orders. The main factors Artix find important in the success of the product include; end user acceptance, the number of service claims and the product's life and reliability.

The success of Artix's products are measured indirectly through the number of orders the company receives, there are no direct measures of new product success, but the three most important success criteria, in order of importance are: profit, delivery on time, and market share. About 3.5% of turnover is spent on research and development.

In the life of the company, eight new products have been introduced and six of these have been successful. Of the two products that failed, both did so once they had reached the market. In general the company feel that products developed meet their performance objectives. Reliability and durability are two of the key factors that are becoming more important for a successful new development. Field service is also a key issue, being strongly related to the reliability aspect.

In the last five years the company has introduced a total of six new products, three of which have been introduced within the last three years. Around 60% of the current sales turnover is made up of products that have been introduced within the last three years. The company's share

of the ADT market has increased from around 30% to 40% during this time. The rate of new products the company is developing has decreased recently although a number of new product developments are currently at the "idea" stage. In the region of 35 staff are involved full time in the new product development process.

Artix has undergone significant changes in recent years as it has transformed from a fast growing, risk taking, entrepreneurial company to a more secure and efficient operation. These changes have resulted from the growth of the company and its improved links with the Caterpillar organisation. In terms of the seven S's the major changes are outlined below.

Structure

New Product development within Artix is led by the Engineering Department. Artix has a conventional organisational structure with three main functional groups: engineering, production, and finance. The engineering function is split into two sections, design and development, both of which are strongly integrated into Caterpillar for technical and manufacturing support.

The main changes to the structure have revolved around building stronger links with Caterpillar. This has meant the changes to the structure, communicated through briefs and the publishing of new organisational and responsibility charts. This change has increased the technical resources

available. Changes to the structure were necessary to satisfy Caterpillar's requirements and also because of the growth in company size. The changes were controlled and implemented from board level.

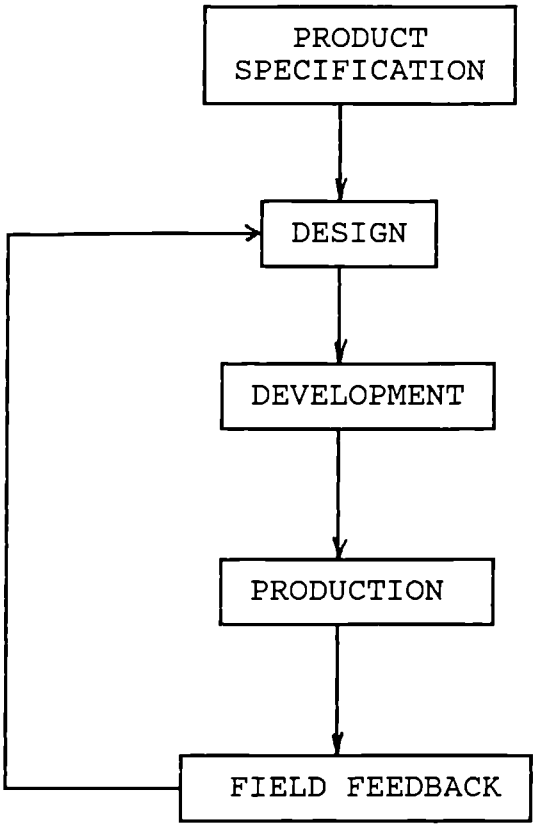
Management Style

Senior management have a strong involvement in the development process. They keep in touch through reports, memos and informal meetings and have a very intimate knowledge of how the new product developments are progressing. The leadership style of the company was described as entrepreneurial and, in the words of one director, "a benevolent dictatorship".

There has been a significant change in the style of the leadership in recent years, mainly due to the input from Caterpillar. Originally the company was very individualistic, with direct "hands on" control from key individuals especially D J Brown. Now there is more delegation. The company has become more organised and to a certain extent more bureaucratic. There is more emphasis on team work as opposed to autocracy and individual effort. The changes have however resulted in some loss of the entrepreneurial spirit. Changes were deliberate and necessary to allow the company to operate more effectively. It is expected that changes will continue in the same direction, resulting in more formalisation.

Systems

Product development in Artix is outlined in the following diagram:



The company has a new product procedure which provides an outline of the new product development process. The tightest controls during the process are on product performance and quality. Time schedules are updated every two weeks. Profit and market share are examined once the product has been launched. The company does not cost out its products very often, initial estimates are revised only if major component prices are altered. The company is usually confident that it will meet market requirements. Project management techniques such as CPA and PERT are used to control the development process.

The main change to the systems, involved the introduction of a new product development procedure two years ago. Definitions of projects are now much tighter, and there are many additional controls and checks. These changes have resulted again from the growth in the company and the close linkage with Caterpillar. Previous to this the old systems were unplanned and the basic development aim was to be as quick as possible. For example, in one case the company was about to test a prototype when it was found that it had been sold the day before by David Brown.

Strategy

The company's aim is to remain a leader in ADT market. Its policy towards this marketplace has involved developing products that are first to the market. Artix will also follow the lead of competitors. The company feels that the skill in the "off road" vehicle business lies in putting existing components together in a way that is attractive to the marketplace. Thus the majority of its products utilise existing markets and existing technologies. The company is moving from an entrepreneurial product strategy to a positional one. Again this is due to the influence from Caterpillar and the growth in company size.

Skills

Artix's skills lie in heavy engineering, involving low to medium technology. The firm has no pure research

department, but draws on Caterpillar's skills where necessary. The firm considers itself very active in generating new product ideas. In recent years Artix has needed to develop more project oriented skills, amongst engineers, to coordinate work in a more formal manner; again in a response to Caterpillar pressure.

Staff

The main training programmes run by the company are based on the technical side, especially CAD. The rest involves management techniques. There is little training emphasis on teamwork as the company is small and feels that teamwork comes naturally. No changes have occurred new staff or training.

Shared Values

The organisation was and still is to a certain extent a typical power culture. The company was centred around one person, D J Brown and was very much an entrepreneurial firm with a "family" type atmosphere. The company is adaptable and reacts quickly to changes in the market. Artix was described as having a large amount of individualism, key individuals play a very important role in the organisation. There is a reasonably high degree of openness and trust.

Today the change in the shared values is towards a more disciplined organisation and work force.

Summary

The changes in Artix show the transition from a entrepreneurial fast growing and risk taking company to a more stable and security conscious organisation. Initial success and growth in the company was based on its risk taking and entrepreneurial flare, however the senior management now feel that in order to remain successful and continue to grow the company needs to consolidate and change. This has been prompted and helped to a large extent by Caterpillar.

APPENDIX XIV

Structured interview case study; company 2

BARR AND STROUD ltd

BARR AND STROUD

The Company

Barr and Stroud are a subsidiary of the Electro optical division of Pilkington plc. The company is involved in the development and manufacture of electro-optical products (eg. military lasers) for the defence industry. The company was founded over 100 years ago when a professor of physics and a professor of engineering came together to combine their knowledge in order to develop possible products. This culture, a combination of practical engineering and theoretical physics still exists within the company today. The majority of products are technology driven as opposed to market driven, the basic idea being to take knowledge or new technology and convert it into a product. The company's annual sales turnover is in the region of £ 90 million and the company employs a total of 2300 staff.

New Product Performance

The company's main customer is the Ministry of Defence (MOD). Five new products have been introduced within the last five years and a successful product is defined as one which finds its way into production. In terms of success criteria, profit is one of the main factors, followed closely by performance and delivery on time. Around 75% of the company's products are successful with 5% failing once they have reached the market. The remaining 20% being

products cancelled prior to introduction. Few products fail once they have reached the market as they generally have a guaranteed customer, and in many cases products are developed to order. The company had difficulty defining new product success, as some products that initially failed had at a later stage become successful. Around 30% of current sales turnover is made up of products that have been developed and introduced within the last 3 years. Barr and Stroud's market share has increased in recent years by about 10%, although the number of new products being developed has decreased.

The defence industry is not typical of most other markets as it is subject to major external influences such as governments, world events and market forces way outside the control of the company. Proposed government changes to the ministry of defence purchasing structure are forcing companies such as Barr and Stroud to become much more competitive. Previously the MOD specified exactly what they wanted and marketing effort was modest. The MOD will become a buyer of equipment "off the shelf" rather than to specification and it is important for Barr and Stroud to be able to anticipate market needs. This has led to major changes and effort within the company to improve the chances of new product success.

Changes within Barr and Stroud; the total quality management (TQM) programme.

Barr and Stroud is in a period of intense change and there are significant attempts within the company to change

and improve the chances of new product success. The changes have stemmed from the board's realisation that the company needs to change in order to survive. A leading management consultancy company was called in, and has been involved in guiding the company through various changes. Many of these changes have concentrated on the shared values aspects. The majority of the recent changes have stemmed from the TQM programmes.

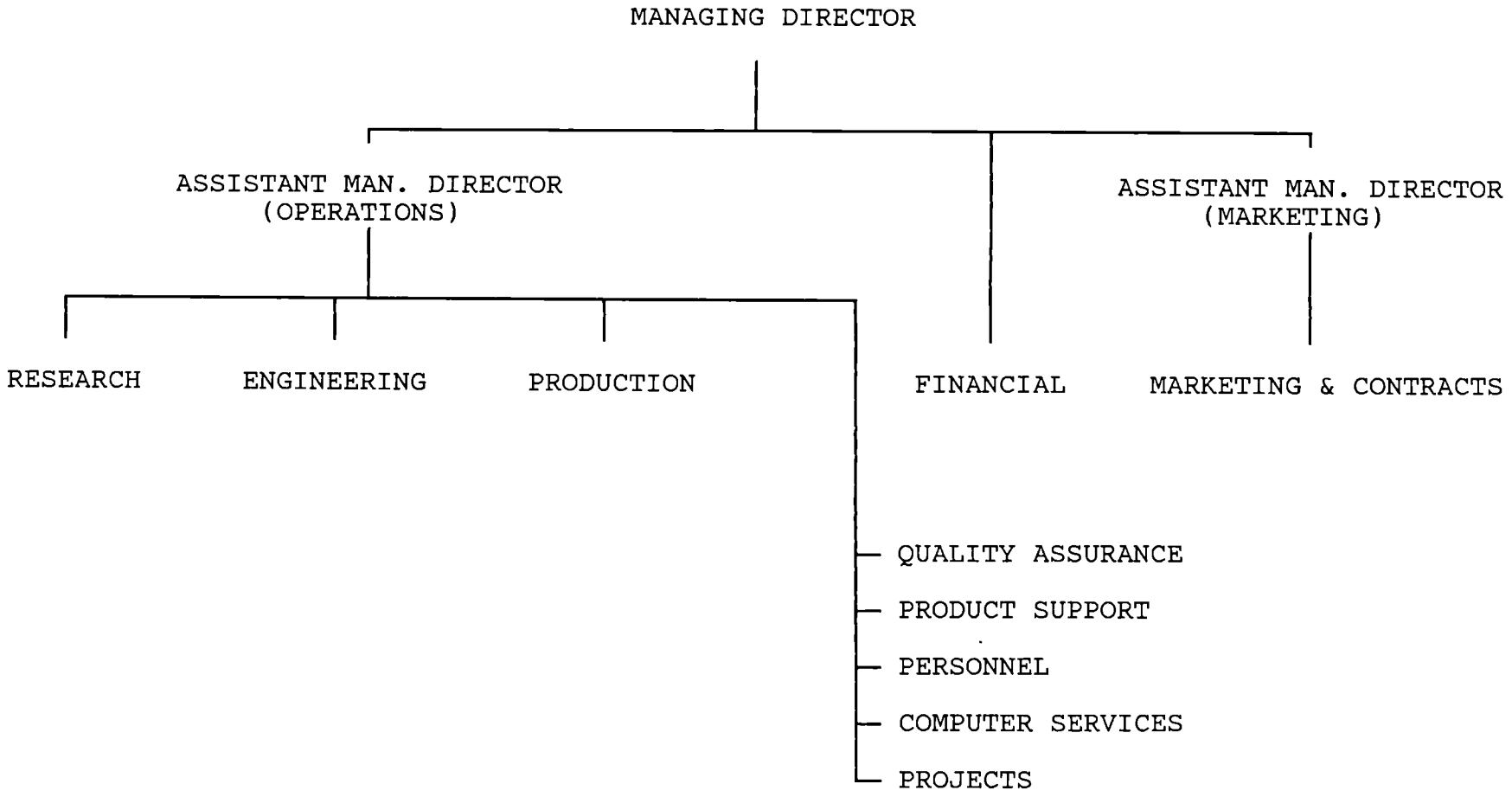
Total quality management (TQM) is described as a vehicle for change, requiring a clear statement of purpose, a planned strategy of implementation and means of evaluation, feedback and follow up. The programme is very similar in many respects to the Organisation Development concept tested within Delco Electronics. At Barr and Stroud however, the focus has been on improving all aspects of quality throughout the company. Within Delco Electronics the focus was on the improvement of new product development.

Through the TQM programme the company has been able to look, analyse and measure how well it has been doing at certain activities. A variety of teams have been set up to critically examine key problems within the company. One such team has been investigating ways of improving the new product development process.

Structure

New product development in Barr and Stroud is controlled by the engineering and research departments. An outline of the company structure is shown in figure 10.1

figure 10.1 The organisational structure of Barr and Stroud



Recent changes to the structure were intended to put more emphasis on marketing. It was felt necessary to make the changes for three main reasons: past experience, changing customer needs, and the need to grow as a company. The changes have resulted in a strengthening of sales and marketing functions. This resulted in the setting up of a new business development group. The changes were initiated from a realisation at board level that things were not quite right. The original structure was very much technology driven and organised. The trend in the changes have been to put more emphasis on marketing. The changes were communicated in the form of a directive from the board. Few people were involved in deciding the type and emphasis of the changes.

Style

Senior management have a daily involvement in new product development through their own managers. They also keep in touch through reports and formal meetings. Research and Development have a detailed and intimate knowledge of the new product situation, however other key managers do not always have sufficient information.

The leadership style within the company is changing from a paternalistic, "old guard" style to a much more involved leadership. New people within the organisation are promoting this transition.

Significant changes to the style have been driven mainly by the need to survive, increased competition and a

shrinking defence budget. The original style was very authoritarian with emphasis on line management. The new style tends towards much greater involvement. These changes stemmed from senior management's realisation that something had to be done to improve the present situation. Many of the changes in style have resulted from the TQM programme. Initially the intention to change was communicated quite badly but recent communications have been more successful. Involvement in the changes initially included only the management but lately this has included the entire work force. The action so far has been very successful; too successful in some respects as this has built up the expectations of the work force and management feel it will be difficult to keep up that momentum. Future changes will hopefully mean more involvement and more business awareness for everyone in the company including the shop floor.

Strategy

The company is a broad span leader in several market segments. The company is usually first to the market with its new technologies. The "newness" of the products varies with about half involving new technology and the other half new markets. The main product technologies the company is involved in are still developing.

Changes have occurred to the strategy again from a technology push company to a market led, customer driven policy. These changes were initiated as expected from board level as a result of changing market conditions. The

strategy changes have in effect led to the other changes within the company.

Skills

The technology employed by Barr and Stroud is very high and sophisticated. The four main ingredients of this technology include, mechanics, electronics, lasers and thermal imaging. These skills are put together in the form of systems. The firm is very strongly oriented towards research and development.

Changes in the skills have been towards acquiring more marketing skills in the high technology areas. As mentioned previously the company is very technically based and somewhat lacking in marketing skills. Changes have involved the establishing of a new business development department into which technical people have been seconded. These changes have not been too successful.

Systems

The company use a design review procedure as one of the main guides for controlling the new product development process. This is not followed rigidly and is meant to provide only a loose outline for development. Communication during development is carried out through formal and informal meetings of the research and development department and occasionally the marketing department. All projects are controlled by some form of project management technique such

as PERT. The computer package ARTIMIS is always used on projects for external customers.

Changes have been made to the systems to improve efficiency as a result of tighter budgets, and the need to reduce product lead times. Many of the changes to the systems have been evolutionary. The changes have resulted in a general tightening of the rules and procedures and again originated from board level.

Staff

Traditionally many of the training programmes run in the company been on the technical side. The company is now using more and more management training. The company has a structured Organisation Development programme in the form of TQM (total quality management). Emphasis on teamwork is high and although no special selection methods for the TQM teams are used there is emphasis on team training.

Changes to the staff have aimed at improving the marketing awareness and have stemmed from the marketing environment, again these changes were initiated by the board. They have been successful and the intention is to follow them up with more emphasis on management development.

Shared Values

There has been and still is a transition going on within the company from a paternalistic, authoritarian type of culture to one with much more involvement. This has

occurred as a result of the TQM programme. The culture is mixed, key individuals play a major role. The company is power oriented and one of the major sources of power is expert power. Bureaucracy still exists in the company and is more or less a requirement for the MOD. This bureaucratic environment, slow to change, with many rules and procedures is becoming more integrated and adaptable with the TQM programme.

Direct effort has been made to change the shared values through the TQM programme. At one point the whole work force, over 2000 people met at the exhibition centre where various people including the MD. spoke about the company, where it is now, and its future. The company is trying to bring about cultural change throughout the whole work force through the TQM programme (other companies that have used this approach include M&S, IBM, Honeywell, BA, and Ilford). Initiated by the board the programme has been communicated over a long period of time through training seminars. The programme has involved everyone within the company. The programme aims at changing the attitude of the work force and managers alike to improve quality and breakdown some of the manager / work force barriers. The TQM programme is an ongoing process, similar in nature to organisation development and will take a period of at least five years to implement.

Summary

Barr and Stroud are making considerable efforts to change the whole culture of their organisation. The company's previous success seems to be based on a technology driven approach. Today however with increasing competition and changes to the MOD the company has recognised the need to change in order to survive.

APPENDIX XV

Structured interview case study; company 3

BOC ltd

BRITISH OXYGEN COMPANY

The Company

BOC's main area of business is the supply of industrial gases. The gases themselves can be considered as a commodity and in this case study new products refer not to new industrial gases but new applications for the gases. The main business opportunities for BOC in new product development lie in finding new methods of exploiting the gases they supply. BOC is an international company, UK owned, with a turnover in the region of £2 billion. The company employs over 32,000 people worldwide.

New Product Performance

The company defines a successful new product as one which achieves a minimum level of sales. Success is measured in terms of market share and product performance against the effort put in to sell the product. Applications are sold in a variety of industries including food processing, metallurgical and environmental industries. The development of new products therefore involves finding new uses, or applications for BOC's end products, the gases.

Applications are very much dependent on the price of commodities. For example during the oil crisis it became commercially viable to inject oxygen into oil powered heating systems so as to increase their efficiency. Another example is the use of nitrogen to re-liquify petrol vapour.

The viability of this process depends on the price of petrol relative to the price of nitrogen.

Many of the new products developed are technically obvious and it is simply a case of waiting for viable market conditions. In the last five years the company has introduced approximately 10 new products. Lead times for developments vary and can range from 1 to 30 years as many developments may be kept on "hold" until they are economically viable. The company estimates that around 20% of its products are successful, a deceptively low figure. Around a third of products fail once they reach the market and the rest, about half, are put "on hold". The company has a relatively fast turnover of products and around 30% of sales turnover is made up of products that have been applied in the last three years.

In the UK over 300 people are involved in the development process and the company as a whole spends in the region of 2% of its turnover on R&D. The industry is growing steadily.

Structure

New Product development in the gases division is carried out by a new products department. This is a totally self sufficient development unit employing about 80 people. New Product needs are serviced on a divisional basis. Work in other divisions is coordinated across the company through a series of international working parties whose heads meet around four times every year. Only one country will lead a

particular development and this will be chosen depending on the economic incentives of the time.

Style

Senior management have a reasonable involvement with new product development. Management keep in touch with product developments by tracking success at particular customers. Much of the company's development work is done on the customer's site. The leadership style was described as aggressive and hands on; tactical rather than strategic. The major changes to style have involved management placing more emphasis on support and tracking.

Strategy

The company's position in the market was described as being a broad span leader, with emphasis on becoming first to the market in a particular application. The majority of applications developed apply to new markets and around 30% of these involve new technology. The company's future changes will involve greater market diversification.

Skills

The company puts little emphasis on research and development, yet is very active in developing new product ideas. It acquires around half of its product technologies by buying in the specialist knowledge it requires. It will

buy skills from brewing or metal specialist companies etc., develop the required product and sell back the process application. Future changes to skills will happen naturally as and when required.

Systems

The company measures its efficiency in development by calculating the total sales against its use of resources in terms of people (man years effort). Sales figures take into account defending existing business together with historic and short term sales. BOC do not have a new product procedure or checklist. Performance of products is measured as required; market share, in terms of gas sales is measured monthly. Financial performance is not measured as these figures are not considered important during the development. Many developments start in the Advanced Technology section where new ideas are nurtured and passed forward quarterly to the new products department.

Significant changes have occurred to the new product systems. In general they have become more formalised, and this has meant a tightening of the rules and procedures. The old systems were very informal, often based on hunches and the forces of personalities. The new systems involve time sheets to measure effort, and more direct measures of sales etc. These changes came about as a result of experience and the need for an international comparison and common dialogue. The changes were initiated from corporate head office, and the new systems were drawn up by an

international working party committee. A pilot plan was carried out in one country and the results were reported back to the working party. Revisions were made and the the changes were then initiated across the whole company.

Staff

The types of training programmes run in the company include "process specific" training as well as general management training and interpersonal skills. Line managers and management development specialists are responsible for identifying training needs. There is a high emphasis on teamwork. Changes in the training side have meant more emphasis on management and interpersonal skills. The company has also made effort to improve its customer knowledge.

Everyone in the company has undergone a two day training programme "putting the customer first". This programme focuses on customer needs and teamwork, the idea being to improve the service quality. The programme was described as "gimmicky" but it works.

Shared Values

Within BOC key individuals play a very strong role. The need for change is accepted and new product development is part of the culture. The company was described as being risk averse, and because of its success in recent years it has to a certain extent become "smug". No major changes have occurred in the shared values these have evolved gradually.

Summary

BOC is a very successful company. Changes have been towards improving its marketing ability, this can be seen in its training programmes and decision to buy skills and attract people from its customers. Its other major changes have meant a tightening of the rules and procedures, these place a stronger emphasis on physical measure of success eg. market share, man years deployed, rather than financial considerations. It is absolutely essential that the company is close to the market place to take advantage of possible applications.

APPENDIX XVI

Structured interview case study; company 4

BRAY LECTROHEAT ltd

BRAY LECTROHEAT

The Company

Bray Lectroheat design and manufacture electrical heating elements for industrial applications. The company's main products include process ovens, boilers, heating elements and load banks (energy dissipation units). Bray Lectroheat is the smallest company in the case studies, employing just over 200 people. The company has an annual turnover in the region of £ 4.5 million. The company is UK owned. Product manufacture is carried out in small batches and much of the work also includes "one off" specials made to customer order. The company has grown in recent years and its market share has increased relative to the heating element industry as a whole, where growth has remained steady.

New Product Performance

The company defines a successful new product in terms of its impact and acceptance within the marketplace. The main measure of success, it feels, lies in market share, followed closely by profit. The company has introduced one major new product within the last three years, and currently has three products in the "test marketing" phase. There are 11 staff involved in new product development, three of these are at senior management / board level. The company believes it achieves in the region of 100% success on products

(excluding loss of orders), this high rate being due to the nature of manufacture and the technology of the business. Around 6% of turnover is due to products that have been developed within the last three years, although the number of new products currently being developed has increased significantly. This case study describes a recent new product development in Bray Lectroheat, and then looks more closely at what changes in the company have led to its success.

The Loadbank (Energy Dissipation Units); A recent new product development in Bray Lectroheat

A "loadbank" consists of a box of electric elements, with a bank of contacts and switches that are used to increase the amount of load. A loadbank is used to test electric generators. Generators need to be tested after they have been built to ensure that they give full load, and also periodically on site to ensure they are working properly. Generators such as these are used as back up supplies to buildings such as hospitals and offices. It is impractical to test a generator on a building's actual load, as this cannot be controlled, and if anything was wrong with the output it could have serious effects. It is therefore essential to use an artificial or dummy load. The load itself can be provided either through a bank of heating elements (a loadbank) or with a "tank" (a series of electrodes, and electrolytic salts) not only is the latter more dangerous, it is not portable. Resistive load banks,

incorporating heating elements are therefore much more popular.

Bray Lectroheat had by the mid eighties already built two loadbanks to customer's specifications and both had been successful. When a new management team was put in control of the company it was decided that loadbanks presented a possible new market. They did in fact already manufacture all the components, it was simply a case of assessing the market potential. At this time Bray Lectroheat had no idea of the potential market size, or the total market worth.

The first stage in the survey was to carry out an "in depth" market survey into the use of load banks. The generator manufacturers were questioned in depth to find out how they tested generator sets, and how they would react to another company coming into the loadbank market. Bray then contacted the generator set users, to find out how often they tested and used their equipment. Finally they identified and assessed the competition. After about three months Bray had a good picture of the market and the product, however they could not get a clear picture of the market worth.

A standard range of units and options was drawn up to suit customer requirements. These were then tested in the marketplace. The options received a good response, and after three potential customers expressed their interest, the entire market survey and findings were presented to the board.

A meeting was held and Braylec decided to go into the loadbank business. The designs were finalised and the number

of options agreed on, along with a temporary pricing policy. A number of products were built and put straight into the test marketing stage (no prototypes were developed). A number of customers who were interested in the product at the market research had in effect acted as a marketing campaign. At this stage, definite projections were drawn up in terms of the business development over five years.

A simple catalogue was produced. Publicity was arranged through adverts and editorials were followed by a mail shot. Five orders were received immediately and these covered the cost of the launch. In the first twelve months after launch sales have exceeded targets by a third. Twenty five percent of the products are exported, and these sales have been achieved through advertising alone. The company has even changed the name of the product from the traditional "loadbank" to a more understandable "energy dissipation unit" (EDU). Other innovations on the product include an infra red remote control so that the EDU can be used from a distance. This optional extra is already sold on over 50% of models.

The success of the product was based on the market research. Clearly they had the capability to manufacture the product, and have had so for a long time. However the company did not even know the size or strength of the market. The EDU is the first major product the company has introduced for a long time, and is one of about six developments currently underway. This new product effort is entirely due to the setting up of a new management team, which followed the appointment of a new managing director.

Structure

The company is small and has a typically functional structure. There are three directors for, Finance, Sales, and the South Wales manufacturing plant. There is also a Technical manager and a Manufacturing manager at the Leeds plant all reporting to the Managing Director.

New Product development involves four key people within the organisation, the technical manager, the market development manager, the product manager and the works manager. These four people are responsible for new product development and report directly to the board. There is no separate new product department within the company, and one is not really necessary considering the size of the company.

Systems

The company does not use a new product development procedure or check list to guide its new product developments. It does however produce critical path analyses for specific projects. New product development is controlled through various product development and review meetings and because of the small size of the company many of the issues can be dealt with on an informal basis. The process itself begins with a full market survey, after which the company will loosely define a range of products, these will be designed developed and test marketed in the field until the product is right.

The company does not cost out individual product

developments and measure them against the financial criteria set early on in the development process. However measures similar to these are currently being instigated.

The main changes in the new product development systems were necessary to achieve better coordination and to get more input to the new product development programmes. The changes involved the introduction of a "product development" meeting and a "market development" meeting. The main change in the company's new product system is the number of management staff now developing new products whereas several years ago updates and changes were the responsibility of the technical manager.

Style

As one might expect in such a small company senior management are extensively involved in new product development programmes. Their "hands on" approach is out of necessity because of the size of the company. The management style was described as (sometimes) open and democratic, but with an element of autocracy from the MD. The management consists of a relatively young and new team.

The management style has changed considerably in recent years as the whole of the management team has been replaced. A younger MD was appointed and recognised that the company was stagnating. The previous management had been in place for a considerable amount of time and it became clear that fresh input was needed all round. These changes were initiated from the new managing director. The original style

was one of complacency; the company was stagnating. The new style is much more dynamic and fast moving (in the interview it was likened to replacing the company with a new engine). The introduction of new people has brought in new ideas, new systems, new enthusiasm and this effect has snowballed through the rest of the work force. Much younger people have been recruited and this has improved the image of the company. The whole management approach has changed radically, many meetings are more formalised with detailed minutes, but at the same time a strong informal organisation has developed which in itself has generated many of the new product ideas.

Strategy

The company is a leader in one market segment, heating elements. Three years ago the Bray Lectroheat was very much a production led company, and the majority of its products were based on improvements to existing models. The strategy has changed and the company is now becoming market driven. Its products are based mainly on existing technology, although the main product technology itself could be described as still developing. Its new product strategy emphasis today is mainly positional but at the same time the company is reconfiguring some parts of its technology base to meet new markets (as in the loadbank).

The change in strategy from a production led to a marketing led company was initiated through the new managing director and the management team.

Skills

The products Bray Lectroheat develop employ are of a relatively low technology compared to the rest of the sample of case studies. The firm has few research and development skills, but is becoming more active in acquiring the necessary development technologies. Its manufacturing is carried out in small batches and although its new products rarely employ "state of the art" production technologies, they do fit very well with the available resources. The skills have changed recently to include more marketing emphasis. This was achieved through the variety of knowledge gained through the development of the load bank.

Staff and Staff Development

The company does not put much emphasis on the training of its people, most of the skills are brought in as and when necessary. There is low emphasis on teamwork and teamwork training is not thought necessary because of the company's small size. The whole of the management team does on occasions spend weekends in a relaxing environment. This informal, uninhibited atmosphere is good for generating ideas and occurs twice yearly and is an important part of the communication process. The staff have changed significantly although the formal structure of the company has not altered much. Recently though, a product manager position has been created due to the volume of work and new product developments. More people are now involved in the

development of new products.

Shared Values

Recently the company has come to strongly accept the need for change. Key individuals carry a high profile, again probably due to the size of the company. There is a reasonably high degree of openness and trust, and the company was described in terms of a good atmosphere and friendliness. The company is becoming much more risk taking and adaptable yet individualism and stability can still be found.

Summary

Braylec's turn around in recent years has been driven to a large extent from major staff changes. Its recent product success with the EDU indicates that the company is keen to grow through new product development. The major change in operating philosophy has been from a production led operation to a market led approach.

APPENDIX XVII

Structured interview case study; company 5

ICL ltd

INTERNATIONAL COMPUTERS LIMITED

The Company

International Computers limited, better known as ICL is in the business of providing information systems. In simple terms ICL's products are designed to enable customers to run their own businesses more effectively. The company is large with the total number of employees standing at over 20,000. ICL is part of the STC (Standard Telephone and Cables) group of companies and accounts for well over half of its turnover. ICL's own turnover has increased significantly in recent years and for the 1987 financial year stood at £1.3 billion.

The information business is a fiercely competitive and dynamic world market which is growing steadily, although this growth has slowed in recent years. ICL tackles this market by supplying information systems to selected market segments such as the retail industry. Its products include mainframe computer systems, micro computers and software. In the early 1980's ICL nearly went bankrupt. In 1988 it announced record profits of £110 million, a rise of 23% on the previous year.

New Product Performance

Despite a significant part of ICL's turnover relating to service contracts, over 50% is due to product sales.

Successful new products within ICL are defined as those that meet the performance targets laid down during the early stages of development. New product success therefore depends on meeting the plan as specified. The success of individual new products is measured and ultimate success measures include return on investment and market share. These factors, however can only be achieved through meeting the required quality, product performance and timing requirements and in terms of success criteria, these initial factors must therefore take priority over profit.

ICL's products are very fast moving and a product's life cycle, from introduction to withdrawal will vary between 18 months and five years. Timing is a key issue, and most products are required to meet a "market window" governed to a large extent by the competition. Performance of the product and its quality are high, again a direct result of the fiercely competitive industry.

ICL feels that in the region of 30% of products are estimated to meet the success criteria outlined above. Sixty percent are disappointing in some way and around 10% fail once they meet the market. The company has a very fast turnover of products. This is reflected in new product sales where around 60% of the turnover will be made up of products that have been introduced within the last three years. Over a five year period this figure will be 100%. Tactical sales are sometimes necessary and although these may not be successful commercially, they may be essential for future growth.

The company's success in recent years is reflected in

its profits, its image as an innovator and its world market share which has remained steady. Considering the position in the early 1980's when the company was close to bankruptcy ICL today can definitely be considered successful.

Strategy

ICL's strategy is to become the number one choice in its selected markets. The majority of products it develops involve existing markets and new technology. Its new product strategy is positional with emphasis placed on achieving efficiency and improving current products to ensure they keep up with the competition. The product technology is still developing although the market itself is beginning to mature and the pace of change slowing compared with recent years.

In the early 1980's competition increased significantly and forced a major change in ICL's strategy; up to his point the company had sold individual "products". In order to gain an advantage over competitors, the company decided to approach the market from a "systems" point of view. From this time on ICL saw itself as a solutions company rather than a product company. This change in strategy made it necessary to reorganise to serve specific markets and led to the creation of business units, and a whole series of structural and systems changes.

Changes to the strategy also occurred continuously at a detailed level. Today the company has no specific new product strategy, there are however marketing strategies and

business strategies and these have recently taken a much "sharper" customer focus. There has been a move to improve the company's share of the world market, which has increased, however this has resulted in a decline in ICL's UK market share. ICL's strategy from 1982 to 1985 was to allow market share to decline in favour of profit. This was reversed in 1985, and overall share as well as sector share by industry is increasing. The company's goal is still to increase overseas share, but this is problematic.

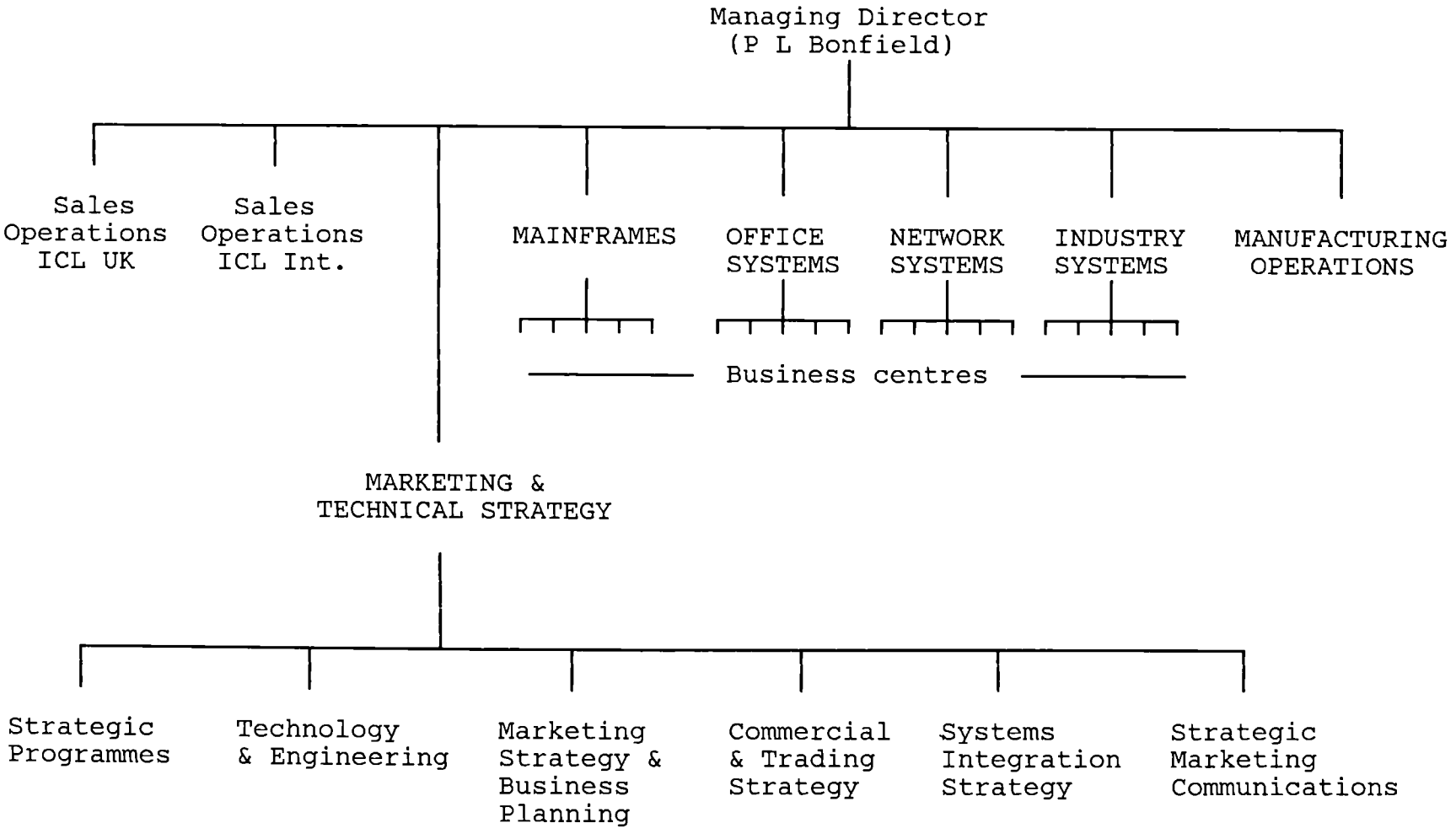
Structure

The organisational structure of ICL is in the form of business centres. An outline of the structure is given in figure 10.2. Each business centre concentrates on one particular segment of the market, for example, there is a Retail business centre that sells computer systems and software to chain stores and retailers.

The number and type of business centres are reviewed annually by the board. The manager of each business centre has complete responsibility for developments within that particular centre and in effect it is like running a mini business. The business centres compete for manufacturing resources. They also draw on marketing, and specialist technical resources within the company as and when necessary.

New product development occurs within the individual business centres and as such is carried out on a product line basis. There is no new product development department

figure 10.2 ICL structure



for the company as a whole.

Marketing and Technical Strategy department

The marketing and technical strategy (M&TS) department's function is to ensure that all the business centres are moving in the same direction, and that product development work is not being duplicated. M&TS provide the framework for the rest of ICL in terms of planning, marketing and technical capabilities. In this way the M&TS function provides consistent business guidance to the rest of the company. The department provides expert consultancy on marketing, commercial or technical matters and provides a focal point for the company in terms of drawing in technological advice from outside the company. The M&TS division employes around 200 people against 3500 in business centres and divisions.

Changes in the Structure of ICL

The main changes to the structure of ICL occurred in 1984/5 and involved establishing business centres within the company. At the same time a number of marketing and technical people were brought together in the form of the M&TS department. Before these changes were carried out the company was organised on a functional basis with separate marketing and product development divisions. The company had focused on "vertical" product markets (ie. main frames, micros etc.) selling individual products rather than

systems. As competition increased, ICL's strategy became one of selling systems. It was necessary therefore to reorganise to serve specific markets. This led to the creation of business centres.

The changes to the structure were initiated from a very senior level within the company and stemmed originally from the presence of a key individual. In 1981 the company was experiencing severe financial difficulties and a new management lead was needed. Rob Wilmot (originally from Texas Instruments) was brought in, and has had a big influence on the company's recent success.

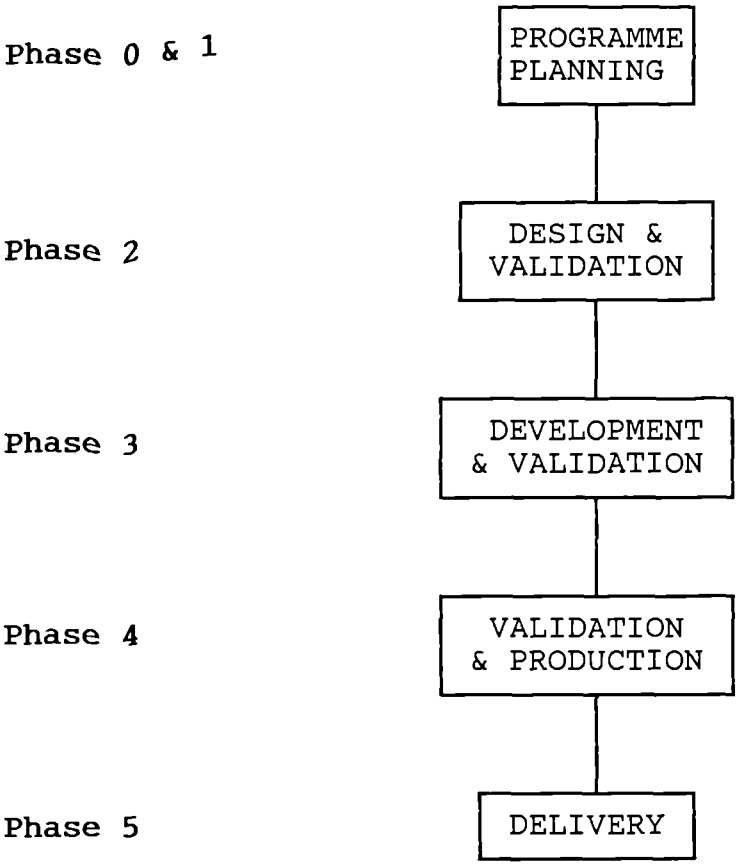
The overall trend in the change was from a functional organisational structure to a more autonomous business centre approach. The marketing and technical strategy department was established to ensure coordination across the various business centres.

The changes to the structure were made by setting up two "trial balloons". Two business centres were established. The success of these two units drew much attention with the resulting effect that most people in the company wanted to become part of one. The business centres in effect were made "heroes of". The changes were not all smooth however, some people were uncomfortable and worried about who would end up with the "plum" jobs leading to some anxiety and fear of change. This was overcome as the changes got underway and was helped by regular half day sessions where the people who were affected were fully involved. A management of change programme was set up where individuals were encouraged to get involved with, and accept the changes.

The changes in structure were driven by the strategy and the need to compete more effectively in a world market. Overall these changes have been very successful, although M & TS are experiencing some problems in coordination across the business centres, especially with regard to software.

Systems

The main system or procedure used to control new product development in ICL is known as the "phase review process". This is the company's mandatory tool for controlling the "investment process" and the "quality development" process, which is in effect new product development. There are five phases and at the end of each phase the project is reviewed and assessed. During the review stages risks are highlighted and based on this the project is either continued, cancelled or revised. The phase review process is outlined in the following diagram:



The phase review process in effect manages any R&D or new product development investment. There are various supportive computer tracking systems, each business centre will select its own method of tracking the development programmes. Products are tracked for their entire life, from the initial concept through to introduction and on until the product is withdrawn from the market. Investment and quality are the two main criteria managed and reviews are carried out on average every 4 to 6 months. Controls start once the business director has given commitment to any idea or project.

The present phase review process was introduced in 1984 and took two years to become an effective working procedure.

The company has always had a new product procedure of one form or another, however previously these have not been followed and consequently have not worked effectively. The latest procedure was introduced and updated to ensure quality and project coordination. This procedure was introduced to meet the demands of changes in strategy and structure. The procedure has in effect been reinforced and qualified. It was introduced to make more sense out the financial aspects of development, people had to justify the next financial investment. The introduction of the phase review process has resulted in a general tightening of the rules and procedures. Changes to the procedure were made and introduced through documentation and a training programme.

Staff development and training

ICL put high emphasis on management training and the company invests a considerable amount of money on developing its people. There is a core management development programme, and a wide range of technical and marketing training programmes available. There are also a number of teamwork programmes. In general, line managers are responsible for identifying training needs. The company places a very high emphasis on teamwork.

Slight changes have occurred in the training programmes available and the emphasis put on them. The increase in technological complexity is leading to a greater use of teamwork within the company, which in turn is leading to more emphasis on teamwork training. Around 90% of ICL's

managers are graduates, and staff are recruited through a variety of methods.

Skills

The products ICL design and manufacture are at the leading edge of technology. The company is very strongly oriented towards R&D and is active in maintaining this stance. Many of the skills are brought in through outside contact with universities. Changes to the skills base of the company fall into three categories:

1. Attitude; the company believes that you don't have to own a technology to utilise it.
2. Marketing skills have been developed in technical and R&D staff. This has been achieved through formal marketing training programmes.
3. Systems capability is also being strengthened. An ICL systems college is currently being developed.

The need for these changes again flowed from the strategy.

Shared values and culture

The need for change within ICL is well accepted by the personnel. Change is major part of the culture, and indeed essential for the type of products it produces. The company is currently using the McKinsey seven S model to ensure that the changes to shared values "go in the right direction".

ICL's culture could be described as being very "British" and to a certain extent inward looking. The organisation thrives on complexity, there are many rules and procedures and ICL could at best be described as an efficient bureaucracy. Positional power is felt to be one of the main sources of power yet there are also many key individuals that play a major role in the organisation.

Until now no attempts have been made to change the culture or shared values. The company is currently looking at these areas. It feels that these aspects will change gradually as a result of everything else.

Management Style

Senior management at board level is quite extensively involved with the new product development programmes. There is a formal reporting procedure through the phase review system. These reviews occur as and when necessary.

The leadership in ICL could be described as autocratic, directive and non problem solving. There is a distinct "hands on" approach as opposed to remote management.

The management style has changed slightly since 1982. There is more openness, cooperation and participation. These changes have stemmed again from the board. The education programmes in terms of management development have helped considerably. However there has only been a slight change in style and the company still has a long way to go.

Summary

ICL is clearly a successful company, based in a very fast moving market. It has undergone major changes in recent years most of which have stemmed from increasing competition. Initial changes in strategy resulted in major changes to the structure, systems and skills. The company has been successful in changing these "hard" aspects of the organisation and is now attempting to change the "softer" aspects such as shared values and style.

APPENDIX XVIII

Structured interview case study; company 6

LAND ROVER ltd

LAND ROVER ltd

The company

Land Rover is well known throughout the world for its tough four wheel drive cross country vehicles. The company has two major products, the Land Rover and the Range Rover. Land Rover's market includes anyone who needs a four wheel drive vehicle. About 80% of the business is export, the majority of this to countries with few or no roads and inhospitable terrain. Major fleet buyers include armed forces around the world. Land Rover has a reputation as one of the best all round cross country vehicle available, even though current Japanese competition may have an advantage as far as quality and price is concerned.

The Range Rover is a combination of a luxury car and a very tough "off road" vehicle, even though 95 % will never be used off the road. They are generally purchased by the rich as part of their image as with other quality names such as Rolex.

The company produces around 500 Land Rovers and 600 Range Rovers every week, in the region of 45,000 vehicles per year. Land Rover is regarded by many analysts as one of the most successful parts of the Rover group. Land Rover itself employs 8000 people with a turnover in the region of £ 500 million.

New Product Performance

A successful product within Land Rover is defined as "one that satisfies the customer whilst meeting Land Rover's own business targets". Key measures of success include; meeting the required quality standards, delivery on time, profit, and market share. The life cycle of either of the company's two products is far from complete. The most recent introduction, the Range Rover was launched 18 years ago. The Land Rover was introduced 40 years ago. Both these products could be classed as substantial innovations. This does not mean however that since their development the company has not been heavily involved in new product development. Product innovation within the company occurs through product changes. In the region of ten major product developments have taken place in the last five years. These have included, for example, new engines, major face lifts, and suspension developments.

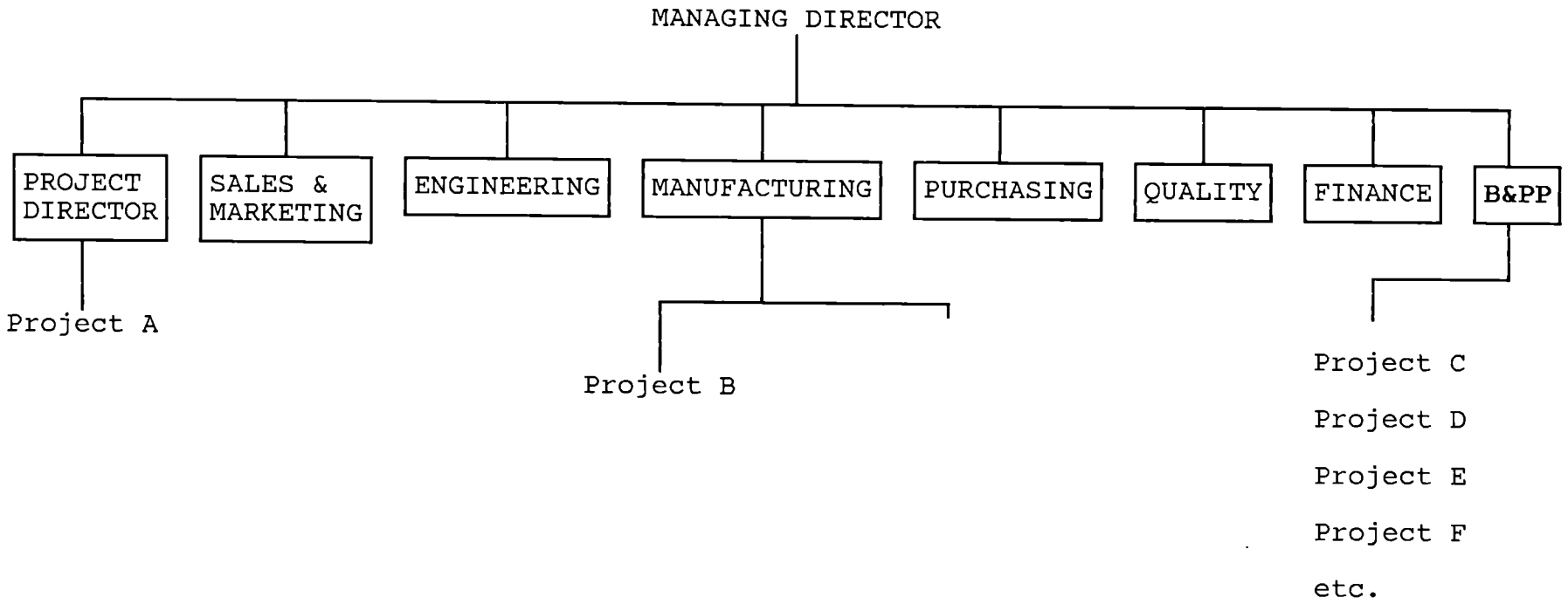
The company's products have enjoyed astounding success and have become household names. The company feels that although recent new developments on the products themselves do not always meet the targets set by Land Rover, they have been successful in the marketplace. Over 800 staff are involved in the new product development and the company spends about 5% of its turnover on R&D.

The organisational structure at Land Rover

The development of new products at Land Rover is controlled by the Business and Product Planning (B&PP) department. New Product development is carried out for the Land Rover group as a whole, and involves developing new parts, systems and products. The B&PP is a staff function reporting directly to the Managing Director. This function is responsible for coordinating and tracking the development of projects across the other functional units. An outline of the organisation structure is shown in figure 10.3.

The present structure has evolved gradually from successful experiences in teamwork. Recent changes in the structure have resulted in alterations to the responsibility for new product development. Land Rover currently believe that teamwork is essential for the coordination of work across the various departmental boundaries. The structure chosen for a particular development will vary depending on scale of the product development. Generally however, the current philosophy is that rather than transferring responsibility from one department to the next, one team or group should be responsible throughout the development process. Project A (see figure 10.3) was recently set up on this basis and because of the nature of the development both in terms of time (approximately five years) and resources the project will report directly to the managing director rather than the B&PP department. Other smaller changes have also involved greater use of teamwork throughout the organisation.

figure 10.3 The organisational structure of Land Rover ltd.



Outside help in the form of consultancy has also been acquired for assessing the organisational structure. From the results of a study using the technique of "zero base analysis" the consultants have recommended major changes to the structure. These would alter it from its present form (figure 10.3) to one which would focus on three main areas:

1. Business and Market definition.
2. New Product Development.
3. Order fulfilment and Current Business.

It has been decided however that these changes would cause a major upheaval, and at the present time the company is not ready for this. Also the length of time required for the effect of these changes to take place would be considerable. Consequently the board has put the proposals on "hold" for the time being, and decided to achieve the principal benefits of the proposal in other ways.

All changes to the structure were initiated to a large extent from the managing director, with little involvement from a "grass roots" level. When project B was set up, the idea for the change was discussed at board level and communicated downwards. With project A however again the decision for the change was discussed in detail at board level, but in this case the decision was communicated downwards in a more considered and gradual education process. This involved cascading the information down through the organisation from boss to subordinate using the team briefing process. In this case management felt it was very important to show total commitment to the project.

The management style

The management style of Land Rover seems to reflect extensive involvement and considerable support. In terms of new product development senior management control the scope of the project and are involved in both styling and design. Other aspects under their control include; piece cost, weight, tooling cost, timing, human resources, etc. These factors are controlled through monthly meetings and specific design reviews. The board are particularly involved in difficult design aspects. Generally the information they chase concerns "off standards"; things that don't go to plan (ie. management by exception).

The leadership style within the company is changing. There are still some tough autocratic and uncompromising managers but there is a genuine change to a more thoughtful and communicative leadership. Land Rover at present are coming through a difficult situation. Five years ago there was very little in terms of new product development and product enhancement. Today that emphasis has changed.

The main driving force behind these changes is the need to become more competitive, more successful and faster at developing new products. This recognition is on a general level within the company. The change in style is being brought about by strong leadership and recognition of the need to change.

The original style of the company was based on a reaction to failure, an elimination of the problem areas; in effect failure was punished. Now however the company is

trying to build on its successes. For example a recent version of the Range Rover launched in the States had new seats. The manufacturing plant at Solihull heavily criticised the seats, as they were difficult to make, incurring many problems. This criticism of the design department continued for some time. However when launched the seats were a resounding success and were pointed out as one of the finer aspects of the vehicle. Now the objective is to build on this success.

The changes in style were not planned, they happened. They have been communicated through the organisation by demonstration: people tend to get "swept up in it". The company hopes to build on these changes, and feels that if it continues in this direction there will be substantial benefits.

Strategy

Land Rover is undoubtedly leader in the market of four wheel drive vehicles. Both Land Rover and Range Rover were "firsts" to the market. Both products were not startling in their use of technology, to put it simply they were designed for a purpose; to exploit a market niche. Land Rover seems to have the attitude of letting others do the groundwork and research, They simply take the technology and apply it to a more hazardous environment. This is reflected in the high number of suppliers, and percentage of components made outside of the company.

A corporate plan is drawn up annually which outlines

the strategy the company will follow over the course of five years. From this, two further plans are drawn up; a business plan and a product plan. The business plan covers one year. The product plan covers 3 years in detail and 5 years in outline. Product plans are drawn up by the product policy committee, who direct the action.

Few changes have been made to the strategy, only detailed alterations.

Skills

The vehicles themselves employ a wide range of technology, some at the cutting edge of vehicle development. Most of the technology employed could be described as conventional, well developed and proven. There is no actual pure research carried out by the company; any research is driven from product needs. The company is active in acquiring new development and product technologies developing. The general philosophy in Land Rover is to create new ideas and apply them to their current products. This gives the company an advantage in niche markets.

Changes have been made to the product development skills in areas such as CAD. and electronics. Future improvements to the skills are expected to keep the company upto date with the available technology.

Systems

The main system used to control new product development

in Land Rover is known as the Product Definition Process. This simple, four stage process is outlined in the following diagram:

1. **Strategy**
   - long term policy
   - drawn up by policy committee

2. **Concept**
   - various alternatives
   - documented by a "Concept Product Development Letter"

3. **Programme**
   - one product
   - documented by a "Product Development Letter"

4. **Implementation**
   - various projects
   - documented by a Product Policy Letter
   - controlled by Planning & Timing review

The procedure has existed in one form or another for about 10 years. A new development may start at any time

during these four stages and may range from a simple modification to the development of a new model.

To control the developments various network analysis techniques are used, in conjunction with key event dates and bar charts. There are very few full time planning engineers in Land Rover, emphasis is placed on putting the engineers themselves in charge of drawing up the timing schedules. The company feels that separate planning could result in the drawing up of plans that are not achievable, simply because the planning engineer has not sufficient experience in the techniques used to develop the product. Computer software used includes two project management systems termed PROSPECS and PRISM. These systems were developed by Land Rover themselves to aid control of the new product development process. All timing, cost and quality aspects are measured regularly.

The major changes to the new product systems have involved the implementation of computer controlled project management and again, the greater use of teamwork to control the process.

Staff and staff training

The company spends a large amount of time and money on training. The company has an open learning centre as well as various management and technical training programmes. Individuals and their supervisors are responsible for identifying their own training needs. As already discussed there is a very high emphasis on teamwork and the use of

teams. There have been no major changes in staff in recent years.

Shared Values

Key individuals play an significant role in the company. The managing director is very visible and has strong views which influence the whole company. Project managers need to be carefully identified to provide a good vision. The degree of openness and trust is developing in line with changes in the style. The culture is very mixed.

Summary

The recent changes that have taken place in Land Rover have been based mainly on the company's own experience. The company has sought external advice through the use of consultants. Five years ago there was little emphasis on product innovation, increasing competition and recognition of the need for change have forced Land Rover to look at itself more carefully. The general trend towards increasing emphasis on teamwork is changing the whole style with which the company operates. These changes in style have been the most significant, and have evolved rather than forced. Other changes have been successfully made to the structure and systems. Implementation of the changes has been rather autocratic however with the change in style these will become less so.

APPENDIX XIX

Structured interview case study; company 7

MIRLEES BLACKSTONE ltd

MIRRLEES BLACKSTONE

The Company

Mirrlees Blackstone, based in Stockport, is part of the Hawker Siddley group of companies. The antecedents of the company was established in 1848 and built the first diesel engine in the UK (the third in the world). The company was established on its current site in 1908. The company designs, develops, and manufactures heavy duty diesel engines in the range of 2,000 to 20,000 horse power. Mirlees Blackstone is a medium sized company with a turnover of £ 40 million employing 850 people. The company is retaining its market share although the industry as a whole is in decline. With a return on capital in the region of 25% the company is still very successful.

Mirrlees Blackstone's customers are governments or large industrial corporations world wide. The engines are used mainly for electrical power generation, marine propulsion and rail traction. Most electricity generating engines used in the Middle and Far East are historically from Mirrlees.

New Product Performance

The life cycle of a typical heavy duty medium speed diesel engine is in the region of 50 years. The last major new product introduced by the company was in 1975. The company's product range consists of three different sized

engines, classified according to piston diameter (270,400 and 430mm). The company sells in the region of seventy engines per year. A complete new engine will take in the region of ten years to develop, and twenty to become fully established. Around 3% of turnover is spent on R&D and the vast majority of this work involves incremental developments and improvements on current engines. These incremental developments aim at getting either the same power out of products more efficiently, or ensuring cheaper products. Around fifty personnel are involved in product development and support.

Products are tailored to customer order and the company defines a successful product in terms of customer acceptance. Success is measured on each individual engine. The most important success criteria to the company are reliability, durability and delivery on time. Commercial success in terms of profitability and market share result from getting the performance and quality right. The company estimates that around 90% of its products are successful with around 8% being unsatisfactory and 2% unsuccessful.

Few changes have occurred within Mirlees Blackstone organisation, and this is a reflection mainly of the company's excessively long cycle time. Most of its changes have been progressive; as a result of experience.

Structure

The structure within Mirlees Blackstone is conventional

with five directors; Commercial, Sales, Works, Finance and Engineering all reporting to one managing director. The engineering department is responsible for controlling the development of new products and this feeds off other functions with the use of full time development teams.

Recent changes made to the structure have led to the establishing of one person, a commercial project manager, as being responsible for one specific major contract. This need has arisen because of increased complexity and various standards that need to be satisfied. The changes were initiated as a result of discussions between the directors of the Sales, Commercial and Engineering functions. Their objective was to ensure accountability for the development and to give the customer a focal point within the company. The changes were implemented by defining the job specifications, appointing the managers and informing the rest of the work force through the notice board. Success of the changes will not be fully apparent until the orders have been completed, in this case 1994. If successful they will be applied to all contracts.

Management Style

Senior management are reasonably involved in new product development. They are involved in setting the objectives and monitor and control progress through the company's engineering director. The management is direct, involved and to a certain extent autocratic. No major changes have occurred in the style in recent years. Future

changes are seen as being very dependent on the key individual at Managing Director level.

Strategy

The company is a leader in the heavy diesel engine market. The majority of its product's contents are based on existing market demands and existing technology. The technology itself is over 80 years old and still evolving. Products are continually being updated.

The major changes to strategy occurred around thirty years ago. Previously emphasis had been placed on developing engines with more power this has now changed and today the industry is continually looking for improved efficiency of its engines.

Skills

The products themselves involve a full range of technologies from simple to sophisticated. The firm is strongly oriented towards research and development. Its production facilities are very modern and much of the equipment could be described as "state of the art".

Changes to the skills have based on the improvement of production facilities. These have involved the development of CADCAM, FMS, and computer systems for FE analysis. The changes were necessary to improve the overall economics of the manufacturing operation. It was felt that the development new technology in the production area was

essential for the companies survival. Future changes will involve keeping up with manufacturing skills, whilst at the same time broadening the skills of engineers within the company through the introduction of "multi-skilling".

Systems

The company does use a new product procedure and this provides a loose outline for the development to follow. Many of the developments are detailed in an annual programme of developments. Each engine order is costed out and there is a continuous process of cost reduction within the engineering function. Factors such as reliability and durability are continually under discussion. Critical path analysis methods for project management are used on the larger projects.

No major changes have been made to the systems. There are plans however to formalise information transfer and retrieval systems within the company.

Staff

The company runs a variety of training programmes, mainly on the technical side. There is a graduate engineering programme and an apprentice training programme.. Training needs are identified through the directors or the personnel department. Around 50% of the management are graduates. The company is not strongly oriented towards teamwork and individualism is still very strong. No changes have been made to staff or staff training in recent years.

Shared Values

The need for change is not strongly accepted within the company. Product development people find themselves having to adapt to changes in technology of all kinds, mainly dictated through customer needs. The company feel that there is a high degree of openness, but most people are mistrustful. The company is based around a "sunset" rather than a "sunrise" technology. Key individuals are important to the company and on a manufacturing front the company was described as being risk taking, adaptable and has the ability to react quickly (relative to the industry). As far as the products themselves are concerned the environment is slow to change and the developments are relatively stable. Again no major changes in the style have occurred during recent years.

Summary

Mirlees Blackstone clearly believe that the best future developments and improvements will come from improving the manufacturing base. The products themselves are still evolving, however both the technology and the markets are mature and the scope for future development is limited. The company has undergone little change compared to others in the case studies however its products have an extremely long life cycle and the entire environment is in total contrast to a company such as ICL.

APPENDIX XX

Structured interview case study; company 8

ROLLS ROYCE ltd

ROLLS ROYCE

The Company

Rolls Royce are in the business of designing, developing, manufacturing, marketing and supporting gas turbine engines for aircraft, industrial and marine power. The company is very large with a sales turnover of £ 2 billion and over 42,000 employees. The gas turbine industry as a whole is growing steadily at the moment. Rolls Royce itself has recently been privatised and came to the market about twelve months ago. Profits in 1987 stood at £ 156 M, a third up on the previous year (£ 120 M).

The company has obtained a high level of orders over the last two years, however its 1988 profit margin is being eaten away due to competition from dollar based rivals Pratt & Whitney and General Electric. Rolls Royce is currently embarking on a three year rationalisation programme aimed at producing a substantial reduction in its cost base.

New Product Performance

The company has introduced 5 new products within the last five years. The average product lead time is in the region of 5 to 7 years. In 1987 the company spent £ 178 million (approximately 9% of its turnover) on research and development, and approximately 2000 staff are involved in the new product development process. The company's main customers include industry, Air Forces, airlines and air

frame manufacturers. The company defines a successful new product as a successful development programme that meets time and cost criteria and a product that makes a profit. Success is measured for individual new products in terms of return on investment. The success criteria measured will vary depending to who one speaks to within the company. They will also vary at different times during the life of the product. It is extremely difficult to measure the success of products within Rolls Royce at any one time because of the product life. The RB211 for example, was one of the reasons which caused the company to go bankrupt in the early seventies, yet today it is an extremely successful engine, regarded by many as one of the safest, most reliable and fuel efficient available today. The success of a product is clearly dependent on its stage in the product life cycle. True success therefore can only be judged when the product in nearing the end of its life. Technical success does not always guarantee commercial success. For example Concord's engine was technically very successful, however not enough were sold to make it a commercial success. (Not all is lost however as often the expertise gained can lay the foundations for cost reductions in future developments.) The product life of a typical gas turbine engine is in the region of 20 years. Consequently the amount of sales turnover made up of products developed within the last few years is minimal. Market share has remained very stable over the long term.

Product Development in Rolls Royce

New product development within Rolls Royce can be broadly divided into three groups:

1. Refinement and incremental developments
2. Technology enabled developments; that is, developments in the technology enable changes to made in the products.
3. Market Research / Technology led developments; diversification.

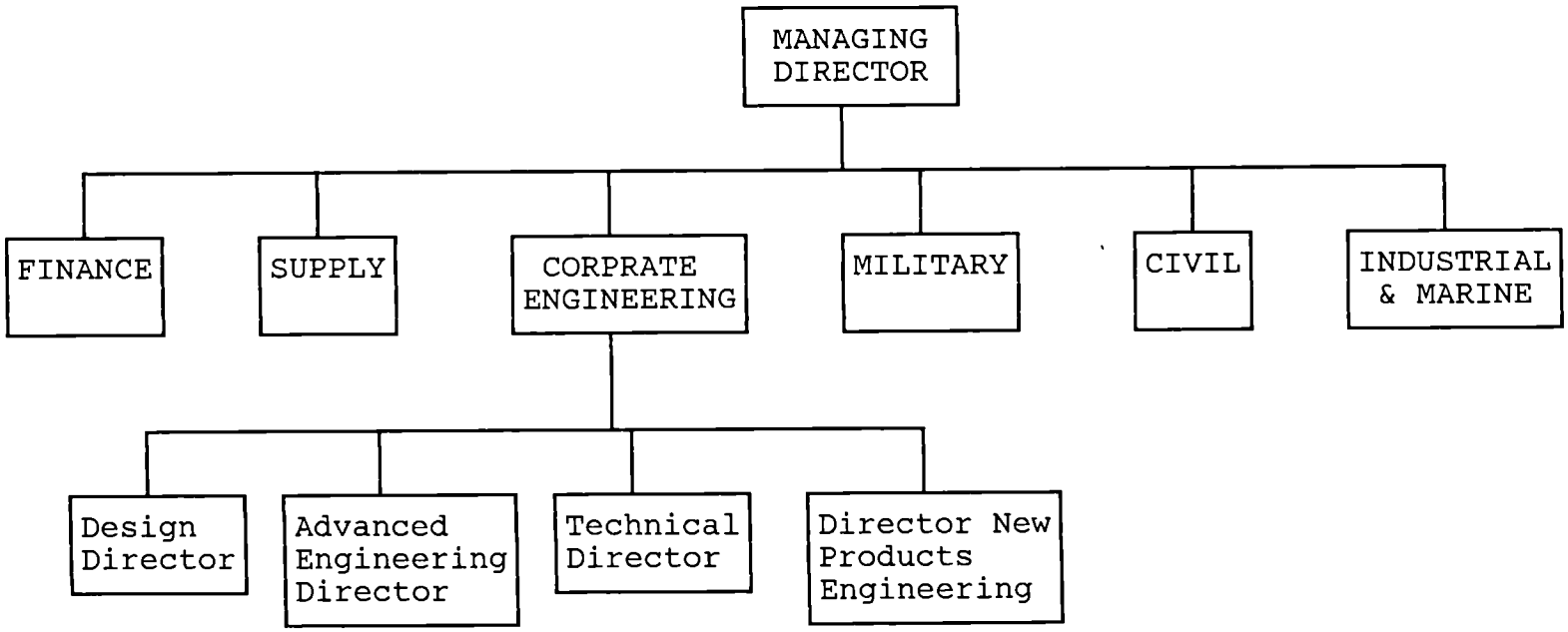
Many new product developments are carried out with partners in order to minimise the risks.

Structure

New product development is essentially controlled by the Corporate Engineering department. The company uses many full and part time teams to control new product developments. An outline of the structure is given in figure 10.4.

Two changes have occurred recently in the structure of Rolls Royce. Privatisation has had an effect, with the consequence of a market change towards diversification. There has been an increased consideration and planning into a larger range of products utilising the companies established technology and market knowledge. This has resulted in the setting up of a department looking at "new" new product development. New products that are currently made within the company come under the advanced engineering

figure 10.4 The organisational structure of Rolls Royce plc



department.

There have also been changes to create a greater market awareness within the engineering department. These changes were initiated by the board and have in the main been evolutionary, resulting in greater links between engineering and marketing.

Style

Senior management within Rolls Royce have a high visibility and a preoccupation with new product development. Management keep in touch through a variety of methods. Key people involved in new product development will use often use "short circuit" methods to get the attention of top managers, who are often responsible for approving various financial aspects.

The style was described as "not as responsive as it should be". The company feel there are some obstacles getting the manpower to bear. The company is to a certain extent bureaucratic and the management is technically oriented. Engineers like to work on things interesting rather than in line with business goals. There have been few changes in the management style in recent years

Strategy

Rolls Royce is a leader in the field of gas turbines, and most of its business is against two competitors, Pratt & Whitney and General Electric. The company is constantly

improving its products and, its new product strategy involves everything from radical new products to incremental improvements. This product technology it is involved with is still developing at a moderate pace.

Changes in the strategy have been towards reducing operating costs, with the emphasis on obtaining fuel efficiency. These changes have stemmed from customer demand. The strategy has changed to put more emphasis on cost and a greater willingness to collaborate with competitors in order to have a complete product line. The changes have been communicated to the organisation as a matter of necessity, through large scale communication methods.

Skills

The company has a strong technological skills base, with the products employing a high and sophisticated level of technology. The company is strongly oriented toward research and development. The best people are often put into one team and assigned to one product.

Changes have been made in order to remain competitive through customer and competitor pressure. The general trend in the changes have been towards a greater use of electronic controls, computer aided design, and more use of manufacturing technology and materials. The changes have involved training, capital investment, and strategic alliance. The changes in skills tend towards a broader product base.

Systems

The company does not "hold" over certain systems in a bureaucratic fashion, moreover they are tailored for individual projects. The company does however use a broad based procedure and this is followed to a reasonable extent. Time tracking, profit, performance and quality are all tracked on a monthly basis. A detailed cost out of the product is done at least every six months. Controls begin as soon as money is spent, and the objectives set during the early stages of development are reviewed continuously.

The systems and procedures used within Rolls Royce have changed recently to ensure tighter resource management through more effective strategic planning. This better use of resources and the improvements in operational efficiency was in part due to the "polishing up process" for privatisation. The main reason for these changes was to ensure the improved competitiveness of the organisation. The changes have resulted in a general tightening of the rules and procedures.

All the changes were initiated from board level and were communicated to the organisation through broad based communications, repositioning and some new appointments. The changes have led to more clearly identified product strategies.

Staff

Training programmes in the company involve everything

from technical and management training to language development. Training needs are identified by either the training departments or the line managers. Individual departments are responsible for recruiting their own staff and in the region of 90% of managers recruited are graduates. There is a high emphasis on teamwork, and teams involved in new product development are chosen to ensure the best combination of skills and experience to suit the task.

There have been no major changes in staff or staff training in recent years.

Shared Values

Rolls Royce is the kind of company where people will always try to ensure they get things right the first time. It is a very cost conscious company, and this detailed approach does not lend itself too well to innovation. On the main product lines mistakes cannot be accepted.

The need for change is strongly accepted within the company. Key individuals play an important role and the identification of opportunities to be included in product strategy frequently depends on the initiative of individuals. The organisation was described as innovative and reactive. Expert power is the main source of power and the company is very "technocratic".

No significant changes have occurred to the shared values either as a result of other changes or direct intervention.

Summary

Rolls Royce is a very successful company involved in the development of extremely sophisticated products. The majority of product developments result out of technology enabled change the main driving force from the customer is increased fuel efficiency. Rolls Royce's strongest points lie in its excellence in refinement and obtaining cost improvements. This cost conscious culture however does not lend itself too well to radical innovations. The company feel it is technology led but is not exploiting technology to its full potential. The company feels that this will only come about if a separate culture, which is not cost conscious is developed within part of the company to exploit technology. The company feels the best prospects lie in small company behaviour (they feel there is a limit to the number of people that can work together effectively) combined with large company characteristics.

APPENDIX XXI

Structured interview case study; company 9

SHANDON ltd

SHANDON SOUTHERN PRODUCTS

The Company

Shandon's main area of business is in life science instrumentation. The company design, develop and manufacture analytical instruments for a variety of uses. Key customers include the medical industry, hospitals, universities and research laboratories worldwide. The market as a whole is steady and Shandon's market share has also remained steady. The company has an annual sales turnover of £ 15 million, and employs around 300 people. Shandon has grown in recent years from a small to a medium sized business. This growth has been attained organically by allowing the research departments to expand, and also through the acquisition of other companies.

New Product Performance

The company has developed five new products within the last five years. Success for these products is defined in terms of their commercial performance over the products lifetime. In terms of success criteria, profit is the most important, closely followed by performance and quality. The company estimates that in the region of 75% of its products are successful with 10% failing once they have reached the market and the remaining 15% cancelled prior to introduction. Around 5% of sales turnover is made up of products that have been developed within the last three

years. The average lead time for new product development is between 18 and 24 months, and the company spends between 6% and 7% of its turnover on research and development. Around 45 out of Shandon's 300 employees are involved in the new product development process.

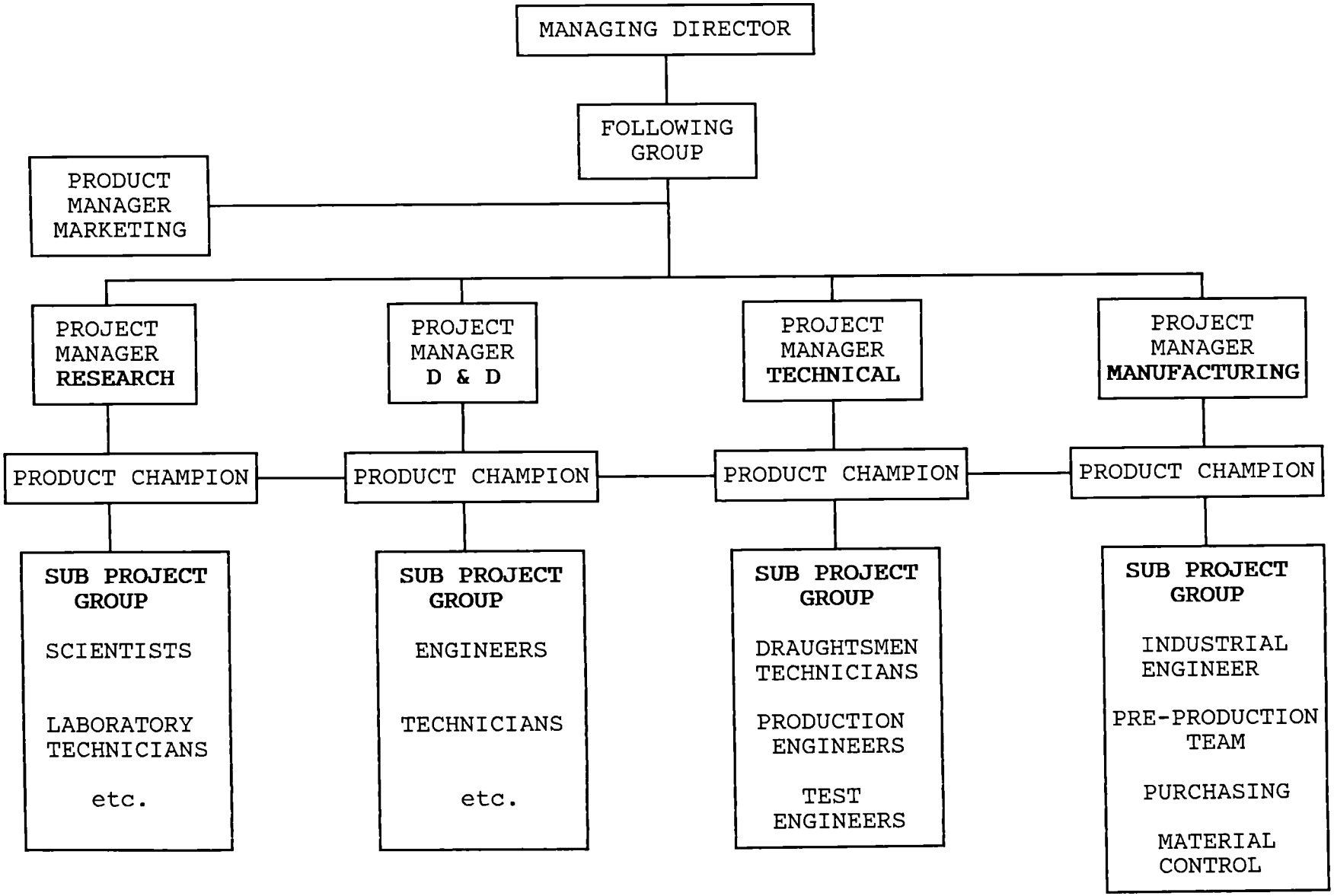
Structure

An outline of the organisational structure is given in figure 10.5. In Shandon, no one department is responsible for the whole development process, responsibility is transferred. New product needs are serviced on a corporate level. Part time teams are used to coordinate the work across the various departmental boundaries.

The board decided several years ago to invest more money in research and development. Originally the company had no research department and no technical department. Changes were made over a period of time and the organisation has been allowed to grow organically into its present state. The changes were communicated to the rest of the organisation through the team briefing process.

In recent years the company has expanded and become more formalised. This has led to some jobs becoming narrower in scope and larger in depth. Previously the company had much smaller functional groups allowing greater variety of work.

figure 10.5 The new product development organisation of Shandon plc



Style

Senior management have little direct involvement with the new product development process, generally there are closer and more formal links with the manufacturing aspects. Board level managers have a reasonsble working knowledge and are kept in touch with development by virtue of documents. The leadership was described as having an element of bureaucracy and the company is very departmentalised.

Changes to the style have been brought about in a metamorphosis from a small ambitious company to a medium sized enterprise. During this growth period the company has had to become more professional.

Strategy

Shandon's strategy is to be a leader in life science instrumentation. It is often first to the market with its products, many of which utilise existing markets and existing technology. The technology in the life science industry is mature.

Most of the changes within Shandon have to a large extent stemmed from changes to the strategy. In its ambition to grow the company had a two pronged attack, firstly to invest in organic growth through more research and development and secondly to invest in growth by acquisition. Shandon has bought several small companies to add to its growth efforts.

Changes have also occurred to the way in which the

strategy has been communicated throughout the organisation. At corporate level this has become more formalised and a clear strategy is now produced every year. This is drawn up by the board with some "grass roots" involvement. Originally the strategy was effective but disorganised and unstructured.

Systems

New product development follows a typical process. Beginning with the marketing specification, which in turn leads to research and the drawing up of a functional specification. Design and development generally leads to the prototype then a series of prototypes and finally information is passed through to the technical department who "productionise" the whole process. There is considerable interaction of departments during the initial stages.

The company does use a new product procedure to monitor important milestones. There is one procedure covering the whole process as well as several departmental procedures that look in more detail at the various stages. The two most important criteria that are tracked monthly are cost and time. Other aspects such a market share are not formally measured, but are looked at about six months after launch. Products are reviewed on a six monthly basis to see if they have met their financial and performance targets. Controls start once the specification has been written. The company uses various project management software packages all based on PERT to control the developments.

The new product procedure has only been in existence for eighteen months. It was introduced to perform a base line for new product information. Previously few formal procedures existed for the development of new products. As the company grew in size and research and development effort increased and the company found it necessary to introduce a system to help with the management of the process.

Staff

Major changes have occurred in the staffing as the company has grown organically. The recruitment of many scientists and chemists has taken place. These staff have been brought in as and when necessary in order to set up the research and technical departments.

A variety of training programmes are run in various technical subjects. Senior management are involved in management training. Department heads and the personnel department are responsible for identifying management training. Around 75% of managers recruited are graduates.

Skills

Significant changes have been made to the skills base driven mainly by the changing marketplace and the changes in the products themselves. Skills have been bought in through changes in the staff. This has involved the recruitment of staff from sciences disciplines such as biochemistry, histology and cytology.

Shared Values

The culture within Shandon is very much a family based type of atmosphere and attitudes. The company has a low staff turnover and has been in the life science market for over 50 years; it is a well established company. This is gradually changing to a more dynamic company as a result of growing, this has forced the company to become more professional.

Summary

Shandon's increase in size has led to a dramatic change in the kind of systems it uses. The company has developed more rules and procedures and its style has to a large extent become more professional. The company's other major changes have occurred in its strategy and structure, allowing the company to grow from a small to a medium sized operation.

APPENDIX XXII

Structured interview case study; company 10

DAVY MCKEE ltd

DAVY MCKEE (AUTOMATION DIVISION)

The Company

The expertise of the Automation division of Davy McKee is, as its name implies, process control. The majority of the developments are customer led. Much of the business involves the installation of quality oriented process control systems to specific customer order. Much of the product development work therefore is contract driven. The main type of process control the company is involved with includes flatness, shape, gauge and temperature control in large steel mills.

The company has only 5 major world competitors, and in terms of size Davy Automation is by far the smallest. The division is largely autonomous and in recent years has been very successful, despite the decline of the steel industry. In some ways the decline has helped, it has caused the major steel producers to look for ways to improve their control systems and there by make them more efficient, more cost effective and able to use quality as a sales feature.

Around 125 people work for the Automation division and the majority of these are graduate engineers, involved in a variety of contracts for the steel industry. The division has an annual turnover of
£ 13 million. The rolled steel itself will generally end up in products such as motor cars, beverage cans, appliance casings etc.

Types of product development in the division

The division is involved in three distinct forms of product development work:

1. Contracts for customers; the design of specific process control systems from tools and software that have already been developed within the division. The majority of these "project type" contracts involve complete "shape control" on hydraulic shape control packages.

2. Development of tools such as measuring devices. These developments would normally be carried out over a 2 to 3 year period, with the objective of giving Davy another tool with which to exploit its process expertise. One recent new product involved the development of a laser instrument to measure the strip speed of steel within mills. Until recently the technology to achieve the product had not been available. The use of a laser as a speed measuring device has always been a possibility but the crucial development work lay in taking the product out of a relatively clean and safe laboratory environment and putting it into a steel mill.

3. The third type of development involves smaller products such as, e.g. load cells that are sold into a separate market. These products require periodic updating and some development work is usually necessary.

Around 70% of the division's work is to contract; a further 10% is absorbed by the loadcell part of the business and the rest involves development and improvement of the software, hardware or instrumentation available. Some of the

best developments have come occurred by accident. The division feels it is difficult to plan innovation, but tries to encourage it by giving free reign to people who exhibit an innovative streak.

Accuracy is of prime importance within the industry. Some steel mills will roll in the region of 4.5 million tons every year at various thicknesses. If the steel is rolled as little as ten microns too thick it could mean millions of dollars of steel are being "given away". Control of steel thicknesses therefore is crucial. When one also considers that the rolls in a steel mill may weigh in the region of 600 tonnes, often generating 9000 tonnes pressure, and this needs to be moved several microns in less than 25 milliseconds the precision and control required can be seen to be immense.

New Product Performance

The company defines a successful new product as one which meets the performance specification; quality is a close second, with profit rising inevitably out of the first two. In the region of 80% of the company's products are commercially successful. Few are cancelled during development but around 25% of developments may only be used once.

Structure

The company has a simple structure with three

directors, Sales, Engineering and Operations reporting to a General Manager. Product development is carried out on a divisional basis within Davy. The engineering department is responsible for development work within the division. The division feels that size is a key factor in the development work; too big and respect within the company is lost. One aspect of the structure was specifically designed to bring sales and engineering closer together. The present structure works well and the division has no plans to reorganise.

Style & Shared Values

Management style varies throughout the division. Basically the style is to engender success and different managers have different ways of doing this. The management feel that there is always a case for feeling the ground and experimenting with new ideas. Senior management sees its role as a steering function and believes in putting a lot of faith and trust in its employees. Senior management will not tolerate lack of respect between functions. It is important to generate mutual respect within the company; employees must have faith across the various departmental boundaries. Staff need to understand other peoples jobs within the company. The division feels that it is important that everyone in the company has a good understanding of what is going on. Teamwork is important.

Systems

The division has no formal new product development procedure. Teams are assigned to various projects depending on the skills available and the course of action to be followed. Development budgeting is deliberately "leaky" on individual projects, but the total spent on development is tightly controlled.

Skills

The division's skills lie in developing hardware and software to control processes more accurately. Davy have a broad range of engineering capabilities. Project management skills and teamwork are vital in the type of contract work undertaken. Much of the work is very theoretical, and some developments are a case of suck it and see.

Summary

The automation division of Davy McKee clearly recognise the need to innovate in order to improve their chances of success. The emphasis with development work is towards higher quality within the steel industry, and indeed this is being constantly demanded by the customers. The company has made use of the book "In Search of Excellence" and in attempts to improve its operation the company has:

1. Loosened the financial reins, ie. made it deliberately leaky.

2. Smiled benignly at "skunk holes". Allowing employees to propose ideas, that if, when reviewed from a commercial stand point are worthwhile are pursued.
3. Learned how to accommodate, within the organisation, brilliant mavericks.

The results from these changes have been excellent. Most have been applied through consciously changing the style of the company. The business is to an extent still immature, changing rapidly and becoming much more specialised.

APPENDIX XXIII

Delco Electronics Overseas Corporation

A case study aimed at improving the process of new product development through the application of known factors associated with new product success.

DELCO ELECTRONICS CASE STUDY

Contents

Introduction

This case study describes the work carried out in Delco Electronics Overseas Corporation (DEOC) over the life of the research project. Initially the work involved understanding DEOC's operation, and the problems the company were facing. Later a team was established in the company to look at improving the process of new product development through a planned programme of change. This planned programme of change aimed at applying the factors identified as being associated with new product success.

Delco Electronics Overseas Corporation

At the commencement of the research project the company was known as AC Spark Plug Overseas Corporation. Due to the change in nature of the instrument cluster business towards the use of more sophisticated electronics, in 1986, GM decided to transfer this business to its Delco Electronics division. The fuel pump business remained part of the AC Spark plug corporation, however to avoid confusion in this case study the company will be referred to as Delco or DEOC.

DEOC supply instrument clusters to a variety of car manufacturers. Their major customers are Vauxhall and Opel. Current contracts also include Jaguar, Rolls Royce, Pontiac (US) and other major car manufacturers.

The site at Kirkby in Mersyside employes approximately 2000 people and has an annual turnover in the region of £ 60 M. The parent company, Delco Electronics is part of the

Hughes Electronics group, which in turn is part of General Motors corporation. As a division in its own right, Delco Electronics is one of the largest electronics companies in the United States. Delco have manufacturing plants in the United States, Mexico, Singapore, and Kirkby. Figure 10.6 indicates the structure of Delco Electronics relative to the GM. group.

The structure of Delco Electronics overseas corporation, based at Kirkby is shown in figure 10.7 together with the 18 key executives who control the company. The structure is "top heavy" consisting of a large executive board.

figure 10.6 **Structure of General Motors showing position of Delco Electronics**

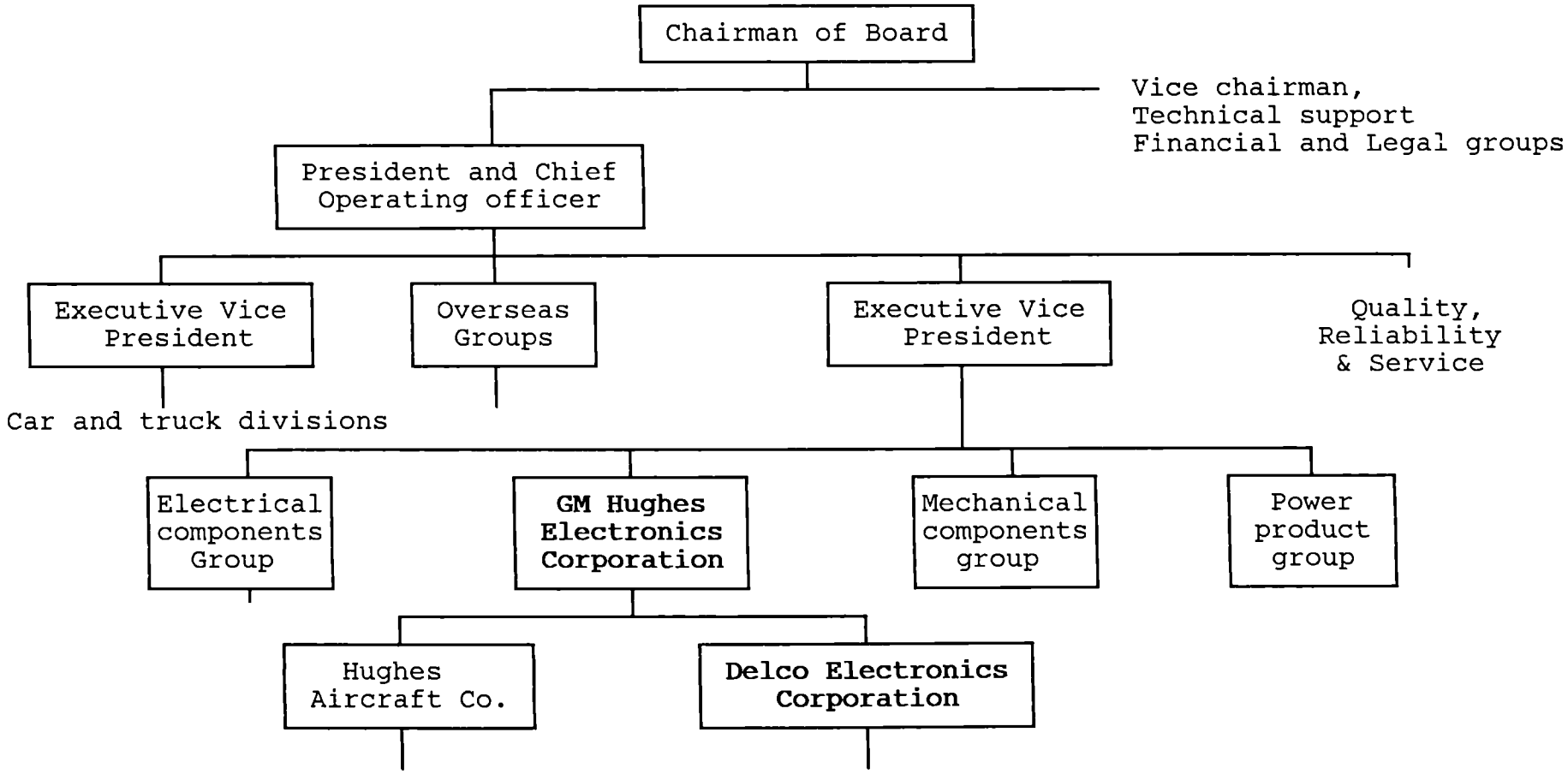
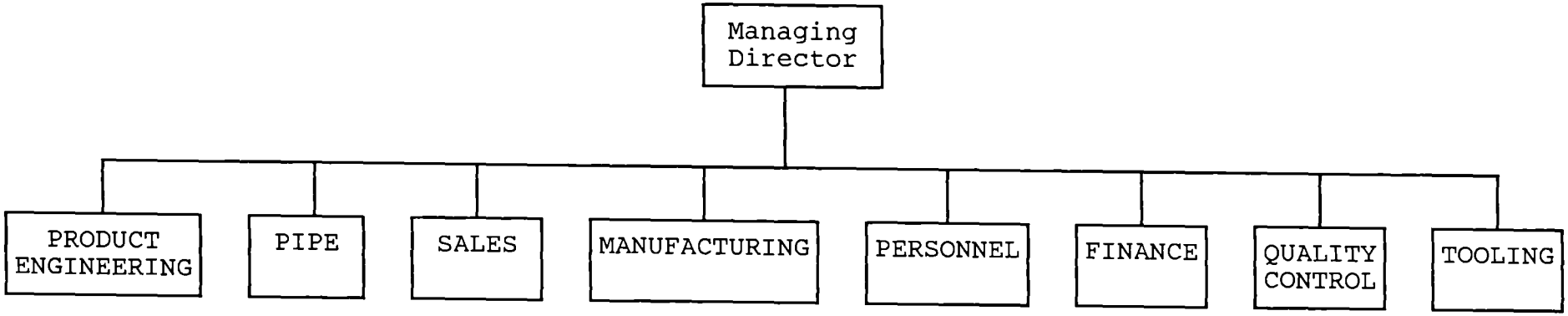


figure 10.7 Structure of Delco Electronics Overseas Corporation, Kirkby



PIPE = Production, Industrial and Process Engineering

J R HIGHAM	PLANT MANAGER	W J JOHNSTON CHIEF ENGINEER
D F GREGORY	ACSP PROGRAMME PLANNING MANAGER	M F FLOYD MATERIALS MANAGER
R K MIDDLEBROOK	PURCHASE MANAGER	G D DORRITY OPERATIONS MANAGER
W A FRANCIS	EUROPEAN SALES MANAGER	J P T JOHNSTON PERSONNEL MANAGER
A C PILKINGTON	RESIDENT COMPTROLLER U.K. PLANTS	S V CHADWICK QUALITY CONTROL MANAGER
A V ASSHETON	PRODUCTION MANAGER AREA 2	E RIDING PRODUCTION ENGINEERING MANAGER
L J HILL	PRODUCTION CONTROL MANAGER	R L DITCHFIELD PRODUCTION MANAGER AREA 1
D S FIRTH	MANAGER MANUFACTURING ENGINEERING	R W L BRECKELL E D S
P WARD	PLANT AND FACILITIES MANAGER	J WILLIAMS MANAGER BUDGETS AND FINANCE

New product development in DEOC.

The new product development process in DEOC is managed with the aid of a 25 key element new product procedure. This procedure was established in 1986 with the aim of ensuring new products were introduced on time to world class standards of quality and technology, fulfilling precise customer requirements. According to DEOC the purpose of the procedure was to:

> Coordinate the activities associated with new product programmes, ensuring the most efficient use of plant, resources and systems.
>
> Monitor key events and ensure target dates are met.
>
> Ensure customer requirements are established on a timely basis and accurately reflected in competitive business proposals which take full account of DEOC design and manufacturing preferences.
>
> Develop designs which provide the basis for world class standards of quality and technology and cost effective manufacture.
>
> Ensure designs are fully validated and released for production on time and right first time.
>
> Develop manufacturing sources and facilities which make fullest use of available technology and ensure cost effective volume production.
>
> Ensure production facilities are fully validated and proven capable of meeting the required quality and production standards prior to commencement of full production.
>
> Provide manufacturing methods that make the most efficient use of labour resources and provide effective working environments.
>
> Provide opportunities for employer involvement and training to ensure most efficient use of available knowledge and skill.

New product development programmes are controlled on a product team basis. These teams are established following

15) Manufacturing plan prepared	P I P E
16) Purchase part ordered	Purchasing
17) Parts and materials available	Materials
18) Capital Equipment and tooling ordered	P I P E
19) Capital Equipment and tooling available	P I P E
20) Production facilities prepared	P I P E
21) Production samples built	Manufacturing
22) Production samples validated & approved	Quality Control
23) Production facilities validated	P I P E
24) Production commenced manufacturing	Production
25) Programme reviewed	Finance

PIPE = Production, industrial and process engineering

The initial CASE proposal

The initial CASE proposal was to undertake an investigation to develop, introduce and establish a concept known as simultaneous engineering into the DEOC operation. This concept was defined as:

"The practice of all the related disciplines participating in the design and development process of a new product or model. The purpose of the practice is to ensure that the product not only meets the customer's requirements, but also to ensure that the design and manufacturing requirements are thoroughly evaluated prior to production start up."

At the time (October 1985) simultaneous engineering was thought of as an answer to the problems DEOC were facing in new product development. On close examination of the

literature however, no references to it or its obvious synonyms were found. Although simultaneous engineering was clearly important to the company, it was felt that it was not in the best interests of the research to concentrate on this area alone. The real problems DEOC were facing would not be solved by its implementation.

The concept of simultaneous engineering (now known within DEOC as Interactive Engineering) was in effect to replace the old sequential method of new product development with a holistic approach, where the development phases overlapped. Takeuchi & Nonaka (1986) discuss this concept under a different heading and suggest that a holistic approach has six characteristics: instability, self organising project teams, overlapping development phases, multilearning, subtle control and the organisational transfer of learning.

Interactive engineering has now been introduced to the DE operation in the United States and at the time of writing was being introduced at the DEOC plant in Kirkby.

Initial work inside the company

The first meeting was held in October 86 involving the Ph.D research student, supervisor and senior management from the Product Engineering department. It was agreed that initial work should involve familiarisation of the student with the DEOC operation, and especially product engineering. Time was spent in product team meetings, and other meetings relevant to new product development. At this stage

simultaneous engineering was "flavour of the month" and Delco felt that its introduction would be the answer to their current problems in new product management.

During the first three months a considerable amount of time was spent within the Product Engineering function talking to and working with the product engineers. The aim of this initial period was to become familiar with DEOC and the procedures used. Time was spent talking to a variety of staff from all departments within Product Engineering.

After several months it became clear that the problems the company were facing with new product development were not something that could be isolated within the Product Engineering department. Product Engineering was the lead group in the new product development process, the company was however very departmentalised and carried strong political influences. The process itself involved almost every department in the company. It was decided therefore that the research should have a neutral base within the company and from this time on was based in personnel.

In the following three months and during the first half of 1986 the project was spread outside of the Product Engineering department so as to get a picture of the company as a whole. Approximately one week was spent in each of the following departments:

Sales

Finance

Production engineering

Industrial engineering

Process engineering

Tooling

Quality control

Materials

Manufacturing

The problems DEOC were facing

DEOC's main problems concerned meeting delivery dates. Many of the product developments would fall behind schedule, requiring increased resources and expenditure during the final development stages to meet delivery dates. This inevitably led to poor costing of the products and the resultant profits were not as expected. In the motor industry missing a date can be disastrous for a supplier's reputation. It could hold up the launch of a new vehicle.

DEOC have long recognised that the problems they were facing, and effort has been made in various areas to improve the new product development process and their chances of new product success. Recently a new product procedure was introduced to ensure tighter control during development.

Other problem areas within the company have included communications and union negotiations. The company seems to spend much of its time "fire fighting" and is often preoccupied with its current day to day problems, rather than planning carefully for the future.

In order to overcome these problem areas, Delco felt they needed a system to make them "dynamic", and help them manage more successfully their new product development process. Although they had just introduced a new product

management system in the 25 key elements they felt that this would have to change as their industry and competition changed.

In effect Delco felt they needed a system to manage a system, to direct their business and ensure the correct markets and products were chosen and pursued.

Development of the organisation development team concept

At the end of the first year of research it was clear that the ideal way with which DEOC could aid the research and vice versa, was to set up a form of experiment within the company. The research studies covered in the literature review had clearly identified the factors associated with new product success. The hypotheses was developed (and later confirmed through the questionnaire survey) that few new product managers were aware of, or attempting to apply, these research studies. The research project had developed in such a way as it was felt both it, and DEOC would benefit from attempting to develop a methodology that aimed at applying the research factors. Careful research tended to suggest that these factors would be best applied through a planned programme of change. It was decided therefore to concentrate within the company on developing a methodology that incorporated the research factors and a planned programme of organisational change.

In effect the work in DEOC was experimental. The aim of the experiment being to test a methodology applicable to any engineering company that would improve its chances of new

product success. An outline of such a methodology was discussed in the first year proposal report. It was clear however that such a methodology could only be developed with the close collaboration and cooperation of DEOC.

Priming the executives

In order to establish the possibility of setting up some form of experiment, it was first necessary to "sell" the research ideas and objectives to key executives within the company. Initially both the personnel director and the product engineering director were sent copies of the first year report and asked to make comments. A series of meetings with key NPD personnel followed during which several points became clear:

1. The work required the establishment of a multi disciplinary team within the company to coordinate a planned programme of change and draw on a range of experience in NPD.
2. It was important that the research received support from all areas of the company. Any team established must have a neutral basis as NPD crossed the boundaries of many departments, and because of political influences it was important that this neutrality was recognised. Thus the team would require careful selection and the establishment of neutral reporting structure.

3. It was recognised that the setting up of such a team would require the approval of the whole board.

In November 1986, a meeting was held with two key executives (Personnel and Product Engineering), and other staff involved in the project, to discuss the progress of the research and the way forward. It was agreed that a presentation should be given to the executives as soon as possible.

On the 8th January 1987, a pilot presentation was given to the two key executives and staff. During the presentation the case was put that research had already identified the factors associated with new product success and that a planned programme of change, such as Organisation Development, was the ideal technique with which to apply these factors. Regarding the steps that DEOC should take however (ie. the details of the methodology) the presentation was left open and DEOC were invited to make suggestions as to "What Next?". No mention was made in the presentation of the establishing of a team but it was implicit that this would be the most effective way forward.

The executives and staff present fully supported the way in which the research was going and suggested that the same presentation should be given to all 17 executives together with an outline proposal on how organisation development combined with a team approach could be used within DEOC. This presentation was essential in order to obtain the support of the board as a whole. It was decided that for maximum impact this should be held "off site" at the

University one evening.

At this point only brief discussion had covered what options DEOC had to push forward. Clearly the only effective way to pursue the organisation development concept was to establish a team. This had been discussed briefly and in order to reinforce the case, the proposal was outlined gradually in two letters to the executives. By the time of the presentation a clear picture of the way forward had been established and a detailed proposal was included in the report that accompanied the presentation. It was suggested that:-

1 An advisory / action team should be established reporting directly to the personnel director.
2 The team should concentrate on identifying improvements to the new product development through the use of organisation development to apply the researched factors.
3 The team should be small, multi functional and multi level.
4 The research student should form part of the team.

It was clear at this stage too that any team established would need careful selection and development.

The presentation was amended in line with the recommendations from the pilot presentation and a report drawn up to accompany it. By the end of January 1987 still no date had been fixed for the presentation. However in early February, with around four days notice, the presentation was arranged for February 17th.

The presentation and proposal report

The presentation was given by Mark Benson, and held after work hours at 6 pm on February 17th, 1987. A copy of the agenda can be found in appendix XXIV. Considerable effort was put into the quality of the presentation as it was crucial to selling the research ideas. In the majority of cases it was also the initial form of contact with executives from other areas in the company. A report was drawn up to accompany the presentation and handed out afterwards. A copy of this report can be found in appendix XXV.

The presentation lasted in the region of 30 minutes and was followed by questions, a lengthy discussion, and a buffet. By the end of the evening it was clear that the management fully supported the research and strongly approved of the idea to set up a team. It was suggested that the way forward should be for the two key executives to select an appropriate team. It was also suggested at the presentation that Mark Benson should visit each of the executives individually to discuss their perceptions of the problems facing new product development.

Establishing the team

The team was carefully selected by the Personnel Manager, the Chief Engineer and one of the Product Engineers to include various disciplines within the company. Team members were also selected because of their ability to

contribute effectively to the team and its goals. The initial team members were:

Paul Milburn	Product Engineering
Colin Rogers	Product Tracking
Anne Hierons	Personnel
Peter Reed-Clayton	Personnel
Jim Bannon	Production Engineering
Tony Francis	Sales manager
Peter Ward	Plant and facilities manager
Mark Benson	(Ph.D research student)

The first team meeting was held on the 10th March 1987. Six of the eight team members were present, the two executives being unable to attend. It was agreed that the initial meetings would be spent drawing up the terms of reference. The goal of the team was agreed as being "to improve the chances of new product success through appropriate changes to the organisation". During the first meeting the discussion focused on two main areas, the problems associated with new product development, and how the team itself would work. The problems associated with new product development included:

- the lack or misuse of resources
- tracking of new product development programmes
- executive new product meetings
- persistent job failures

It was agreed that the team should meet weekly, and produce minutes of the meetings. Other concerns at this stage included the training that was required, and to whom the team should report and when.

At the second team meeting the new product procedure was outlined and discussed to ensure everyone had a clear picture of the process of new product development within the company. Again both executives were unable to attend. Problems associated with the new product development were discussed. It was decided that a structured approach was needed to try and identify the problems. Initially it was suggested that the new product procedure should be reviewed stage by stage. The procedure was broken down into four blocks:

Securing the business	Key events 1 to 8
Product design	Key events 9 to 13
Production planning	Key events 14 to 18
Programme realisation	Key events 19 to 25

This review was intended to form the first task of the team, the objective being to identify the key problem areas. The review in effect would form the diagnostic stage of organisation development. It was intended to be used a tool to ensure all aspects of new product development were covered. At this point the proposal for the team's initial training was outlined, this was to be a week's "team development". This proposal had been passed to the board for approval.

The third team meeting was held on 27th. March this time only one executive was absent. Ian Barclay came in to discuss the team building course and what it would involve. It was to be held the week beginning April 5th. at Alverston Hall, Cheshire. The week's development was essential to bring the team together into a cohesive unit

with a clear understanding and common perception of how organisation development could be used in conjunction with the research factors into new product success and failure to improve the new product development process in DEOC. At this meeting also, the first of the key events in the new product procedure was discussed as part of the planned new product procedure review. This one key event alone brought up eight different problems relating to identifying customer needs.

During these first few meetings it was difficult to see ways to increase the awareness of team members to the research factors identified by previous research. A presentation had been given on the key studies and this was to be presented again during the off site development programme. A more effective interaction was however needed. It was decided that this interaction would be best achieved through the use of a questionnaire that compared the team member's organisation with the presence of the factors associated with new product success. Thus a questionnaire that compared the organisation with the research was developed to be included as part of the team development programme.

The organisation development team building programme

The team building programme was held from Sunday 5th. April to Friday 10th. April 1987. The programme was held at Alverston Hall Hotel in Cheshire. The course was run by Ian Barclay (IB), the research supervisor with the assistance of Mark Benson (MB) the research student. IB has

had extensive experience in running similar management development programmes for major organisations. A copy of the team building course programme an be found in appendix XXVI. The course was residential, and lasted from Sunday evening to Friday lunchtime.

The course commenced on Sunday night with a brief introductory exercise where each team member outlined his "hopes and fears" for the week. Objectives for the week were set in terms of the three most important objectives. This was followed by an exercise where team members were paired off and each had to list the six key elements of their jobs. They were then asked to list the six key elements of their partner's job. The lists were compared to demonstrate how little they knew or perceived about each other's roles within the company. At the end of the planned session, a "workshop" was held to discuss any matters of relevance. One of the key points raised at the end of the first session was the absence of two executives. After a long discussion it was decided that this experience was needed on the team and one of the team members agreed to ring the plant manager the following morning.

On Monday one of the team members rang the plant manager, John Higham, to discuss the problem of the two absent executives. JRH agreed to bring the point up at a direct staff meeting later that morning. Some time was then spent outlining the previous evening to J. Bannon who had arrived late due to prior commitments. The conversation drifted back to the role of the team and the problems DEOC were facing. After about an hour IB stepped in and asked

what was the subject of the conversation?, who had talked the most?, who had talked the least and so on. This gave a flavour of how the team was working. At this stage it was clearly dominated by one or two individuals and was not very effective. The rest of the day was spent involved in various communication exercises, interspersed with discussion on the team and its role. Some of the team members were becoming uncomfortable and kept expressing the view that they should be "doing" something.

Tuesday was spent on "the project". The idea of this exercise was that the team should draw up a model of DEOC's operation that everyone agrees and is happy with. At the same time the team was instructed to improve communication skills based on the previous days exercises. This "simple" exercise proved a major problem for the team. Tempers were frayed and some members were beginning to seriously question their presence on the course. There was immense difficulty in trying to reach a common perception or concept of the organisation. The team was continually setting time limits to complete the exercise, yet these were always missed. The team finally agreed on a model during the evening's workshop, some 8 hours after the initial deadline. A considerable number of lessons had been learnt and this was a turning point in the development course. After dinner an hour was spent discussing the points that had been thrown up by the exercise. It was clear that the team had to learn to become more tolerant of each other and effective in applying itself.

Wednesday was spent discussing the previous night's

efforts and tidying up the the model. This time the team's efforts were much more constructive. The afternoon began with a presentation by IB on innovation and change. This included the Kondratieff cycle, change at work, the process of change, and making change work.

On Thursday, innovation was discussed in more detail along with the research into the factors associated with new product success. The questionnaire developed by the research to test the qualities present within the company proved a very useful way of introducing the team to the factors associated with new product success. At this point the team was beginning to handle itself much more confidently, especially where conflict was concerned. Much of the informal chat was about the team, its role and what it should aim to achieve within the company. Several other team development exercises were carried out during the afternoon.

Friday was the culmination of the week's work and at this point the role of the team was clearly defined. The team saw itself as a catalyst to promote planned change within the organisation. Three plans were also drawn up. It was decided that these plans should to be presented to the executive board.

The whole week was interspersed with discussion on the team's role and what it was going to achieve once it returned to DEOC. The team development course had achieved its objective in bringing the team into a much more organised and effective working unit. One of the main conclusions regarding the way forward was that it was essential to diagnose the real problems facing new product development.

The team felt the best way to do this would be through the use of the questionnaire that compared the company's perceptions with those of the factors associated with success and failure.

The executive presentation

Following the team development course it was decided that it was essential to report back to the executives, to give them a clear picture of the objectives of the team. This presentation was arranged for 1st. May 1987. Several team meetings were held prior to this, these were spent drawing up the various plans in detail and preparing to present the ideas to the executives. These team meeting were now being attended by the two executives, whose presence up until this point had been lacking. The team was in extremely good spirits and strongly motivated.

The presentation was the culmination of the teamwork development course. The presentation involved firstly, a review of the training week, followed by a discussion of the plans and considerations. The following is a summary of the main points presented to the executives.

The training week

An outline of the course was given. Considerable lessons had been learnt and through a certain amount of "blood letting" and aggression. The team had come to realise its own strengths and weaknesses and in effect had developed a "tool kit" for tackling various situations. It was made clear that the team had to go

forward independently, on its own terms as laid out in the presentation. The team had also recognised its own limitations. The situation surrounding new product development was very complex and as a team it was not possible to understand or solve every problem or opportunity, it had to be a "brick by brick" approach. As well as the team development a considerable amount of theory had come across during the course, this included the research into new product success and failure, the management of change, "S" curve phenomena and organisation development.

The role of the team

The team is to act as a catalyst to promote planned change in the organisation.

The ultimate objective

To make DEOC. more successful with new product business.

Organisation development

Organisation development is a term used to describe a planned programme of change, designed to allow the organisation to achieve the strategic goals and objectives for which it was created.

Organisation development is concerned with structures, procedures and systems, as well as other factors such as leadership, teamwork and collaboration between people departments and functions.

The way the team envisaged this organisation development programme working within DEOC was as follows:

1. Identify / Diagnose, through a questionnaire reflecting the factors associated with new product success. (adapted from the NPD success and failure questionnaire used on the teamwork development course)
2. Analysis, the questionnaire results with the aid of the University SPSSX package.
3. Recommendations
4. Presentations
5. Action
6. Review, (and back to 1)

Recognition

Recognition was required to publicise the team and its objectives to gain support. It was envisaged that this recognition would be obtained through presentations, the core brief, the Kirkby comment, the daily news line and the questionnaire.

Short term plan

To identify an existing problem with new product development and take the necessary steps to solve it.

Long term plan

A method of identifying the opportunities and considerations that will effect long term new product development at DEOC.

Business plan

A long term plan which steers the organisation towards its objectives and takes into account, product, customers, competition and technology.

The team felt that as well as tackling its own long and short term plans it needed to tie in carefully with the business planning unit, the executives, and the DE corporation to ensure it was going in the right direction.

The presentation was received warmly by the executives, and the team members too felt that it had gone well. Full support had been given for the idea of the internal questionnaire. It was felt this would give a good basis on which to diagnose the problems associated with new product development. The way in which the team was to work had been clearly defined and explained to the executives. Due to the importance of long term planning and strategy to the team, it was suggested by the executives that Bob McHattie the business planning manager should join the team.

The same presentation was also given to the operating executives a few days later, and on the 1st. June to other executives who had missed the first two presentations.

Diagnosis of the NPD problems; the organisation and distribution of the questionnaire

The questionnaire was intended as a tool for the diagnostic stage of new product development. A pilot questionnaire was sent out to 17 staff from the Product Engineering department in order to test it. At this stage, it was also the intention of the team to question suppliers and customers on their views and perceptions on the new

product success of the company, however these surveys were eventually carried out at a later stage by separate departments within the company for their own purposes.

The final questionnaires were sent out at the beginning of June 1987. A copy of the questionnaire can be found in appendix XXVII. They were distributed by the team members themselves. In total 180 copies were sent out and these were distributed among the following departments / groups:

Product Engineering	25
P I P E	25
Manufacturing	40
Sales	5
Quality Control	5
Finance	10
Purchasing	10
Personnel	5
Shop floor	40
The executives	15

Problems were experienced distributing the questionnaires to staff on the shop floor. It was felt important to discuss the aims of the questionnaire carefully with the union stewards before management would allow its distribution.

At the team meeting on the 8th. June the questionnaire pilot responses were discussed. The comments were exactly what the team had been looking for. One of the team members made the point that there was nothing startlingly new in the comments, these problems had been spoken of many times

before. It was also commented that if this was the case, why did the problems still exist.

The morale of the team slipped during June as the company was very busy and attendance at team meetings was not as good as expected. It was decided that an "off site" meeting was needed to get the team out of the pressure of day to day company activities.

June 1987, 1st. "off site" meeting

On the 30th. June 1987 an off site meeting was held at Liverpool University. The objective of the meeting was to review the work carried out since the team development week in April. The main purpose of the off site was to allow the team to get together for a considerable amount of time without the daily interruptions of work.

The meeting began at 8:30am and after a brief introduction and coffee, time was spent discussing the role of the team together with some of the key issues that had arisen within the organisation. Discussion was again focused on what the team could achieve and what its purpose was within the organisation. After lunch a presentation was given on the BPU (Business Planning Unit; DEOC's strategy). An important point that had come out at an earlier session was related to strategy. Thus it was important for the team to find out exactly what the company had in terms of strategy, thus Bob McHattie was asked to give a brief presentation on its role within the company. It was clear there was no long term plan within the company. After the

presentation it was decided to address the issue of what the team should concentrate on next. One of the prime considerations at this point was to raise the profile of the team within the company.

The pace of the team was also questioned and it was asked if two hours per week was enough time to devote to the problems that were arising. It was decided that more time was required but most managers did not have much more time to spare. In order to pick up the pace, more delegation would be required. At the same "off site" meeting the results of the questionnaire and a session on teamwork was also carried out. At this point the team were still very much feeling their way, although their purpose was becoming much clearer.

Analysis of the results from the questionnaire seemed at this stage fairly straight forward, and was to a large extent in the hands of MB.

July 1987

Four meetings were held as normal throughout July. The profile of the team had been raised through an article in the Kirkby comment, the company's monthly newspaper. A considerable amount of thought was now being given to how the team should progress after the diagnostic stage. It was agreed that the best way forward would be to present the results to the executives with clear recommendations as to who should be responsible for identifying and tackling the problems, and ensuring that action was taken.

It had been noted at an earlier meeting, in June,

that the team needed a leader. On the 6th. July, Peter Ward was elected chairman and Paul Milburn the deputy chairman.

By 13th. July it was still not possible to distribute the questionnaire to the shop floor. The unions were very sceptical of the management's motive behind the questionnaire.

At this stage the preliminary results from the questionnaire were available. The questionnaires had been great success. They were analysed on SPSSX in a similar manner to the research questionnaire. The 20th. July was the last meeting before the Summer break and much of the meeting was devoted to discussing the results of the questionnaire and their analysis. An initial presentation giving an overview of the results was given by MB. The full results and analysis would be available after the summer break and these would also be pulled together in the form of a report for the team.

Analysis of the questionnaire

The questionnaire results were available and fully analysed by the end of August 1987. The results were analysed by department and also for the company as a whole. Initially the results were presented in two parts:-

1. A comparison between DEOC and the research into the success and failure of new products.
2. Comments on the problems associated with new product development.

The initial set of results were not intended to draw any

conclusions or present any recommendations. These results were purely lists of the comments made and rankings of the factors found to be missing.

It was at this point that the McKinsey seven S model was introduced as a framework to break down the results. The seven S model was outlined to the team both informally and in the form of a presentation. It became clear during the analysis and discussion stage that the seven S model was the ideal way to analyse the results.

The use of the seven S model was discussed and put into effect throughout September. The number of problems that had been identified by the questionnaire were very large and it was decided that the most effective way to deal with these would be at an "off site" meeting. The aim of this meeting was to draw together the results of the questionnaire, and to turn these into a series of recommendations, in line with the McKinsey Seven S model.

Prior to this meeting the results were taken and broken down into a more usable form in terms of a report. This report was the basis on which the recommendations were formulated. The report provides a detailed insight into the results of the questionnaire. This report was the culmination of the diagnostic stage and is contained in appendix XXVIII.

Using these results it was possible to group the problems associated with strategy, systems, structure and so on. Where problems overlapped they were put into both groups. This was achieved during a "brainstorming" session, the problems were listed and grouped under each of the seven

S's. These were later analysed and crossed off the list when covered by a recommendation. The final list of recommendations was intended to be as short and concise as possible.

The results and recommendations were issued in a as an interim report to the executives. These results were presented verbally to the executives in November by the team. A copy of the interim report and the main recommendations can be found in appendix XXIX.

Presentation of the results to the executives

The recommendations were presented to the executives during the first week in November. In total 18 recommendations were made, with responsibility and target dates assigned to each one. These recommendations were received cautiously by the executives. The executives were keen to progress the majority of the recommendations and names were put against as many as possible. The team itself had undertaken to progress several of the recommendations, again through the process of OD. beginning with careful diagnosis.

Progression of the recommendations

It was at this point that the management's support began to waver slightly. The problems had been carefully identified and presented. What was of critical importance now was that they were all implemented. The team clearly

viewed the initiation of this action as being the responsibility of the senior manager's as in many cases their authority was required. The team's role had clearly changed again. A number of the team members felt they had done their "job" in identifying the problems. Effectively the team's role now was to push and ensure all the recommendations were followed up.

The research project's links with Delco Electronics were effectively ended during January 1988 due to commitments to the structured interviews and writing up of the thesis. As intended the team was to continue. This case study does not document the progress of the team after March 1988. At this point the majority of the recommendations were being actively considered and implemented. However the success or failure of these recommendations may not be visible for several years.

Towards the end however the team did appear to be running out of steam. The connection with the University itself appeared to be a useful motivator, and this contact with some form of outside and independent organisation appears to be beneficial to the team.

No progress in terms of improvement to the new product development organisation can be made without action and it is coordinated action across the whole organisation that is crucial to the success of the changes. In order to progress that action the team must have the full authority and commitment of the executives, as only they have the power

to implement and progress change quickly.

The case study shows clearly that the key to any change within an organisation is a committed strong management team. That team must create the atmosphere whereby change can occur.

APPENDIX XXIV

Agenda for the initial presentation to DEOC executives

APPENDIX XXIV

SUCCESSFUL PRODUCT INNOVATION

DEOC. Presentation 17th. February 1987.

6:00pm	Assemble	
6:30pm	Welcome to the University	Professor J S Halliday
	Introduction	R K Middlebrook and Ian Barclay
	Successful Product Innovation	Mark Benson
	Organisation Development and new product programmes.	J Johnston
	Discussion	
7:45pm	Buffet	
	Discussion and Close	

APPENDIX XXV

Report accompanying the initial DEOC presentation

APPENDIX XXV

SUCCESSFUL PRODUCT INNOVATION

A presentation to DEOC.

17th. February 1987

This research is being carried out by:-

Mark Benson and Ian Barclay
Department of Industrial Studies
The University of Liverpool
PO. Box 147, Liverpool, L69 3BX.

This research is based on a three year Ph.D CASE studentship, sponsored jointly by the SERC and Delco Electronics (through W.Johnson, J.Johnson, R.Middlebrook and P.Milburn).

Contents

SUCCESSFUL PRODUCT INNOVATION

1. Introduction

New product development

New product development is one of the most important yet least understood activities that a company is faced with. It is crucial to the long term survival of manufacturing industry and remains one of the most important routes to corporate growth. New product development is a difficult and complex process. Inherent in the process is the fact that product innovation is a risky and uncertain business, requiring the collaboration of many people and functions within the company. Any company that does not continually develop and improve new products runs the risk of being left behind by the competition.

Changes in the environment are forcing the development of new products. Customer's wants and needs are changing, technological change is presenting new opportunities, and competition is becoming more aggressive.

If the new product development process is to be managed efficiently and effectively, the techniques used and emphasis put on them must change in accordance with the new product demands. Companies need to take a regular close look at how they manage the development of new products and improve that process.

The project

This project is being carried out to identify methods that will allow companies to improve the management of new product programmes. It is the researcher's belief that most companies still rely solely on experience to identify improvements, and changes tend to be reactions rather than planned evolutions.

Work on new product success and failure

A large number of research studies have put forward the reasons for the success and failure of new products. In the majority of cases the reasons identified are within company control. Despite this, new product failure rates remain high and few companies have used these studies to improve their new product development process.

Little has been done to apply this work, and few companies are even aware of the studies. Some research studies have proposed solutions, such as selection checklists which would use the factors to screen between good and bad projects. Other research has suggested the use of managerial guides. These guides provide a framework for the new product development programme based on the factors that lead to success or failure. There are two major problems with these types of solution:-

1. They will all improve new product programmes, but they are in effect "one off" solutions, that is, they will not

take into account the effects of environmental forces. Thus as changes inside and outside the organisation occur, such solutions will become outdated.

2. They focus on only one aspect of new product development programmes.

The improvement of the management of new product programmes

Ideally, improvements to new product programmes must be:-

1. Made with an awareness of the factors that lead to new product success and failure, so that these factors can be built into the development programme to ensure new product success.
2. Continuous, allowing the new product programmes to react to changes in the environment.
3. Combined with other methods of improving new product programmes, such as improving the new product strategy, to provide a balanced and well planned approach to new product development.

This research puts forward the view that if new product failure rates are to be reduced and the chances of success improved, the most effective way is to apply research that has already been carried out. The most appropriate way of applying this work is through a planned organisation development programme.

2. Organisation development

What is organisation development?

Organisation development is concerned with structures, procedures and systems, as well as other factors such as leadership, teamwork and collaboration between people, departments, and functions.

The need for organisation development.

There is a need for organisation development in many situations, the most common being:

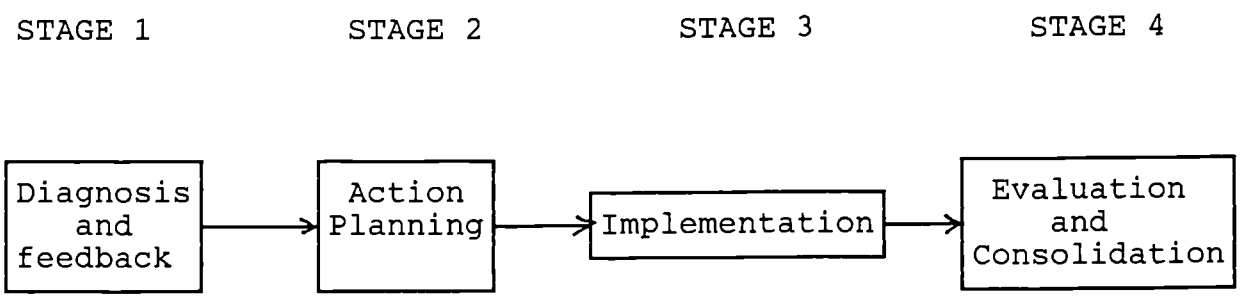
1. Allowing existing organisation to adapt more easily to changes in the external environment.
2. Where the organisation is failing to accomplish its objectives in terms of output, quality or profitability, and where the nature of the organisation itself is limiting the performance of those who work in it.
3. Where the adoption of new technology, systems or methods requires corresponding changes in the organisation for proper implementation.

In the context of new product development, organisation development may be used because:-

1. New product programmes must react to changes in the environment such as technology advances, changing customer needs and more aggressive competition.

2. The organisation may be failing to achieve the level of new product success and the new product management and the organisation itself may be limiting the chances of new product success.
3. The adoption of new product technology and the development of new systems and methods, such as CAD, CAM, FMEA etc. is essential to efficient new product development.

Organisation development is generally recognised as the four stage process, described below:



The first stage in any programme will be to define, diagnose and understand the task to be performed, or the problems to be resolved. A useful starting point will be to define:-

1. Where we are now.
2. Where do we want to get to?
3. What forces are preventing us from getting there?
4. How do we change?

Analysing the current organisation is an essential first step to organisation development. This diagnosis and feedback can result from informal discussion or systematic surveys depending on the nature and complexity of the problem. What is important is that those aspects under review are tested against the reactions and responses of those involved.

Following on from the diagnosis is the Action Planning phase. This is usually conducted by one or more internal management teams who have been involved in the diagnosis and feedback, and are aware of organisation development and associated aspects.

During the implementation phase, changes will be made and tested, with modifications made to ensure the success of the programme. The evaluation stage should review the programme against the criteria agreed at the outset. This evaluation stage must take into account the amount of time that has been allowed for the changes to take place.

At the end of the programme it is vital to consolidate and reinforce those changes that prove effective in practice. A particular programme may end, but the process itself will not. Organisation development should build on experience, continually allowing the management of new product programmes and organisation to adapt to the changing environment, technology and people needs.

Diagnostic methods

New product programmes must reflect the needs of the new product they are to introduce. New products are developed to accomplish the new product strategy which is in turn part of the company strategy. Any organisation development programme begins by defining this strategy so that an examination of the extent to which the existing structure, systems and procedures constitute a logical and effective way of achieving the strategy.

What makes a new product a success cannot be precisely specified, it is a combination of factors that will be unique to every product and company. Each company must decide for itself the factors that make new products successful, and develop the managerial and organisational aspects that will produce the successful characteristics.

The time and effort needed to implement change is considerable and unless action is introduced to accelerate this change, the members of an organisation can take along time to adjust. With the current changes in technology, the shortening lead times and the ever increasing need for new products (Booz Allen and Hamilton (1980) estimate the number of new product developed in the next five years will double) companies are having difficulties keeping up with the changes required.

In a comprehensive organisation development programme a variety of diagnostic methods will need to be employed. These methods could include:-

1. The examination of work roles and coordination

between individuals or between departments and functions.

2. The examination of recent new product introductions to see of they have fulfilled the requirements expected of them.
3. An evaluation of recent changes to the new product management process to establish if they have fulfilled their expectations.
4. An assessment of what makes a successful new product.
5. A review of management aspects of the new product programme, to establish if it is creating the conditions within the organisation that will achieve the factors required for success.
6. An analysis of problems in the new product programme with feedback on attitudes morale and job satisfaction.
7. A review of reward incentives, appraisals schemes, and opportunities for career progression.
8. A review of training programmes to establish if the members of the organisation have the required skills for their input to the new product programme.

And so on.

3. How organisation development could work at DEOC

Proposal

The research is proposing that a small team be established that will initiate and control the work and report back to the executive committee.

Structure

The team would be a small inter disciplinary team of personnel involved in new product development. It would be responsible to the executives via J.Johnson. The key stages at this point in time are:-

1. Education of the team in terms of OD. concepts.
2. Education of the team in terms of the research into new product success and failure.
3. The identification of key problem areas in the setting up of an organisation development programme.
4. The identification of the key problem areas in the management of new product programmes and how these problems could be best resolved.
5. The team should determine its own working structure and working times as appropriate for the organisation.

Establishing the team

The key problem areas anticipated revolve around decision making and to whom the team should be responsible. To be effective the team must be able to respond quickly to opportunities. This means that is must be supported by a

framework that allows decisions to be taken quickly.

Time and Cost

It is envisaged that about two to three hours per week (perhaps two team meetings will be needed). A training budget for appropriate organisation development and teamwork courses will be required.

Feedback

At the end of three months a report could be drawn up specifying exactly how the OD. work inside DEOC would continue. This could cover a three year plan; comments on the information needed; decision making; reporting facility etc.

NB. This could take considerably longer than three months, but it is expected that an initial outline on which to base a further commitment could be made at this stage.

The researcher's role in DEOC.

The researcher would:

1. Form part of the team, in an advisory but not a decision making role.
2. Be responsibile for identifying the key findings of research into new product success and failure, and presenting these findings to the team.
3. Help in identifying information and courses that would be of benefit to the team in coming to an

understanding of how organisation development would work.

4. Identify other people and contacts who would be of benefit to the organisation development team.
5. Need to meet regularly with and have access to who ever was put in charge of the team.
6. Need to be able to move around the company talking to various people about new product development and specific problems.
7. Need to be able to sit in on key meetings that fit in with the project.
8. Coordinate these and other administrative activities.

APPENDIX XXVI

Organisation development team building programme

APPENDIX XXVI

Organisation development team building programme

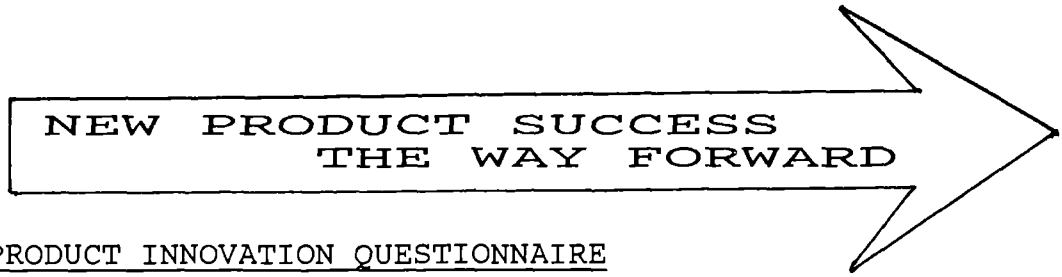
Sunday 5th. April 1987 to Friday 10th. April 1987

Sunday	7:00pm to 9:00pm	Introduction and explanation Objective setting
Monday	9:15am to 5:15pm	Communication and team skills
	7:15pm to 9:15pm	Workshop
Tuesday	9:15am to 5:15pm	The project
	7:15pm to 9:15pm	Workshop
Wednesday	9:15am to 5:15pm	Managing change
	7:15pm to 9:15pm	Workshop
Thursday	9:15am to 12:15pm	New product development management
	1:45pm to 5:15pm	Team plan
	7:15pm to 9:15pm	Workshop
Friday	9:15am to 12:15pm	Team plan
	1:45pm to 3:15pm	Review and close

Coffee 10:30am
Lunch 12:15pm to 1:45pm (meal at 12:30pm)
Dinner 6:00pm
Tea 3:30pm

APPENDIX XXVII

Successful product innovation questionnaire used in Delco Electronics



SUCCESSFUL PRODUCT INNOVATION QUESTIONNAIRE

A team of various disciplines has been formed in conjunction with Liverpool University. The team will research long and short term improvements to the new product processes. The first stage will be to invite participation of all departments via a questionnaire and informal interviews.

If you have any questions please feel free to contact any of the team members:-

Colin Rogers
Jim Bannon
Paul Milburn
Anne Hierons
Mark Benson
Peter Reed Clayton
Tony Francis
Peter Ward
Bob McHattie

Instructions.

The questionnaire is laid out as a series of qualities that have been found to be associated with new product success. Please indicate on the scale if you feel that the particular quality is present inside DEOC.

For example:-

	This quality is present in Delco Electronics.				
Qualities	Always	Often	Unsure	Seldom	Never
1. There is good effective communication between key internal groups.	1	2	3	4	5

In this case the respondent has indicated that, in his opinion, there is often good effective communication between key internal groups.

If you feel you cannot answer a particular question because it is not relevant or outside your experience please put a line through the response.

Please return this questionnaire as soon as possible to .....

All answers will be treated with total confidentiality.

PRODUCT UNIQUENESS AND SUPERIORITY.

Qualities.	This quality is present in Delco Electronics. Always	Often	Unsure	Seldom	Never
1. Our products have significant or unique advantages over competitors products.	1	2	3	4	5
2. Our products meet customer needs better than competing products.	1	2	3	4	5
3. Our products are unique and superior in the eyes of the customer.	1	2	3	4	5
4. The company has the technical and design skills necessary to develop unique and superior products.	1	2	3	4	5
5. Our products clearly meets customers needs.	1	2	3	4	5
6. Our designs are not "me too" designs that result from copying competitors ideas.	1	2	3	4	5
7. Our products are of a higher quality and more reliable than competitors products.	1	2	3	4	5
8. Our products are often highly innovative and new to the market.	1	2	3	4	5

COMMUNICATION AND COORDINATION.

Qualities.	This quality is present in Delco Electronics. Always	Often	Unsure	Seldom	Never
1. There is good effective communication between key internal groups.	1	2	3	4	5
2. There is an efficient multi-disciplinary approach to the development of new products.	1	2	3	4	5
3. There is a systematic logical approach to the development of new products.	1	2	3	4	5
4. There are good communications with universities polytechnics and other technical and scientific institutions.	1	2	3	4	5
5. There is open and honest communication between individuals and departments.	1	2	3	4	5
6. There are extensive and regular communications to customers and suppliers.	1	2	3	4	5
7. Both internal and external communications are effective.	1	2	3	4	5

MARKET KNOWLEDGE AND PROFICIENCY.

Qualities.	This quality is present in Delco Electronics. Always	Often	Unsure	Seldom	Never
1. Everyone involved in new product development has a clear understanding of user wants and needs.	1	2	3	4	5
2. A detailed market assessment is always undertaken early on in the development of a new product.	1	2	3	4	5
3. The sales department is well targeted and has a strong and aggressive sales policy.	1	2	3	4	5
4. A thorough study of customer preferences is undertaken during the initial stages of development.	1	2	3	4	5
5. Most people in the company have a good knowledge of the marketplace.	1	2	3	4	5
6. Market studies and the collection of market information play an important part in the development of new products.	1	2	3	4	5
7. There is an systematic approach to new product development that brings together the various groups involved.	1	2	3	4	5

TECHNICAL KNOWLEDGE AND PROFICIENCY.

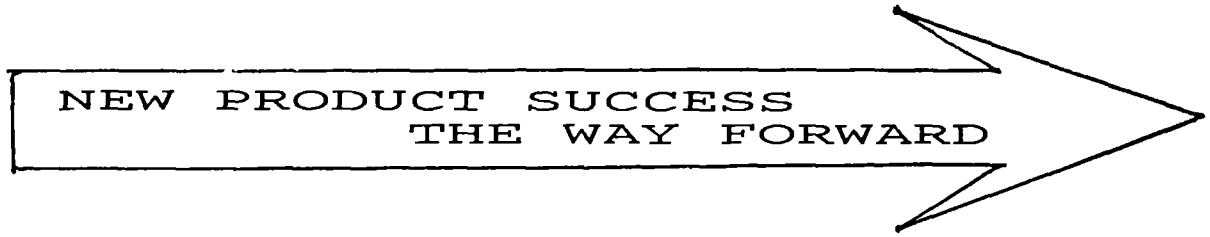
Qualities.	This quality is present in Delco Electronics. Always	Often	Unsure	Seldom	Never
1. The development of new products runs smoothly and is well coordinated.	1	2	3	4	5
2. There is a good "fit" between the resources available, and the new product development undertaken.	1	2	3	4	5
3. There is a high technical strength within the company.	1	2	3	4	5
4. Production knowledge and production strength is high.	1	2	3	4	5
5. The development of new products runs smoothly and is well coordinated.	1	2	3	4	5
6. The company has a strong reputation for quality and reliability.	1	2	3	4	5
7. The launch of the product into production is always a smooth and efficient activity.	1	2	3	4	5
8. Activities such as Prototype Development and Testing are well undertaken.	1	2	3	4	5
9. There are no design "bugs" in the product as it enters production.	1	2	3	4	5

MANAGEMENT AND PEOPLE QUALITIES.

Qualities.	This quality is present in Delco Electronics. Always	Often	Unsure	Seldom	Never
1. The management is of a high quality, professional and well trained.	1	2	3	4	5
2. Senior management openly support new product development.	1	2	3	4	5
3. There is an innovative, creative and open atmosphere amongst all those involved in developing new products.	1	2	3	4	5
4. The management style could be described as progressive and open minded.	1	2	3	4	5
5. Management planning techniques (eg cost control procedures, production planning and sales forecasts, etc.) are efficient and effective.	1	2	3	4	5
6. Everyone is well aware of the new product strategy, and the long term goals and objectives of the company.	1	2	3	4	5
7. Key individuals play a key role in pushing new product developments through the company.	1	2	3	4	5
8. The company has the ability to attract talented and well qualified people.	1	2	3	4	5
9. The company has an effective training policy.	1	2	3	4	5

APPENDIX XXVIII

Results from the DEOC successful product innovation questionnaire survey carried out during June 1987



SUCCESSFUL PRODUCT INNOVATION

RESULTS FROM THE QUESTIONNAIRE SURVEY CARRIED OUT DURING JUNE 1987

14th. September 1987

Mark H. Benson
Peter Ward
Paul Milburn
Anne Hierons
Jim Bannon
Bob McHattie
Tony Francis
Peter Reed Clayton
Colin Rogers

Contents

SUMMARY

This report is a summary and analysis of the findings from the questionnaire survey on successful product innovation. The questionnaire was carried out during June 1987 and a total of 127 responses were received.

The results are presented first as lists of the qualities perceived as being missing from the organisation. A brief summary of the type of comments made is also given. Four key areas of concern were identified:-

Marketing and identification of user needs

Product Launch, timing and resources

Strategy

Personnel

The results represent a complex and interrelated set of problems and need to be considered in relation to the whole organisation. In order to simplify this complexity a framework known as the McKinsey seven-S framework was used. Finally the results are analysed and discussed using this framework.

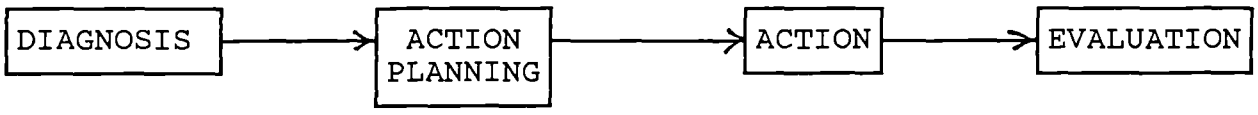
INTRODUCTION

This report outlines the findings from the recent questionnaire on successful product innovation. The results are presented firstly in terms of the qualities found and comments made. The report goes on to break the results down using a framework that considers the whole organisation. The problems associated with new product development are discussed using this framework.

The team and organisation development

The team was established in March 1987. The role of the team is to act as a catalyst to promote change in the organisation, with the ultimate objective of making DEOC more successful with new product business.

The team was set up based around the organisation development process. Organisation development (OD.) is a planned process of change designed to allow the organisation to achieve the strategic goals and objectives for which it was created. In general terms OD. is a four stage process that can be represented by the following diagram.



The first "key" stage is diagnosis and the team felt it was important to identify and diagnose the real problems facing new product development. It was decided that the best way to achieve this was through the use of a questionnaire.

The Questionnaire

To help achieve the long term objective of the team, it is felt that the best way to improve new product development is to use research that has already identified the reasons for the success and failure of new products. At the same time it is also important to identify the key problem areas within new product development at DEOC.

Broadly speaking therefore the questionnaire is divided into two parts:-

1. A comparison between DEOC's perception of the attributes associated with new product success, and research into the success and failure of new products.
2. Comments relating to problems associated with new product development.

QUESTIONNAIRE PART 1

Comparison with research into the success and failure of new products.

In the past 30 years a large number of research studies have identified the factors associated with the success and failure of new products. The objective of the first part of the questionnaire was to compare DEOC's perception of what makes a new product successful with these research studies.

The results from six of the major research studies were drawn together and from this five main areas of importance to new product success were identified, these are (in no particular order of priority):-

1. A unique and superior product, that clearly meets customer wants and needs.
2. Good communications with efficient planning and collaboration between the individuals and departments involved.
3. A good synergy between the new product being developed and the company in the area of technology and production, and a strong proficiency in undertaking technical and production activities.
4. An open minded and professional management who can create an atmosphere of trust, coordination and control.
5. A strong market knowledge and strategy combined with a clear understanding of user wants and needs.

Each of these five key areas represents a section in the questionnaire and in each section there are around eight qualities that have been found to be associated with new product success. The idea of the questionnaire is that members respond by either agreeing or disagreeing (on a scale of 1 to 5) that a particular quality is present inside the organisation.

From a total of 167 questionnaires that were sent out, 127 usable responses were received. (A breakdown of questionnaires given out and the numbers returned is given in Appendix 1.)

The results were analysed individually for each department and also for the company as a whole. The range of responses was between 1 and 5, a response of 1 indicating that a particular quality is present, and vice versa a response of 5 would indicate that the quality was not present. From these responses a value for the mean, mode and median was calculated. Those qualities with a mean of 3 or more were considered more likely to be missing from the company.

Results; Qualities not present inside DEOC.

Out of a total of 40 qualities associated with new product success a total of 26 were found to have a mean score greater than 3.0 at some point in the organisation. (A full breakdown of these responses, in order of priority is given in appendix 2.)

The following qualities have been associated with success, and according to the questionnaire are perceived as **not** being present inside DEOC. (These are in no particular order of priority.)

Market Knowledge and Proficiency

1. Most people in the company have a good knowledge of the marketplace.
2. A detailed market assessment is always undertaken early on in the development of a new product.
3. The sales department is well targeted and has a strong and aggressive sales force.
4. Everyone in new product development has a clear understanding of user wants and needs.
5. A thorough study of customer preferences is undertaken during the development stage.
6. There is an efficient multi-disciplinary approach to the development of new products.
7. Market studies and the collection of market information play an important part in the development of new products.

Product Uniqueness and Superiority

1. Our products are highly innovative and new to the market.
2. Our products are unique and superior in the eyes of the customer.
3. Our products are of a higher quality and more reliable than competitors products.
4. Our products have significant or unique advantages over competitors products.

Communication and Coordination

1. There is open and honest communication between key individuals and departments.
2. There is good effective communication between key internal groups.
3. Both internal and external communications are effective.

Management and People Qualities

1. The company has an effective training policy.
2. Everyone in the company is well aware of the new product strategy, and the long term goals and objectives of the company.
3. The company has the ability to attract talented and well qualified people.
4. The management style could be described as progressive and open minded.
5. The management is of a high quality professional and well trained.
6. Management planning techniques are efficient and effective.
7. Senior management openly support new product development.

Technical and Production Strength

1. The launch of a new product into production is always a

smooth and efficient activity.

2. There are no design bugs in the product as it enters production.
3. There is a good "fit" between the resources available and the new product development undertaken.
4. Activities such as prototype development and testing are well undertaken.
5. The development of new products runs smoothly and is well coordinated.

Although all the above qualities are perceived as not being present inside DEOC, it does not mean they are all problems or areas for concern. It may simply be that a particular quality is not relevant or necessary for the organisation.

Qualities present inside DEOC

According to the questionnaire results for the company as a whole the following qualities were perceived as being present inside the organisation.

1. DEOC does have the technical and design skills necessary to develop new products.
2. There is a high technical strength within the company.
3. Key individuals play a major role in pushing new product developments through the company.

QUESTIONNAIRE PART 2

Problem areas relating to new product development within DEOC.

On the final page of the questionnaire, respondents were asked to list the top three problems facing new product development. Over 85% of the questionnaires were returned with comments. This section of the report briefly summarises the main problem areas identified.

Timing

A large number of comments concerned the lack of time available for new product development. Many people feel there is insufficient time to carry out the various activities involved in development. Delays in funding, and approval of projects seem to set back the whole process. Design freeze comes too late in the product development process and a lack of design information is also felt to be a problem. Some people feel that more attention to timing charts and the new product procedure will help to reduce these problems.

Resources

Insufficient use of resources and lack of resources also attracted a large number of comments. The major resource shortage (excluding time) was felt to be a lack of skilled personnel in certain key areas. Also there is a lack of financial support and investment in equipment.

Prototype development and testing

There is insufficient prototype development and testing of products prior to finalisation of designs. Again it is felt that there is a shortage of resource in this area, both in time available, and equipment, to develop and test prototype samples.

Marketing and customer needs

There is a general lack of market knowledge within the plant. A greater awareness of customer needs and requirements is necessary together with more accurate market data.

Communication

There is need to establish and maintain more effective communication not only within the DEOC, but also with customers and suppliers.

Coordination

Lack of coordination through the various departmental boundaries. A number of comments referred to a "divide" between product and production engineering, the two departments do not get together until late in the product development. It is generally felt that there is insufficient liaison between departments prior to finalising the designs.

Innovative ability

There is a need to be more innovative and keep up with customer requirements. There are too many "me too" designs and it seems that DEOC is not willing to branch out into anything different.

Engineering Changes

There are too many engineering changes.

Product Approval

The process of, and delays in obtaining approval causes bottlenecks later in the development process.

Costing

Previously quoted costs can cause design constraints. A definite lack of monitoring of the product cost during the development stage tends to lead to costs being higher than intended.

Management Style

Some people feel that direction, leadership and commitment by senior management is lacking.

Strategy

There is a need for a more meaningful new product strategy. There is lack of feedback and communication from the Business Planning Unit.

New Product Teams

A much closer team approach is needed with more thought given to the people who make up the teams and more training in the new product procedure.

Personnel

There is concern over DEOC's inability to retain highly qualified young technical personnel, and it felt there is lack of qualified personnel especially in new high technology areas.

Training

A more effective training approach is needed

Technology

There is a definite lack of new technology and skills in DEOC.

Competition

Competition is becoming more aggressive.

OTHER FINDINGS FROM THE QUESTIONNAIRE

Perception of the problems

It is interesting to note the how the number of perceived problems within the organisation varied (appendix 3). The results from PIPE showed 21 qualities with a mean greater than 3.0, in comparison the executives only identified 8 problems with a mean greater than 3.0.

Inter-departmental differences

The type and range of problems identified also varied across the departments surveyed. For example the top 3 problems (both for success qualities and comments) identified by Sales do not coincide with those identified by other departments. Also the differences in the emphasis on the problems varied. Over 60% of the questionnaires returned from product engineering had comments relating to shortage of resources, yet in the rest of the organisation this is not regarded as a major problem (excluding comments on time).

KEY AREAS OF CONCERN

The following are seen as areas for concern:-

1. Marketing and user needs

Almost every research study undertaken into the success of new products has emphasised the importance of understanding the market and the customers' wants and needs. It is easy for a company, and especially the engineers and designers within the company to become complacent and feel that they know more about what the customer wants than the customer himself. Indeed in many cases the customer himself does not know what he wants until he has got it!

In the case of DEOC Marketing has never played a major role, mainly due to the nature of DE business. However it is still essential that key people in the organisation are fully aware of customer wants and needs, and have good knowledge of the marketplace. The results from the study show that this is not the case.

- People within the organisation do not have a good knowledge of the marketplace.
- The market strategy is unclear.
- No detailed market assessment is undertaken early on in the development of a new product.

2. Product launch, timing and resources

Every department in the company agreed that production start up and the launch of a new product is not a smooth and efficient activity. It is also evident that there are too many design "bugs" in the product as it enters production. Problems such as poor timing and lack of resources will play a major part in delaying product launch. In fact almost every problem identified through the comments will affect the success of the product launch.

3. Strategy

Most people within the organisation are unsure of the long term business plan or strategy. If DEOC is to be more successful people within the organisation need to move in the same direction, towards the same goals and objectives. At present confusion exists over over the new product strategy, and the role of the BPU.

4. Personnel

Training also emerged as a major concern within the organisation and was again identified by all the departments surveyed as a problem. Generally it is felt that the company does not have an effective training policy. An equally important problem in this area is the companies inability to attract and retain talented and well qualified personnel.

ANALYSIS OF THE RESULTS

The results presented represent a significant number of problems throughout the organisation. Many of these problems are interrelated, and may not be problems in themselves, but symptoms of problems at other stages in the development process. For example, many people have identified lack of time and resource as a major problem however this could be due to bad planning or mismanagement.

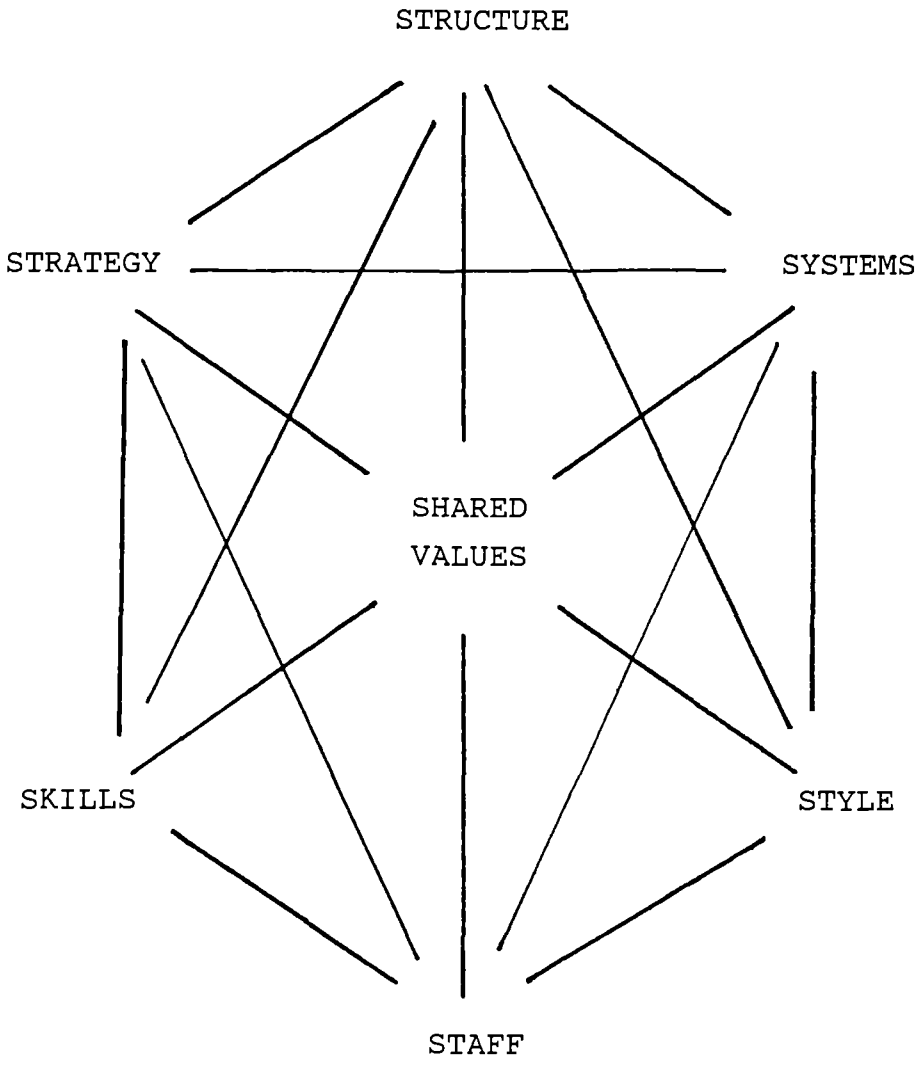
The results themselves represent the perceived problems with the organisation today. From these results several key areas of concern have already been identified. However these key areas will be biased and prejudice to the teams own personal preferences and perception of the problems (the results cover such a wide area that any "pet" problems could be pursued).

In order to look at the organisation in a more constructive way , and put the problems identified into perspective, it is essential that some form of model or framework is used that will encompass the whole organisation. This will allow the team to break down the problems and get a better understanding of the organisation.

A FRAMEWORK FOR ANALYSIS

The McKinsey 7-S Framework.

There are a number of analytical models or checklists of factors, that will allow us to examine efficient management practice. Probably one of the most popular in recent years is the McKinsey seven-S Framework.



(Source: Peters and Waterman 1982)

(This conceptual framework underpinned the book "The Art of Japanese Management" by Athos & Pascale, and was developed further by Peters and Waterman in "In Search of Excellence". More recently it has been used by Johne & Snelson to look at success factors associated with new product development.)

The seven S's refer to the following:

Strategy: The plan or course of action leading to the allocation of a firm's scarce resources.

Structure: The way in which the firm is organised, ie. the characteristics of the firms organisational chart.

Systems: How information is moved around the organisation, these "systems" will vary from formal reports and procedures to meetings etc.

These are probably the most familiar of the seven S's, the remaining four factors are known as the "soft" S's.

Staff: People qualities needed for the organisation, eg. entrepreneurs, engineering types.

Skills: The skills and capabilities of key personnel or the organisation as a whole.

Style: The pattern of behaviour of the top executive and senior management team; also the cultural style of the organisation.

Shared Values: The significant meanings or guiding concepts that an organisation creates in its members, this factor too is concerned with the culture of the organisation.

Any organisation is complex, and the idea of this framework is to help management develop a more effective way of perceiving and cutting through the complexity of their organisation. Athos and Pascale (from which the above has been adapted) describe these 7-S's as "indispensable parts of any corporate commitment to long term success".

As a team we feel it essential to break down the factors associated with success and the problems identified into this framework, this will allow us to:-

1. Simplify the complexity of the results from the questionnaire.
2. To obtain a better understanding of what action can be taken to resolve the problem areas.
3. Ensure that all areas of the organisation are considered, (ie. A global approach) in a structured and logical way.

The final section of this report reviews each of these seven-Ss individually.

STRATEGY

The new product development strategy and long term plan. Those goals and objectives which define the type of new products to be developed, the resources needed, the markets to be pursued, and the technologies to be adopted.

Results from the comparison tend to suggest that:

Everyone in the company is **not** well aware of the new product strategy, and the long term goals and objectives of the company.

There is a **poor** "fit" between the resources available and the new product development undertaken.

The sales department is **not** well targeted and does **not** have strong and aggressive sales force.

Market studies and the collection of market information do **not** play an important part in the development of new products.

Comments relating to Strategy generally indicate:

The need for a more meaningful new product strategy with more feedback and communication from the BPU.

Discussion

The new product strategy is a critical part of a firms overall corporate strategy. The plans, goals and objectives for new products must be carefully integrated with other planned changes to the organisation. Booz Allen & Hamilton, based on an in depth study of "best practices" in the management of new product development, concluded that successful companies will "implement a company specific approach, driven by corporate objectives and strategies, with a well defined new product strategy at its core". They argue that any formal new product procedure should begin with a clear NP strategy. Many writers have compared and researched how the various types of strategy vary with success in NPD.

Whatever the strategy followed it is essential that it is implemented effectively and communicated to key members of the organisation.

SKILLS

The specialist knowledge and techniques needed to execute new product development tasks.

Results from the comparison tend to suggest that:

Most people in the company do **not** have a good knowledge of the marketplace.

Our products are **not** always of a higher quality and more reliable than competitors products.

The launch of a new product into production is **not** always a smooth and efficient activity.

There **are** design "bugs" in the product as it enters production.

Activities such as prototype development and testing are **not** well undertaken.

Comments relating to Skills generally indicate:

A shortage of skills in:-

Prototype development and testing
Identifying market and customer needs
Innovative ability
New technology

Discussion

If we use Booz Allen and Hamilton's model of the innovation process, the skills required for new product development fall into seven main areas.

1. New Product Development Strategy
2. Idea Generation
3. Screening and Evaluation
4. Business Analysis
5. Development (including prototype development and design)
6. Testing
7. Commercialisation (Launch)

Most of the problems identified, from the questionnaire, fall into the last two stages of this process. This could be due to the lack of effort and clear objectives earlier on in the process. There is a definite need for more marketing information throughout the process, especially stages 2,3 & 4.

Not only are skills needed in the technical and development areas. It is equally important that communication skills, presentation skills, team skills etc. are recognised as an essential means of integrating the whole process.

SYSTEMS

Those coordination and communication mechanisms used to control and transfer information around the organisation.

Results from the comparison tend to suggest that:

A detailed market assessment is **not** always undertaken early on in the development of a new product.

A thorough study of customer preferences is **not** undertaken during the development stage.

There is **not** an efficient multi-disciplinary approach to the development of new products.

Market studies and the collection of market information do **not** play an important part in the development of new products.

There is **poor** communication between key internal groups.

Both internal and external communications are **not** effective.

Management planning techniques are **not** efficient and effective.

The development of new products does **not** run smoothly and is **not** well coordinated.

Comments relating to Systems generally indicate:

Timing and resources are possible two of the major problems caused by poor systems. The type of systems used to transfer and control new product information will also affect problems relating to communication, coordination, engineering changes, product approval, costing, and the new product teams.

Discussion

In the context of this report, "systems" refers to the way in which information is transferred throughout the organisation. In effect therefore the most relevant system will be the new product procedure. At the other end of the scale a more informal system would include team meetings. The systems and procedures used are very closely related to the structure of the new product organisation.

STAFF (PEOPLE)

The qualities of personnel needed to execute the new product development process.

Results from the comparison tend to suggest that:

The company does **not** have an effective training policy.

The company does **not** have ability to attract talented and well qualified people.

Comments relating to Staff generally indicate:

The need for a more effective approach to training and the ability to retain highly qualified personnel.

Discussion

Many of the skills needed within new product development can be developed through effective training programmes. More emphasis is needed on team skills, communication, time management as well as the technical skills needed. Other skills (especially high technology) may need to be "bought" in. People are the key to new product success and their attitude to the company and its members plays an essential part in new product success.

STYLE

The type of support given by, and characteristics of key managers involved in new product development.

Results from the comparison tend to suggest that:

The management style **cannot** be described as progressive and

open minded.

The management is **not** of a high quality professional and well trained.

Senior management do **not** openly support new product development.

Comments relating to Style generally indicate:

The lack of direction, leadership and commitment from senior management.

Discussion

Many recent studies have indicated the importance of style in managing new product development. Top management support does not need to involve making key decisions, indeed studies have shown that over meddling by top management causes delays and upsets the innovation process. Ideally top management's role should be based on creating an atmosphere of change and determining the strategic direction of these changes. Ideally top management need to support more risk taking and be more tolerant of the mistakes that will result from it.

SHARED VALUES (CULTURE)

Those guiding concepts or values that give direction to those involved in new product development.

Results from the comparison tend to suggest that:

Everyone in new product development does **not** have a clear understanding of user wants and needs.

There is **a lack** of open and honest communication between key

individuals and departments.

Our products are **not** highly innovative and new to the market.

Our products are **not** unique and superior in the eyes of the customer.

Our products do **not** have significant or unique advantages over competitors products.

Comments relating to Shared values generally indicate:

Innovative ability is one of the key problems relating to shared values, other problem areas include communication and attitudes.

Discussion

The shared values or culture of the organisation is probably the most important factor in new product success. It is often these factors that distinguish the successful innovating companies from the less successful. Yet the culture, or atmosphere of a company is the most intangible factor and it is also one of the hardest to change. Many studies have shown that an innovative culture is fostered by an openness and interchange between different units, function and operating levels in the organisation.

CONCLUSIONS

The questionnaire has identified a large number of problems both small and large in the organisation. This presents us with a reasonably accurate picture of how the organisation perceives itself today. The problems themselves form a complex and interrelated pattern. Breaking these down using the model has helped us to simplify some of that complexity and allowed us to make sure all aspects of the organisation are considered.

APPENDIX 1

Questionnaire distribution and response rates.

Group	Number Sent Out	Number Returned	Response rate	% with comments
Sales	5	5	100%	80%
Product Engineering	25	21	84%	100%
Manufacturing	50	17	34%	47%
Finance	10	10	100%	100%
Quality Control	10	5	50%	100%
Personnel	5	5	100%	60%
PIPE.	25	25	100%	80%
Purchasing	5	2	40%	50%
Executives	16	13	81%	92%
(Pilot)	(25)	(24)	(96%)	(92%)
Company	167	127	76%	85%

APPENDIX 2

Qualities perceived as **not** being present inside DEOC.

Numbers refer to the ranked order of priority.*

	QUALITY **NOT** PERCEIVED AS PRESENT	Company	Execs.	Sales	P.E.	PIPE.	Manuf.	Finance
1.	Most people in the company have a good knowledge of the marketplace.	1	1	8	5	3	1	2
2.	The launch of a new product into production is always a smooth and efficient activity.	2	8	14	1	2	2	5
3.	A detailed market assessment is always undertaken early on in the development of a new product.	3	3	13	4	7		9
4.	There are no design bugs in the product as it enters production.	4	4	10	5	5		3
5.	The sales department is well targeted and has a strong and aggressive sales force.	5			8	11	4	1
6.	The company has an effective training policy.	6	2	4	12	16	5	6
7.	Everyone in the company is well aware of the new product strategy, and the long term goals and objectives of the company.	7	6	16	7	1	7	
8.	There is a good "fit" between the resources available and the new product development undertaken.	8		9	2	20	3	
9.	Our products are highly innovative and new to the market.	9	5	12	10	13		
10.	The development of new products run smoothly and is well coordinated.	10				4	6	
11.	The company has the ability to attract talented and well qualified people.			11	3	6		4
12.	The management style could be described as progressive and open minded.			1		8		10
13.	The management is of a high quality professional and well trained.			2		15	7	
14.	Management planning techniques are efficient and effective.				11	17	8	

APPENDIX 2 (CONTINUED)

Qualities perceived as **not** being present inside DEOC.

	QUALITY **NOT** PERCEIVED AS PRESENT	Order of Priority: Company	Execs.	Sales	P.E.	PIPE.	Manuf.	Finance
15.	Our products are unique and superior in the eyes of the customer.		7	3				
16.	There is open and honest communication between key individuals and departments.			6		18		
17.	Both internal and external communications are effective.					19	8	
18.	There is good effective communication between key internal groups.					9		
19.	Everyone in new product development has a clear understanding of user wants and needs.					10		
20.	Activities such as Prototype development and testing are well undertaken.					12		
21.	A thorough study of customer preferences is undertaken during the development stage.					14		
22.	There is an efficient multi-disciplinary approach to the development of new products.					21		
23.	Market studies and the collection information play an important part in the development of new products.				9			
24.	Our products are of a higher quality and more reliable than competitors products.			5				
25.	Senior management openly support new product development.			14				
26.	Our products have significant or unique advantages over competitors products.			16				

* Numbers in columns refer to the order of priority of the qualities identified for each particular group. All the qualities represented in this table have a mean of three or more.

APPENDIX 3

Perception of problems within the organisation

	Number of problems identified with a mean of 3 or more.
Company as a whole	10
PIPE	21
Sales	17
Personnel	13
Product Engineering	12
Quality Control	11
Finance	10
Manufacturing	8
Executives	8

APPENDIX XXIX

Recommendations from the questionnaire survey

Delco
Electronics

To Mr J Johnston

Copies All Executives

INTERNAL MEMORANDUM

Date 12th. October 1987

Subject RECOMMENDATIONS - NEW PRODUCT INNOVATION

The attached report is a condensed version of the results obtained from the "Successful Product Innovation" questionnaire which was recently distributed to a sample of 168 staff from all disciplines, including the executives.

Could you please read this in detail as the results are significant and represent the concerns and attitudes about new product introductions.

The team would welcome the opportunity to discuss the study in full with the executive team. A favourable time may be the week beginning 2nd. November 1987, following the October shut down.

Organisation Development team

FORWARD

TITLES CAN MEAN MUCH OR LITTLE. THE TITLE OF THIS REPORT - "NEW PRODUCT SUCCESS - THE WAY FORWARD" - IS MEANT TO PROVOKE. THE CONCERNS REVEALED IN THE REPORT DEMAND TO BE CHALLENGED. THE FINGER POINTS AT ALL OF US.

THE REPORT REVEALS WEAKNESSES IN OUR NEW PRODUCT DEVELOPMENT AND INTRODUCTION, IT ALSO EXPLORES HOW WE THE MANAGERS OF DEOC MIGHT BE ENCOURAGED TO RECOGNISE AND SHOULDER OUR RESPONSIBILITY COLLECTIVELY AND INDIVIDUALLY, AND ENSURE THAT OUR ABILITY TO COMPETE IS NOT FURTHER ERODED.

THIS REPORT CONTAINS SPECIFIC SUGGESTIONS FROM THE "NEW PRODUCTS TEAM" FOR ACTION BY THE MANAGEMENT.

WE HOPE THAT THEY AND OTHERS TOO WILL GIVE THEM THEIR FULL AND SERIOUS CONSIDERATION.

FINALLY WE SHOULD LIKE TO THANK ALL THE MANY INDIVIDUALS, TRAINING ORGANISATIONS, COLLEGES, UNIVERSITIES AND ELSEWHERE WHO GAVE THEIR TIME.

CONCLUSIONS AND RECOMMENDATIONS

1. Delco Electronics future international competitiveness and economic performance will be significantly influenced by the speed with which substantial improvements can be made in the time scale and effectiveness of new product introduction.

2. The new product innovation team investigated the main factors which influence new product development successes within the company. The main factors studies covered the whole element of successful new product development (NPD) including a) STRATEGY b) STRUCTURE c) SYSTEMS d) STAFF e) SKILLS f) SHARED VALUES and g) STYLE.

3. STRATEGY

   a) Formulate strategy for DEOC over next five years to include:-

      People development
      People needs
      R&D / technology needs
      Funding required
      Customer wants and needs

   b) Clear communication of strategy to the whole of the work force.

c) Detailed plans to be drawn up based on strategy for the whole organisation, individuals and departments.

4. STRUCTURE

a) The team would recommend the planning and introduction of Simultaneous Engineering within the very near future.

b) The study revealed a serious concern in terms of general accountability and responsibility for NPD and its introduction. The report covers the detailed concerns raised during the course of the study. The recommendation from the team would be the introduction of a Programme Manager for all new product development and introduction. This position could be covered by the head of "Simultaneous Engineering".

c) The study highlights a lack of direction among the "New Product Teams". The recommendation would be the appointment of individual chairmen for each team. The chairmen would report into the "Simultaneous Engineering" organisation.

5. SYSTEMS

a) The study reviewed shortfalls and reasons for

missing laid down target dates during new product development and introduction. One major concern was the existing tracking system. This consists of a single PC. located in the Supply department. The team recommend an investigation into the adoption of a full project management software package, capable of being loaded on to the existing HP3000 mainframe computer. Access to inputting and retrieval of information could then be viewed plant wide.

b) Due to problems exposed during the study, an urgent review is required in the need for implementing a re-training programme on the "New Product System".

c) The team recommend a complete review of the Sales Enquiry Form (SEF) system.

6. STAFF

a) The report highlighted a demand from all sections of engineering staff for a greater training and re-training. The team studied a recent government report on attitudes to training within industry (A Challenge to Complacency). Many of the findings criticised the general attitude of management to training, some of these concerns are reflected in DEOC. As a result of these findings we are

recommending the setting up of an "Open Learning Centre" within the plant. This centre will facilitate and coordinate a training strategy covering engineers, skilled traders and direct operators. The "Open Learning" approach is a new concept within the training field. Results so far on pilot schemes within the plant have far out reached our level of expectations.

b) Develop fixed salary structure that will motivate existing personnel and attract and hold future engineering requirements.

7. SKILLS

a) In terms of the Business Planning Unit (BPU) we would recommend a review of the role of the unit with priority being placed on:

1. The customer
2. Resources required
3. Validation
4. Capital required
5. Return on investment

b) The new product manager (4b) takes responsibility for carrying out the decisions of the BPU.

8. SHARED VALUES

a) Increase commitment to the customer.

b) Increased involvement of hourly paid employees on new product teams.

c) Increased publicity re new products to the work force and suppliers.

d With the advent of increasing higher technology in terms of new equipment coming into the plant, increase the involvement of the skilled trades at the early stages of equipment design.

e) Recommendation for cross fertilisation across all departments, with individual presentations. A successful example of this is the use of "improving" programmes used by British Airways. They introduced a corporate programme named "A day in the life". This is a programme for all the airline staff and it examines the way in which British Airways goes about its business. On each event the staff a series of theme presentations to learn more about the many different parts of the company.

The philosophy is that staff who have a greater awareness and understanding of the business should be able to provide a higher professional standards

of service. Messages delivered on their programme are reinforced and the concept of teamwork is encouraged. This type of programme could be adopted to any type of concept.

f) In terms of gaining extra commitment form the hourly work force, visits should be arranged to suppliers and local motor manufacturers.

9. STYLE

The "style" of the company is strongly influenced by senior management. Many recent studies have indicated the importance of style in managing new product development. Top management support does not need to involve making all the decisions, and indeed some studies have shown that over meddling by top management causes delays and upsets the innovation process. Ideally top management's role should be based on creating an atmosphere of change and determining the strategic direction of those changes.

a) The team would recommend the continuance and expansion into differing fields of the existing "management team development training".

b) If the style of the company is to change, all employees need to be more involved, responsible and accountable.

APPENDIX XXX

Responsibility for implementation of the recommendations

RECOMMENDATION	DETAIL OF ACTION	TARGET DATE	RESPONSIBILITY
STRATEGY	1. Develop Strategy. 2. Close communication of strategy to the whole of the work force.		J R HIGHAM J JOHNSTON
STRUCTURE	1. Implementation of interactive engineering (simultaneous eng.) 2. Introduction of Programme Manager. 3. Appointment of individual "new product team" chairmen.		D FIRTH C LABOSKY D FIRTH C LABOSKY
SYSTEMS	1. Introduction of a "real time" project management software package. 2. Retraining on the new product procedure. 3. Review of SEF procedure.	APRIL 1988 JAN 1988 MARCH 1988	OD. TEAM J JOHNSTON I BARCLAY
STAFF	1. Set up "open learning centre".	MAY 1988	J JOHNSTON

	2. Develop flexible salary structure.	MAY 1988	J JOHNSTON
SKILLS	1. Review the role of the "Business planning unit.		R H McHATTIE
SHARED VALUES	1. Increase commitment to the customer 2. Involvement of hourly paid employees on new product teams. 3. Increase involvement by "service" departments at the early stages of new equipment design. 4. Increase cross fertilisation across all departments. 5. Gain extra commitment from hourly work force. 6. Involvement of hourly paid employees on OD. team.		OD. TEAM J JOHNSTON P WARD OD. TEAM OD. TEAM J JOHNSTON
STYLE	1. Continuance and expansion into differing fields of the existing "management team development" training	ONGOING	J JOHNSTON