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THE MANAGEMENT OF DIVERSIFICATION

IN A

LARGE INDUSTRIAL COMPANY

Martin John Callaghan

A Thesis Submitted for the Degree of Doctor of Philosophy

The University of Aston in Birmingham

October 1982

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SUMMARY

This work is the result of an action-research-type study of the diversification effort of part of a major U.K. industrial company.

Work in contingency theory concerning the impact of environmental factors on organizational design, and the systemic model of viable systems put forward by Stafford Beer form the theoretical basis of the work. The two streams of thought are compared and found to offer similar conclusions about the design of effective organizations. These findings are taken as the framework for an analysis both of organization structures for promoting innovation described in the literature, and of those employed by the company for this purpose in recent years. Much attention is given to the use of venture groups, and conclusions are drawn on particular factors which may influence their success or failure.

Both theoretical considerations, and the examination of the company's recent experience suggested that the formation of the policy of diversification, as well as the method of implementation of the policy, might affect its outcome. Attention is therefore focused on the policy-making and planning process, and in particular on possible problems that this process could generate in a multi-division company.

The view finally taken of diversification effort is that it should be regarded as a learning system. This view helps to expose some ambiguities in the concepts of success and failure in this area, and demonstrates considerable weaknesses in traditional project evaluation procedures.

Key words: Diversification; Innovation Management; Venture Groups;
Business Policy

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CHAPTER ONE

THE BACKGROUND TO THE PROJECT

OUTLINE

When compared with the great majority of postgraduate research IHD projects appear rather unconventional. The department itself, the kind of problem its students tackle, and the way in which the problems are tackled are all relatively unusual. In the case of this project, the potential confusion arising from this situation is compounded by the fact that the sponsor is a large, multi-division organization, with many layers to its structure.

Given this state of affairs, it seems sensible to begin the story of the project by providing some explanation of the environment in which it was conducted.

1.1 ABOUT I.H.D.

The University of Aston Interdisciplinary Higher Degrees Scheme (IHD) was established in 1968 following the Swann Report which recommended that means be found to encourage closer co-operation between Universities and Industry. The particular contribution that IHD makes to this objective is to establish and co-ordinate a wide range of projects sponsored by industrial and commercial organizations, to be undertaken by postgraduate students. As an entirely research-oriented department, IHD takes on students in three streams. Those in the Interdisciplinary PhD Stream may be pure or applied scientists or social scientists who work on projects of all types. The Total Technology Stream is open to those with an engineering or physical science background who intend to remain as engineers or technologists. The projects undertaken consequently tend to have an engineering bias. Finally, the Industrial M.Phil Stream provides projects of a shorter duration for students from a wide range of disciplines whose future career may be in any business function.

Projects are welcomed not only from industrial companies but from organizations of all kinds. IHD project sponsors have included local and central government, public utilities, charities and so on. To be accepted, projects have to meet two basic criteria. They must address problems of genuine practical relevance to the sponsor, and they must provide sufficient scope and originality to form the basis of a research thesis.

Appropriately for a collaborative project, time is split between sponsor and University. At least one third of the student's time is

spent doing practical work within the organization and one third in the University at lectures, visiting the library and in discussion with supervisors. The remaining one third is split between the two in whatever proportion seems appropriate in each case.

Within the University IHD arranges an element of "core" coursework, especially for the Total Technology Students, but does not regard itself as a teaching department in the normal sense. A distinctive feature of the scheme is that its students attend lectures in other University departments, wherever relevant expertise is to be found. Furthermore, the research is supervised by a member of the University department most appropriate to the project. IHD staff are not generally responsible for the academic supervision of students, but act instead as co-ordinators in the management of projects. In addition, the interdisciplinary emphasis which is central in IHD almost invariably means that departments other than that of the main supervisor have a contribution to make. Consequently members of these departments may also be invited to participate in the project as Associate Supervisors.

In order to ensure that all the various parties should agree on the direction the project ought to be taking, a supervisory team is established for each project. This consists of the Main Supervisor, the IHD Tutor responsible for the project, an 'Industrial Supervisor' representing the Sponsor, and any Associate Supervisors from other University departments. The intention is that the supervisory team meets regularly to review progress. The Student is also expected to maintain informal contacts with the members of the team between meetings.

This structure can be unwieldy, but seems to be necessary given the broad range of objectives IHD seeks to achieve. It does mean however that the co-ordinating role of the IHD Tutor is an important and potentially difficult one.

1.2 ABOUT DUNLOP

In the case of this project, the sponsoring organization was Dunlop Ltd.'s Engineering Group in Coventry. Dunlop is well known for its tyre, bedding and sports goods interests, but Engineering Group produces mainly intermediate goods sold to other manufacturers. An indication of the structure of the company at the beginning of the project, showing in particular detail the organization of Engineering Group, is given in Fig. 1.1.

Because Engineering Group does not sell directly to the consumer, its products are not generally well-known. Nevertheless it has developed some successful new products, including the disc brake and the hydroelastic suspension. Recently it achieved a considerable technical success in its design of the braking system for Concorde, although the inability to find other uses for the technology has limited its commercial impact.

Despite these successes, the long-term future of Engineering Group is in doubt because of structural changes in the economy. BL is the major customer for wheels and suspensions, and although their performance has improved recently, it is well known that they have lost a considerable share of the car market in recent years. Similar considerations apply to the Aviation business. The British aircraft industry has suffered

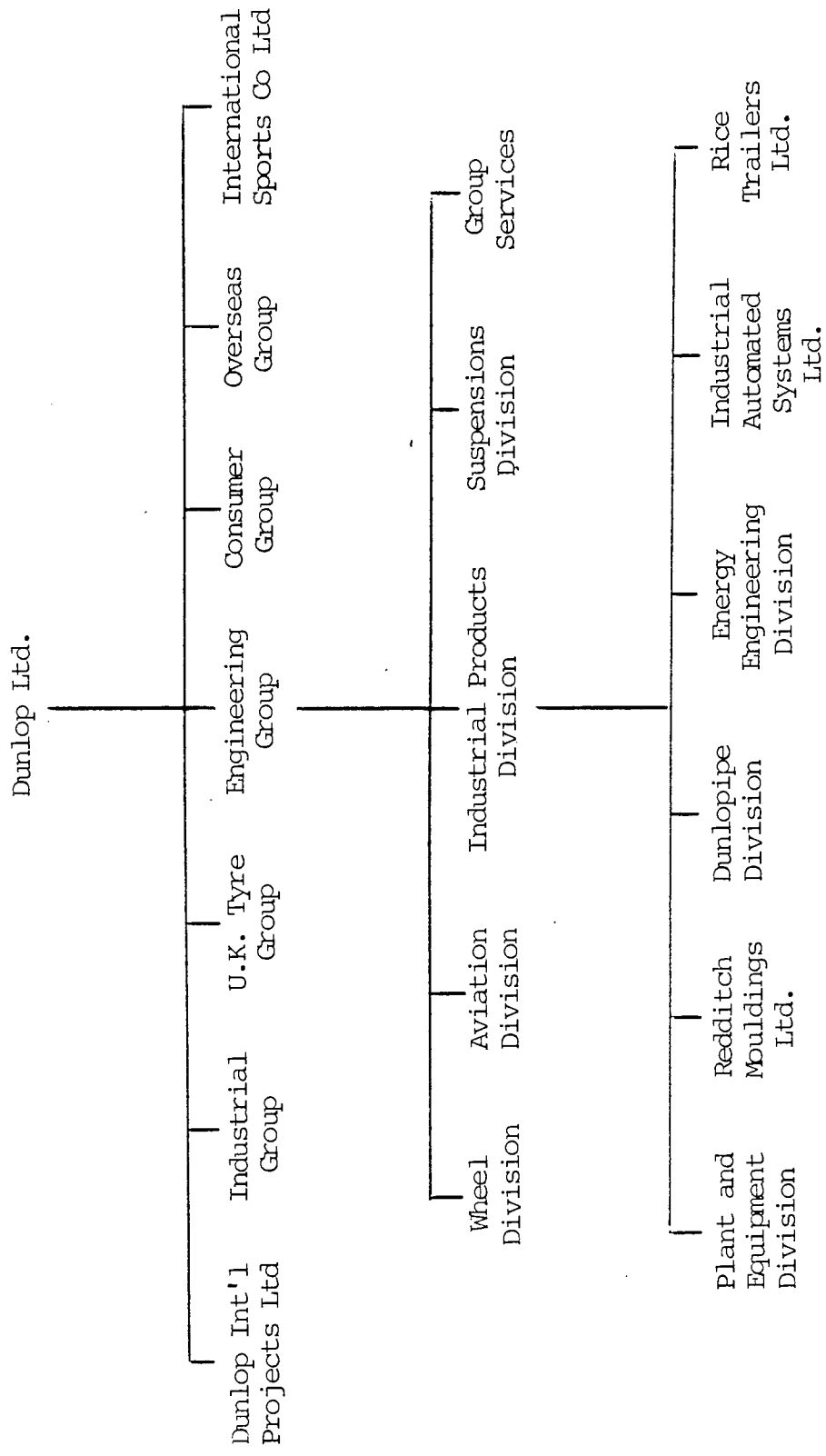


FIG. 1.1.1

DUNLOP LTD. - ORGANIZATION STRUCTURE

considerable decline as competition from the United States and Europe has increased. In particular, the cost of developing new aircraft is so great that co-operative ventures between European manufacturers have become increasingly common. In these circumstances, contracts for the supply of components become subject to political and strategic considerations, as well as depending on the usual factors of price and quality. In fact Aviation Division succeeded recently in obtaining its first US Military contract, although some uncertainties remain.

The reason for giving this background is to introduce the division in which this project was undertaken - Industrial Products Division. This was a kind of umbrella under which several different businesses were jointly managed. These were of two kinds. Firstly there were Plant and Equipment Division and Redditch Mouldings Division, which both had old-established product lines in need of rejuvenation. Secondly came Dunlopipe Division and Energy Engineering Division. These were new businesses in markets unfamiliar to Dunlop. Their purpose was to provide a vehicle for the development of innovative activity in the Group, in markets that would be more secure than those of Aviation, Wheels and Suspensions. It is thus with Dunlopipe and Energy Engineering, together with Industrial Automated Systems, (a small electronics company newly acquired by Dunlop), that this project is mainly concerned. These three names recur repeatedly in the course of this study, so a little more detail on each is introduced here. The comments are intended only to be descriptive. A more analytical discussion of each division appears in Chapter 2, and in the Appendices.

Dunlopipe Division

'Dunlopipe' was the name given to Engineering Group's new development in pipeline technology. The main structural component of the pipe was steel ribbon which was wound helically onto a cylindrical form called a mandrel. In the manufacturing process, the mandrel was first coated with a release agent, then with an Araldite-like resin compound. A layer of steel ribbon was then wound on, and clamped at both ends. The process was repeated with a layer of resin and a layer of steel, ending when the pipe was of the required strength with a final coat of resin, which had the effect of glueing the steel in place. Several advantages were claimed for the new pipe. For example it was light relative to its strength, making it easy to transport and install. Its smooth internal finish gave it a particularly low flow resistance. In addition, the resin coating inside and out made it resistant to both harsh external environments and to corrosive fluids flowing through it. It therefore offered the corrosion resistance of plastic and GRP (Glass Reinforced Polyester - a kind of fibreglass pipe), with the strength advantages of steel.

In market terms, Dunlopipe is a rigid, large diameter pipe system. Pipes of this general description find uses in many industries, although the most important applications are in irrigation and drainage, water supply and sewage disposal, the oil and gas industries and in industrial process plant. Competitive pipe materials are concrete, ductile iron, PVC, GRP and steel. It was realised at the outset that Dunlopipe would not be able to compete over this whole range. For example asbestos cement, used in irrigation, is cheap and easily manufactured in the country where it is required. At the other end of the scale, the Dunlopipe technology was not sufficiently

advanced to cope with the problem of joining the sections of pipe at high pressures. This effectively prohibited entry into the oil and gas industries at least in the short term. The intention was therefore to compete at the lower and middle range of pressures and to offer pipe in the range of 200mm to 2000mm diameter.

Dunlopipe Division was established in 1977 and after a period of development and testing the official product launch was in April 1978 and the first order obtained early in 1979.

Energy Engineering Division

Energy Engineering Division (EED) had its origins in 1970 when Engineering Group's development workshop began to investigate burners for natural gas. The burner eventually designed, which was called 'Thermimax' had the characteristic that it produced a long, thin, highly stable flame that burned fuel very efficiently. Indeed, it is the only such burner to have received a Design Council award. It was realised, however, that the burner would not support a business on its own, and two further developments followed. The first was to design two products - a tank heater and a radiant tube heater - which incorporated the burner. The second was to expand the product range by buying in conventional industrial warm air heaters from Europe and reselling them. These three products were seen as being sufficient to start up a viable industrial heating business, and EED was established in 1976. The business was divided up along product group lines, the basic distinction being between process heating and environmental heating.

Process Heating had two aspects, the sale of individual burners for building into ovens, and the sale of tank heaters. Tank heaters operate on the same principle as an electric kettle - that of a heat exchanger element immersed in a liquid. In this case the difference was that the element was hollow, with a burner firing a thin flame down inside it. At the far end of the tube, a fan extracted the hot exhaust gas. The burner and fan were fairly standard in each case. Each heat exchanger was individually made, its design determined by the size of the tank.

Environmental Heating involved the sale of the warm air heater and the radiant tube heater. The warm air heater simply had a metal core heated by a row of gas burners. A fan blew air across the hot core and out through a grill. The radiant tube worked on the same principle as the tank heater - a steel U-tube with a burner at one end and a fan at the other. The tube heated up, but this time a reflector directed the heat down to the workshop below. This form of heating was becoming increasingly popular, both because it was fuel efficient and because the heat could be directed where required.

Energy Engineering Division looked set to become profitable for the first time in 1979-80. It was also unusual in that it was located in Rugby, rather than on the Engineering Group site at Coventry.

Industrial Automated Systems

IAS was one of two acquisitions made by Engineering Group in 1978. Situated in Lichfield, Staffs, IAS's principle business is in manufacturing electronic control equipment for process plant of all kinds. Two examples are the control panel for the cooling plant of a Russian chemical works, and a control panel for an Irish power station.

An unusual feature of IAS's position in this market was that they designed and manufactured each unit individually for each customer. Their competitors typically produced a range of standard equipment that was either accepted by the customer or modified to suit. IAS would build to the customer's specific requirements.

The Company's traditional skill was in building electromechanical or 'hard-wired' control desks, but they had come to realise that the demand in future was likely to be in microprocessor controlled 'programmable logic' units. They had therefore negotiated a distributorship agreement with a major supplier of this type of component, and were increasingly building them into their designs.

IAS had one further, rather specialist, business. This was to manufacture industrial gas igniters. These are rather similar to domestic electronic gas cooker lighters, consisting of a long steel tube with an electrode down the centre. The tube was inserted into a gas-fired furnace, which could then be ignited by a spark from the electrode.

At the time of the study IAS were facing two problems, both on the electronics side. First, their workshop area was too limited for the

business they were doing. Second, the changing technology had increased the demand for electronics engineers and designers. They were able to negotiate the purchase of a larger factory, but had not been able to attract the new skills required.

1.3 THE STRUCTURE OF THE THESIS

Finally, in this chapter it is worth making some remarks about the structure of the thesis. A distinction is made here between 'the project' and 'the research', which is regarded as a subset of the project.

In order to understand how the particular area of study came to be selected, it is necessary to appreciate the course the project took in its early stages. This is discussed in Chapter 2. The subsequent Chapters (3 to 7) are then structured more along the lines of a conventional piece of research, with the research findings set out in Chapter 7. Finally, Chapter 8 offers some reflections on the project in total - as a learning experience, as well as a piece of postgraduate research.

A diagrammatic representation of this structure is given in Fig. 1.2.

FIG. 1.2

STRUCTURE OF THESIS

-
- "THE PROJECT"
1. The Background to the Project
 2. How the Project Developed
 3. Some Issues in Organizational Design
 4. Methods of Managing Innovation
 5. Organizing for Innovation in Engineering Group
 6. The Nature of Policy-Making in Business Organizations
 7. Some Conclusions on the Management of Innovation
- "THE RESEARCH"
8. The Outcome of the Project

CHAPTER TWO

HOW THE PROJECT DEVELOPED

OUTLINE

This chapter gives a roughly chronological account of the conduct of the project.

It begins with what I have called a 'model' IHD project which is intended to put the subsequent account of events in context. The discussion shows how the form of the project moved substantially away from the model structure - an issue which will be explored in more detail in Chapter 8.

(a) A Model I.H.D. Project

One of the ways in which IHD projects differ from 'conventional' research is that it is generally recognized that the problem as originally presented is a symptom of some other problem whose true nature will only gradually emerge as the student becomes more familiar with his company and his new subject area. For this reason the first year

"should be a time for exploration, a time when there is room for the occasional blind alley, and also for examining what has been done elsewhere that might throw light on the path to take. Long shots can be tried and the whole area can be thought around so that by early summer, focussing can begin in earnest" (1).

After this experimental first stage, comes the next step in project development. The last line of the quotation gives the key to this - "focussing can begin in earnest". Six to nine months after starting the project the student will begin to appreciate what the nature of his company's problem really is. Although continuing research will shed new light on the subject, he will be able to define with some accuracy what exactly his study is about (see Fig. 2.1). This is a necessary development because it restricts the field that the student has to research. Time is limited and it is important to know what kind of information is going to be relevant to the project and to devise appropriate research methods. The earlier one defines the problem, the more likely it is that a solution can be worked out.

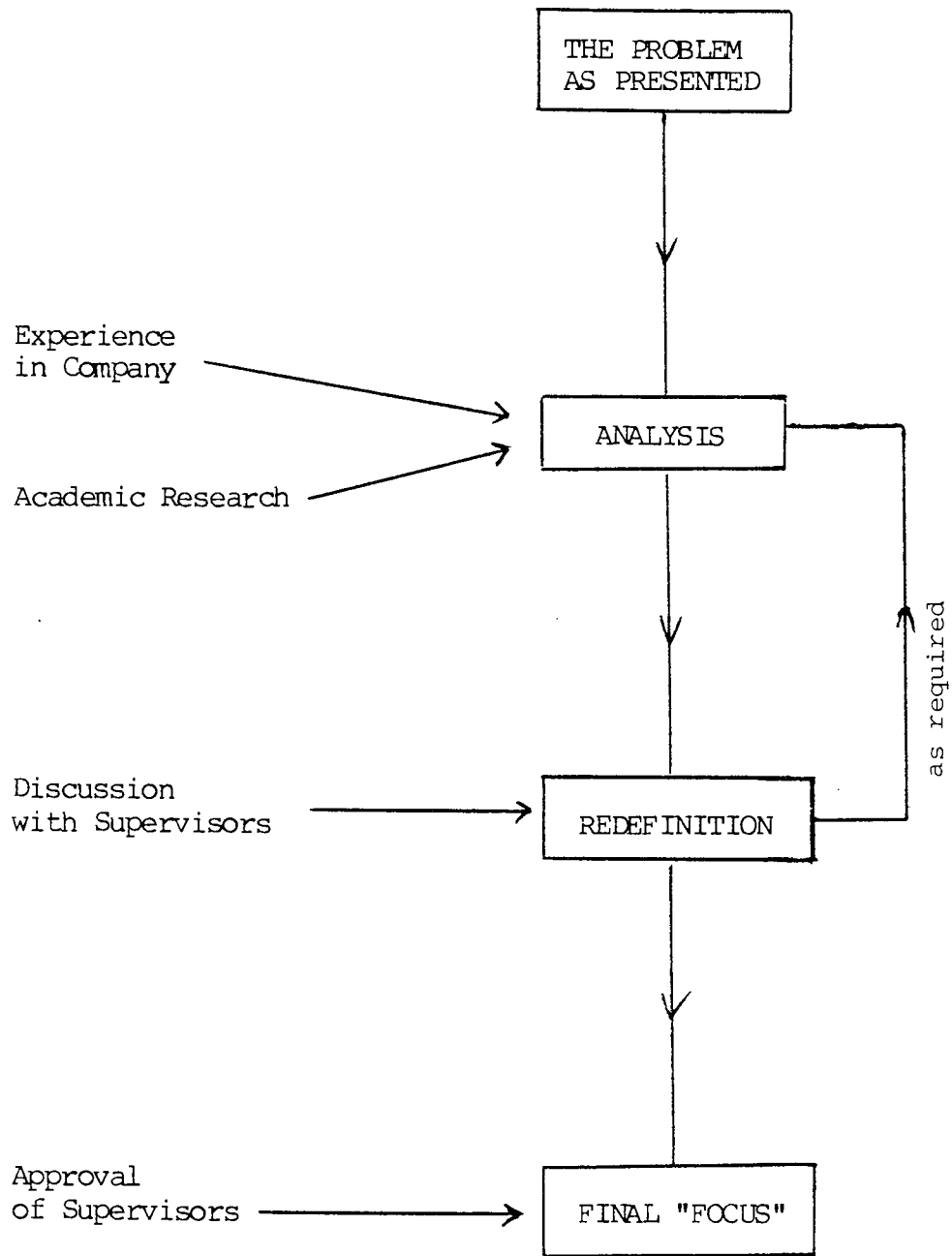


FIG. 2.1

THE "MODEL" PROJECT - EARLY STAGES

By the end of the second year, the bulk of the research should have been completed and the student should have a fairly clear idea of the final structure of his thesis. The process of writing up will almost certainly reveal weaknesses which can be corrected by limited further investigation in the final year. The objective is that

"at the end of the day, the firm should have a series of manuals and drawings on how to do things, and if possible, a new product or range of products. The University will have some general lessons on how things work in practice, and authentic case-study material" (2).

This is achieved by the total process of gathering data, reporting findings and interpreting the results.

As with any ideal structure, it is unlikely that any actual project conforms exactly to this pattern. Nevertheless, it is important to understand it because it serves two functions. The first is to define in advance the objectives against which the final results of the project will be assessed. The second is to set out a timetable by which the student can judge the progress he is making. The IHD tutors make every effort to encourage students to conform to the model and there are formal review procedures which reinforce it. I.H.D. themselves have published a chart showing the schema of this kind of ideal project, which outlines the plan of a model thesis. A version of this is shown for illustration in Fig. 2.2.

As the following sections show, my project did not take shape in this way. In fact, its development was sufficiently different as to cast doubt on the value of the methodology implicit in this 'standard model', or at least to question its generality.

PLAN FOR A MODEL I.H.D. THESIS

Chapter

1. Project Background
 - the project as presented
 - the issues identified
 - the value system interpreted
2. Review of Literature
 - on issues identified
3. Research Design
 - how from 1 & 2 topics were selected and why
4. Experimental Work
 - methods
 - data gathered
 - analysis of results
5. Results
 - significance for problem-owner
 - synthesis for new design
6. Discussion
 - significance of results in general context and in light of literature
7. Further Work
 - remaining knowledge gaps and why they should be tackled
8. Implementation
 - recommendations made to problem-owner and what happened
 - evaluation
9. Comment
 - thesis process
 - what has been learnt
10. Conclusions
 - contribution made to knowledge

(b) Dunlopipe

When I joined IHD, there seemed to be no doubt about what the project entailed, and I was given the working title 'Marketing and Materials Procurement for Wound Pipe Manufacturers'. Dunlop had developed a new kind of pipe, made mainly of steel, resin and fibreglass matting. The company thought that it would be competitive in a particular range of uses. If they could make it more cheaply, it would be able to compete more widely and the potential market would be increased. My task would be to find the cheapest sources of materials and the cheapest method of combining them, given certain quality and performance constraints - an exercise firmly rooted in my own first discipline of economics.

I first visited Dunlopipe Division in May 1978. It was still very much concerned with development rather than production for sale. Trial lengths of pipe were being produced on a secondhand GRP filament winding machine which had been modified to wind steel. These lengths, which were made up of various different combinations of steel, resin and fibreglass, went mainly for test. The only other facilities that the division had at that time were a small test area and a trial loop of pipe on the shopfloor.

This initial visit was made with the Group Training Manager and it was not until after the graduate induction week when I joined the company in October that I met any of the Dunlopipe personnel. On the last day of that week, Dr. Derek Newton, who was manager of the division at the time, met me at the training school. He confessed that my arrival was somewhat unexpected but he thought that he could find me something to do. As it turned out, this 'something' was to read through masses of literature about DUNLOPIPE and little else.

In the course of this reading it became apparent that a former employee of the division had been doing work very similar to that I had planned. He had written a computer program which, given the technical specification of each class of pipe and the cost of each raw material, would calculate the cheapest way of making the pipe. It seemed that provided one bought the materials as cheaply as possible, the original problem I had been set was solved.

As part of the development of Dunlopipe's marketing strategy, the division had looked at manufacturing the pipe abroad. It was thought that this might be done in two ways: first, as a joint venture in association with an established overseas company; second, and more novel, to pack the production equipment into containers and ship it out to the site where the pipe was to be laid. If this were done, there would not only be problems of obtaining raw materials but a complete production site would be required. Living and working accommodation, food and water, power and so on would all have to be provided. Although professional engineers from Dunlop would supervise the work, local labour would be needed too.

Nevertheless, this seemed an interesting proposition from several points of view. One of the most important was that it would allow Dunlop to keep full control of the manufacture of the product. In addition, much of the transport cost associated with sending completed pipe abroad would be avoided. Finally, such a scheme might be attractive to overseas governments if it could be shown that local materials and labour were to be used. Clearly, with the unit capable of being taken anywhere in the world, the problem of finding the least cost combination of inputs would be considerable. It was therefore suggested by Dr. Newton that I should look at this problem alongside

Assistant Marketing Executive Mr. Mike Graham who had done a considerable amount of groundwork for this plan.

Almost immediately after I had begun to look at what Mr. Graham had done, Dr. Newton announced that he was leaving Dunlop to set up in business on his own. He told me privately that part of the reason for keeping me reading up on the background for so long was that he did not want to start me off on something that his successor would immediately change.

Although Mr. Eric Skidmore took over as Manager of Dunlopipe Division on Dr. Newton's departure a month later, my new industrial supervisor was the division's technical expert, Mr. Philip Cocks. Mr. Cocks knew little or nothing about I.H.D. or my role in the company. He was also highly sceptical of my being able to do anything constructive within Dunlopipe that would be worth a Ph.D. At this time, the full scale production machinery was being installed and commissioned and I felt that he saw me as a headache he could do without.

Mr. Cocks's view was that Dr. Newton's priorities were the wrong way round and that I would do better to spend my time looking at the potential overseas joint ventures that Dunlop was planning. In particular, it looked as though the pipe might be produced in the United States and the Middle East, possibly in Saudi Arabia. Of these, the American venture was the more imminent. Could I therefore find out what it would cost to set up a factory there, what materials were available and at what cost, and where the factory should be.

I began this exercise by visiting the British Overseas Trade Board Library in London. I wrote to numerous suppliers of steel and fibreglass in the United States. I also spoke to Mr. John McManus,

Marketing Vice-President of the newly-formed Dunlopipe Inc. on a visit to Coventry from America. It rapidly became evident that the discussions on producing DUNLOPIPE in the U.S.A. were going to be concluded before I had any contribution to make. In addition, although there was disagreement as to where the cheapest steel in the world was to be found, it was certainly not in the United States. Even if it were, the prices that companies were quoting for the purposes of a paper exercise were no guide to those that they would offer for actual orders for large quantities of steel, all of which made my efforts rather irrelevant.

It was by now the end of January, and apart perhaps from identifying some new sources of information that the division might use, I felt that I had done nothing useful. Nor did it seem likely that I would as things stood.

During the four months I had been with the division, however, a great deal had happened. Full scale production pipe of an acceptable quality was being produced and for a number of weeks 'the first order' (which was often discussed) looked about to be landed. Pressure test facilities were being constructed for large diameters of pipe and new mandrels were being ordered. Offices were changed around and personnel arrived and left.

Although much was happening, it could not be said that, taken overall, things were going smoothly. As a newcomer to manufacturing industry I found this surprising, at least in the degree to which it was true. It seemed to me that the division had problems with the product itself, with the market and with its own organization. I therefore spent the rest of my time at Dunlopipe trying to understand their causes and effects.

By now I had been round the 'redefinition' loop several times, and felt that I was still no further forward. The original problem had already been tackled by someone else (and in retrospect, would not in any case have yielded a worthwhile study); the near-site operation was too far distant for an examination of it to be meaningful; a review of the American joint venture had the opposite drawback - the company could not afford to wait three years for the conclusions.

What I had observed was that Dunlopipe was facing difficulties in many respects. These are fully detailed in a report which I produced on the division in May 1979. (See Appendix A for the complete text, Appendix B for the summary version submitted to the company.) Briefly, the conclusions were that:

- 1) The pipe was suffering from a number of technical defects which severely limited both the total potential market and the likely rate of diffusion.
- 2) The production technology was inadequate to the task of producing pipe in volume.
- 3) The marketing strategy had not been thoroughly thought out.
- 4) Allocation of funds was inadequate and uncertain.
- 5) Communication within the division was poor.

The scale of these problems made me think about the question of developing new products in general. Perhaps it was the case that such difficulties were not unique to Dunlopipe, but were just symptoms of an infant business. I therefore proposed, in a memo of February 1979 that I should study Engineering Group's other new product divisions. This plan was agreed to by the supervisory team, and I now felt that my project had found its focus and was on the correct course.

(a) Energy Engineering and I.A.S.

As I was now working at a more general level, it was felt that I ought to have a new Industrial Supervisor. This was Mr. Jon Bayliss who was, at the time, working for Industrial Products Division General Manager Mr. David Air on evaluating new business proposals. In consultation with him, I drew up some new plans for the project. These involved working in the other sub-divisions which together made up I.P.D. Mr. Bayliss had himself previously worked at Energy Engineering Division (EED), so he arranged for me to visit there first.

I was at EED in Rugby during the summer of 1979. My experience at Dunlopipe had suggested that working to the normal IHD pattern of three days a week at the company and two at the university was unsatisfactory because company employees who were not familiar with the scheme found this lack of routine disconcerting. It tended to reinforce the idea that I was 'not one of them' and prevented my becoming properly involved in the business. Given this feeling, and the fact that the EED Manager had a particular job that he wanted me to do in return for his co-operation, it was agreed that I would work in the division every day for three months.

This was an extremely successful period as far as it went. My task was to create a servicing department to back up EED's manufacturing operation. This I did, and I was responsible for running it for a time (which included travelling to visit customers whose equipment was faulty and occasionally doing the commissioning and servicing jobs

myself!). In return, I had access to all the information I asked for. I was first an observer, then a participant, in the weekly management meetings, and I was able to talk freely with all the staff.

At the end of the three months, I found that I had case-study material that was as different from Dunlopipe as it could be. As I had with Dunlopipe, I wrote up a report on Energy Engineering (see Appendix C) and presented it to Mr. Air as part of a longer review of the project. He described it as 'quite useful and helpful', which gave me further encouragement.

According to my schedule, I was now due to spend about three months working on a review of the literature on innovation. To date, I had done rather little on the academic side except in the field of Civil Engineering. This was the department (through its connection with pipes) to which I was attached at the beginning of the project. Looking back, it is quite clear that the Civil Engineering department was never the right 'home' for the project, but since the relevant expertise seemed to be lacking in the university, there had been no compelling reason to change the original position. Now that I was working full-time at Aston for a period, however, it was felt that in the absence of a wholly appropriate supervisor, I should receive academic supervision directly from IHD.

My view of the literature was deliberately restricted as it quickly became apparent that a thorough survey was impossible. Research on innovation covers subjects as diverse as the generation of new product ideas, the management of R&D and the effect of innovation on economic growth and development.

Since my objective was to improve the chances of a large company

successfully introducing new products, I came to the conclusion that I should concentrate on studies which looked at factors leading to success or failure in innovation. There was, however, one other point that seemed to be important. Why was it that there was a problem of innovation at all? Why was it treated as a separate issue in its own right?

After two months of studying, I felt that the conclusions reached in the literature tallied well enough with the subjective impressions I had gained from my own experience. It seemed that I could produce a synthesis of the two that might be useful to the company. I therefore prepared an 'Interim Project Report' which contained some of my initial ideas for doing this. The report was submitted to both industrial and academic supervisors at a Review Meeting in February 1980.

It was agreed at this meeting that I should continue my studies of the various divisions. Mr. Bayliss had now moved to Industrial Automated Systems Ltd. (IAS), and it was arranged that I should begin there in March. The terms would be the same as at Energy Engineering Division - a three-month stay with a particular job to do.

The thinking behind this move was founded on a particular implicit understanding of the problem I was studying. Each of these divisions represented an innovative activity in that they were operating in technologies and markets of which Engineering Group had no experience. They were therefore concerned with diversification as well as innovation. The question was, if the company decided to enter new businesses was it better to do it by development from within or by acquisition.

My task at IAS was to examine the buying, stock control and goods

receiving procedures which were felt to be inadequate. Again I found that working full-time in the organization, even temporarily, I was able to learn a great deal. Again I produced a report on the division and sent it to Mr. Air (Appendix D).

(b) The Strategic Study

Although I was undertaking specific tasks in each of these divisions, I was also learning about Engineering Group as a whole. In particular, I was interested in finding out about why the particular product areas had been chosen for diversification. Whilst the internal workings of the new divisions were obviously important to their success, it seemed that the strategic issues might be of equal significance.

During a meeting with Mr. Air, I put this point. He said that the Group had undertaken a study to look into the future and identify likely areas for growth. The following were uncovered:

(1) Pipelines

There was evidence, particularly from the United States, that pipelines were becoming more and more competitive with more conventional forms of transport. As an example, it was only more expensive per ton mile to move coal by pipeline than by train because the railroads were subsidized.

(2) Energy

The recent events of the 1973-74 oil crisis were making everyone aware of the need to conserve energy. There would therefore be an increase in the market for fuel-efficient products.

(3) Comfort

The argument here was based on growth in real income. Studies have shown that as income rises, a smaller and smaller percentage of it is spent on 'necessities' and a correspondingly larger proportion on luxuries. Increases in incomes would therefore lead to a growth in the demand for the 'luxury' of comfort.

(4) Agriculture

This was certain to be a stable market because of the inevitable and increasing demand for food.

Mr. Air observed that the available possibilities in each of these fields would be limited by the fact that this part of Dunlop was an engineering concern. The areas of potential interest were consequently defined by the addition of the word 'Engineering' to each category:

1. Pipeline Engineering
2. Energy Engineering
3. Comfort Engineering
4. Agricultural Engineering

The need for diversification into these new industries arose out of doubts concerning the existing Engineering Group activities. Although Aviation Division now has full order books, there were then questions about whether it could compete on price in the important U.S. market. In addition, the decline of the British civil aircraft industry and the move towards European co-operation in this field made the outlook for any individual manufacturer rather uncertain. A similar situation existed with the other divisions, notably Wheel and Suspensions. With British Leyland their largest customer, the future did not look particularly secure.

I thought that it would have been helpful to look at this study document myself, so that I could consider its conclusions in more detail. Unfortunately, Mr. Air did not feel able to let me see it. Nevertheless, the information he had given me was valuable in itself.

(c) A Step Back

By this time, I had gained direct experience of three divisions, an overview of the Group's strategy from the General Manager, and a guide to some relevant issues from the literature. I now felt that it was time to take a step back and look at the project as a whole.

Unfortunately, this decision seemed to represent a step back in another sense. The overall project no longer seemed to present a coherent picture. This emerged when I asked the question, 'Who is this research for?' Who was supposed to be the 'client' of the project?

The results that had been produced so far tended to suggest that the individual divisional managers were the clients. Certainly that appeared to be the case at Energy Division and IAS. In both divisions there was a clear 'action research' or 'client-consultant' content to my work. I had been asked to examine a particular problem. This allowed me to study the concern from within and to help to introduce changes in the organization that the analysis suggested were necessary. In both cases, the divisional managers seemed to be happy at the outcome.

Whilst this much seemed clear, it could not be reconciled with other aspects of the project. In particular, I had not prepared my report at the end of each study for the divisions themselves, but for their General Manager. That tended to suggest that Mr. Air was the client.

It was he who was responsible for the performance of these ventures, so he was entitled to expect some overall conclusions - generalizations from both the literature and my own research - about how to make them more successful.

Finally, there was the very broad objective - to discuss the nature of industrial innovation. The literature invariably treated innovation as a process undertaken by companies. In this respect, Mr. Air was in some sense Dunlop's agent - responsible for the implementation of a corporate policy. One could easily make out a case that Dunlop Ltd. itself was the client.

These considerations brought to light two important conclusions. The first was that if it were possible to identify 'clients' at so many levels, the implications of the study were more complex than I had realised. There was clearly a need to investigate the connections between the various levels to discover how policy given down from 'Head Office' was translated into action in the new businesses themselves.

The second conclusion was that as the project stood, the final outcome desired from a 'good project' was unattainable. The idea was supposed to be that the firm should "have a series of manuals on how to do things". The interpretation of this in my case seemed to be "how to do things better than at present", but from whose point of view this was to be judged was not clear. To take an extreme case, the best course for the company might be to close down all the small businesses, but one could appreciate that this might not be seen as 'best' by Engineering Group, or by the businesses themselves.

(d) A Final Definition

One possible solution to this problem would have been to have made a decision about who the client was to be, and to have structured my future work on that basis. This would have removed the conflict of interest and would have allowed me to work towards producing a specific set of recommendations for improvement.

In the event, I chose not to do this. The main reason was that I found it personally unsatisfactory. The essence of the problem seemed to me to lie in the very complexity that this course would have eliminated. The relationships between individuals and groups within the organization gave rise to some interesting issues that I thought should be explored further.

This meant, of course, that my ultimate objective had to change. There was no longer going to be a 'hard' problem with well-defined boundaries that I was somehow going to 'solve'. In Checkland's terms (4), what I was now seeking to do was "to service a debate about the validities of a range of possible viewpoints...to improve the quality of debate about possible action". This decision has proved to have more far-reaching effects than I realised at the time, in that it removed the degree of protection that the structure of a definite research proposal affords the student, leaving only the task of trying to change the perceptions of actors in the real world. This, in retrospect, was a highly ambitious goal to attempt, seeming the more so in the circumstances of this particular project.

One immediate result, however, was a further, and final, change in my supervisory team. For the company, Mr. Air agreed to become more closely involved. It was also decided that the Aston Management

Centre's Systems Analysis Group would have the most relevant academic expertise, and responsibility for main supervision was transferred there.

The final outcome of the research is developed in the following chapters along two lines. The first examines the ways in which a large company might organize to promote the effectiveness of its innovative effort - this is one of the main themes of research into industrial innovation. The second explores the policy context in which these structures have to operate - how is good policy made? Both these debates are conducted in the context of a general model of organizational effectiveness, outlined in the following chapter.

CHAPTER THREE

SOME ISSUES IN
ORGANIZATIONAL DESIGN

OUTLINE

In the introduction to Organization and Environment, Lawrence and Lorsch observe that 'traditional' organization theories assume there is one best way to organize in all situations. Currently, the contrary view (that the best way to organize depends on individual circumstances) is widely held, and is known as 'contingency theory'.

This chapter looks at the development of contingency theory, in particular (in Section 3.1) at the relationships that have been suggested between an organization's structure and its environment.

After a discussion of these ideas in Section 3.2, a systems model of effective organization is described in Section 3.3 which has much in common with the contingency approach.

3.1 THE DEVELOPMENT OF CONTINGENCY THEORY

(a) Burns and Stalker

Burns and Stalker's work (1) was concerned with the study of firms in several sectors of British industry. Based on a series of extensive interviews, Burns and Stalker identified "empirical evidence which has brought us to regard the system of management as a dependent variable" (2). The principal independent variable was taken to be the rate of technical or market change confronting the firm. Differences in this respect gave rise to the two 'ideal type' management systems which they called 'mechanistic' and 'organic'.

The characteristics of each of these types as described by Burns and Stalker are shown in Tables 3.1 and 3.2. The mechanistic system depends for its successful working on there being a readily-defined and consistent set of specialized tasks in the organization. It is therefore appropriate to stable environmental conditions.

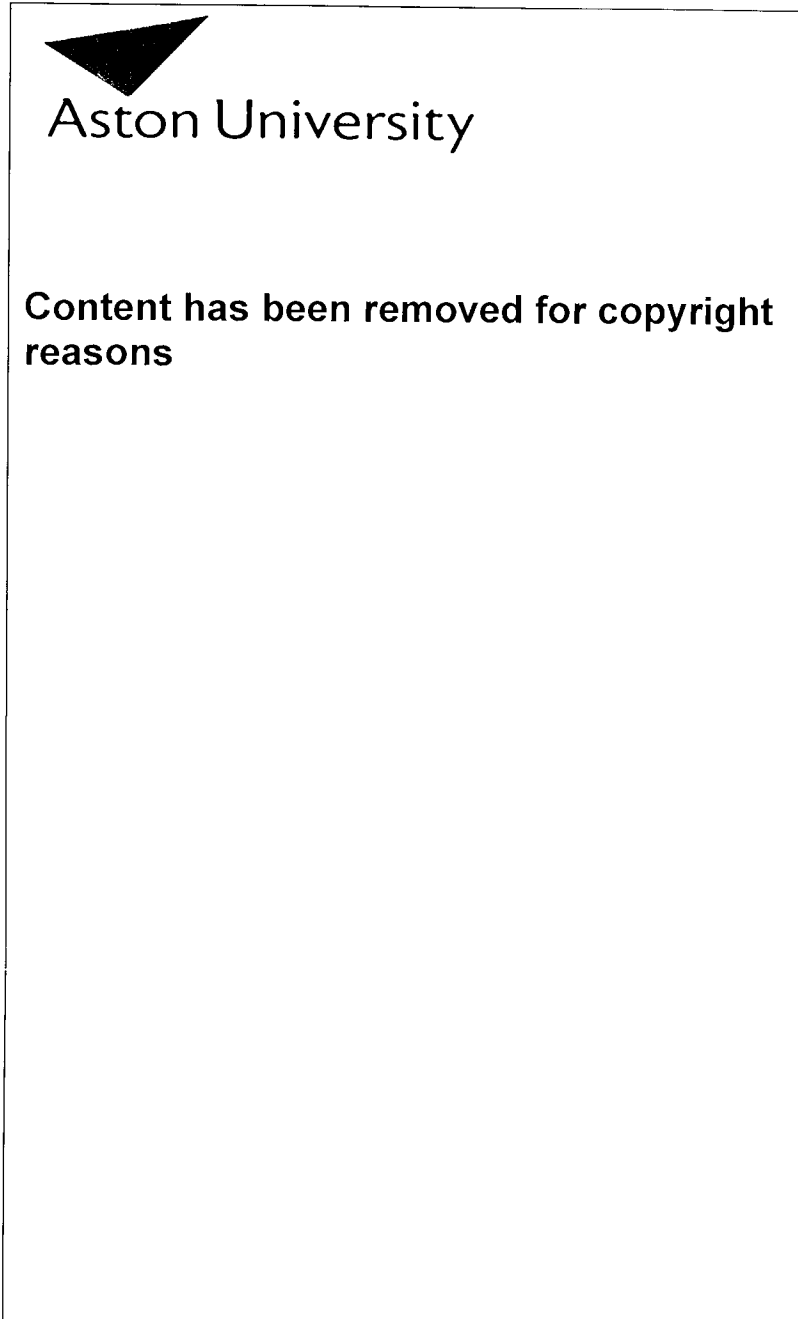
If the firm cannot be managed by a series of 'pre-programmed' responses to familiar situations, the mechanistic system breaks down and 'pathological' management systems emerge. Burns (3) describes three of these:

1. The 'Ambiguous Figure' System

Problems not previously encountered must be referred upwards in the hierarchy for decision. In a rapidly-changing environment this happens often. The senior management has to take many decisions and nothing can be done until this happens. People lower down in the organization

TABLE 3.1

FEATURES OF MECHANISTIC MANAGEMENT SYSTEMS



Source: Burns & Stalker (4)

TABLE 3.2

FEATURES OF ORGANIC MANAGEMENT SYSTEMS



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source: Burns & Stalker (5)

start to feel that they must go 'straight to the top' to achieve anything, which leads to a system of pair relationships developing between the top men and other managers that bypass the official reporting channels.

2. The Mechanistic Jungle

Difficulties in communication in mechanistic systems may be tackled by introducing more people into the bureaucracy (for example in liaison roles). This is bad because such people depend for their existence on the perpetuation of the difficulty.

3. The Super-personal or Committee System

Committees should exist to tackle temporary commitments above the normal functional tasks but they can become permanent when a new problem seems to need a solution that overlaps traditional functional roles.

These descriptions suggest that the problem of trying to maintain the mechanistic system in inappropriate circumstances is that the organization cannot use new and unfamiliar information effectively. Either there is no person or group in the firm capable of taking appropriate action (hence the need for a committee) or the relevant individual or department becomes overloaded.

In an organic management system, however, individual tasks are continuously redrawn to take account of environmental changes; organization charts 'defining' areas of responsibility are avoided because they impose rigidities which hinder its effective functioning. "The operation of an organic management system hinges on communication" (6). The formalities that go with hierarchy impede communication. This study seems to suggest that the mechanistic or bureaucratic system

of management cannot be made to work in a rapidly changing environment, but that on the other hand, management efforts to introduce an organic system will be resisted by workers whose status and power depend on the maintenance of the status quo.

(b) Lawrence and Lorsch

Although they acknowledge the contribution that Burns and Stalker's ideas made to their work, Lawrence and Lorsch's study (7) and its conclusions are somewhat different. The focus in Burns and Stalker is on the management of the whole enterprise. Lawrence and Lorsch explicitly emphasise that the various subdivisions of the firm will display different structures - "the greater the degree of certainty of the relevant subenvironments, the more formalized the structure of the subsystem" (8).

If it is true that organizational subdivisions show differences in internal structure, they might also be expected to have differences in other dimensions. The propensity for there to be "differences in cognitive and emotional orientations among managers in different functional departments, and differences in formal structure among these departments" Lawrence and Lorsch call 'differentiation' (9). The type of relationship they found to exist between these elements is summarized in Table 3.3.

Going on to examine the way in which the performance of an organization was related to these factors, the authors found that the firm's environment imposes a dominant competitive issue that must be handled effectively if the company is to succeed. In the plastics industry,

for example, this was the innovation of products and processes; in the container industry, production scheduling was the main problem.

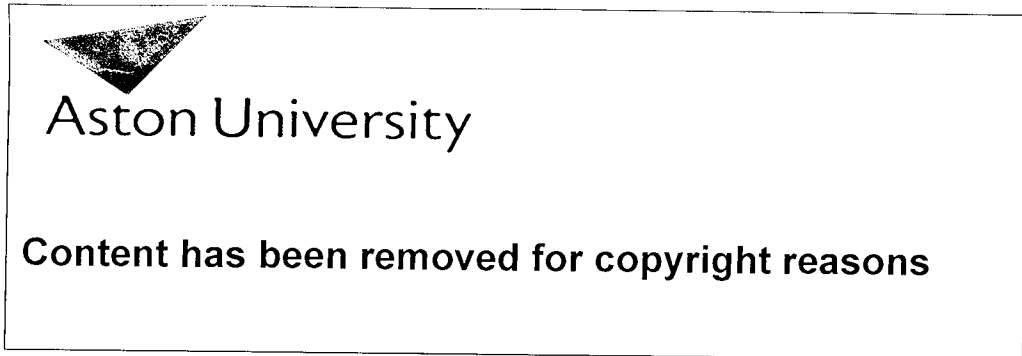
Although not all industries required equal amounts of differentiation, it was the case that within any particular environment, the more differentiated the firm the better it performed. This was true provided it also had the ability to get the relevant departments to cooperate in tackling the dominant competitive issue. Thus performance was also conditional on "the quality of the state of collaboration that existed among departments that are required to achieve unity of effort by the environment" (10). The departments had, in Lawrence and Lorsch's definition, to be integrated.

To summarize: differences in departmental subenvironments caused them to exhibit differentiation, but the overall needs of the firm required integration between departments. Successful firms exhibited high degrees of both.

Given that more highly differentiated organizations would face greater problems of integration, Lawrence and Lorsch examined the various integrative devices which were used in effective organizations. They found that in companies facing low uncertainty the existence of a management hierarchy (in which the discretion allowed to any individual group is limited), backed up by the usual planning and reporting systems, was sufficient to achieve integration. Where a high degree of differentiation was necessary, effective firms employed other integrating devices such as co-ordinators, cross-functional teams, and even whole integrating departments. These findings are summarized in Table 3.4.

TABLE 3.3

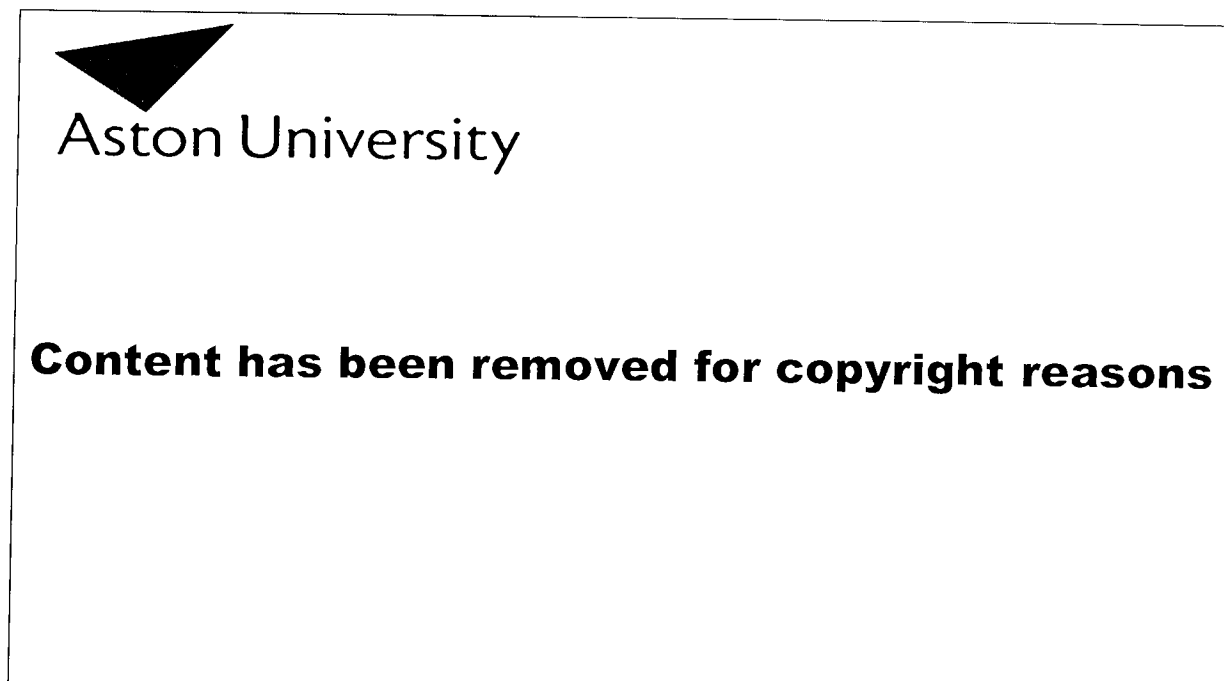
THE DEGREE OF DIFFERENTIATION IN DIFFERENT TASK ENVIRONMENTS



Source: Lawrence & Lorsch (11)

TABLE 3.4

ENVIRONMENTAL FACTORS AND CHARACTERISTICS OF EFFECTIVE ORGANIZATIONS



Source: Lawrence & Lorsch (12)

What also emerged, however, was that some of the low performers in each industry also had appropriate integrating devices. Lawrence and Lorsch therefore came to the conclusion that the successful firms were better at resolving the conflicts that would inevitably arise between departments with the different orientations they describe. The distinguishing factors were that in effective organizations:

(1) "There was more of a tendency to confront conflict instead of using raw power to force one party's compliance or instead of smoothing over the conflict by agreeing to disagree" (13).

(2) The individuals mainly responsible for resolving conflict (whether they were a common superior or in an integrating role) had influence based mainly on generally recognized competence and knowledge rather than relying on power derived from their formal position in the hierarchy.

(c) Thompson

The design of integrating devices is a subject considered by Thompson in Organizations in Action (14). Three types of mechanism are identified:

1. Co-ordination by Standardization

Here rules or routines are established which constrain the freedom of action of each department "into paths consistent with those taken by others in the interdependent relationship" (15). Thompson stresses that this can only work in stable conditions where tasks are few and repetitive.

2. Co-ordination by Plan

The difference between planning and standardization lies in the relative ease of their revision. In this context, 'plans' are schedules organizing the work of the different departments. These can be amended periodically as necessary to ensure that the efforts of the various departments are mutually compatible. Planning requires a less stable environment than does standardization.

3. Co-ordination by Mutual Adjustment

The implication of the two previous methods of integration is that the integrative effort can occur at discrete intervals of time. In dynamic, unpredictable circumstances departments may have to adjust their actions in response to new situations arising elsewhere in the firm. Effective co-ordination therefore requires more continuous and elaborate means of exchanging information.

Thompson discusses these ideas in the context of interdependence between sub-units of the organizational structure. He identifies three types of interdependence which may exist:

1. Pooled Interdependence

Departments are functionally independent but the failure of any one may jeopardize the future of the concern as a whole and hence of all the others.

2. Sequential Interdependence

The outputs of one department are inputs of another as part of a 'chain'.

3. Reciprocal Interdependence

The outputs of one department are inputs to others and vice versa in a complex relationship.

The three types of co-ordination are regarded by Thompson as applicable to the three types of interdependence respectively.

It is clear from Thompson's discussion that the organizational differentiation which gives rise to these interdependencies arises from differences in technology rather than directly from variations in environment. Nevertheless, he does go on to consider differentiation due to environmental contingencies:

"Under norms of rationality, organizations facing heterogeneous task environments seek to identify homogeneous segments and establish structural units to deal with each" (16).

In addition,

"...boundary-spanning components facing homogeneous segments of the task environment are further subdivided to match surveillance capacity with environmental action" (17).

Here, 'boundary-spanning components' are those parts of the organization which mediate between its 'technical core' and the environment.

Although Thompson suggests that the ultimate form of the organization will depend jointly on the nature of the technology and the complexity of the environment, he does not explicitly discuss the problem of integration between boundary-spanning and technical-core activities. However, he does admit the possibility that these two types of unit may be reciprocally interdependent, so that one concludes that the complex integrating devices inherent in 'co-ordination by mutual adjustment' are required in these circumstances.

The essence of Thompson's scheme of co-ordinating mechanisms is the transfer of information. The principal difference between them is the

interval at which the information necessary to achieve integration is passed between departments. The 'rules' deriving from standardization may be altered very infrequently, but for 'mutual adjustment', the exchange of information is a near-continuous process.

The effort involved in co-ordination is costly for the firm and its structure will reflect the need to minimize this cost. For this reason, sections which have a high degree of interdependence will be grouped together in clusters to make co-ordination easier. If this process gives rise to groups of an unwieldy size (negating the benefits to integration), the most closely interdependent departments will be clustered and the clusters combined into a second-order grouping. In this way, hierarchies develop.

In a complex environment, it will be necessary to further subdivide the organization. This is done by identifying 'separable domains' for each cluster group and providing that group with limited autonomy. This is how multi-division organizations come about, although Thompson sees this structure as presenting risks to the firm:

"Where contingencies are many, organizations tend to cluster capacities into self-sufficient units, each equipped with the full array of resources necessary to meet contingencies. This means, in effect, that variables controlled by the organization are subordinated to the constraints and contingencies it cannot escape. The more its technology and task environment tend to tear it apart, the more the organization must guard its integrity" (18).

(d) Allen

One writer who has done an empirical study of highly-diversified firms is Allen (19). His work draws some interesting conclusions about the ability of such organizations to preserve their integrity in the face of the environmental complexity confronting individual divisions.

According to Allen:

"Two distinguishing features of any corporate form are (1) the diversity of management problems faced by its primary subunits and (2) the complexity of the organizational devices it employs to achieve integration among these subunits. When we look at conglomerates along these two dimensions we are confronted with a rather intriguing paradox. By definition, conglomerates consist of a sizeable number of subunits which face very diverse management problems; and yet, corporate-divisional integration in these firms is accomplished through comparatively simple organizational devices" (20).

Allen mentions paperwork systems (such as planning, budgeting and head office sanctioning of capital expenditure) together with occasional meetings between divisional and corporate management as examples of such devices.

In Allen's view, the explanation of this paradox is that conglomerates have successfully clustered interdependent units into semi-autonomous divisions. The presence only of 'pooled' interdependence among divisions means that integration between them can be achieved simply. Head Office has only to ensure that each division performs to a standard adequate to the survival of the business as a whole. In addition, "because of the number and broad range of industries encompassed by its product divisions, the corporation is obliged to permit them considerable autonomy in both strategy and operations" (21). In these circumstances, corporate management cannot participate directly in divisional planning. At best it can reserve the power of

veto and the final say in the allocation of resources between divisions.

As well as the need for Head Office to ensure co-ordination between the divisions, it has the additional problem of integration between the divisions and itself. This arises, according to Allen, because of the differentiation that exists between the two. Measuring along the same dimensions as used by Lawrence and Lorsch, Allen found that corporate headquarters tended to have less formal structures, longer time horizons and more strictly financial goal-orientations. Divisional managers tended to have goals which reflected the type of industry they were in. For example "managers in a defence division ranked research goals as the most important criteria in their decisions whereas executives in a producers' durables division ranked manufacturing goals as more important" (22).

Allen invokes the concept of 'conditional autonomy' to suggest how the balance of differentiation and integration is achieved. As long as they are performing well the divisions have considerable freedom of action. When a division is doing poorly, headquarters is obliged to offer, and the division to accept, much closer scrutiny. Only then does the difference in orientation between the two create difficulties. The main requirements for successful integration here seems to be that each party should have an understanding of the other's point of view, and a willingness to confront and discuss differences of opinion directly.

(e) Galbraith

According to Galbraith (23) the common thread that links studies of this sort is that the structure of an organization is seen as depending on the predictability or certainty of the task it is trying to perform. He goes on to argue that

"the greater the task uncertainty, the greater the amount of information that must be processed in order to insure effective performance. From this proposition it follows that variations in organizational forms are variations in the ability to process varying amounts of information" (24).

The simplest case is one in which all possible situations that may confront the firm are known in advance. Rules and procedures can then be created which would allow complete co-ordination among departments without the need for any communication between them. As complexity increases, there is a need for a managerial hierarchy so that exceptional circumstances for which the rules make no provision can be referred upwards for resolution. Decisions are taken at the point where a shared superior exists for all the departments affected by the new situation.

The difficulty with this system is that the hierarchy can become overloaded if there are a large number of exceptions. The next step therefore is to introduce planning or goal-setting. As long as all departments meet their targets, there is co-ordination. How each unit sets about reaching its target is left largely to its own discretion. Again there is management by exception, so that only when a department fails to attain its goal is there a need for decision-making (and hence information-processing) at higher levels. This process is limited by two factors. One is the ability to design a set of consistent targets, which in turn hinges on the degree of interdependence between subunits.

The other is, once again, the information-processing ability of the hierarchy, which depends on task complexity.

If this group of mechanisms is still inadequate, Galbraith suggests that the organization will adopt one of two strategies:

"First it can take action to eliminate the need for processing information and therefore reduce the number of exceptions referred up the hierarchy. Second, the organization can take action to increase its capacity to handle more information" (25).

The various methods of achieving these objectives are illustrated in Fig. 3.1.

The creation of slack resources is simply the lowering of acceptable performance criteria in order to reduce the likelihood of a target being missed. This reduces the information load on the hierarchy but imposes costs in terms of budget or quality.

The creation of self-contained tasks reduces departmental interdependence by giving each unit all the resources it needs to do its job. Although this eliminates interdepartmental scheduling problems, it also creates waste (e.g. by allocating a specialist computer programmer to each of four divisions where previously two were sufficient to serve the whole organization). Alternatively, it may reduce the division of labour (for instance, if it is decided that no individual division can justify having its own programmer). Either way, the interdependence is eliminated, but both outcomes have their costs.

The first of the two courses that enhance the organization's information-processing ability is investment in vertical information systems. In order that the decision-maker is not overloaded, he may have to be aided "by employing computers, various man-machine

FIG. 3.1

STRUCTURES FOR INFORMATION PROCESSING IN ORGANIZATIONS



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Source: Galbraith (26)

combinations, assistants-to, etc." (27). The cost to the firm is clearly the cost of employing these extra resources.

Finally, the organization may elect to create lateral relations. Galbraith identifies many forms, according to the amount of inter-departmental integration required. These are described in Table 3.5.

In summary, Galbraith's approach is an attempt to explain the findings of previous research. Empirically it has been suggested that task uncertainty (a feature of the environment) is a major determinant of organizational structure. This is the central assertion of this stream of contingency theory. Galbraith's hypothesis is that the more uncertain the task, the more information will have to be processed to manage the task well. Therefore, in order to be effective, an organization must have a structure which is able to process the volume of information demanded by the task.

3.2 DISCUSSION

(a) Review

As outlined in the introduction to this chapter, the central thread connecting all the studies discussed in Section 3.1 is that there is no 'one best way' to organize. It depends on circumstances, and in particular, on the characteristics of the environment in which the firm is operating. The environmental contingencies which give rise to this problem of design are not exactly the same in each study. Furthermore, the various authors differ in some respects in their interpretation of the link that exists between organization and environment.

TABLE 3.5

LATERAL RELATIONS



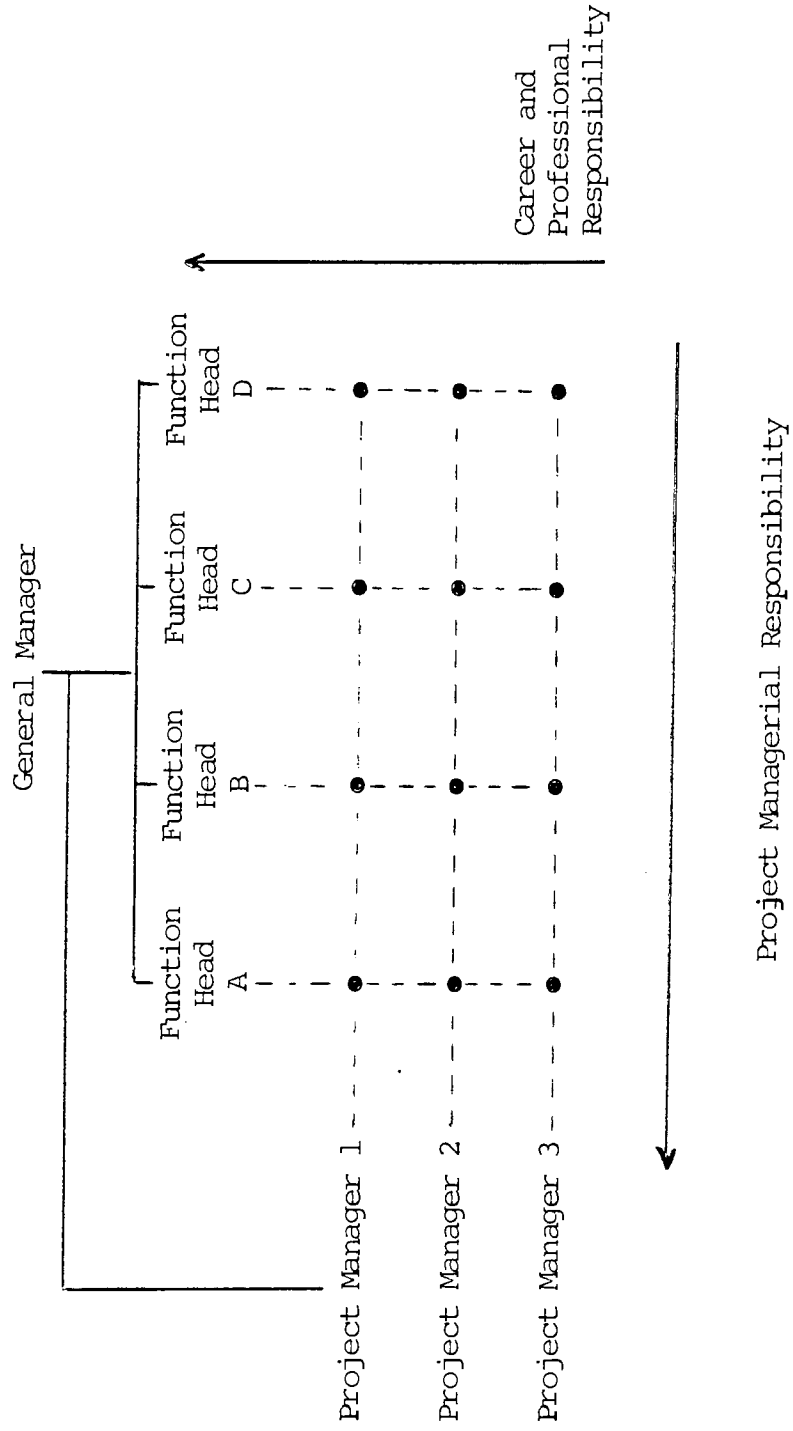
Aston University

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Source: Galbraith (28)

FIG. 3.2

A MATRIX ORGANIZATION



For Burns and Stalker, the rate of change in the technical or market environment is the main influence. This is important because 'unstable' conditions tend to throw up problems for the enterprise which cannot be dealt with by any of the functional roles in the traditional bureaucracy. The occupants of these roles have responsibility for a task which is somehow distinct and separate from the task of the company as a whole. Therefore, no-one will feel obliged to tackle problems which may be of great importance for the survival of the organization but which do not fall within any existing job-description. In the mechanistic system, only top management has the total concern in mind, so that all otherwise 'unallocated' decisions must be taken there. The overload of work on the head of the concern is so great in unstable conditions that liaison departments and committees are required to assist him. Burns and Stalker regard this as 'pathological'; only an organic management system can cope adequately with such rapid change.

For Lawrence and Lorsch, the main contingent variable is also the predictability of the environment, although they treat each functional department as having a separate sub-environment. One therefore looks for organic- or mechanistic-type management systems within departments, but expects there to be differentiation in this respect between them.

If such differentiation exists, Lawrence and Lorsch suggest that integrating devices are required. These appear to be precisely of the form that Burns called pathological, yet they are aimed at precisely the object that he demands: the recognition and support of the aims of the enterprise as a whole. The answer to this paradox seems to lie in distinguishing the purpose of these mechanisms. This point emerges from the systemic model considered in Section 3.3 and will be discussed

again there.

It has already been noted that Lawrence and Lorsch emphasize the need for departments to organize to meet the contingencies in their subenvironments. They must therefore have a degree of independence. As parts of a single organization, however, they are also interdependent, which gives rise to the need for integration. Taking Lawrence and Lorsch's and Thompson's conclusions together, it appears that the difficulty of achieving integration will be greater the more differentiated the departments and the more interdependent they are.

Thompson takes one step further, however. He recognizes that the problems of integration may be so severe that it is impossible to achieve between every department. This is most likely to happen when the organization is very large. Thompson's solution is to allow a second order of autonomy to groups of highly-interdependent units, creating a hierarchy.

This in itself will cause difficulties in that the 'Head Office' is confronted with the need to handle integration both among the divisions and between the divisions and itself. Allen suggests that it copes with both together by the use of divisional targets. Only if these are not met must there be a close (and potentially difficult) interaction between the two. If they are met, both integration problems are solved.

This is an interesting conclusion, looked at from Galbraith's perspective. The fact that the Head Office is able to use a fairly uncomplicated device to achieve the required integration tends to suggest that multi-division organization is a rather efficient means of coping with environmental complexity.

Galbraith goes further than any of the other writers in discussing these points in terms of information processing. Nevertheless, his analysis does seem to highlight the problem of information handling as one of the main issues to emerge from contingency studies, through its link with the more general arguments about the management of uncertainty. The other central theme would seem to be that for an organization to be effective two conditions must hold. First, there must be some means of coping with the diverse problems generated by its environment; second, these means must be consistent with the pursuit of the organization's overall goals.

According to Kast and Rosenzweig (29):

"The contingency view seeks to understand the inter-relationships within and among subsystems as well as between the organization and its environment and to define patterns of relationships or configurations of variables. It emphasises the multivariate nature of organizations and attempts to understand how organizations operate under varying conditions and specific circumstances. Contingency views are ultimately directed toward suggesting organizational designs and managerial actions appropriate for specific situations."

This seems to encapsulate the current state of contingency theory well. It highlights the intentions behind the thinking but maintains an appropriate degree of uncertainty about its achievements, thereby providing a useful starting point for a look at some of the criticisms of the approach.

(b) Critique

According to Miles and Snow (30) critics of contingency theory identify two main limitations:

- (1) The emphasis it places on the differences between situations rather than the similarities;
- (2) A deterministic bias that ignores the existence of managerial choice.

On the first point, these authors correctly observe that:

"ultimately the notion that 'every situation is different' becomes an atheoretical point of view that provides even less guidance than did the universalistic assumption that 'every situation is the same'"(31).

There is some force in this objection. Apart from the effect of environment, technology, size and employee behaviour have also been regarded as important influences on organizational structure.

This particular line of criticism is put strongly by Longnecker and Pringle (32):

"One who proposes contingency concepts as a general theory attempts the difficult feat of building a unified body of thought on such nebulous items as 'it all depends' and 'situational variables'. Concluding correctly that management principles of one kind or another lack universality, the contingency theorist attempts to build a theoretical edifice from the bricks of non-universality."

It is for this reason that only one line of contingency thought is pursued in this chapter. The reason for the choice of environment as the central factor will emerge in Section 3.

The criticism that contingency theory is deterministic rests on the idea that environmental factors strictly govern organizational structures. Whilst this would be a just criticism if true, that idea does not follow from any of the studies reviewed here. If anything, the reverse is true. The prescriptions given tend to make the changing of organizational designs appear a relatively straightforward process. In fact, as Espejo found from his own experience, it may be extremely

difficult to bring these changes about:

"Even if it were possible to agree at a rational level the organizational implications of a policy, at a more fundamental level it is very likely that this agreement will be in conflict with the very essence of the tacit norms supporting the interpersonal relationships defining the existing organization. As long as these tacit norms are kept unchallenged at the level of the individuals the likelihood is that the existing organizations will not be superseded by new ones despite all claims to the contrary" (33).

This is consistent with the Burns and Stalker finding that firms do not adapt to new situations by changing their management systems from mechanistic to organic. Burns suggests that this is because individuals within the firm belong to social and political alliances with sectional interests. "These individuals are deeply concerned with the position they occupy relative to others, and their future security or betterment are matters of deep concern" (34). In other words, people have strong impressions of how an organization 'ought' to be and how to make progress within it. Any upheaval which challenges these images may be opposed to the point of bypassing the new structures and covertly or openly maintaining the old patterns of interaction.

There is, however, an area of management choice which is not considered by contingency theory. This is the fact that there are other courses open to organizations faced with increased uncertainty or change than to try and alter their structure, a point which is identified by Child (35):

"The analysis of organization and environment must recognize the exercise of choice by organizational decision makers... To an important extent their decisions as to where the organization's operations shall be located, what clientele it shall serve or the type of employee it shall recruit determine the limits to its environment - that is, to the environment significant for the functions which the organization performs."

In other words, organizations do not have to expand their ability to

process information in the face of greater uncertainty. They can instead pursue alternative goals which reduce the information processing requirement to that consistent with current capacity.

This is not a choice which is directly considered in the contingency view and the need to address this weakness creates an opportunity to explore an alternative conceptual scheme of organizational response to environmental complexity. It is rather more abstract, the discussion being couched in terms of viable systems, rather than of business organizations. Nevertheless Beer's model of the structure of viable systems produces conclusions which have strong parallels with those of contingency theory, and the two approaches taken together offer a powerful analytical tool for later parts of the study.

3.3 A SYSTEMS MODEL OF ORGANIZATIONS

(a) The Model in Outline

One should perhaps begin by making clear the sense in which the Beer model and contingency-based thinking on organizational design are seen as compatible. In Davies, Demb and Espejo's definition:

"very generally a system can be said to be composed of distinguishable parts or elements whose relationship to one another is defined and whose behaviour is mutually supportive towards the achievement of a common objective" (36).

Clearly the normal concept of a business firm fits this description and such an enterprise is consequently a system. Therefore any rules which apply to systems in general ought to be applicable to the firm.

The views examined so far in this chapter have been about organizations dealing with contingencies arising from their environment, with Galbraith couching his argument in terms of the need to expand information-processing capacity. Beer introduces his analysis of the problem confronting organizations by considering the concept of complexity in the abstract:

"Complexity, it is argued, is the stuff of management. The basic unit of complexity is any one possible state of the system. For, as the number of possible states increases, the complexity rises - to very alarming proportions because that rise is exponential. Management is shown to be the task of manipulating that complexity. The measure of the number of possible states is called VARIETY. Then it is the manager's job to be a Variety Engineer" (37).

Where, therefore, the central problem of the contingency theorist is in the design of organizations for effective information processing, the problem for Beer is in the design of systems in terms of effective variety engineering.

The reason for this emphasis on variety can be explained by introducing one further idea which is central to Beer's model. Since variety is simply 'the number of possible states of whatever it is we want to measure' (38) it follows that there is such a measure in principle both for the organization and for its environment. It is readily apparent from contingency ideas that the more complex the environment the more complex must be the organization. To put this idea another way, the performance of the organization is limited by its own complexity. The insight which gives power to this straightforward statement is Ashby's Law of Requisite Variety: only variety absorbs variety (39).

Therefore, if it is to perform effectively, the variety generated within the organization must match that generated within its relevant environment.

The way in which that relevant environment is defined is important in understanding the strategies which can be used to accomplish this task of matching variety. It follows from the definition of a system given above that it must exist for a purpose, must have some objective. The relevant environment of the system therefore "consists of just these factors which are relevant to objective achievement" (40). Thus two possibilities exist for a system faced with the problem of coping with increasing environmental complexity. Either it can attempt to increase its own internal variety, or it can redefine its objectives so as to restrict its relevant environment. This is exactly the point raised by Child above which began this discussion.

The concept of a system's objectives is a useful one for exploring the idea of the structure of a system in Beer's model. This can be most easily understood by reference to a business enterprise. At the most senior level there will be some general statement of objectives, such as to pursue growth, and there will clearly be many potential ways of achieving it. The detail that policy makers can go into at this level is limited by their own variety, so they are compelled to restrict themselves to stating how it is to be done in broad terms, such as 'to be in the oil business'.

At the next lower level, managers now have their own policy problem. Given the general objective (growth) and the particular strategy (to be in the oil business) they must take their own decision about which sectors of the oil business would best promote growth. This involves them in exploring a more restricted environment, but in more detail. Having made their decision, which might be to operate drilling rigs and refineries, the policy problems at the next level are such as where to drill, where to locate refining plant and so on.

There are two points to be noted here. The first is that this process is a tremendous variety reducer. At each level, policymakers select from a range of strategic options at a level of generality they can comprehend. Having made this choice, the discarded options no longer need detailed consideration and are removed from the relevant environment. Secondly, this logic is identical for each level of the hierarchy. Policy is made at the top for the system as a whole; another policy process exists within the sub-systems, and within the sub-sub-systems. Systems and processes are nested one inside the other (see Fig. 3.3). They exhibit recursion. It is the existence of this recursive structure which allows the attainment of the variety balance mentioned above.

Obviously it is not enough that policy be made. It must also be relevant, both to the constraints and the contingencies imposed by the environment and to the capabilities of the system itself. In addition, this policy must receive effective implementation. In this model, five functions are seen as necessary and sufficient for the creation and implementation of relevant policy and the maintenance of system viability.

The first of these is the policy function itself. As already described, this selects from among the many strategic options open to managers at each recursive level, subject to the constraints of the policies handed down from the level above.

The criterion of relevance is supported by the intelligence and control functions. In Beer's phrase, the intelligence function is concerned with outside and then (42). In other words, it scans the environment for changes affecting the system and devises a range of strategies for dealing with them. Some of these may be beyond the system's existing

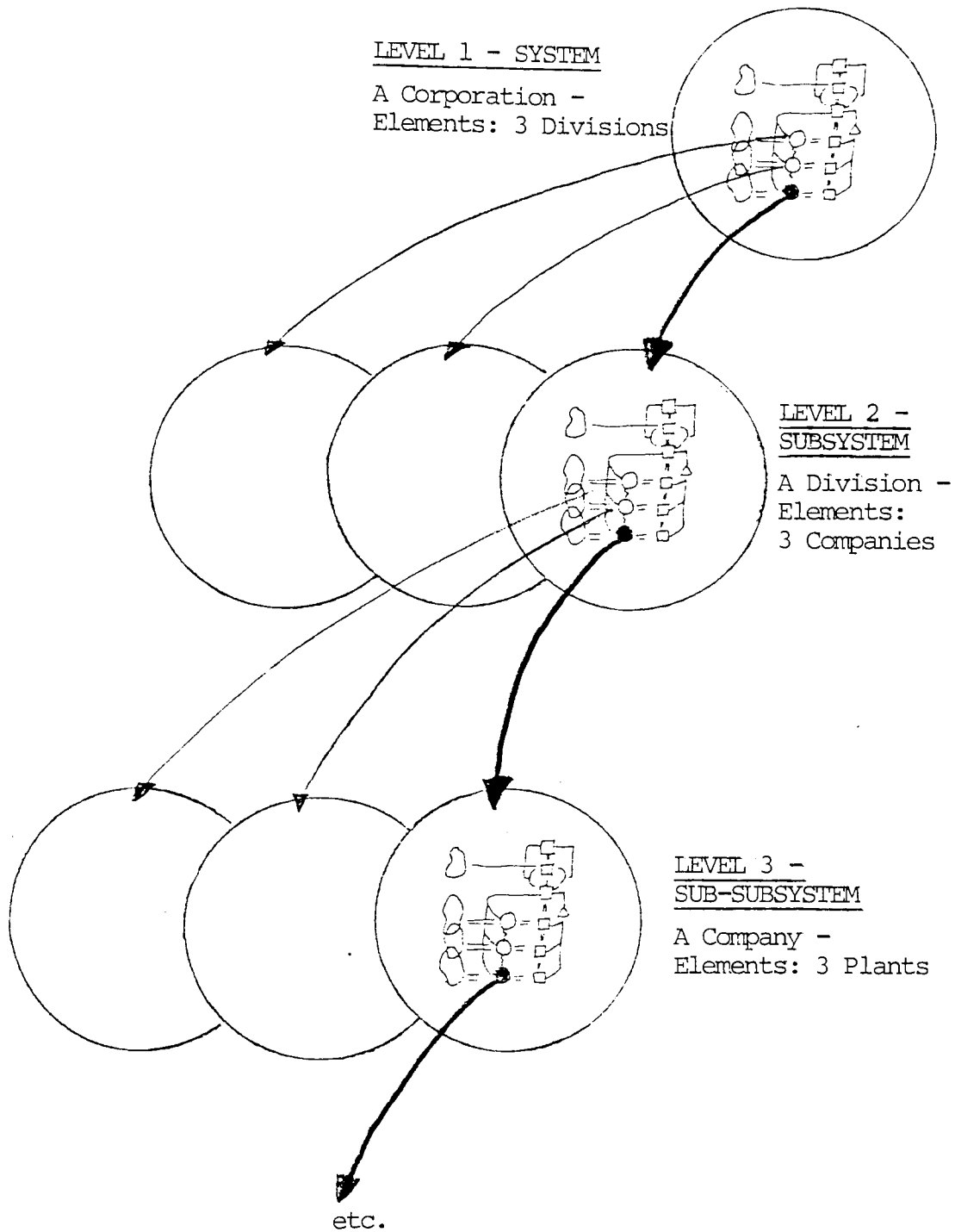


FIG. 3.3

THE PRINCIPLE OF RECURSION

Source: Adapted from Beer (41).

competence. This will be revealed by the control function, which takes an overview of the state of affairs inside and now.

The control function mediates between policy formulation and policy implementation. It not only advises decision makers about policy relevant to the existing system, it also has the responsibility for structuring existing policy in operational terms, and for ensuring that the actions of the operational units of the system are in fact directed towards achieving the stated policies.

These operational units exist to do what the system is for and make up the implementation function which is "responsible for the actions which create changes in the environment" (43). Because of the recursive principle, each operational unit itself contains at least one viable system. These sub-systems are generating their own policies to support the achievement of the objectives passed down to them. However, such operational units are likely to be interdependent, and their individually established policies may not mesh with one another. There is therefore a need for a co-ordination function, which assists the operational units to resolve these problems by direct communication among themselves.

These five functions, policy, intelligence, control, co-ordination and implementation maintain the effectiveness of policy making and its performance. Since it has been shown that policy-making occurs at all levels of recursion, it follows that all the functions are found at each level of the viable system. This is represented diagrammatically in Fig. 3.4.



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FIG. 3.4

BEER'S MODEL OF VIABLE SYSTEMS

Source: Espejo (44)

(b) Autonomy and Constraint

In contingency discussions of organization design, differentiation, or the existence of structural and other differences between subunits of an organization, exists because of the need to adapt to different environments. In this model, exactly the same is true. Operational elements of the organization have policy-making capacity, and appropriate policy is determined to a large extent by the characteristics of the environment.

In contingency theory, it was found that these highly differentiated units had to be given a degree of independence. In the systems model, the existence of policy-making capacity means that these units have autonomy. It is clear, however, that this autonomy cannot be unlimited. The reason it is necessary at all is so that the policy of the enterprise as a whole can be implemented effectively. There is a need to ensure that individual subsystem policies are mutually compatible and directed towards overall policy goals. This management problem is the concern of the control function. In fact, this is one of the greatest difficulties encountered within organizations.

The concept of control, both in popular understanding and in dictionary definition, implies the exercise of direction and command. As Galbraith's discussion illustrates, this power rapidly becomes insufficient to the task of maintaining true control, in the sense of maintaining the effectiveness of the organization. Galbraith suggests that only in highly stable and predictable circumstances will senior management be able to direct the activities of the operational subunits by the use of rules and programs. In other words, to impose control by means of commands is to restrict autonomy tremendously at



the lower level, and will only be successful if environmental disturbances are minimal.

As environmental complexity increases, however, the control function cannot afford to operate in this way. The autonomy of the subunits is vital for effective performance and in any case, the variety being generated within them is far greater than the control function can cope with directly. Nevertheless, control must be maintained.

One solution to this situation is for the control function to increase its activities on the command axis. Managers at this level feel that they are losing touch and demand more reports or introduce new procedures in an effort to keep on top. As was pointed out above, this decreases the autonomy of the operational units. This is exactly the opposite of what is required, because it reduces the level of their performance.

An alternative is to allow more freedom to the subunits and to accept that the task of control is beyond the capacity of management. This in effect destroys the purpose of the organization, which is defined by its overall policy, because the very necessity of control arises from the need to support policy implementation.

The solution of the problem is uncovered by a further discussion of Galbraith's alternatives for action. What these reveal is the necessity for the operational elements at any level to organize amongst themselves. The first of Galbraith's strategies is to lower acceptable standards of performance. For highly interdependent units especially, this may be the most effective way of achieving what Thompson describes as 'mutual adjustment' but the alternative, to improve information flows within the organization is likely to be a particularly powerful

solution.

To the extent that poor communication channels limit the information-handling capacity of the control function, investment in vertical information systems will be useful. However there may be a temptation to use this method to expand the capacity of the command axis. This is what seems to be happening in Burns's 'pathological management systems'. For the reasons outlined above, this will not work. The creation of lateral relations, or the development of direct interaction between subunits, will also be required.

Each of the devices listed by Galbraith under this heading serves to promote control. This happens because the management of each subunit is able to exercise discretion in deciding the best method of achieving inter-unit co-ordination in its own circumstances. In other words, the operational units are using their discretion to constrain their own autonomy, which is precisely the co-ordination function described in the previous section. The implementation functions are exhibiting self-regulation. This minimizes the adjustment problems that have to be handled directly by the control function, whose task in this scheme is simply to approve the form that the co-ordination mechanisms take.

There will, of course, be problems that are not resolved by these means. In this event, minimal intervention by the control function is legitimate in the interests of improving the performance of policy. In addition, the control function will want to ensure that each of the implementation activities consistently behave in a way which accords with policy. This is achieved first by the existence of formal reporting channels on the command axis between managers at the two levels.

However, if these lower-level managers have autonomy, errors may occur which go undetected by the control function because they are not reported. Therefore, as an adjunct of their autonomy, subunit managers must agree to the monitoring of implementation activities directly by the control function. The familiar expression of this is auditing, but discussion between a manager in the control activity and junior members of the subsystem, or simply the manager making unannounced visits to the shop floor are examples of this monitoring role. The control function must, in other words, have an independent check on the accuracy of the reports arriving on the command axis.

To sum up, it is necessary to allow subsystems to have autonomy in order to cope with environmental complexity, but control must be maintained in the interests of the cohesion of the organization. Since control in the sense of 'command' limits autonomy, it must be used to the minimum. The balance is achieved through the self-regulation of the subsystems via the co-ordination function, and by the existence of monitoring. These three channels of control are depicted in Figure 3.5.

The relationship of this model to the contingency ideas can now be made explicit. Differentiation is the outcome of the ability of autonomous subsystems to make their own policy. Integration is the monitoring and constraint of this autonomy in the pursuit of the cohesiveness of organizational purpose.

It has been suggested that the integrative mechanisms described by Galbraith support this task in various ways, and the same is true of Lawrence and Lorsch's ideas. Allen's finding that a head office is obliged to allow autonomy to its divisions is also clearly explained in this model.

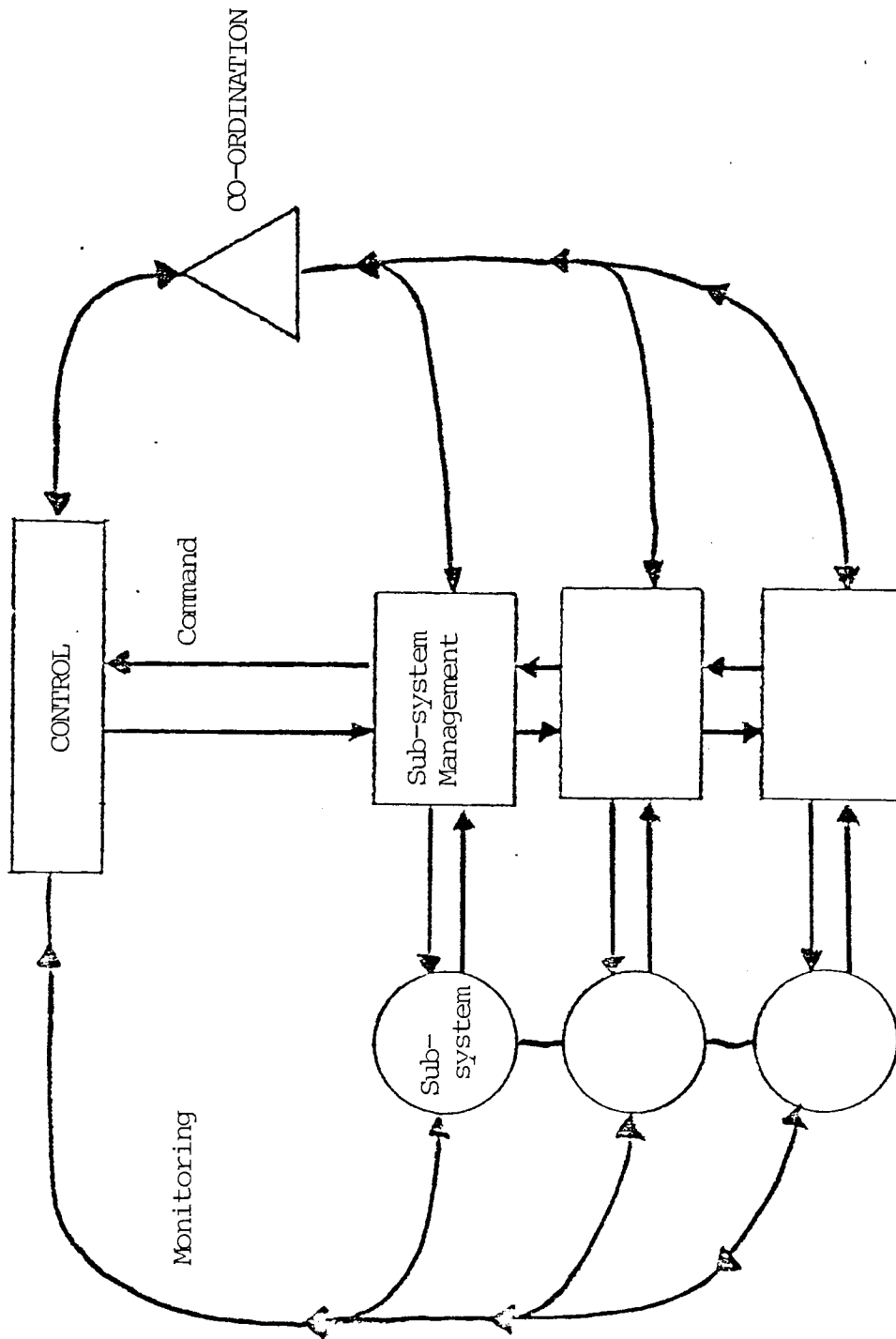


FIG. 3.5

CHANNELS OF CONTROL

The apparent conflict of Lawrence and Lorsch's conclusions with those of Burns and Stalker, raised in Section 2.2(a) has already been alluded to in this discussion. The solution to it seems to be that Burns and Stalker's pathological systems are designed to try and bolster the effectiveness of the command axis, whereas Lawrence and Lorsch see their mechanism in a co-ordinating role. Looked at in this light they are not inconsistent.

Finally, two examples, one from Galbraith and one from Thompson, show how close contingency ideas and this systemic model are in the insights they generate. Galbraith captures the central principle of the model by observing that "the task information requirements and the capacity of the organization to process information are always matched" (45). Not only is this an implicit recognition of the Law of Requisite Variety, it also uncovers a more subtle conclusion. That is that if the mechanisms which exist in an organization to handle information are poorly designed, its task performance will be correspondingly poor.

Thompson explicitly recognizes that the structure which exists within an organization will be determined both by environmental considerations and by internal factors, such as the degree of interdependence between the subsystems. The conclusion he derives from this has already been quoted: "The more an organization's technology and task environment tend to tear it apart, the more the organization must guard its integrity" (46). Expressed in the language of contingency theory, effective organizations must achieve a balance between the forces of differentiation and integration. This conclusion is exactly mirrored in the more formal terms of the model by Beer's First Axiom of Management (47):

"The sum of horizontal variety disposed by the operational elements equals the sum of vertical variety disposed on the vertical components of corporate cohesion".

In other words, the control function must match the variety that the operational elements generate to cope with the contingencies of their environments. This is a further expression of the need for a variety balance which emerged from the discussion in Section 3.3(b).

3.4 CONCLUSION

The broad conclusion of contingency theory is that there is a need for differentiation within organizations to enable them to cope with turbulent environments. The degree of differentiation required depends on the extent of environmental uncertainty. There is an associated problem of maintaining the cohesion of the organization in the face of such diversity. This gives rise to the need for integrating devices, whose complexity reflects the level of differentiation.

The systems model described in the latter half of the chapter sees the problem of organizations as that of coping with complexity or variety. The need for autonomous subunits arises because 'top management' cannot hope to specify appropriate responses to all environmental threats. Yet management must maintain control in order to promote the achievement of the overall goals of the concern. The parallel between this approach and the contingency view is clear.

However, the systems model identifies two separate elements to integration. The essential feature of co-ordination here is that it is developed by and between the sub-units themselves. They are able to

use their discretion to limit their own autonomy in an appropriate way, rather than having rules laid down for them. There will need to be 'commands', but if the organization is to operate well they need to constrain the sub-units to the minimum degree necessary to achieve general organizational objectives.

This model was introduced because it appeared to extend and improve contingency ideas in two respects. Firstly, it makes clear the importance of the distinction between co-ordination and command. Secondly, it provides for an analysis of effective policy-making in the same framework as that which discusses effective policy implementation. The overall performance of the enterprise depends on both.

The following chapters look directly at the question of innovation and the analysis contained in them is developed in terms of the concepts introduced here. Both the contingency and systems languages will be used in an effort to understand the problem of innovation management.

CHAPTER FOUR

METHODS OF MANAGING INNOVATION

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OUTLINE

The middle sections of this chapter look at some of the organizational devices for promoting innovation that have been described in the literature. These are interpreted in Section 4 in the light of the concepts discussed in Chapter 3.

First, however, it is necessary to investigate the issue of why innovation presents a particular management problem.

4.1 THE NATURE OF INNOVATION

Despite the concentration on the management of innovation in recent years, and its development into an area of study in its own right, it appears rather difficult to obtain a satisfactory definition of the term. The OECD study (1) gives 'technological innovation' as "the first application of science and technology with commercial success". More usually, authors use expressions such as 'incremental innovation', 'radical innovation' and so on, whose meanings are intuitive rather than clearly explained. According to Ray and Uhlmann (2) for example, 'basic innovation' involves "creating new scientific knowledge concerning the product or technique" and applied innovation consists in the "application of known scientific phenomena to new technologies". However they also discuss the innovation categories 'cost-saving innovation', 'market-orientated innovation' and 'new technologies' without explaining their meaning.

Marquis (3) has attempted a broad classification of innovations which includes:

'Systems Innovations' - revolutionary changes such as completely new transport or communication media.

'Radical Innovations'- which transform an industry (e.g. the jet engine or stereo sound).

'Nuts and Bolts Innovations' - which are additions to and variations in product lines which firms routinely undertake to improve a business.

It appears from this classification that Marquis derives his definitions from the impact on society at large. The OECD definition

quoted above clearly has the same outlook. If one is attempting to study the management of innovation though, perhaps a more relevant definition would concentrate on the effect of the innovation on the company.

Severiens (4) has such a classification:

(1) Product Adaptation: Small changes to existing products which involve little organizational change or risk.

(2) Product Modification: Changes in the product which open it to new markets. These require new marketing skills because the field is unfamiliar. It is more disruptive than adaptation because new personnel or retraining may be involved.

(3) Product Renovation: Satisfying old needs by the use of new technology. This may require re-tooling, new investment, retraining etc. It may also render a firm's existing product line obsolete and is therefore the most disruptive of the types of change.

These ideas may be represented diagrammatically with examples as shown in Fig. 4.1.

This scheme seems to move towards the idea of innovation which is implicit in much of the literature, but there are two problems with it. The first is that the reason for the management of innovation being regarded as a legitimate area of study in its own right is that it is somehow different from ordinary 'day-to-day' management. 'Product adaptation' would not seem to be innovation in this sense because it is a continuous process in nearly all businesses. 'Product modification' might be innovation depending on how large a step the company is taking away from its existing markets.



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FIG. 4.1

SEVERIENS' TYPOLOGY OF INNOVATIONS

Source: Severiens (4)

The fundamental concept at the root of this discussion is that of unfamiliarity. Once a firm becomes involved with a product or market with which it is unfamiliar it faces a special sort of management problem. There must, it appears, be a minimum degree of unfamiliarity before the problem is encountered, but this is really impossible to define at all precisely. It would seem that this is the reason for the vagueness about the term 'innovation'.

Although Severiens' idea of 'product renovation' would certainly give rise to problems of innovation management, this does not go far enough. The second difficulty with this classification is that it only covers new developments in a field in which the firm is already operating. The concept suggested here as an alternative would include enterprises which are new to the particular firm, even if they are not new to society as a whole. As Kelly and Krantzberg observe, "something can be new only in relation to some frame of reference. It may be 'new under the sun' or 'new under this roof'" (5).

This definition links the issue of innovation management with the ideas in Chapter 3. By choosing to enter an unfamiliar market or field of technology, the firm is creating uncertainty for itself. It is this uncertainty, together with the fact that no existing subunit of the organization is competent to deal with it which generates the problem.

As Child points out (6):

"A large organization entering a dynamic environmental field will often create a separate and relatively small subsidiary to deal with the new area of operation - the creation of venture groups fits into this category."

In creating this additional structure, the firm has two things to consider. One is to achieve the appropriate degree of differentiation

within it. The other is the parallel question of integrating it into the existing organization. A large company operating in fairly stable conditions may be taking a large step away from the pattern of organization it is used to, so the associated management problems may be particularly difficult to handle.

The literature acknowledges the existence of such problems and suggests a variety of organizational design strategies which may help the firm to cope with them. The following sections discuss these strategies, beginning with the one mentioned by Child - the formation of venture units.

4.2 VENTURE GROUPS

The creation of venture groups is perhaps the most popular and widely-discussed means of dealing with the uncertainties of innovation. In this section, the features of a venture group are examined, along with the experience of some companies that have used them.

Although discussion of venture groups figures prominently in the literature, there is no clear idea of exactly what they are. According to Fast (7):

"A New Venture Division is an organizational unit whose primary functions are

- (1) the investigation of potential new business opportunities,
- (2) the development of business plans for new ventures and

- (3) the management of the early commercialization of these ventures".

Whilst this covers many of the features that one would expect to find, it does not capture the real essence of the idea as it seems to be generally understood. Adjectives typically used to describe such groups include small, independent, interdisciplinary, entrepreneurial. Hanan (8) for example, gives better the flavour of a venture unit:

"It is probably no accident that so many businesses have originated in garages. To minimize a venture's cost burden and endow it with the character of a small business, large companies have often rented space for their venture teams in such places... These locations get them out of the mainstream of the parent companies' business [and] make it difficult for head-office people to poke around."

In these circumstances the venture manager would be expected to have the maximum amount of freedom of action. Describing the venture system at Heinz, Oates (9) observes that the venture manager "works as chief executive of his own company" and quotes Heinz's Managing Director as saying:

"Apart from going back to his 'shareholders' and saying that he has bought this or taken a lease on that, he really doesn't have to tell us very much. I would say our participation in the venture is little more at this juncture than that of enlightened bankers."

Indeed in many U.S. ventures, the venture manager will himself be a shareholder in the new enterprise. His own financial rewards then depend on his success at generating growth.

A major field of debate in this area is the relationship that the venture team should have with its parent company. There seems to be some agreement that the group must have access to, and support from, top management. Beyond that, opinions differ.

The Heinz approach is at the extreme of autonomy, although Rothwell (10) agrees that there is little point in creating a new venture group designed to foster an atmosphere of committed entrepreneurship and innovation if management then forces it to conform to traditional operating procedures. Another advocate of the same view is Hanan (11).

Child (12), however, takes a somewhat different line:

"A paradox in the organization of innovation derives from the need for the innovators to form a self-contained group of their own with considerable autonomy and the requirement that this same group be not cut off politically and in terms of shared understanding from the rest of the organization upon which the refinement, production and launching of the innovation depends. The autonomy helps to provide the group with an identity and freedom from interference that should motivate creative processes; yet at the same time, a bridge must be maintained to the rest of the organization."

A firm which did maintain this bridge, somewhat at arm's length, was British Oxygen (see Gardner (13)). In this organization, venture groups would rent temporary premises from one of the existing divisions. The new group would, however, be monitored and provided with services by a 'New Venture Secretariat'. This structure was supposed to provide autonomy, flexibility and "low overhead but the right tools". It should be noted, though, that BOC did not find the venture concept to be a success.

Vernon (14), describing a new venture within ICI discusses a similar form of organization:

"Having identified the particular line which the new venture would take, it was decided that it should exist as a 'satellite' of the main Division activity, taking from the Division and from the company as a whole the support services which it required to establish a firm foundation in the chosen field."

Quite what these 'support services' are is rather unclear as Vernon

goes on to say that the new venture is responsible for its own R&D, production, marketing and sales.

A firm that keeps even closer links with its venture teams is Du Pont. Peterson (15) observes that creating a successful new business involves three phases:

- (1) Search for the concept or idea
- (2) Commercial evaluation of the concept or idea
- (3) Commercialization

At Du Pont, all the stages take place in the Development Department. After a project has been approved, a manager is appointed to run a 'company in miniature' within the Development Department. After commercialization it is handed over to the appropriate industrial division. This was also the final outcome for BOC ventures.

It is clear that all this is quite a long way removed from the shareholder/manager to be found in Hanan's garage. Yet each of these schemes is designed with the same end in mind: to retain creative, entrepreneurial managers within large organizations and give them scope to create successful new businesses. Such variations in approach present no problems for von Hippel (16). According to his analysis:

"Corporate venture management is a robust concept which can be successfully practised (1) in a wide range of industries, (2) on a wide range of scales, (3) by venture sponsors who may or may not be 'close to top management' and (4) by venture managers who are not screened for special 'entrepreneurial' characteristics but are simply 'rotated through' management of a venture as part of their career with the parent corporation."

Despite von Hippel's claim, the fact is that venture groups frequently fail and "a failure list would read like a compendium of the blue chips of American business" (17). Hanan (18) quotes the cry of one

industrialist:

With all our resources, talent and money, how is it that we have failed when small companies have succeeded? Every day, successful businesses are started up on a shoestring by people who couldn't even get jobs in our shipping room."

Hanan himself picks out two of the most important factors for success in corporate ventures as finding the right man for the job (an "entrepreneurial type" with a "highly personal leadership style") and devising appropriate performance criteria. On the first point he is backed by Rothwell (19) who calls for "a fine balance of youth and experience" although he in turn is at odds with von Hippel (20) who finds a negative correlation between the "previous corporate level of a venture manager and venture success".

At Heinz, Managing Director O'Reilly

"believes that administrative controls that monitor the ordered efficiency of an organization on a short term basis are in many cases the death knell of entrepreneurial activities. Managers often lose their nerve halfway through a speculative project if the short-term pointers look unfavourable. Others do not embark upon long-term projects because they feel they are being judged primarily by what they produce today" (21).

Hlavacek and Thompson (22) believe that since it is organizational bureaucracy that stifles innovation in the first place, this financial question will be highly significant:

"Since reduction of risk is so important in releasing creative behaviour, it is not surprising that the budget of some venture groups at least is not subject to tight accounting controls. Resisting the inevitable bureaucratic pressure for tighter budgetary control of venture groups appears to be one of the most difficult and most important contributions that higher management can make to a new product innovation."

By contrast, Kraushar (23) demands early results from his 'development organizations' though his recommendations relate to the rather

different packaged goods industry. Montgomerie (24) wants failing ventures to be "stopped before they absorb too many resources". This is an attitude which again points out the need for fine judgement in the application of performance criteria, given the counter argument that it is lack of financial support which causes failure in the first place.

A different perspective is provided by Dunn (25). Examining a number of venture group failures he found that a principal cause of their demise was that they were autonomous enough to be able to spend large amounts of unnecessary money!

Among other reasons for failure was first that successful venture managers received accelerated promotion (as would be expected) and were therefore resented; failing managers not surprisingly suffered the opposite fate. Either way, company managers found that the job was 'all risk and no reward'. Finally, the groups were found to be unproductive.

The only ideas they produced were killed off because they 'did not fit in with corporate policy', although corporate policy was nowhere defined. This tends to support Fast's (26) conclusion that ventures related to existing businesses are more successful than unrelated ones. The reasons he gives are that unrelated ventures suffer from a lack of expertise, higher start-up costs and a lower degree of top management commitment.

Finally, another of Fast's findings (27) is that there are two fundamentally different types of venture group. In a study of 18 'new venture departments' (NVDs), he distinguishes between:

1. Macro NVDs which are large scale ventures representing significant diversification effort by the company concerned. They

often employ several hundred people and have a budget in the millions of pounds.

2. Micro NVDs which are small operations which are not expected to have a major impact on the company. Their strategy is generally to establish a 'beach-head' in the new market. They typically receive fairly low investment.

A summary of the characteristics of the two types is given in Table 4.1.

4.3 OTHER DEVICES FOR PROMOTING INNOVATION

The thinking behind all innovation-promoting devices described in the literature is revealed by considering Horwitch and Pralahad's 'modes' of innovation (18):

Mode I innovation occurs in small, high technology firms. These show little differentiation of function and have simple, informal, effective communication systems.

Mode II innovation occurs in large divisionalized corporations which can apply massive resources to achieve success in their chosen innovation programmes. Their problem is that necessary skills are distributed throughout the various functions, which makes communication difficult.

If firms who use venture groups are attempting to create Mode I conditions within their organization, many of the devices described here are attempts to overcome the communication problems inherent in Mode II. It follows, of course that the integrative mechanisms

TABLE 4.1

CHARACTERISTICS OF MACRO & MICRO NVD's COMPARED



Aston University

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Source: Fast (27)

discussed in Chapter 3 are relevant in this context. This section extends these ideas somewhat by noting the literature which applies to them in the context of innovation.

The first of these studies explicitly identifies the two options of venture groups and co-ordinating devices as alternatives to the problem of innovation management. This is the work of Hlavacek and Thompson (29). In their view, new developments can be promoted by the appointment of a Product Manager.

The Product Manager has no line authority or organization of his own, but must work within the existing company structure. Nevertheless, he is held responsible for the success or failure of the new product. He must therefore rely on his powers of persuasion to acquire the necessary personnel and resources.

An exactly similar concept is described by Pessemier (30) (under the title of 'Co-ordinator') as one of the four techniques he advances for good project management. Another is the 'Project Leader' who is given all the resources he needs to accomplish the task. Also suggested is the setting up of a 'Core Team'. This would be made up of a permanent Chairman and representatives from each department on part-time assignment. The final idea is that of 'Joint Project Leaders'. These would be one each from the development lab and from marketing, who would co-operate in the overall promotion of the new product.

A report of one company which used a particular co-ordinating mechanism in the management of innovation is given by George (31). This study looks at Litton Industries' move into the market for microwave ovens. Litton decided that they needed a new organization to attain rapid growth which would be both responsive to change and able to maintain

tight financial and operating controls. They chose a functional structure overlain with cross-functional 'task teams'. Planning and product development were among the responsibilities of these teams. Their purpose was to take decisions which were seen to be relevant by each function, without overloading senior management by continual upward referral.

Of course, this can only work if the teams have both knowledge and authority. This point was raised in a case study reported by Lawrence and Lorsch of two American corporations which they called Crown and Rhody (32). Both companies had co-ordinating departments whose responsibility it was to integrate the innovative activities of the research, production and sales units. In order to resolve the differences which inevitably arose between them, both also had permanent cross-functional groups, made up of managers from each department.

At Rhody, both these mechanisms were seen as useful. At Crown, both were unsuccessful. The Crown co-ordinating departments had too much of a sales bias, where at Rhody there was a balance between the functions. The Crown cross-functional group failed because it was made up of middle managers who had neither the detailed knowledge of their departments' operations to reach relevant decisions, nor the authority to enforce them. This meant that each member had to bring with him subordinates to provide the detail and superiors to ratify their conclusions. Rhody avoided this problem by allowing managers at the operating level to reach and implement necessary agreements.

The quality of decision-making also differed between the two companies. Rhody managers were highly committed to group decisions and efforts were made to confront and thrash out interdepartmental disagreements.

Crown's difficulties were compounded by putting disputed matters aside until a crisis developed and they had to be tackled.

The most comprehensive study of product management methods has been undertaken by Souder (33). In an analysis of 100 innovative projects, half successes and half failures, he identifies nine different management techniques. He also draws conclusions about the relative merits of each technique and about the factors which distinguish successful and unsuccessful projects managed in the same way. The following is a summary of his findings:

1. New Product Departments

These were co-ordinating and expediting departments responsible to top management for planning, market research and product design. They existed to promote communication between R&D and marketing, but had no line management authority. In the successful departments, personnel were always technically qualified and had previous R&D experience. They had high status and respect within the organization and maintained particularly close links with the R&D function. None of this was true for the failures.

2. Product Committees

These typically consisted of permanent task-forces of senior managers who were responsible for planning and overall co-ordination of the marketing and technical development. They were aided by ad hoc subsidiary task forces as necessary. This structure was mainly used where projects were large and expensive.

3. Commercial Project Manager

This was a manager, based in marketing, who was given responsibility, resources and line authority for the development of a new product by a

multi-disciplinary team. At the end of the project, all personnel returned to their own departments. In successful projects, the project manager always had the direct backing of senior company managers and easy communication with them, but senior management never became involved in the detail of the project. The manager himself was always a strong personality, able to keep the project on schedule and to resolve conflict when it arose.

4. Technical Project Manager

A similar structure but with a manager based in R&D. Neither of the projects managed in this way was successful because technical development tended to be pursued at the expense of marketing.

5. Commercial Line Management

Here, a single senior manager would take direct responsibility for all aspects of the project. This method tended to fail because of poor communication and collaboration between R&D and marketing. Where the responsible individual was a marketing man, technical development was often neglected and those managers who did seek to overcome this problem typically went through their senior R&D colleagues. This long chain of command made communication difficult and the long response times stifled the ability of lower-level personnel to pursue their task.

6. Technical Line Management

In this system, the R&D department would generate and manage the whole development project. All attempts to use this technique failed because R&D could never get the marketing department to accept the finished product.

7. Commercial One-Man Show

This term was used for the identification of a need, the promotion of technical development, and the final sale of the product by a single individual from marketing. It was seldom used, and was successful only where the person concerned had a technical background and his product was in a familiar technical and market area.

8. Technical One-Man Show

An identical concept except that the individual was from R&D. All but one of the projects managed in this way failed, again because the resulting products were seen as irrelevant by the marketing personnel.

9. Dyads

A dyad was a close relationship between two colleagues, one from R&D and one from marketing. It was effective when the close co-operation of the two was tempered with a willingness to challenge the other's viewpoint.

A summary of the performance of the various management methods is given in Table 4.2. Souder believes that only four of the nine are really effective, and that the choice depends on the nature of the technological and market environments. This is shown diagrammatically in Figure 4.2. Souder also notes that the best methods are the most expensive.



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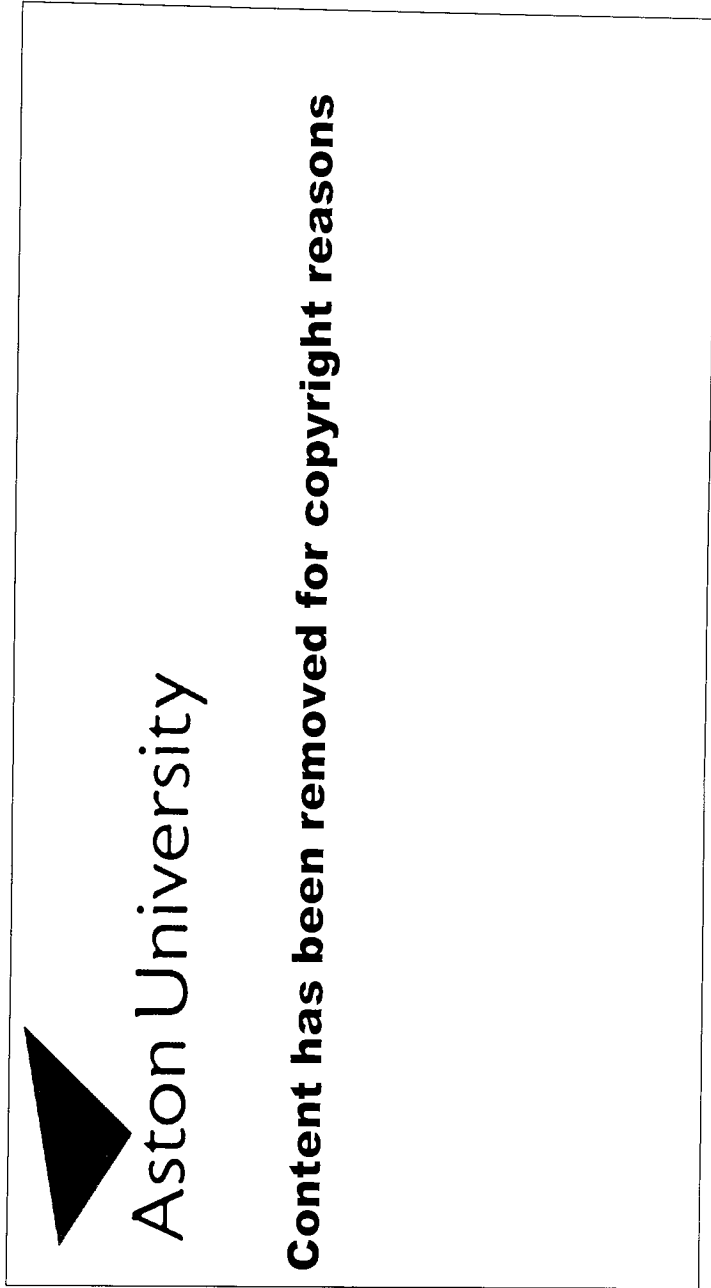
TABLE 4.2

EFFECTIVENESS OF PROJECT MANAGEMENT METHODS

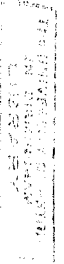
Source: Souder (31)

FIG. 4.2

PREFERRED PROJECT MANAGEMENT METHODS UNDER DIFFERENT ENVIRONMENTAL CONDITIONS



Source: Souder (31)



4.4 DISCUSSION

There is general agreement that, in Galbraith's terms, entering a new technology or market increases the information load on a company. Two sorts of structure are used to deal with this. One is to create separate organizational sub-units, the other to improve the capacity of the existing organization.

In trying to understand which of these options a firm would be likely to choose, two factors seem at first sight to be important. Firstly, all the devices described in Chapter 4.3 stress the need for co-ordination between functions, and therefore seem to be appropriate where the organization is of functional form. The venture principle would appear to be more suitable where the company has product-based divisions.

Alternatively, one could view the choice as depending on the scale of the innovation. Even within a divisionalized structure, the organization of the divisions is likely to be functionally-based. Co-ordinating teams could therefore be used to promote innovation within the division, while diversification into new business areas would require venture groups. As Hill and Hlavacek observe, "Large business corporations designing product modifications or 'me-too' products do not need the venture structure" (34).

The real nature of both techniques is, however, much more complex than this and is difficult to unravel. Nowhere in the literature does there seem to be an explanation of what innovation is, and how these various mechanisms are supposed to help with the problem of managing

it. It is therefore worth pursuing this initial point before looking at the existing studies in detail.

The conclusion of Section 4.1 was that the problem of innovation is one of unfamiliarity. This was based partly on the contingency view that it is coping with environmental unpredictability which is the central task of management. The activity of innovation is bound to be highly uncertain in that it involves technologies or customers of which the firm has no previous experience. Studies of success and failure in innovation conclude that it is extremely important to have both a clear understanding of the needs of the market and to have efficient technical development (35). In short, this is to say that the firm must learn adequately about its new environment.

Such learning may take place at many levels. If the plan is to enter a totally new business, diversification opportunities will be investigated by the concern's most senior executives. If a particular division wants to extend a product line, its market research and technical work will be more limited in scope (though more detailed). In the terms of the systems model of Chapter 3.3, this is simply an expression of the working of the intelligence function at different levels of recursion.

The first problem of managing innovation is therefore one of learning, and any of the organizational structures described in this chapter may be employed to support this intelligence activity. This is not the end of the story, however. If the new investigations carried out by the firm suggest that the new product or business is worth pursuing, a new operational element is introduced (at whatever level of recursion).

There is now a problem of controlling a new implementation activity.

The firm may nevertheless continue to use similar forms of organization

identified their ventures as intelligence activities. This is confirmed not only by the formal 'hand-over' which marked their becoming new operating units but also by the features of the supporting organizations. As long as they were in development, B.O.C. had their ventures under a 'New Venture Secretariat', and Du Pont's were contained within the Development Department.

The reverse seems to have been true at Heinz, and in Hanan's concept of a venture group. In both these cases, what one might have expected to have been an intelligence activity was cast adrift and expected to make its own way. In fact, these units had remarkable independence even for implementation subsystems. Perhaps the key here is the remark that Heinz see themselves simply as 'shareholders' in these enterprises. The objective set for the ventures was simply that they should make money. The parent company exercises no control, being content simply to take its dividend at the end of the year. In these circumstances, 'venturing' is reduced to a purely financial transaction, and the venture is not really part of the same organization. Since there is no policy in common between the unit and its parent company the issue of control does not arise. This type of venture concept is not constructed, therefore, on the basis of any organizational logic.

Whether or not a 'true' venture group is an intelligence or an implementation activity can be a source of confusion, and although he distinguishes between two types of venture departments, Fast seems to be a victim here. Although it did not regard itself as such, Fast would certainly see Litton Industries' microwave oven operation as a macro venture. It fits exactly his definition of being a major diversification project with a large budget and many staff. All such ventures are certainly operational units, rather than involved in

development. Clearly Litton had done the necessary research and made the decision to diversify. They then created the organization to achieve that objective.

There seems to be no difficulty here. It is with the micro NVDs that the problems arise. As Table 4.1 shows the aims of these departments include the establishment of beachheads in new markets, and the retention of creative people in the organization. Both these objectives are consistent with the view that micro NVDs are elements of the intelligence function. However, Fast also suggests that such ventures have short pay-back periods.

What distinguishes implementation subsystems is that they are themselves viable - able to maintain a separate existence. In order for such a subsystem to be viable, within a company, it must be profitable in the long run. One of the criteria which differentiates venture groups in the intelligence function from those which are operational units is therefore the demand that they be profitable. Thus it seems that even some of Fast's micro NVDs are implementation units. The distinction between macro and micro ventures is not the same as that between development and operating departments. Indeed, it may well be that the companies themselves do not understand this point, which will be pursued at greater length in Chapter 5.

It has been seen in the case of venture units that apparently similar organizational structures may in fact operate in different ways. Exactly the same is true of the co-ordinating devices in Section 4.3. The various mechanisms described in Chapter 3.1 were designed to support integration within an organization. They were seen to be necessary because of the differentiation required to handle the contingencies of a complex environment. Broadly speaking they were

identified with the co-ordination function of the systems model.

It should be reiterated that this model is based on systemic logic, and is not intended to imply any particular organizational structure. It follows from the analysis that if a new product or business is introduced, a new implementation subsystem is created. The requirement to control this activity will mean that the capacity of the command, co-ordination and monitoring channels will need to be expanded, and more complex co-ordinating mechanisms will be needed.

From the contingency perspective it can also be seen that this new operation will extend the relevant environment of the enterprise. Whatever the formal structure of the organization, this is likely to mean taking on new people, or some of the existing staff specializing in the new area. In either case, differentiation will be greater, and more sophisticated integrating devices will be needed. Thus improvements in co-ordination will be a feature of the organization once a new subunit is created.

This does not mean that the structures normally associated with co-ordination always exist in the co-ordination function of the systems model. In fact, it would appear that almost all the integrating techniques to be found in the innovation literature are aspects of the intelligence activity. One can recall the co-ordinating committees described by Lawrence and Lorsch. Their purpose was to integrate the innovative activities of each of the functions - a 'research' rather than an operational task. If one looks, for example, at the technical management categories in Souder's classification, this view is confirmed. Neither the 'technical line management' nor the 'technical one-man show' was an integrator at the operating level, because the products that emerged were rejected by the marketing departments that

were supposed to sell them.

The problem of distinguishing the functional role of these structures is very well illustrated by the Litton Industries case. Here one finds a macro new venture department created as an operating element of its parent company. Within this unit, one also finds task teams working in both a co-ordinating role (participating in the control of manufacturing) and an intelligence role as part of the R&D function.

CHAPTER FIVE

ORGANIZING FOR INNOVATION

IN ENGINEERING GROUP

OUTLINE

This chapter looks at the various organizational forms that have been tried within the Dunlop Engineering Group to promote innovation in recent years. It traces a progression from a pure development workshop, through the introduction of venture groups to the acquisition of new companies.

The analysis of the last two chapters is drawn on in discussing these moves.

5.1. R & D DEPARTMENTS

(a) Product Development Unit

The individual divisions within Engineering Group have a history of successful innovation. Dunlop's developments of the disc brake, anti-skid systems for lorries, hydrolastic suspension and the carbon aircraft brake were all made at Coventry. For the reasons outlined in Chapter 1, however, it was felt that new products ought to be generated outside the traditional fields of aircraft and vehicles.

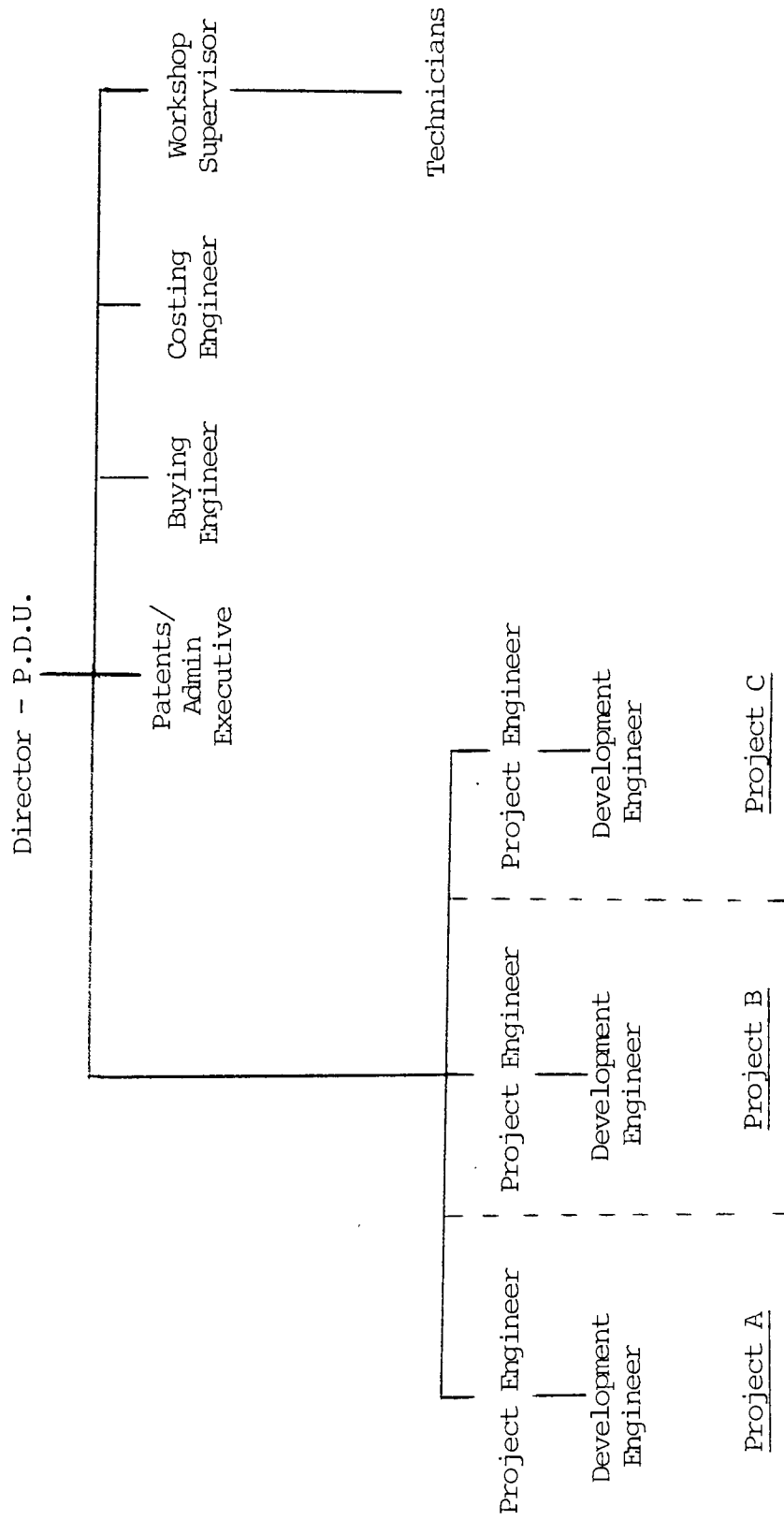
In the early 1970's, Engineering Group was joined by a senior manager who had an acknowledged record in the product development area. It was decided that he would be the best person to uncover new products, so he was given responsibility for a new department, which was called 'Product Development Unit' (PDU).

PDU was involved with the development of a number of projects simultaneously. Each project was under the leadership of a Project Engineer, and the Project Engineers had design draughtsmen and development engineers under them. The various project teams shared common workshop facilities and certain support services were also provided. An idea of the structure of the unit is given in Fig. 5.1.

Such charts inevitably create the impression of a rigid, static organization, but this seems not to have been the case in PDU. The Director was personally involved with each project and was of great assistance. The workshop provided an extremely efficient and co-operative service to all the project teams. Components were built and

FIG. 5.1

PRODUCT DEVELOPMENT UNIT - ORGANIZATION STRUCTURE



modifications done very quickly.

Although the unit worked well internally, it was not successful. One reason was that whatever the original intention had been, it tended to concentrate on technical development at the expense of commercial. In fact, no marketing personnel were assigned to PDU, and this seems to be a reflection of a general weakness in marketing which existed within Engineering Group at the time. What market research was done was conducted casually through the Director's contacts in various industries. The Director himself was an engineer, and one gains the impression that he was mainly interested in developing new ideas for their own sake.

According to Oakley (1),

"the consequence of this was that products were sometimes extensively developed, perhaps over several years, only to be rejected by the markets they were intended to exploit. Because of the product orientated development process, ingenious and complicated designs were sometimes encouraged while competitors, with better awareness of their markets, favoured orthodoxy and simplicity."

He suggests, however, that this technical orientation was not the only reason for PDU's lack of success. Even when marketable products were developed, they were rejected.

This seems to have occurred for two reasons. Firstly, each of the operating divisions had an independent R&D facility. PDU developments were therefore rejected as 'not invented here'. Secondly, there seems to have been something of a paradox in the attitude of Group management to these projects. Despite the fact that PDU's mission was to develop products outside existing business areas, the ideas that were put forward were rejected specifically because the Group had no expertise in the new field.

(b) The Special Project Organization

By 1976, PDU had failed, for whatever reason, to develop any products that had become commercially viable. Following the arrival of a new Director for Engineering Group as a whole, the unit was closed in April of that year. Of its existing products, the decision was made to try and commercialize two by means of venture groups. Two others were not advanced enough technically for a judgement about their likely success to be made. A new department was created to deal with these two, which was called the Special Project Organization. The former PDU Director maintained his responsibility for advising the Group on technical development, but entirely within a staff role. He was no longer the head of his own group. Nevertheless, he was put in charge of the Special Projects.

It is difficult to see in what sense this was really an 'organization'. All support facilities were withdrawn from the projects concerned, and the impression is that the work was left to the individual engineers whose 'pet products' they were. It was up to them to persuade the operating divisions to provide assistance with buying, component manufacture and so on. Since the managements of those divisions seemed to have no interest in (if not actual opposition to) the projects, their co-operation was difficult to obtain. Nor did there appear to be any commitment to them by Group Management who might otherwise have brought pressure to bear.

Of the two developments within the Special Project Organization, one was eventually abandoned. The other had a brief career as part of the new structure which emerged towards the end of 1976 - the venture units.

(a) Background

Although previous attempts to promote diversification had failed, Engineering Group was still aware of the need to develop in new business areas. In late 1976, therefore, a new division was established by the Group Director. It was called Industrial Products Division.

This was not a 'division' in the real sense because it had no operations of its own. Rather it was an 'umbrella' under which a number of projects were drawn. These were of two types. First, there were two old-established smaller divisions whose product lines were felt to be in need of rejuvenation. Second, there were several new enterprises that were thought to have commercial potential. These included the two products that had been developed in PDU - the Thermimax burner and the Kestrel air-sprung cab seat for lorries. In addition, Engineering Group had recently acquired the development and production rights for the concept that became Dunlopipe.

Learning the lessons from the weaknesses of PDU, the decision was taken to establish each of these new businesses as independent venture groups. Expertise in the technologies and markets associated with each of the products was brought in from both within the Group and outside it. In this way it was hoped that technical and commercial development would progress together and would be mutually reinforcing.

Each of the venture operations was originally established in premises

on the Coventry site, although the wisdom of this decision was debated by management at the time. Subsequently it was decided to move Energy Engineering Division, as it became, to its own factory in Rugby. A similar plan for Dunlopipe was considered but rejected.

Of the three, the Kestrel seat has not survived. Although it generated interest at the Motor Show where it was launched, and some fleet customers specified it for their trucks, it was never adopted by any major manufacturer. This would have been needed to make the market for the product at all significant. There also remained some technical problems with it.

For these reasons, Group management decided to sell the design to a competitor, although members of the venture team claimed (as one might expect) that it was disposed of just as it looked likely to succeed.

(b) Dunlopipe

The full details of my impressions of Dunlopipe and Energy Engineering Division are given in the Appendices A to C already referred to. Here I shall just summarise the main points.

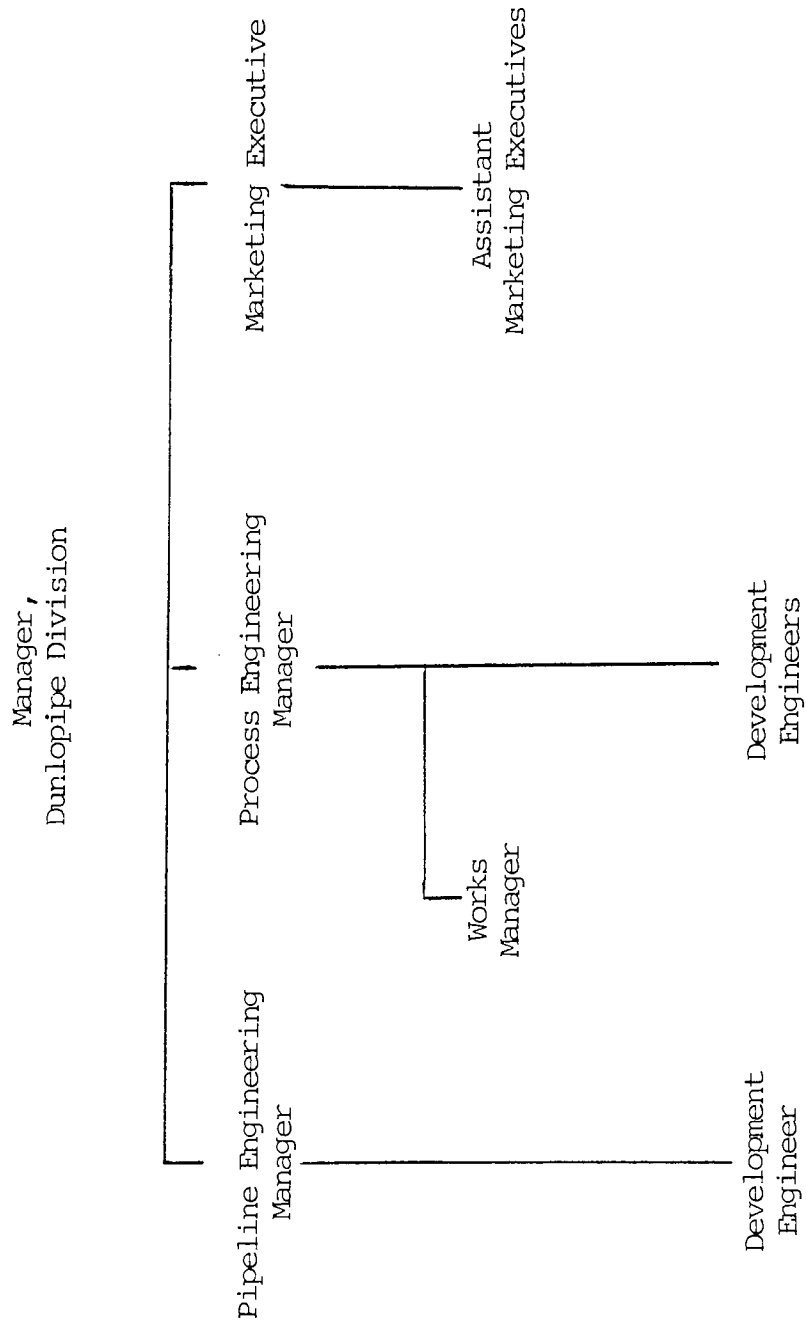
The reason that Dunlopipe was kept in Coventry seems to have been that it represented easily the largest development investment within Industrial Products Division. It may well be that a need was felt for closer scrutiny of its performance than that of the other ventures.

The decision to keep it on the main site has proved highly significant.

The Dunlopipe venture team had the structure shown in Fig. 5.2 and here the impression of hierarchy is quite justified. In fact, the

FIG. 5.2

DUNLOPIPE - ORGANIZATION STRUCTURE



senior people in the unit were physically separate from the development engineers. One group had individual offices upstairs, the other were below in a shared room. One could expect poor communication in these circumstances, and so it was.

The development engineers did not know what the overall development policy for the project was. They tended to be set ad hoc tasks on a day-to-day basis, and complained that where they were given medium to long term objectives these were impossibly ambitious or unrealistic given the resources available.

What was even more striking was that no attempt was made to match the comments of potential customers made to marketing personnel with the actual technical development in progress. This was despite the fact that the stated intention of the venture concept was to ensure that technical work was relevant to market needs. When I myself examined the marketing department visit reports to see what end-users had been saying about the pipe, I was told that they were none of my concern.

Finally, it was often difficult to see the managers of the project. They were frequently in the office of the Industrial Products Division General Manager discussing its progress. The impression that it was the General Manager who was taking or ratifying decisions about the project was supported by the fact that he often travelled abroad alone on Dunlopipe business.

The role of many of the individuals in the venture was rather ambiguous. Apart from its having had three Project Managers in 2½ years, one of the senior personnel (who came from outside Dunlop with great experience in the water industry) was responsible for the laying and installation of the pipe. Since no pipe had actually been sold, it

was difficult to see what his function was. It was not surprising therefore that the development engineer under him had no work, and left. Another of the development engineers acted as buying clerk, filling in requisition forms to be sent to Wheel Division through whom orders were placed. She also decided to leave and took a job elsewhere in Engineering Group. At some time during my work with Dunlopipe, all but one of the development engineers were actively seeking another post. At the same time, there was talk of employing another senior man in the role of Development Manager, although nothing seems to have come of this.

In general it must be said that Dunlopipe was far from being the dynamic, goal-oriented, organically-managed unit that one would expect in a venture group. Certainly the results obtained whilst I was there reflected this.

(c) Energy Engineering

The second of the 'venture groups' which still exists is Energy Engineering. Having spent many years developing the Thermimax burner within PDU, it was felt that it was sufficiently advanced to be worth exploiting. It was recognized, however, that the burner was of little commercial interest by itself, and that it needed to have some manufactured products built around it.

The initial work, when the group was still in Coventry, centred around the design of the tank heater and the radiant tube. Warm air heaters and air conditioners were also brought in as factored items to create a viable business. Having established its base, the group was moved to a small factory on an industrial estate in Rugby. The intention was to

generate the independence and flexibility necessary for the effective operation of a venture unit.

This decision has had a profound effect on attitudes within the team. To begin with, one was immediately aware of a commitment among all the members to the growth of the business as a whole. This was reinforced by periodic meetings which the Manager had with everyone concerned, including the shopfloor, secretaries and senior technical and marketing people. In these meetings, the financial and sales performance of the unit was reviewed, problems were exposed and objectives set for the future.

The Manager's personal style was most important in this. He demanded, and largely achieved, a high level of autonomy. For example, he was unusual, if not unique, in Engineering Group in being able to do his own hiring and firing, negotiate his own wage and salary rates and so on, without being bound by Group procedures.

Psychologically, members of the venture felt that the move away from Coventry had given them all more freedom of action. Asked to elaborate, they mentioned industrial relations problems, having to use central facilities and even the Coventry site's telephone system as factors which would have held them back. The essence of the complaint seemed to be that the inertia of a large organization slowed them down. They preferred to be independent, despite the lack of some useful services (such as telex) which would otherwise have been available. If communication between the team and Engineering Group was sometimes poor because of their separation, within Energy Engineering itself it was the key word. It was also particularly noticeable that when it broke down, efforts were made to identify what had gone wrong and to prevent it recurring. This, the attempt to confront and learn from

mistakes, and the independence which the group had from its parent organization, were the two most striking differences between the venture teams.

5.3 ACQUISITIONS

The failure of either Dunlopipe or Energy Engineering to grow rapidly into a significant element of Engineering Group's business was clearly disappointing. Perhaps because of this, the next diversification moves made by the Group were by acquisition.

The purchase of Rice Trailers, after considerable analysis, fulfilled (in a way which the company recognize as rather distant) the objective of moving into agricultural engineering. It was argued that even if it was rather on the fringe of this activity, it was in another growing field - leisure - and it would be foolish to miss a profitable opportunity. So far, the business has kept its promise of profit.

Industrial Automated Systems (IAS), the most recent purchase, was not acquired with the strategic study in mind. Rather the opportunity was taken to expand Engineering Group's expertise in the manufacture of plant and machinery to include the emerging microelectronics sector. The company started out as a one-man business and its founder remains as Chairman. Despite the Dunlop takeover, he still seems to be the key figure. The employees identify strongly with IAS rather than with Dunlop and continue to regard it as his company. He appears to be de facto responsible for creating internal company policy because there is

a general feeling that nothing can be done without his approval and co-operation. In fact, one of the most striking things about the firm is that becoming part of Dunlop has had no apparent effect on its day-to-day workings. Financial statistics have to be prepared in the approved way, and IAS receives visits from internal auditors (and even from Dunlop board members). Otherwise all contact between Engineering Group in Coventry and IAS is handled by the Chairman, who 'filters out' the Dunlop influence.

The same cannot be said at the strategic level. The link between the expertise of IAS and Plant and Equipment Division (PED) has already been mentioned. One of the projects that IAS had on hand at the time of the acquisition was a new electronically-controlled powder-handling system. The decision was taken by Engineering Group management to establish this project as a separate venture within PED in Coventry and this has had important implications for IAS.

It was pointed out in Chapter 1 that IAS builds mainly one-off units. The result of this is to increase uncertainty about the flow of future work. An initial customer enquiry may or may not lead eventually to a contract. Even if it does, the intervening period during which designs are discussed may be quite long. This presents considerable work-scheduling problems, because if the contracts do not fall in as expected, or they are delayed, the workshop is idle. If sales do too well, it is swamped.

The outcome of moving powder-handling to Coventry seems to have been to upset the programme of contracts to the extent that when I was there the main assembly shop had no work at all. This in turn meant that sales engineers were quoting shorter delivery times than usual, but these could only be honoured if two large orders did not come in

together.

Delivery times were in fact one of the major difficulties at IAS. They were frequently missed for several reasons. One was that quoted times were known to be tight in any case, but this was necessary in order to obtain the work at all. It meant that no allowance was built in for doing the modifications that customers inevitably demanded. In addition, the company exhibited a classic conflict between design (who wanted everything they ever specified to be in stock) and buying (who wanted standardization of components to keep purchasing and stock-holding costs down).

The designers would assume that certain items were in stock or readily available and would therefore requisition them late in the progress of a job. The fact that there was a stock book in which the components actually kept were listed seemed to make no difference. Faced with a late request for a non-stock item, the buyer would approach one of the 'preferred suppliers' with whom he had negotiated a good discount. If they did not stock the item, he generally ordered it from them in any case, making no effort to find a stockist who could provide it at short notice. The problem was exacerbated by the fact that the goods inwards procedure was not watertight and parts which did arrive 'went missing'. Since both parties blamed the problem on the other's inability to do his job properly, the IAS management was eventually forced to reorganize the company in an effort to improve the situation.

5.4 A CRITIQUE OF THE STRUCTURES

This section and the next present a critical appraisal of the techniques described above. The structures will here be considered individually, whilst Section 5.5 looks at some more general aspects of the problem of innovation management.

Analysis of the R&D departments is much the most difficult. It is now many years since they were closed and it is not at all easy to assess the quality of the limited information available about them. Not only are the sources few, but issues always seem to be clearer to the participants in retrospect. Even if the details given are accurate, the picture they present may not be a representative one.

Having sounded this note of caution, however, there are several points that it does seem reasonable to accept on the grounds that they are made by several people, or come from a contemporary account and accord with the findings of other researchers. The first is that the Director of PDU whilst a fine technical man, paid little attention to the financial and marketing aspects of the products under development. Secondly, products developed were rejected as 'not invented here' by the other divisions. Thirdly, products designed for unfamiliar markets were rejected by top management on the ground of insufficient expertise. All of these highlight problems which seem to be endemic in R&D management.

The personal history of the PDU Director is relevant to the understanding of the first of these points. Although he had been involved with new products in a large company in the motor industry, he was originally recruited for one of the senior line management posts in Engineering Group. He was not considered a success in this job, and

the fact that the need was felt in the company for some development work outside the traditional business lines offered the opportunity to move him to a position better suited to his talents. It seems to be generally agreed that he was, in the eyes of his staff, an excellent R&D manager. However, PDU made hardly any long-term impact on the business as a whole.

The apparent paradox is explained by a number of research findings concerning the relationship between R&D departments and the rest of an industrial organization. According to Twiss:

"If asked what he does for a living, a research worker will describe himself as a physicist or a biochemist, whereas his contemporaries elsewhere in the business are more likely to mention their function and probably name the company as well. He is likely to relate his career goals to advancement in his own discipline... Even senior managers in R&D may not identify closely with their company's business objectives, and do not view their personal careers in terms of advancement within a particular company" (2).

The consequences of this technical orientation were explored at length by Burns and Stalker. They found that scientists were seen as somehow 'different' in terms of their attitude and group culture from people in the rest of the organization. The scientists themselves sought to maintain this image by avoiding professional and social contacts with others in the firm, and by operating under different rules with regard to timekeeping for example. The outcome tended to be that the researchers found themselves isolated:

"The simplest and most direct consequence of the special status ascribed to the industrial scientist is that in extreme cases he becomes so detached from the rest of the concern that it derives little benefit from his presence" (3).

Against this background one can begin to appreciate the position that PDU must have found itself in. Its Director had already been seen as

ineffective as a Divisional Manager, although his scientific colleagues were impressed with his performance in the technical field. Such evidence as there is tends to confirm the view that PDU was strongly motivated to demonstrate technical achievements in isolation from more general business objectives. Furthermore, the observation by Twiss that scientists tend not to be concerned with career objectives inside a company may have been particularly applicable here because the Director was approaching retirement.

All this tends to lay the responsibility for the un-productiveness of PDU entirely on its own staff, but this is unfair. The point here is a more general one. In Chapter 4.2 Child was quoted as observing that there is a need for a 'shared understanding' between the development organization and the rest of the firm, and this seems to have been lacking here. Oakley, as a PDU development engineer, complained that no business objectives were ever set for the group to work towards, so that it was not surprising that technical developments were pursued for their own sake. Such differences of perception seem to have been at the root of PDU's problems, resulting in each side blaming the inadequacy of the other.

For example, it seems to have been felt in PDU that the Divisional Directors rejected proposals for new products somehow out of malice. This is both too simple and too extreme an interpretation. In the first place, it does appear that there was no consensus within Engineering Group concerning what PDU was for. What seems to have happened in this situation was that the Divisional Directors (all of whom had their own R&D facility) concluded that it was either irrelevant (as a duplication of effort) or a threat to their future resources, or both.

A combination of the two seems the most likely answer, although even had PDU's role been understood by all, there would still have been political differences. Many such arguments are described by Burns, who concludes:

"What is striking about all these kinds of political conflict is that they were allied to the appearance of a new group, or the rapidly enhanced performance of an existing group. This threatened the power, influence and prestige of the formerly dominant groups" (4).

PDU was just such a new group, and in any case "as long as organizations continue as resource-sharing systems, where there is an inevitable scarcity of resources, political behaviour will occur" (5). What therefore seems to have led to the demise of PDU was the difference in understanding amongst people in Engineering Group about what it was supposed to achieve, and its inability to maintain its position in a highly politically-charged atmosphere.

This situation was resolved by changes in Engineering Group which led to the emergence of a new and powerful management team. The position of PDU was tenable only as long as the debate about its role could be sustained. With the new management came a definitive statement that the task of product development was to commercialize new lines in previously unexplored markets, and that on these criteria, PDU had failed. The new system was to be venture groups, run as 'mini-divisions' whose managerial orientation would be much more similar to that of the Group's senior management.

Before completing this step, however, there was a halfway stage. Some of the products under development, whose future was uncertain, were moved to a 'Special Projects Organization' for further work. It can fairly be said that there was no real commercial rationale behind this move. All the existing technical, purchasing, secretarial and other

services which had existed at PDU were withdrawn, and only the individual engineers who were most closely identified with the products were kept on. These people continued to report to their former director, whose influence and budget were now extremely limited.

One can only conclude that there was never any real expectation that the developments under the umbrella of the Special Projects Organization would ever be viable business propositions. It is more probable that senior management felt under some subsidiary personal commitment to the individuals concerned, particularly to the Director. This can be inferred from the fact that the organization was wound up on his retirement.

The venture structure, which had now completely replaced the more traditional laboratory-type organization at the Group level, marked a significant change in outlook in two main respects. The first was that the emphasis was now firmly on diversifications away from existing markets. The individual divisions were continuing to improve their product lines, but ventures were exploring new opportunities.

Secondly, the ventures were committed to ensuring that the commercial development of their products went hand in hand with their technical development. One of the main problems with PDU was that it had no marketing personnel of its own and the existing marketing departments were not interested in what was produced. This is exactly the outcome that Souder found in his study of cases where technical personnel managed new projects.

For this reason, marketing and technical people with experience in the particular product field were brought in to Dunloppe, Energy Engineering and Comfort Engineering, often from outside. The structure of each group was that of a functional organization in embryo, and more

people were added as the momentum of development increased. The objective was to have a fully operational division by the time the product was ready for launch.

Although the venture concept was aimed at overcoming the two critical problems of PDU, it seems to have suffered many of its own, all of which illustrate well the points that emerge from the literature discussed in the previous chapter. One important structural feature that lay behind the design of the groups was that the intention of beginning ventures was to develop an understanding of new markets and technologies. To this end, they were to have a small budget until they had established a 'beach-head' in their marketplace. They were therefore, in Fast's terms, 'micro-NVD's'. They were also supposed to be independent, flexible and dynamic. Their difficulties arose in two areas. One was in their internal operation, the other in the nature of senior management control.

If there is agreement on any single point in the literature it is that the purpose of a venture is to create an organic-type management system in an otherwise mechanistically-organized concern. One would therefore expect to find lateral rather than vertical communications, a co-operative, mission-oriented effort and so on. These things were largely absent in the Engineering Group ventures. The best example of this was Dunlopipe, where the rigid managerial hierarchy was reflected in job titles, office allocations, cars and so on exactly as was to be found elsewhere on the Coventry site. Even in Energy Engineering, which was far less structured, thanks to its off-site location, the Manager alone was entitled to a car as a reflection of his status.

Peterson, describing the Du Pont venture system, writes of running a 'company in miniature'. This is a dangerous way of looking at a

venture group if the Dunlop experience is any example, because this is exactly what Dunlopipe seems to have been from its earliest days. The rigidities which the company's 'status structure' imposed on the Division were remarkable, and in many ways totally negated the stated intentions of the venture. This was particularly so at the marketing/technical interface which was given such prominence in the venture plan. Technical developments could not be directed at solving marketing problems because the internal marketing department reports were to all intents and purposes kept secret from the people who did the development work.

More significantly, the Dunlopipe venture managers did not seem really independent despite the stated intention. It always appeared to the more junior members of the team that the important decisions were being made by senior Engineering Group management, rather than by those nominally in charge of the project, and the physical proximity of the Divisional and Group managers' offices meant that the venture never generated any air of autonomy. This seemed a fair picture at the time, and in any case, junior personnel were almost never informed of significant events, not even that the first order for which they had all been working had been won. This all contrasts strongly with the position in Energy Division, where the combination of being several miles distant and having a strong Divisional Manager was sufficient to make the venture team more independent than any other division in the Group.

Although the differences in the internal organization of each unit were reflected in their morale and motivation, both Dunlopipe and Energy Engineering were labouring under what must be regarded as a significant handicap. This concerned the goals set for them by senior management,

presumably in accordance with Head Office guidelines. One of the most significant facts about R&D departments is that they are not generally expected to turn in a profit - their expenditure is an overhead.

Engineering Group, having decided that it would take the venture route to product development seem to have hoped that it would no longer have to suffer these losses.

The emphasis given to the commercial aspect of the ventures meant that their business plans tended to demand a profit in the very near future. The result of this was that when it became clear that development targets were unrealistic (as was certainly the case with Dunlopipe) nothing could be done. There was tremendous concern for keeping the figures as little in the red as possible, regardless (it seemed) of the potential long-term benefits of the proposed expenditure. This should be seen as one of the most significant barriers to successful diversification to be found in the company. It is not unique to Engineering Group, but seems to be built into the whole company planning structure. This is a point which will be developed in greater detail in the next section and in Chapter 7.

By the time that the ventures had been in existence for two or three years, the Kestrel Seat had been sold and only Energy Engineering and Dunlopipe remained. Neither of these had made any money, and the next diversification move was into Rice Trailers. This was at least profitable, even if not exactly a good match with the stated strategy. Both with this purchase and the acquisition of IAS, Engineering Group seemed to be admitting that it was somehow constitutionally unsuited to the internal development of new products.

The merit of the decision to pursue this new course was, from the company's point of view, that it acquired a product range, a set of

customers, factory premises, equipment and expertise in a new technology, and all for a fixed price. One of the main difficulties associated with internal development is that there is an open-ended financial commitment with a highly uncertain outcome. Whilst this might be acceptable if the potential profits are very large, it is a rather risky course for the small-scale operations being undertaken in Engineering Group. Two countervailing problems with acquisitions are that the management often has to be at arm's-length, and that the acquired company may have management problems peculiar to itself or its industry. Certainly IAS has such problems, as Appendix D shows, but it is difficult to know how these can be identified in advance.

One feels that to some extent Dunlop was bowing to the inevitable in choosing to diversify by acquisition. This emerges from consideration of what the venture groups actually became, which was mini-divisions rather in the image of the existing operational units. When the acquisitions were made, the company bureaucracy was presented with an organizational structure which it knew how to assimilate, whereas the ventures could not be successfully operated under the existing rules. This seems to be another important lesson from Dunlop's experience, and it is reflected in the final section of this chapter which looks at the company's problems of innovation and diversification in a more general light.

5.5. A CRITIQUE OF INNOVATION MANAGEMENT

Having considered the types of innovation mechanism individually, what can be said about the management of innovation in Engineering Group generally? There seem to be three issues. The first is that of establishing a common image throughout the organization of what the innovative structures are for. The second concerns the role of management within each unit. The third is about the control of the programme overall. The general conclusion is that in all the structures used, one or more of these is causing problems.

To some extent it is true that there are no real solutions, particularly on the first of these points. Individuals' perceptions and values differ, and no two people will interpret the same set of circumstances in the same way. Having said that, it is all the more reason not to have such vague terms of reference for a development organization that it becomes impossible to obtain an agreed judgement about its performance.

This certainly seems to have happened in the case of PDU. From the Group management's point of view, it failed because it produced no 'marketable' products. From the researchers' point of view, it was a success because it produced many good technical ideas which were 'irrationally' rejected. As far as the operating divisions were concerned, its existence was a threat and its output irrelevant. The situation was only finally resolved by a change in the political power structure. Even then there was no real agreement. There was a 'forced' solution to the conflict, in Lawrence and Lorsch's terms, although this did serve to restructure the Group's thinking on product development.

The closure of PDU and the establishment of the venture groups seems to have been very effective on this basis. Divisional managers now seem to believe that their relative failure to maintain their pace of innovation is of less consequence now that there is a well-established diversification programme. The objective has been set of low-cost, high-growth development, and the venture managers understand that their responsibility is to generate this growth within a tight budget, and to produce a profit in the fairly short term.

Unfortunately, although this is understood, many organizational variables make it extremely unlikely to happen. At the level of the individual division, the company culture, which emphasises the importance of politics and status, is a very effective bar to the kind of management systems which are most effective in a turbulent environment. Of the original ventures, only Dunlopipe and Energy Division survive, and Dunlopipe finds itself with a rigid hierarchical structure which, as Galbraith shows, is only applicable in highly stable and routine circumstances. It is to Energy Division's credit that it has managed to avoid this situation, but life was certainly made easier (as they themselves admit) by their release from a location where status considerations are a way of life.

Taken as a whole, the diversification programme seems beset by internal conflicts and inconsistencies. Aside from the general issues of organizational politics, which are bound to occur where there is competition for resources, goals are being set at all levels which are mutually incompatible. One can appreciate that in the view of Dunlop's Head Office, with cash extremely tight they cannot afford to make heavy outlays on risky investments. However, much of the innovation literature tends to the view that the level of profit to be expected

from a new development is in proportion to the risk involved. The incongruity which is apparent here cannot be escaped by simply instructing Group and Divisional Managers to turn in good results without spending proportionately.

In Engineering Group, senior managers have answered this dilemma by investing on a small scale in unfamiliar markets. This is a sensible strategy as far as it goes, but it is unlikely to generate substantial growth in the long run. The reason for this is that it has been found that there is a 'critical mass' which a new business venture has to achieve before sufficient momentum is achieved for significant growth to occur (6). 'Testing the water' is a short-term approach which is likely to cost money rather than to generate it.

This is the essence of Fast's distinction between macro and micro ventures, and it can be seen extremely well from consideration of the systems model outlined in Chapter 3. A micro NVD (which all the Engineering Group ventures were) presents an opportunity for a company to learn about a new technology or market. In the terms of the model, it is an intelligence activity. A macro NVD is a fully-fledged operating division in the new field, and is an implementation activity. It must therefore be viable, which in turn means being profitable in the long run. What Dunlop is trying to do is to create an intelligence unit, and demand that it be viable at the same time.

This strategy is almost bound to fail. For the activity to be viable, it must have autonomy. This the Engineering Group ventures are denied because they are correctly perceived not to be fully operational. If they are not fully operational, it is to be expected that they will need financial support. This the ventures are also denied, because they are intended to 'stand on their own feet'. Fortunately the Energy

Division has been able to resolve this conflict because it has a range of marketable products and has asserted its independence sufficiently to act as an operating division. Dunlopipe has not resolved it because its product is not adequately developed, and seems unlikely to become so because the company will not go on supporting a loss-making enterprise. This is a completely sealed vicious circle.

The most important point about this is that it is a conflict which is not of either the Divisional or Group management's making. The inconsistency which causes problems at all levels is generated by the setting of incompatible objectives at the corporate level. The whole situation seems to be made worse by the fact that the bureaucratic structure cannot cope with the form of organization that is caught inside this loop. Because a venture group looks like a division, it is treated as though it were one, and becomes effectively transformed into one. At least PDU looked like an R&D lab - a recognizable intelligence activity which could tolerably be carried as an overhead.

What this really shows is that the issue of innovation management is not just about the organizational structures used at divisional level. Indeed, it may not even be principally about them. Strategy guidelines come from the corporate level, as do divisional business objectives. It is therefore necessary to explore the issue of policy-making as an integral part of the whole process.

CHAPTER SIX

THE NATURE OF POLICY-MAKING

IN BUSINESS ORGANIZATIONS

OUTLINE

As Chapter 2 suggests, it was considered rather unsatisfactory to examine the implementation of a diversification policy in Engineering Group without inquiring into the creation of the policy itself. As the description of the 'strategic study' shows, the company was able to make a clear statement as to the markets it was trying to enter, and it seemed legitimate to ask how this statement was arrived at.

Unfortunately it never became possible to investigate this issue. Nevertheless, some consideration of policy problems appears necessary to give balance to the overall discussion. In this chapter, therefore, a brief review is given of the considerable literature on the subject, followed by a discussion of the fragmentary evidence on strategy-making in Dunlop. The final section analyses the literature and sets out a model which might account for the observed behaviour in Engineering Group.

6.1 INTRODUCTION

The objective of the first part of this chapter is to provide a brief summary of a very broad subject. Under various headings - 'Business Strategy', 'Corporate Strategy', 'Strategic Planning' and so on - it is a field which has become of increasing interest to management writers in recent years. There is, however, no single body of thought which can be said to represent the prevailing view. In fact, there seem to have been few attempts even to structure the various opinions into 'schools of thought'.

One notable exception to this is provided by Mintzberg (1). He identifies three 'modes' of policy-making which are discussed in the literature:

"In the entrepreneurial mode, found in the writings of some of the classical economists and many contemporary management writers, one strong leader takes bold, risky actions on behalf of his organization. Conversely in the adaptive mode, described by a number of students of business and governmental decision-making, the organization adapts in small, disjointed steps to a difficult environment. Finally, the proponents of management science and policy science described the planning mode, in which formal analysis is used to plan explicit, integrated strategies for the future".

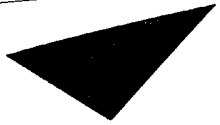
A summary of the main features of each mode is given in Table 6.1.

A different three part classification is provided by Ackoff (2) of what he calls 'philosophies of planning'. He labels these 'satisficing', 'optimizing' and 'adaptivizing'. Satisficing involves making small changes in the way an organization operates so as to bring about a satisfactory level of improvement in some predetermined variable. The objective is to achieve a few simple goals without radical change in

TABLE 6.1

THREE MODES OF STRATEGY MAKING

SUMMARY OF MAIN FEATURES



Aston University

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Source: Mintzberg (1)

the organization. Ackoff suggests that this is the most common approach.

The optimizing planner seeks to do as well as possible, rather than just well enough. Here, models are used which aim to represent the total business system, and the variables in it are manipulated to achieve the optimum value of some stated objective function. The advantage of this type of planning, says Ackoff, is that "efforts, even unsuccessful efforts, to develop fully optimal plans, almost always produce a valuable by-product: a deeper understanding of the system being planned for" (3).

Finally, adaptivizing, which Ackoff sees as "more an aspiration than a realization" (4) has three main points:

1. The principal value of planning lies not in the plans themselves but in the method of producing them.
2. The need for planning derives from the lack of effective management and control.
3. Future events may be classified as certain, uncertain or unknown, each of which requires a different kind of planning. The aim is to develop an adaptive organization. It is towards achieving this ideal that Ackoff's own work is directed.

According to Steiner and Miner (5), there are five approaches to strategic decision making. The 'Formal Structured Approach' attempts to be systematic, rational and comprehensive. By contrast, the 'Intuitive Anticipatory Approach' generally relies on the experience and insight of a single individual, often the company president. In the 'Entrepreneurial Opportunistic Approach' the search is for new business ventures, whilst the 'Incrementing Approach' looks only at changes which are a small step away from existing activities. Finally,

there is the 'Adaptive Approach' in which the firm changes its strategy according as the quality of the information available to it improves.

It is clear that whilst there are features in common, the categories suggested by the different authors are far from coincident. This reflects the diversity of view which exists in the study of strategic management, but does also tend to make the subject difficult to approach for the purposes of a short review. No alternative classification seems to summarize the variety of ideas wholly satisfactorily. For this reason, a somewhat arbitrary decision has to be made about which to use. Of the three considered, Mintzberg's is probably the best known, so his headings will be used here. Both Ackoff's and Steiner and Miner's frameworks will nevertheless be used for comparison and discussion.

6.2. THE ENTREPRENEURIAL MODE

The 'entrepreneurial mode' of strategy-making has its origins in economics. The idealized perfect competition theory of the firm imagines an owner-manager running his concern in pursuit of a single explicit goal - maximum profit. Profit itself, in straightforward terms, is seen as the reward to enterprise or risk-taking. Two features of this simple view find their way into the modern entrepreneurial view of strategy creation. One is that it is necessary to take risks to earn profits. The other is that a single individual may give direction to the firm.

Mintzberg identifies Drucker as typical of the school which regards risk-taking as important, even vital, in business. As Drucker himself

observes:

"Economic activity, by definition, commits present resources to the future, i.e. to highly uncertain expectations. To take risks is the essence of economic activity. One of the most rigorous theorems of economics (Boehm-Bawerk's Law) proves that the existing means of production will yield greater economic performance only through greater uncertainty, that is, through greater risk" (6).

The thrust of the entrepreneurial approach according to Steiner and Miner is its concentration on identifying and exploiting opportunities, rather than on dealing with operational issues, a view with which Drucker strongly concurs:

"Entrepreneurship requires that the few available good people be deployed on opportunities, rather than frittered away on 'solving problems'" (7).

How the firm should set about identifying opportunities is not discussed except in the statement that they should "emerge from the analyses of the economic dimensions of the business" (8). When they have been identified, however, Drucker suggests that they should be classified as 'additive', 'complementary' or 'breakthrough' opportunities, according to how far they alter the character of the existing business. These represent increasingly significant but increasingly risky options.

The next step is to decide whether an identified opportunity is the "kind of opportunity that would help us realize our idea of the business" (9). Drucker does not suggest how this 'idea of the business' emerges. What he does say is that if the opportunity does not match the concept, either the opportunity should be discarded or the concept altered. Unfortunately this gives no guidance on which of these paths should be followed in a particular case.

The way out of this impasse would seem to lie in the second strand of the entrepreneurial approach. According to Mintzberg, one of the chief characteristics of this mode is that "in the entrepreneurial organization, power is centralized in the hands of the chief executive" (10). If this is the case, then it could be argued that the firm's view of what business it is in is simply that of its President. If he wants to pursue an opportunity which takes the enterprise outside its current sphere of operation he does so, and thereby changes its image. The problem with this for the policy analyst is that which Steiner and Miner identify with their 'Intuitive Approach'. That is that "no-one really knows the precise mental processes and steps introduced" into the decision making (11).

Although one might reasonably accept that firms controlled by one man would have intuitive/entrepreneurial-type policy-making, the converse argument, that if strategy is made in the entrepreneurial mode the firm is likely to have a dominant manager, needs looking at more closely. Mintzberg bases his view of this issue on the psychology of entrepreneurial types. He quotes Collins and Moore as saying:

"The entrepreneurial personality is characterized by an unwillingness to submit to authority, an inability to work with it, and a consequent need to escape from it" (12).

Steiner and Miner also give several references in support of similar conclusions. The attitude seems to be that entrepreneurial policy-making is undertaken by individuals whose psychological make-up gives them the need to be independent and in control.

6.3 THE ADAPTIVE MODE

Mintzberg's 'Adaptive Mode' is traced back to two works - Braybrooke and Lindblom's A Strategy of Decision (13) and Cyert and March's A Behavioural Theory of the Firm (14). The same category (under the title 'Incrementing') is to be found in Steiner and Miner, who also see Lindblom as its most consistent exponent. However, the similarly-named section 'Adaptivizing' in Ackoff describes a totally different concept which is discussed below.

The problem faced by Cyert and March is exactly that which Drucker avoids. In Section 6.2 it was seen that Drucker offers no mechanism by which a firm's concept of 'the business we are in' can emerge. The general point which Cyert and March regard as basic to this issue is that:

- "1. People (i.e. individuals) have goals; collectivities of people do not.
2. To define a theory of organizational decision-making, we seem to need something analogous - at the organization level - to individual goals at the individual level" (15).

They observe that this difficulty has generally been tackled in one of two ways. The first is by postulating a single entrepreneur or entrepreneurial group whose goals define the organizational goals. Other members of the organization are made to conform to these goals by means of the system of payment and control within the firm. Alternatively, organizational goals have been seen as being reached by consensus. In other words, all members of the organization share the same set of objectives.

Cyert and March reject both these views. They stress the diversity of goals which will exist in any organization because every individual in

it will have his own personal ambitions. For organizational goals to emerge amid this diversity, these individuals will have to group together to promote some common interest. However, the objectives of each coalition may be at odds with one another, leading to the likelihood of conflict. Cyert and March suggest that this is handled by the organization pursuing different objectives at different times, regardless of the inconsistencies.

This process recognizes that the creation of a set of goals consistent with the intentions of all coalitions is too difficult a task for the organization to handle. A similar understanding of this overcomplexity emerges in Cyert and March's view of other aspects of the firm's operations. In particular, they suggest that it will be happy to accept adequate rather than optimum levels of performance, and that any investigation it undertakes outside its immediate familiar environment will be directed towards finding a solution to a particular problem:

"In a general way, problemistic search can be distinguished from both random curiosity and the search for understanding. It is distinguished from the former because it has a goal, and from the latter because it is interested in understanding only insofar as such understanding contributes to control" (16).

Writing from the perspective of public administration, Braybrooke and Lindblom begin by specifically rejecting the notion that complex problems can be solved in such a way as to produce a unique, optimum strategy. They argue that except in very limited circumstances, neither the amount of information available nor the capacity of the human intellect is adequate to the task, despite the fact that what they call the 'rational-comprehensive' approach is the dominant paradigm in policy studies.

In any case, the rational-comprehensive method simply cannot

accommodate any situation in which there is disagreement over personal or social values, or the relative desirability of different outcomes. An agreed value system can almost never be obtained, so:

"unable consequently to formulate the relevant values first and then to choose among policies to achieve them, administrators must choose directly among alternative policies that offer different marginal combinations of values" (17).

Policy options tend therefore to be restricted to small departures from the status quo. In this way 'limited comparisons' are made. Although they still require a policy maker to choose between possible alternatives "his capacity for grasping, comprehending and relating values to one another is not strained beyond breaking point" (18). Clearly, the 'policy-maker' in Lindblom's context would be, for example, a government minister. For Cyert and March, the relevant value system would be that of the coalition promoting the policy.

As a method of strategy-making, the adaptive mode stresses a limited search for alternatives aimed at overcoming a known problem, in the knowledge that the solution found will not be optimum. In Lindblom's eyes

"the piecemealing, remedial incrementalist may not look like an heroic figure. He is nevertheless a shrewd, resourceful decision-maker who is wrestling with a universe which he is wise enough to know is too big for him" (19).

6.4 THE PLANNING MODE

The last of Mintzberg's categories is the 'Planning Mode'. Of the three, this is probably the most widely discussed, and the literature surrounding it shows wide variations of emphasis. The general direction taken by this kind of thinking is revealed by Ansoff:

"Strategic decisions are primarily concerned with external rather than internal problems of the firm and specifically with the selection of the product-mix which the firm will produce and the markets to which it will sell... Specific questions addressed in the strategic problem are: what are the firm's objectives and goals; should the firm seek to diversify, in what areas, how vigorously; and how should the firm develop and exploit its present product-market position" (20).

A textbook exposition of strategy-making in the planning mode is given by Christensen, Andrews and Bower of the Harvard Business School. In essence:

"Deciding what strategy should be may be approached as a rational undertaking... The principal subactivities of strategy formulation as a logical activity include identifying opportunities and threats in the company's environment and attaching some estimate of risk to the discernible alternatives. Before a choice can be made, the company's strengths and weaknesses should be appraised together with the resources on hand and available. Its actual or potential capacity to take advantage of perceived market needs or to cope with attendant risks should be estimated as clearly as possible" (21).

The final choice of strategy will depend on the objectives of the firm and on a 'moral component' dictated by the expectations of society.

It is interesting that in this model the objectives of the business are assumed to be determined by the values of the senior management and in particular, of the Chief Executive Officer. The notion of coalitions with competing interests within the firm is quite absent and Christensen et al. suggest that anyone disagreeing with the management line would be well advised to leave. In addition, "the personal needs

of the hourly-paid worker must be taken seriously and at least partially satisfied as a means of securing the productive effort for which wages are paid" (22). In other words, the goals of those outside top management are not important for their own sake, but only because they can affect the economics of the business.

A summary of the overall process is depicted in Fig. 6.1, but the core of the model, and indeed of the planning mode itself, lies in the matching of ability with opportunity. It is here that the emphasis on rational analysis is most apparent.

Two excellent examples of the rational-analytic approach are to be found in articles by Smalter and Ruggles (23) and by Pryor (24). The first-named pair studied the development of strategic planning techniques in the Pentagon in the early 'sixties. From this, and the application of the ideas to their own company, they derived a series of 'six business lessons' (see Table 6.2). Not only do these lessons show the emphasis laid on mathematical techniques, but they also capture the didacticism present in many 'planning mode' writings.

The article by Pryor gives a good account of an actual example of strategy creation in the Singer Company. It illustrates both the efforts of the company to determine its existing needs and resources, and the firm's 'philosophy of search' for opportunities. Singer used an analysis of their existing internal resources to construct a detailed list of criteria against which to rate new opportunities.

"A systematic review of all Department of Commerce two-digit Standard Industrial Classifications was then undertaken, rating each Division against the criteria on a one-to-seven scale. The twenty or so two-digit fields which scored highest were then analysed by three-digit groups, and ultimately the most promising groups were selected and the industries within them analysed. At this point, after studying the major industries of interest which had been isolated, three areas were presented to management.

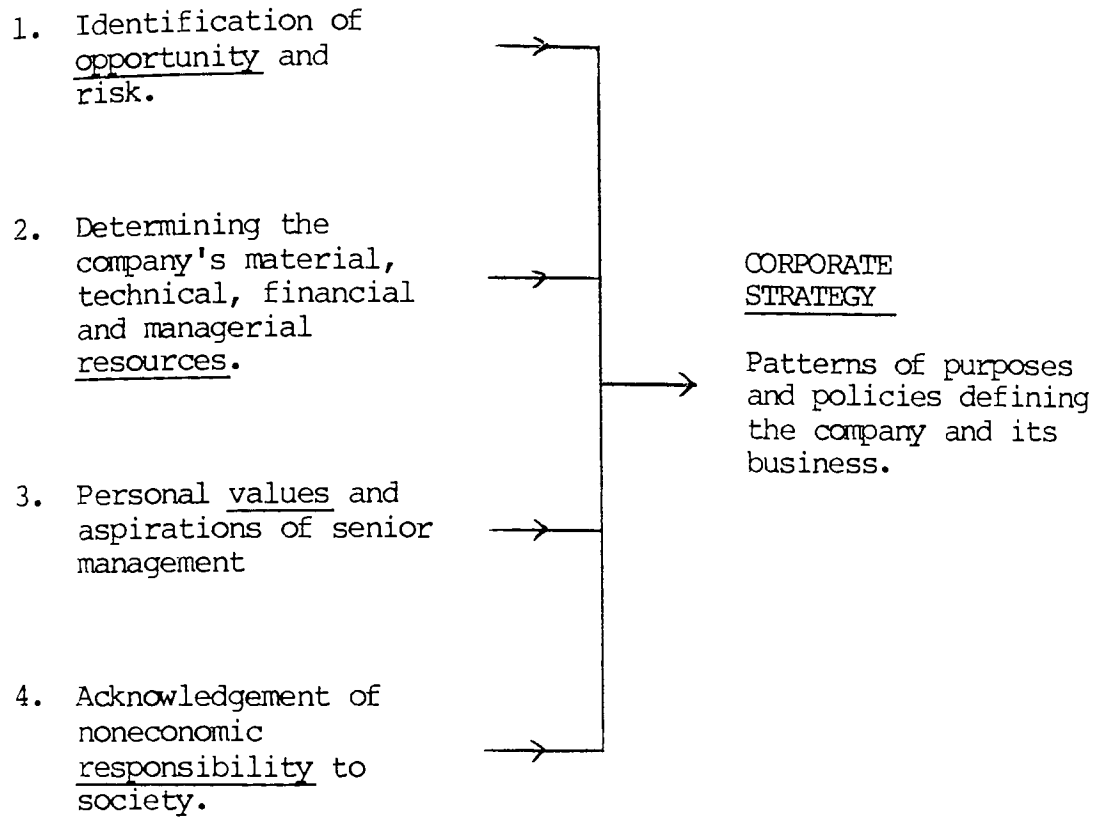


FIGURE 6.1

THE HARVARD VIEW OF STRATEGY FORMATION

Source: Adapted from Christensen, Andrews and Bower (21)

TABLE 6.2

SIX BUSINESS LESSONS FROM THE PENTAGON



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Source: Smalter and Ruggles (23)

After a thorough examination of the ramifications of these three alternatives, the business machines and data-processing field was ultimately chosen as the area of highest interest to Singer" (25).

Any attempt at a comprehensive search for opportunities of this sort must have a purpose. The criteria which were used at Singer to evaluate the various business areas were derived from some idea of the objective that the strategy was meant to achieve. This emphasis on a stated goal for the enterprise is of particular importance to both Steiner and Ansoff.

Steiner's 'conceptual model' of corporate planning is shown in Table 6.3. Similarly, Ansoff's formula is in a series of steps:

- "1. A set of objectives is established.
2. The difference (the 'gap') between the current position of the firm and the objectives is estimated.
3. One or more courses of action (strategies) are proposed.
4. These are tested for their 'gap-reducing properties'. A course is accepted if it substantially closes the gap: if it does not, new alternatives are tried" (26).

As Steiner's model shows, the goals of the firm are supported by a general strategy which is itself broken down into a number of operating plans. Such planning has been characterized as 'O.S.T.' (Objectives, Strategies, Tactics) by Patrick Haggerty of Texas Instruments who claims it as the guiding philosophy of their success (27). In Ansoff's model, the same structure can be seen in his 'cascade approach'.

It is clear that comprehensive strategic planning of this sort is beyond the capacity of top managers acting alone. This accounts for what Mintzberg sees as one of the main features of the planning mode, that specialist analysts play an important part in the policy-making process.

TABLE 6.3

STEINER'S CONCEPTUAL MODEL OF CORPORATE PLANNING



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Source: Steiner (28)

In a review of the role of corporate planners, Litschert notes that they have been identified in three roles:

- "1. As brokers they will be involved with maintaining the planning system and will not play any role in deciding on the substantive issues for the plans.
2. As advisors they will offer their own opinions on the plans in addition to maintaining the system.
3. As evaluators they would have an even greater substantive role" (29).

Similarly, Lorange (30) found that planners were involved either in the "active implementation of plans" or in improving the system so that planning could be done more effectively by others.

This distinction is interesting in the light of Ackoff's 'Concept of Corporate Planning' (31). It is his view that the best type of planning is that which allows the firm to respond quickly and appropriately to changes in the environment. He calls this 'adaptivizing' but it is nevertheless to be identified with the planning mode. The reason for this is that for it to be effective, a good understanding must exist of the organization's behaviour. To develop this understanding and to use it effectively, managers require technical support from experts in the various disciplines of management science. However, they should not constitute a separate planning department. "There is no profession of corporate planners" (32).

The integration of management science specialists and managers themselves into a strategic planning team would doubtless find favour with all writers in the planning mode, but Ackoff would find no room for the traditional distinction in management between 'staff' who provide the information and 'line' who make the decisions. Equally, all would agree that those companies who plan effectively "are most

likely to develop and exploit the potentialities of their organizations" (33). Nevertheless there is a large gap between Andrews' view of strategy defining 'what business the firm is in' (34) and Ackoff's vision of strategic planning as "primarily and systematically committed to producing more adaptive organizations" (35).

6.5 AN EXAMPLE - STRATEGIC PLANNING IN DUNLOP

The purpose of this chapter is to try and understand the thinking behind the 'strategic study' mentioned in Chapter 2. It will be recalled that in searching for opportunities for diversification the following product areas were identified:

1. Pipeline Engineering
2. Energy Engineering
3. Comfort Engineering
4. Agricultural Engineering

Although I was told the conclusions of this study, I did not have access to the document itself or to the reasoning behind it. What I am able to describe is the company's planning process as seen from the corporate level (which is available in the published literature) and the circumstances surrounding divisional strategy-making as they appeared to me. These observations will be tied in with the review given in preceding sections of the chapter, to see what can be concluded about the Engineering Group strategy.

According to Rossiter (36), the basic philosophy of Dunlop Corporate

Planning is the kind of 'gap analysis' advocated by Steiner and Ansoff. The question of determining what Ackoff calls the 'reference projection' (37), or what is likely to happen given existing circumstances, is left to the divisions. It is each Divisional General Manager's responsibility to draw up a five-year Strategic Plan showing the growth and profitability he expects in his current operations over the period.

At Head Office, a Corporate Plan is then constructed which

"sets out (after agreement by the Board) specific quantified, timed objectives for the Group over the next 5 years. These are mainly financial objectives... to reflect the expectations of the stakeholders and the aspirations of the Group. The plan clearly identifies the gap between those objectives and the sum of the organic growth intentions of the divisions as revealed in their Strategic Plans. Finally, and most important, it sets out the way in which the gap is to be bridged (by accelerated organic growth, diversification, acquisition, divestment and so on) and highlights the additional resources that will be necessary" (38).

In order to decide which of these 'gap-reducing' courses to follow, the corporate planners institute a comprehensive and detailed analysis of each division and its market. Using the criteria in Fig 6.2(a), the characteristics of the particular market and the strengths and weaknesses of the division operating in it are evaluated. The position of the business is then plotted on the diagram illustrated in Fig. 6.2(b). Finally, the current and expected earnings potential is estimated and classed in one of the categories shown in Table 6.4. These 'Investment Categories' ultimately determine the allocation of funds.

What this process would seem to produce is a course of action for reducing the identified 'strategic gap' by internal growth or divestment. For this reason, Rossiter points out that

FIGURE 6.2(a)

BUSINESS EVALUATION CRITERIA IN DUNLOP

Market/Industry Criteria

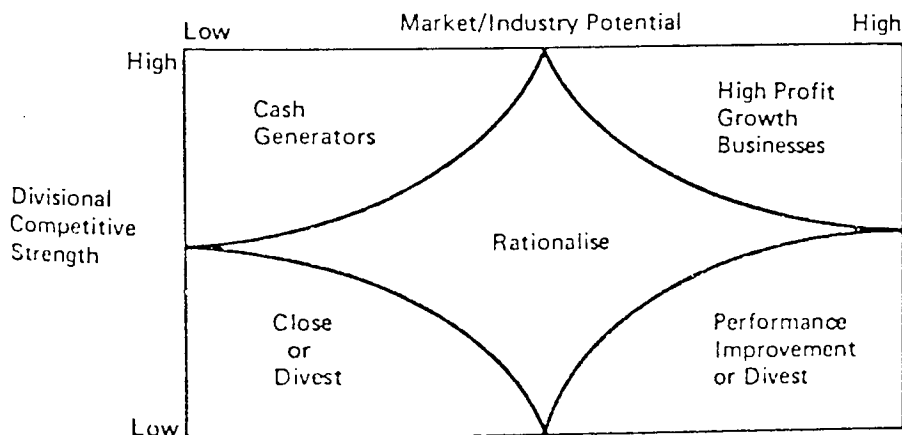
1. Market Growth
2. Industry Profitability (Particularly Margins)
3. Capacity versus Demand
4. Opportunity for Specialization
5. Complexity of Products/Services

Divisional Competitive Criteria

1. Profitability
2. Market Share
3. Product Quality and Performance
4. Innovative Ability and Resources
5. Marketing Strengths (e.g. Brand Names, Distribution Networks)

FIGURE 6.2(b)

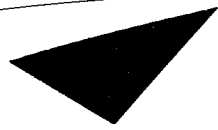
BUSINESS EVALUATION CHART



Source: Adapted from Rossiter (36)

TABLE 6.4

INVESTMENT CATEGORIES IN DUNLOP



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Source: Rossiter (36)

"new ventures, acquisitions and major diversifications are outside the normal allocation, and a sum is set aside at the outset to cover anticipated requirements in the period" (39).

Given this corporate planning structure, it would appear that one needs to consider divisional strategy in two parts. Firstly, the division will have to plan for the development of the existing businesses within the funds allocation procedure just described. Secondly, separate account must be taken of any acquisition or diversification plans, which are subject to a separate approval and financing procedure.

In the case of Engineering Group, it has already been suggested that its traditional businesses were in decline. Particularly in the automotive field, this was largely due to the state of the market, but the 'divisional competitive strength' was also low. This probably had less to do with the quality of the product or the management than with the relatively strong competitive position of the vehicle manufacturers, who could force down suppliers' margins in an industry with overcapacity.

Faced with this situation, the most persuasive of all strategic objectives had to be sought - survival. It was therefore agreed between Engineering Group management and the Dunlop Board that funds would be made available for a diversification programme. In the first instance, the new enterprises brought in were to aim at making good the current decline.

The decision was made to approach this diversification on a broad front. The option of investing on a larger scale in a single new venture to generate the necessary growth was said not to be open to the Group because of the extremely tight financial position. The alternative was to make a number of relatively small-scale investments

in growth industries in the hope that one or more of them would rapidly develop to the necessary size. The 'strategic study' was designed to identify these industries.

The timing of this study relative to the introduction of the various new ventures is quite important to the understanding of the policy process. Unfortunately it has not been possible to establish this. Two particular points stand out, however. Firstly two of the 'growth industries' identified were ones in which Engineering Group already had products under development. Secondly, in both cases, the existing product was taken as the centrepiece of the diversification effort.

In the case of Energy Engineering, one can readily enough accept this as a fortunate coincidence. The focus on the need for efficient use of energy resources had been sharpened by the oil crisis, and the company had a particularly efficient, flexible gas burner. Had the strategic decision to move into the gas appliance industry and the search for a suitable product been undertaken separately, the Thermimax burner might well have represented a sound opportunity.

It is more difficult to say this of the Kestrel Seat. It will be remembered that the logic behind going into the 'comfort engineering' field was that people would be willing to spend a higher proportion of their income on comfort (rather than necessities) as real wages rose, and this seems a plausible view. However, the Kestrel Seat, the focus of Comfort Engineering Division, was designed to give additional shock absorption in the cabs of long-distance lorries. This is not a product area which would suggest itself immediately from the real-incomes argument. The point about the seat was that it was in an industry in which Engineering Group already had some expertise - vehicles. Perhaps it was felt that given the right slant, the product

could be seen to be in accord with the strategy as well as exploiting existing experience.

Any judgement about these coincidences would be made easier if one knew the circumstances surrounding the acquisition of the licence for Dunlopipe. This is where the question of timing becomes important. It would be very interesting to know whether the licence was obtained (or the decision to develop the product taken in principle) before or after the strategic study was done.

It has already been seen in Chapter 5 that Engineering Group changed its plan of action after its experience with the burner, the seat and the pipe. It was decided that the rate of progress of internally-generated new products was not fast enough, and that the Group needed to invest in developed businesses. To this end, Rice Trailers and IAS were acquired. Their acquisition has significant implications in terms of the strategy, in that both are acknowledged to be outside it to some extent.

One of the business areas the Group sought to enter was agricultural engineering. After a search for a really suitable candidate failed, it was learned that Rice Trailers might be for sale. After substantial investigation it was concluded that the company was a good candidate for takeover. Quite clearly, a company which manufactures horseboxes cannot be said to be in agricultural engineering, especially in view of the 'food supply' argument behind the strategy. The Group therefore admitted that they had 'stretched' the definition of this term somewhat in deciding to buy Rice Trailers.

In the case of IAS there was no question of whether the stated policy could accommodate the acquisition. The answer was unambiguously no.

That is not to say it could not be justified. The reason for the decision to buy IAS was that it had expertise in the field of electronic control equipment which complemented the skills already available in Plant and Equipment Division.

To sum up, it seems to be the case that each decision to enter a new field has to be justified on its own individual merits, rather than in terms of a pre-specified strategy. One possible interpretation of this finding is that attitudes to diversification at the corporate level are somewhat ambiguous. On the one hand it is expected that divisions will have a stated diversification policy. On the other hand, for any individual proposal the division is forced by what they would regard as head-office over-cautiousness to marshal all possible arguments in support of their case. This may encourage the division to look at each diversification opportunity in isolation despite the nominal existence of a strategic plan.

Centre-division relations are a highly vexed issue surrounding the whole subject of industrial innovation. Although corporate planners typically make comments such as:

"Detailed plans - whether of a strategic or an operating nature - can never be imposed from above if there is to be any hope of real commitment on the part of those who must execute them" (40)

there does seem to be a real conflict of expectations between the planners and operating managers. This is graphically illustrated by Oakley in his account of his product development experience in Engineering Group:

"The Corporate Planning Department intervened with its own lengthy product appraisal form. The Project Leader provided several sets of answers to its questions, but each time the form was re-issued with requests for greater detail... This pressure to produce detailed information meant that so many estimates had to be made

about hypothetical aspects that, in the writer's opinion, the exercise was misleading rather than informative. For example, estimates of detailed manufacturing costs were meaningless until the method of [production]... was known. More disturbing was the tendency for exaggerated expectations to become facts as subsequent editions of the Plan were issued. Hence the fatigue life became 2 million cycles although only 400,000 had then been achieved and the anticipated UK market share grew from £½m to £3m" (41).

6.6 DISCUSSION

One of the great confusions surrounding discussions of business strategy concerns terminology. At one extreme, expressions such as 'strategy formation', 'policy creation' and 'corporate planning' are used as synonyms. At the other, authors make careful distinctions between these ideas in order to build up a precise model. As Andrews points out:

"That objectives and goals are usually multiple and various and that they are usually arranged in a hierarchy from something very lofty and broad to something mundane or specific complicates our approach to definition... Policy is just as much an accordion-like word as objective. If a policy is a guide to action, then it in turn can be an objective served by more specific policy" (42).

Given this semantic confusion and the general disagreement surrounding the subject as a whole, language should be seen as less important than meaning. In trying to get through to the meaning (at least in terms of the business enterprise) Ansoff's classification of decision types into 'strategic', 'operating' and 'administrative' is helpful. Strategic decisions are about the "allocation of total resources among product-market opportunities" (43). The internal organization of the firm to ensure effective use of those resources is not a strategic, policy or planning issue. It is this distinction which is the relevant one in

the discussion here.

It would appear from the literature on strategic management that there are two main issues to be faced. The first is how the objectives of the business are set, the second how the firm decides what course of action to take in pursuit of those objectives. None of the three modes of policy making seems to cover both these points particularly well. In the entrepreneurial mode, a single individual is seen as determining these questions on his own. Whilst this is at least a consistent view, it says nothing about the decision rules that the strategy-maker is using. It therefore offers little in the way of analysis which can help other policy-makers facing complex decisions.

As far as deciding what course of action to follow is concerned, the planning mode offers a highly developed prescription. At the extreme, mathematical techniques of analysis are seen as giving the decision-maker a scientific and objective assessment of the costs and benefits of the courses open to him. Even those writers who admit that these judgements have to be rather more subjective seem to believe that such quantitative measures are obtainable in principle.

Although this part of the procedure is well elaborated, the process of goal creation itself is largely avoided. Reviewing the existing philosophies in rather the way that Cyert and March do, Ansoff concludes similarly that none of them is satisfactory, and proposes his own. He argues that maximization of long-term return on resources can be regarded as a global objective which will act as a proxy for any set of more specific sub-objectives. This also meets his stipulation that for any strategic objective to be operationally useful it should imply a quantifiable measure of performance.

The 'rational-comprehensive' perspective from which almost all of this writing comes invariably requires there to be a specific quantitative measure of company performance. This is easiest to see in the case of the 'optimizing' planner who needs an unambiguous objective preference function whose maximum value his model is designed to determine. Even satisficers have to have some means of deciding whether a particular policy achieves an adequate measure of performance.

For this reason, those who advocate rational planning cannot accommodate adaptive-mode type goal setting which depends on negotiation. The outcome of these negotiations depends on the current power relationships within the organization, and these are likely to be unstable. If policy-makers' values are subject to unpredictable changes, objective planning is only likely to produce wide swings in the firm's behaviour as one set of goals is vigorously pursued, then another.

In all three modes, the issue of power is central to strategy-making. In the entrepreneurial mode, the power to direct the business comes either from ownership or from some quality of charismatic leadership which seems to be implicit in the psychological studies. In the planning mode, the belief is that business objectives come from the top management group. Since in the modern corporation, management and ownership are unlikely to coincide, the assumption must be that the members of this group derive their power from their seniority in the social institution that is the business enterprise. Although senior managements do ultimately have the ability to dismiss unco-operative employees, it does seem that their commands are accepted as legitimate on some basis other than that of fear of disapproval or dismissal.

Both Ansoff and the adaptive mode writers appear to find this an

untenable view of policy-making. Lindblom suggests that conflicting values throughout the social system will limit strategic initiatives to small departures from the status quo which can be debated and agreed. On the other hand, Ansoff, finding it necessary to account for the fact that planning actually is done in companies, posits a universal, quantifiable objective for the planners to aim at - maximizing the long run return on resources, although it seems difficult to reconcile this with his 'cascade approach' to achieving it, which he claims to be a satisficing technique.

Although it appears that this whole debate is confused and uncertain, it is possible to construct some order out of it. Three significant points stand out from the most casual observation of business life. Firstly, modern corporations can and do employ detailed and elaborate planning systems. Secondly, planners do not have perfect information about present or future events, nor anything approaching it. Thirdly, firms do make bold, risky decisions about their future, and their strategy-makers are not continually bound up in disputes over values which limit their actions to incremental adjustments. It follows from these propositions that the policy-making which typically occurs in large companies cuts across the 'pure modes' identified by Mintzberg.

It is undoubtedly true, as Cyert and March assert, that coalitions are formed in organizations to promote sectional interests. It is also clear, however, that not all coalitions have an equal degree of power. The centre of power in a large corporation is the Board of Directors. This is a rather stable grouping which ultimately derives its authority from the fact that it is nominated by the owners of the business - the shareholders.

In all normal circumstances, the Board is the ruling coalition, and its structure is designed to ensure that it is likely to remain so. No one is likely to be elected to the Board if his views are greatly at odds with those of its existing members. It has often been pointed out that those who become directors of major companies tend to come from very similar, conservative backgrounds, a tendency which is reinforced by the conservatism of the City institutions who are often their main shareholders. In an important respect, this shared culture amongst those who become directors is valuable to the firm. It is difficult enough for the organization to adapt to change in the external environment, without having to cope with frequent swings in policy caused by internal disputes among the Board.

An example of what may happen when such philosophical changes are built into the system of policy-making is provided by the electoral process. Many commentators have observed that the alternation of Labour and Conservative governments in recent times has had an adverse effect on economic performance. In businesses, however, it is usual for changes in outlook to occur relatively slowly, for the reasons mentioned above.

This is not to say that there are no constraints on what directors can do once they are in power. The Boardroom battles reported in the press demonstrate that there is a minimum standard of financial performance which is acceptable to shareholders. A decision to take over a competitor may be blocked by anti-monopolies legislation. A trade union may oppose a decision to close a factory by means of strikes or sit-ins. These are, nevertheless, only binding constraints in extreme circumstances, and while it would not be true to say that strategy decisions are never opposed by more powerful coalitions, under usual

conditions, Boards can enforce their policies.

This ability gives an organization's policy-makers the sort of 'entrepreneurial' freedom demanded for the effective operation of strategic planning. What they still cannot do is to specify the quantifiable objective function required by the optimizers. To quote Grinyer and Spender:

"Over the last 20 years there has been a steady development of ideas about how the planning process may be done systematically. At the same time, however, there has been a developing understanding that such rigor depends on certainty in management's information about the organizational environment, its internal processes and the relationships among them; but management's information is invariably fragmentary, ambiguous and riddled with uncertainty, and this proves to be a damning critique of the systematic approach" (45).

This does not mean, though, that managements should just give up, nor do they. Conscious that they cannot achieve optimum results, they also know that the lack of a systematic means of comparing the internal abilities of the company with the threats and opportunities in the environment gives them little chance of maintaining any sort of control. Most senior managements are surely aware that in Lindblom's phrase they are 'wrestling with a universe which is too big for them'. Their answer to this is not to set out goals in terms of a mathematical model which can be 'solved'. Rather the process of developing a corporate plan occurs as a number of stages which involve highly variable degrees of analysis and precision.

The first of these stages is a statement about the areas of business the firm is interested in. To begin here is to reduce enormously the complexity confronting the firm by defining the limits of the relevant environment. Such statements may be developed in any number of ways. They may emerge by planners giving the Board what Ackoff calls

'scenarios' to choose from (46). They may derive from suggestions made by operating managers who can see developing trends. They may simply represent the personal interests of Board members. Often, says Ackoff, they result from what he calls 'style' - an unquantifiable concept which reflects senior management's beliefs about what the company ought to be like now and in the future.

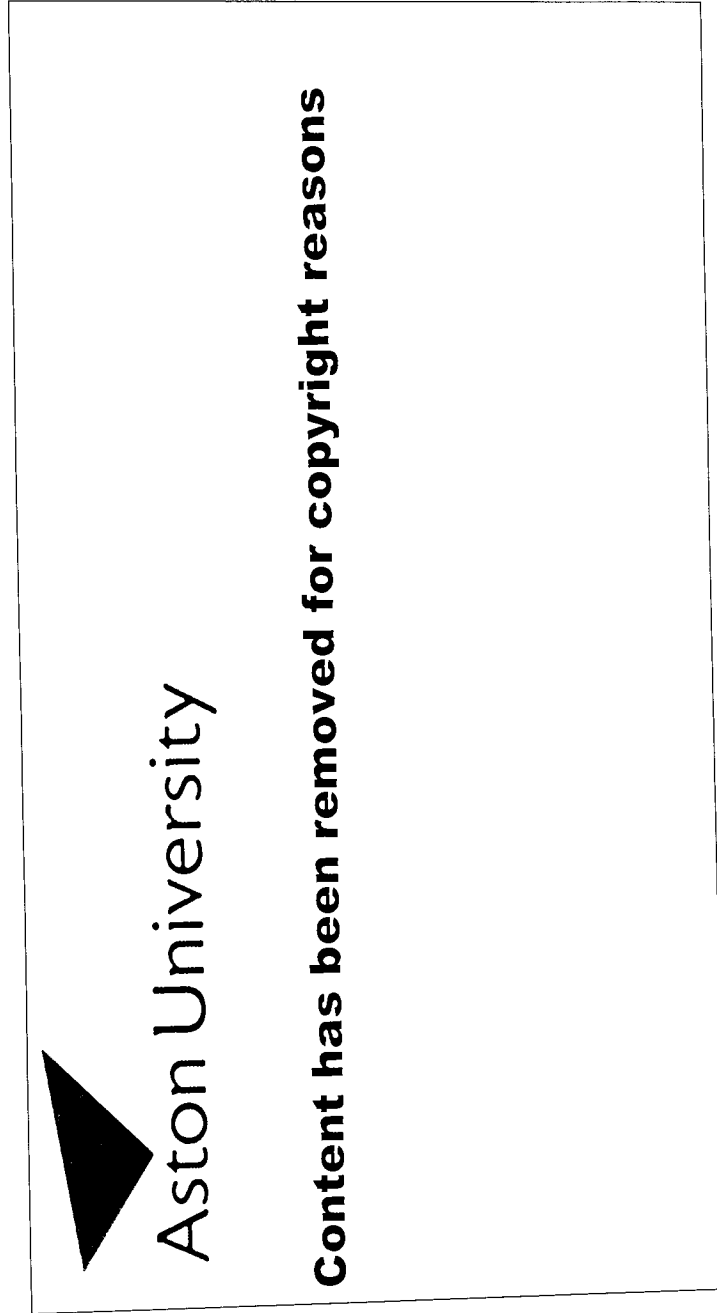
The second stage is to conduct the kind of search for new ventures advocated in the literature and to present the policy-makers with a range of options in the chosen field. Finally, that choice having been made, the detailed plans giving turnover and profit targets and so on can be drawn up to make the initial idea an operating reality. This three-step model admits some of the features of all the strategy modes - the role of 'style' from the entrepreneurial mode, the acceptance of imperfect understanding from the adaptive mode and the elaboration of detail from the planning mode.

It has, of course, been expressed only at the corporate level. This is a weakness, and one which is apparent in almost all studies of strategy-making. What is also required is some discussion of the policy process in a multi-division organization. The problem is that under a corporate planning system the capacity for Divisional General Managers to make policy for their businesses is qualitatively different from that which the Directors have for the company as a whole.

The way in which policy formulation is generally regarded in a multi-division company is illustrated in Fig. 6.3. This imagines an overall corporate strategy within which divisional managers have to work. They are given certain objectives and targets which they must achieve, and have a considerable degree of discretion in determining the strategy they will use to meet them. Unfortunately, the centre-division

FIG. 6.3

STRATEGY FORMULATION IN A MULTI-DIVISION COMPANY.



Source: Glueck (47)

conflict which appears in Dunlop and which, it seems, is not uncommon in industry generally, suggests that the process does not work quite like this. There are good reasons in fact why this should be so.

In the policy model outlined above, the Corporate Board and the Corporate Planners appeared to be in a traditional kind of line/staff relationship. The planners were there to provide assistance to the decision-makers. When one looks at the interaction between the corporate planners and the divisional management, however, the relationship breaks down. To Divisional General Managers, the planners frequently appear not as advisors but as surrogate decision-makers for the Board.

In Dunlop, not only does the corporate planning department examine all diversification and acquisition proposals, it also vets all capital expenditure sanctions. Since one or other of these is an almost inevitable part of any divisional strategy, the Divisional General Manager is likely to find that his supposed authority is in fact quite tightly constrained. Part of the planners' role is to ensure that allocations are spent only for approved purposes. There will therefore inevitably be friction generated here when contentious applications are refused, particularly if what looks a sound economic proposal is rejected on the grounds that it does not fit with the planners' interpretation of what the Board intends by its strategy.

To understand this point it is useful to consider the similarities between the model proposed by Hedberg and Jonsson (48) and that set out above. According to these writers:

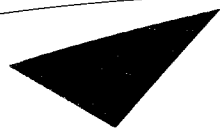
"Strategies are operationalizations of theories of the world which service the double purpose of (1) forming defence networks against information overloads and (2) being ordering systems that map information into 'definitions of the situation'. These

definitions - or mappings - get their meaning from the metasystems of postulates and assumptions that constitute theories for understanding the world."

What this means, in less abstract language, is that a strategy, as a means of coping with environmental complexity, is founded on a particular theory of what the world is like. This model of the real world which policy makers have in mind guides the actions and decisions of the top management group until it is shown to be inaccurate, or at least inferior to some alternative model. These theories of the world, which Hedberg and Jonsson call 'myths' may be seen as part of the organizational 'style' mentioned above. They change only infrequently, mainly as a result of some organizational crisis precipitated by the fact that the existing ruling myth does not specify appropriate responses to current problems. A diagrammatic representation of these difficult points is given in Fig. 6.4.

The implications of this for centre-division relations are that Head Office staff and operating division managements could well be trying to structure policy on the basis of different models of reality. Indeed, such differences in outlook have been discovered by Allen, as mentioned in Chapter 3.1(d). This may lead to strategic actions proposed by divisional managers being rejected by Head Office on what appear to be arbitrary grounds. The fact is, however, that as long as these proposals are subject to Head Office scrutiny, the 'corporate view' will always prevail over that of the divisions, leading to complaints from the operating level that whilst they are given strict performance objectives, they are denied the authority to attain them in the way they think best.

What increases this friction is the fact that the divisional management is bound to have a far more detailed understanding of the strategic



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FIG. 6.4

HEDBERG AND JONSSON'S STRATEGY MODEL

Source: Hedberg and Jonsson (48)

proposals which they put forward than the planners do. It is impossible to design a planning system which provides this detail. In consequence, what divisional managers regard as sound propositions in all the circumstances are turned down because their benefits cannot adequately be captured on an 'acquisition appraisal form' or the like.

Freeman, quoting Thomas (49), exposes what can happen under these conditions. Divisional managers simply deliberately overstate the financial returns from the project to make it look irresistible. According to Rossiter (50) all that then happens when the details reach the corporate planning department is that they are "modified where tendencies to 'celestial magnetism' are revealed". This totally undermines the whole planning system, with neither party having any trust in the other.

What all this reveals is that the planning department is only operating in a strategic role in its relations with the Board. Vis-a-vis the divisions, it is an instrument of corporate control. Perhaps it is an understanding of this role that accounts for the strategic behaviour of Engineering Group. Since it has no planning department of its own, it is difficult to see how the Group can aspire even to the limited degree of 'rational planning' suggested as possible in the model presented here. Furthermore, since there are clearly conflicts of values between the Group and Head Office, much of its effort must necessarily go into adaptive-type policy making to see what changes will be acceptable. Occasionally, however, an opportunity emerges which divisional management is determined to pursue. This is an entrepreneurial-type decision backed by strong advocacy in each case.

This is a risky approach, but it may be unavoidable given the considerations described above. It is likely, however, that to adopt

this style of strategy-formulation openly would be unacceptable. The influence of the business policy textbooks and the professional orientation of the central planners may well give rise to a company norm that only 'rational-comprehensive' kinds of policy-making are permissible. A strategy is therefore constructed which appears to be of this type but which is elastic enough to allow the Group to seize the limited opportunities which it has the resources to uncover.

The role of planning as both a strategic process and a means of maintaining corporate control suggests strongly that a model of organizations which integrates these two aspects is needed if the outcomes of policy decisions are to be understood. Such a model exists. It is the same systems model which was introduced in Chapter 3 to analyse organizational structures designed to promote innovation. We are now in a position, therefore, to integrate the two themes of policy formulation and policy implementation in terms of the systemic framework and to analyse its lessons for the management of diversification.

CHAPTER SEVEN

SOME CONCLUSIONS ON THE
MANAGEMENT OF INNOVATION

OUTLINE

This chapter presents the conclusions of the 'research' element of the project.

It begins by reviewing the main issues discussed, (in Section 7.1), before going on in Section 7.2 to consider what lessons have emerged, both for Dunlop and for the study of innovation generally, through the application of the particular analytical tools used in this work.

The final two sections explore the consequences of viewing innovation effort as a learning system, and in particular, how this might affect traditional project evaluation procedures.

Although the debate in this work has been couched in fairly general terms (e.g. 'the management of innovation') it is in fact directed at something rather more specific. Literature on innovation covers everything from the role of individual creativity to the effect of economic policy. Here the focus is on innovation as an activity undertaken by industrial corporations, and specifically on their ability to operate in a new product market.

To understand this orientation, one must consider what was happening in the company at the time the study was taking place. Engineering Group were attempting to introduce a number of totally new activities. One of these, Dunlopipe, (in which my project was based) clearly had problems in its internal management. Whilst this may have been significant in itself it was made more important by the fact that the company clearly believed that the organizational structures it was using to promote the innovations were a factor in their success or failure. This was apparent from its decision to close the R & D workshop, and introduce venture groups.

A further interesting fact was that there exists an assumption in the literature that the management of innovation is different to that of an existing business. One of the earliest and most widely quoted studies, that of Burns and Stalker, points clearly to this conclusion, and one of their central findings is that "the beginning of administrative wisdom is the awareness that there is no one optimum type of management system" (1).

Against this background, the starting point for an enquiry into the problem of innovation management seemed naturally to suggest itself. Was it possible to predict the kind of management system which would be effective in particular circumstances? The obvious place to begin such an investigation was with contingency theory, which postulated precisely that the structure of an organization would be determined by the external conditions facing it. This is therefore where the theoretical discussion begins, in Chapter 3.

The theme of the chapter is what has been called 'the argument from environment' - that it is the environmental contingencies which are the greatest influence. This certainly accords with Burns and Stalker's view. They see the rate of technical or market change confronting the firm as determining the appropriate management system, with 'organic' systems appropriate to turbulent, changing conditions and 'mechanistic' ones to stable, predictable conditions.

Subsequent writers, building on this idea, tend to stress that different units or departments within the firm will face different contingencies. In this event, each will develop a system or design appropriate to its own particular task environment. Whilst this is the best course for the individual unit to follow, it presents a problem to the company as a whole, because the departments will be differentiated with respect to their behaviour and attitudes. There will therefore be a need for integrating devices, to ensure co-ordination and co-operation. This need arises from the fact that the sub-units are interdependent, and the complexity of the integrating mechanisms depends on the degree of interdependence. It is the organization's ability to find the appropriate levels of differentiation and integration which define its level of performance.

The same conclusion is reached by a different route in the systems model presented in Chapter 3.3. Effective performance is expressed in this model as a question of variety balance. An organization will be effective only if it is able to generate sufficient internal variety to match that of its environment.

In the systems model, organizational sub-units require a degree of autonomy which allows them to develop in a way appropriate to coping with their own immediate environment - this is an expression of differentiation. However to be able to deal with the wider environment, the department or division to which the sub-units belong must be able to integrate them all into an effective whole, at the same time as maintaining its autonomy within the firm of which it is itself a part. This is the essence of the principle of recursion - that the balance between autonomy and control must be maintained at every organizational level if the variety balance needed for effective operation is to be maintained.

Finally, the model goes on to argue that at any operational level in the organization, five functions will be necessary and sufficient to maintain this effectiveness. Policy implies a systematic capacity to choose between the many possible responses to environmental disturbances, which are themselves monitored by intelligence.

Necessary information about the internal state of the system is generated by control which is also responsible for seeing that policies are properly carried out by the various implementation functions. The fact that these units have autonomy means that inconsistent decisions are likely to be made. If the control function had to resolve all these, it would be swamped, so a co-ordination function is needed, in which managers of the implementation activities can liaise among

themselves.

The consistency apparent between the streams of thought seemed to suggest that the two together would offer a powerful tool to analyse problems of innovation management. It was now clear that the essential issue was the tremendous uncertainty surrounding novel projects, and the amount of information which had to be assimilated in making effective technical and commercial decisions in such circumstances. Equally important was the suggestion that, in an industrial organization, R & D should be regarded as a different type of function to the operation of existing businesses - the one an intelligence activity, the other implementation.

With this framework for analysis it was now possible to consider individual methods of managing innovation in more detail. Aside from the more traditional method of maintaining an R & D lab., venture groups have been the most widely discussed innovative structure. They were obviously also especially relevant from the point of view of this particular study, because of their use in Engineering Group.

The discussion of venture groups illustrates a very common feature of the innovation literature. The structures discussed are highly diverse, and yet they are all claimed to work or to have worked in the circumstances described by the authors concerned. Von Hippel even goes as far as to claim that venture groups of almost any design can be made to work. What he does not say is how, and the fact is that most ventures fail.

Like venture groups, the many structures described in Chapter 4.3 have implicit in them the idea that innovation management is a problem apart, and one that cannot adequately be dealt with by most existing

business organizations. The inadequacy which these techniques seek to overcome is that of ensuring good communications between the functional departments of the company. This is achieved either by giving one man responsibility for looking after the interests of the new product (otherwise it just becomes submerged in the problems of the current business) or by devising a structure which divides people's attention between the project and their functional responsibilities. The matrix organization is the extreme example.

Two points stood out from this literature. One is that all these schemes have been shown to work, although they seem to fail at least as often as they succeed. The second is how firmly embedded all the ideas are in the contingency framework, whether they are acknowledged to be or not. The venture idea is founded on the principle that no existing unit has the characteristic structure, behaviour or emotional orientation necessary to succeed in a new market. The other devices see inadequate integration as the reason why new products founder.

Given these considerations, it appeared that it ought to be possible to conduct a debate, at some more general level than is usually attempted, to try and understand why these techniques are sometimes seen as productive and sometimes not. In addition it seemed likely from the analysis so far that the factors already identified as relevant to organizational design would be a useful context for such a debate. Whatever the arguments from the literature though, there was one other element to consider. That was the experience gained first-hand in this project.

This proved in fact to be of some importance. Although the discussion of Engineering Group's experience provided support for some of the prescriptions given in the literature (e.g. 'locate ventures away from

the parent site') it also raised issues which other studies did not treat adequately (or at all). The first was that the structures supposed to support innovation were not of themselves a significant factor in success or failure - the key was the organizational logic which lay behind them. Not only did Fast's 'macro-micro' distinction suggest this when applied to the Engineering Group ventures, but the same conclusion could be reached by applying the principles of the systems model. The fact that the same outcome could be attained by either route was valuable confirmation of the relevance of systems ideas in this context, and in using them to extend the analysis, the second important conclusion emerged. This was that the issues surrounding innovation are different when seen from within a division of a conglomerate company than when seen from the corporate level of the same company.

The imperative to consider the problem of innovation from the corporate level was strengthened by the findings concerning the kind of difficulty faced by the division. These largely concerned constraints on the actions that divisional managers could take, which arose principally out of the differences in perception and understanding between Head Office and divisional managers about the desirability of different courses of action. The existence of such differences was not surprising - the differentiation between the two, (as identified by Allen) was mentioned in Chapter 3.

Chapter 6 investigated this issue of understanding in more detail. The two most important conclusions seem to be these. First, there is a definite problem of finding a measure of performance for novel projects on which the two parties can agree. Development managers frequently argue that projects are terminated just as they are about to succeed.

This leads them to overstate the potential of future innovations - a self-defeating strategy in the long run. Second, the strategic planning advocated in much of the literature may be destructive rather than constructive. The amount of information available to planners is so limited that plans may or may not represent what is achievable. Some means need to be found of providing a balance against tendencies to treat the plan as definitive.

At this point, therefore, it is possible to state the elements which appear from this study to be important issues in the management of innovation in a conglomerate company. Within a division, the understanding of the role and purposes of the various alternative organizational designs is central. Many such designs have been seen to work, but one must try and understand why they work. In the relationship between the division and Head Office, the key lies in developing a level of comprehension concerning the performance and potential of the new venture which extends beyond the kind of financial appraisal usually found. Overall, the problem is to interpret the processes which are taking place throughout the organization in terms of their likely impact on the success of an innovation.

7.2 LESSONS FROM THE THEORETICAL MODELS

One of the intriguing things which has emerged in the course of this study had been the way in which the correct statement of a problem can fail to be translated into appropriate action. This seems to have been the story of Engineering Group's efforts to innovate. The twin

theoretical structures - contingency theory and the Beer model - offer excellent insights into what has happened, and this section begins by restating those efforts and analysing them in terms of that framework.

From early on, the company's declared position was that the decline in its traditional markets necessitated an investigation into possible areas of diversification. At the beginning of the project, it was suggested that the intention was to replace gaps in the company's operations, including tyres, and one still hears the expression that Industrial Products Division has 'corporate' responsibility for such diversification. It was felt to be appropriate at the time that an attempt should be made to generate new products internally. The intention was both to keep the cost down, and allow the company to learn in detail about the technologies and markets it was proposing to enter. Overall the objective was rapid growth for a relatively modest investment.

Industrial Products Division, the vehicle established to promote this programme, was founded on three main principles. One was that the existing R & D department was too technically orientated, and that commercial development needed more attention. The second was that the development units should initially be kept small, so as to investigate novel projects at low cost, allowing them to be abandoned if they proved unattractive. Thirdly, it was felt that venture groups would have sufficient expertise to ensure balanced development and the flexibility to be expanded or closed as appropriate, with the minimum of disruption.

It must be said that this strategy has not been a great success. Of the three larger ventures, one has been closed and one is still losing money. The third, whilst now profitable, does not look like generating

enough growth rapidly enough to fill the gaps in Engineering Group's performance, let alone that of the company as a whole. However desirable the intention, the execution has generated many problems which are explicable in theoretical terms.

The first point which emerges clearly from the systems model is that there was never any prospect of the developments within Engineering Group having a significant impact at the corporate level. Just how far removed the venture groups were from that ideal can be seen by looking at the respective recursive levels. The position is illustrated in Fig. 7.1. Armed with the information that the size of the Tyre Group's turnover at level 2 is something over 500 times as great as that of Energy Engineering Division at level 4, this conclusion might seem trivial. However, there is more that can be read into the diagram.

The position of the new businesses (which for brevity will be referred to here collectively as 'ventures') is such that the resources available to them is extremely restricted. In terms of finance, personnel, capital and so on, and in terms of their freedom to take independent action, their allocation will be only a fraction of that available to the more established divisions higher up. In short, the internal variety which they are able to generate will severely constrain their level of performance.

Now, the purpose of going into these ventures was to test new technologies and markets to see what prospects of growth they offered. It must therefore have been expected that some would produce negative results. What the diagram shows, however, is that if the ventures are treated from the outset as though they were operational elements of the company, no single business will have the capacity to develop to the size of the existing divisions. This means that to achieve the

objective of filling the strategic gaps even at the level of Engineering Group, all the ventures will have to be successful, because the size of the divisions at level 3 in Fig. 7.1 is equivalent to the sum of those at level 4.

If this conclusion is correct, the consequences are very revealing. Firstly, all the innovation literature suggests that by far the majority of novel projects are failures. Since Engineering Group cannot afford any, they would need a quite uniquely sophisticated intelligence network and a perfectly discriminating project selection procedure in order to be successful. What information exists suggests that this is far from the case.

Of the three main products around which venture groups were built, two come directly from the old Product Development Unit. It is difficult to believe that had the search for new products been comprehensive, a coincidence of this order would have occurred. This fact, and the absence of any identifiable, consistent intelligence-gathering operation in the Group, gives the impression that the ability to search for new opportunities is (or was then at least) severely limited. This is not to say that no such channels existed, because the Dunlopipe concept was uncovered through regular contacts with a research institute.

All this would seem to provide a reasonable case for dropping the idea of developing new products internally, and acquiring new businesses instead. Product innovation is a notoriously uncertain activity, whereas (for the reasons given in Chapter 6) the process of buying a company has a much more predictable outcome. Thus the recent change made by Engineering Group in its approach to diversification appears as quite a rational course to have taken.

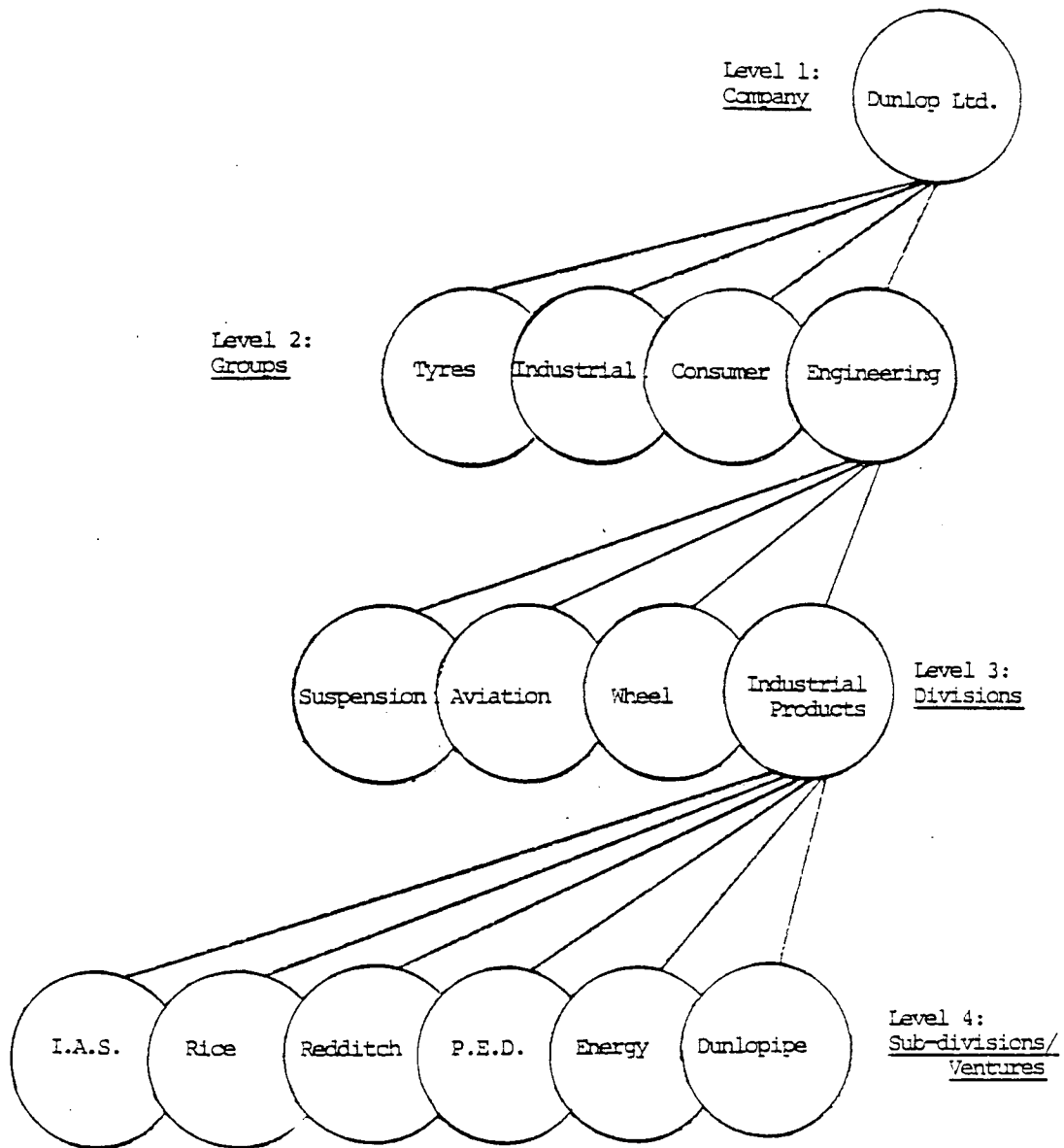


FIG. 7.1

LEVELS OF RECURSION IN ENGINEERING GROUP

It should be reiterated though, that this is only true if the conclusion that no individual venture has adequate growth prospects is also true. This is something that needs discussing at greater length. The diagram shown in Fig. 7.1 is presented as an interpretation of the way the company structure actually exists. The significant point about it is that if it is compared with Fig. 3.3, it is apparent that it is only legitimate to draw it in this way if all the 'circles' contain viable systems. However, they can only be viable systems if the circles at each level represent implementation functions or operating elements of the system at the next higher level.

What follows from this is that the company seems to be treating its ventures in the same way as it treats any other division - in fact, just like the 'company in miniature' mentioned in Chapter 5.4. Such treatment is not consistent with the firm's statement that these units were established to allow it to learn about new businesses, and it is this inconsistency which is the direct cause of the inhibited performance discussed above.

This is where the analysis of Chapter 5.5 becomes relevant. The criteria against which an operating division of a company should be judged are clearly not the same as those which apply to a development unit (part of the Intelligence function in the systems model). The most immediate difference is the time-horizon concerned. This can be illustrated with two examples. At one end of the scale, Bright (2) has estimated that the full innovation process takes upwards of 10 years, and that 25 years is not uncommon. On the other hand, companies quoted on the U.S. stock markets are required by the Securities and Exchange Commission to publish results every 3 months. Even in Britain, the fact that company results come up for scrutiny by shareholders once a

year make the performance of their operating divisions of short-term significance.

The effect of ambiguity over the time horizon of a company's management can be exemplified at a personal level by considering a development manager. Although the success of the firm as a whole may depend on the stream of products emerging over a long period, his own financial rewards may nevertheless be linked to the financial performance of the department for which he is responsible. Substantial, risky expenditures with great potential if they come off may therefore be rejected in favour of attempts to generate innovations which are more certain and less costly, but of less significance.

The inability, particularly in multi-division companies, to distinguish between intelligence and implementation activities would seem to be widespread. In a thoroughgoing review of the innovation literature, Kelly and Krantzberg make the following judgement:

"Divisionalized, decentralized organization is more likely to identify incremental, rather than disruptive-discontinuous R & D advances. Thus a paradox results - the organizational form least suitable for identifying disruptive-discontinuous opportunities appears more suitable for managing the resultant innovation" (3).

The reason why a divisionalized company should be particularly susceptible to this problem can be understood by referring back to contingency theory. The systems model demands considerable autonomy for each operating element of an organization, at the same time as requiring control to be maintained. The usual position actually encountered is that managements feel that things are out of control because the divisions have too much autonomy and their answer is to demand more information. The problem is that in a large company, management's information-processing capacity is very limited, compared

to the amount of information being generated at divisional level. It will be remembered from Chapter 3.1(d) that Allen found very simple integrating devices between corporate headquarters and divisional offices - paperwork systems backed up by occasional visits. It is now clear that such simplicity is inevitable for the problem to be manageable at all.

The consequences of this for the development unit are serious. The problem of judging every case on its own merits would be overwhelming in Dunlop's circumstances because all funds allocations are approved by Head Office. Standard forms of appraisal are therefore used which may be appropriate to established divisions but which cannot hope to capture the complexity confronting the new business.

A further paradox is apparent in the use of the venture group format. Two important problems facing large firms who want to develop new products are the inflexibility of the management hierarchy and the transition between development and production. The first point is the one highlighted by Burns and Stalker in their distinction between mechanistic and organic management systems. The second is implicit in many of the 'integrative-type' structures described in Chapter 4, which are aimed at overcoming the tendency identified by Souder and Oakley for managers of existing businesses to reject new developments.

The venture principle offers tremendous potential for overcoming both these obstacles. An independent unit dealing with one particular product market can develop characteristics of differentiation which are appropriate to the new task, rather than to the existing business structure. Equally, if the venture is successful, it will have a group of people involved with it who are committed to its commercialization. The difficulty is that the venture group looks outwardly like a

miniature division and is therefore more likely than more traditional structures to attract inappropriate measures of their performance.

What these conflicting expectations do is to compel the venture to behave as though it were an established business. It is forced to compete for funds on the same basis as existing divisions, but has no performance record to back up its applications. Since risky investments may make its figures look worse and cause difficulty in obtaining funds in the future, it will tend to develop slowly, by incremental changes. There will be tremendous emphasis on cost-saving in the early years because turnover is low, despite the fact that spending to improve the product range might boost sales.

What is being described here is quite clearly not a development organization in any accepted sense of the term, and its position is untenable. Dunlopipe is suffering from just this syndrome, with requests for funds for investment in resin-spraying systems being rejected on financial grounds despite substantial demonstrable improvements in pipe quality, waste of materials and so on. At least Energy Division has come to terms with the problem by ceasing, to all intents and purposes, to be the intelligence operation it began as. It is now simply a small division, making steady progress in its own limited market.

One important conclusion, therefore, is that the form of control being exercised from the corporate level is inimical to the successful performance of the ventures in their product development role. There is also, however, an intervening stage. Although requests for funds are dealt with by Head Office, the prime responsibility for the management of the diversification programme lies with senior Group management. The effort of trying to reconcile a set of objectives

against which their performance will be judged with an organizational bureaucracy which makes those objectives unachievable must create tremendous pressure on individuals at this level. This pressure is made worse by the political nature of the company, for the following reasons.

The policy directive which stipulates that the purpose of the diversification programme is to fill strategic gaps on Engineering Group's performance is quite clear and unequivocal. This statement gives direction to the business, and (at least implicitly) gives the managers at Group level who are charged with carrying out the policy the authority to implement it as they see fit. The measure of their achievement is the success of the strategy.

At the same time, it should be remembered, the company is in financial difficulty. Therefore the policy statement is made that expenditure is to be controlled by subjecting all capital proposals to Head Office scrutiny and that cost-saving schemes are to be implemented at all levels. Managerial performance in reducing spending is to be closely monitored.

This second directive completely destroys management's ability to diversify effectively. Any major investment in developing new products will raise expenditure in the short run, and perhaps for many years. This will be regarded as unacceptable, and will in any case be blocked at the corporate level. Without such expenditure, the diversification effort will not succeed and this too will be unacceptable. The managers concerned will quickly recognize this, but there is nothing they can do. To claim that the two requirements are inconsistent would be regarded as a form of 'special pleading' and hence of weakness. The problem is therefore undiscussable. These two elements - the

conflicting norms for performance and the inability to expose the conflict - are precisely those which create a double-bind (4) for the individuals concerned. It is a battle they cannot win.

What seems to be happening in this situation is an attempt to keep performance within acceptable limits in each respect. What it certainly means is that the subordinate managers cannot be allowed any degree of autonomy. The necessary balancing act is so difficult that Group Management must keep the closest possible control. Immediately one can see why, for example, the significant decisions in Dunloppe, where the position is most critical, are taken at this level (albeit with consultation) rather than by the venture managers. The tightness of this control is emphasised by the embargo imposed at IAS on the making of telephone calls in the morning.

Two final points emerge from the systemic analysis. The first is that excessive control from the Group level severely restricts the variety which can be generated in the subsidiary units. The fact that the Dunloppe development engineers never had anything of consequence to do was not because the environmental challenges were not there, but because the organizational capacity did not exist to make their work useable.

Secondly, concentration by Group Management on the detailed problems of the ventures directs their attention away from their own necessary role. One of the responsibilities of the control function in the systems model is to create synergy between the various operational units at that level of recursion. One of the very revealing observations made during the study was that whilst concern was expressed at Group level to find synergy between products within Energy Division, more than once the comment was heard that the ventures

themselves had little in common with each other, and did not seem to make up a consistent whole.

7.3 ORGANIZATIONAL LEARNING

If there is a single expression which captures the kernel of the argument presented above it is to be found in Beer's First Axiom of Management quoted at the end of Chapter 3.3. Here, the vertical dimension of his model, which was identified with the concept of integration, was described as the axis of corporate cohesion. It is exactly the inadequacy of such corporate cohesion which seems to give rise to the difficulties encountered by Engineering Group in its attempts to innovate. This phenomenon appears as the lack of any mechanism through which the divergent views of the problem held at different levels of the organization can be reconciled, but as Allen explains (see Chapter 3.1(d)) the willingness to confront differences openly is the essence of integration. The implications of this are serious, because some of the research findings on the management of innovation have produced conclusions which although attractive to managers with responsibilities in this field might well be startling to those at the corporate level.

Perhaps the best example of this is provided by Hlavacek (5):

"The terms success and failure contain certain ambiguities. For example if a venture that might have cost a lot of money is terminated before much money has been invested, should that be counted as a success or a failure?"

This is one of the most significant points which arises out of the confusion described in the previous section between the venture as an implementation activity and as an intelligence activity. If the venture exists to enable the company to learn about the new technology, the conclusion that it is not a profitable avenue to pursue is a successful outcome. However, if the same venture were treated as an operational element of the company, its closure would undoubtedly be seen as a failure. Clearly, divisional and venture managers do not want to be associated with failures, and are likely to go on supporting this latter type of venture almost regardless of their view of its future. This is destructive in terms of company performance and managerial morale.

It has already been suggested (in Chapter 6.6) that innovation managers attempt to 'beat the system' by deliberately 'slanting' the information they pass upwards in the planning process. This is frequently regarded as an inevitable political move:

"One has to acknowledge that organizational politics may be influential in the nature and degree of commitment to technological innovation. The social context of project estimation may well be a process of political advocacy and clash of interest groups as opposed to a dignified rational assessment of probabilities, costs and benefits - all of which may be of a spurious accuracy anyway. Mathematical formulae may be employed as 'scientific' weapons in the constant internal corporate politicking that accompanies the hassle for power and resources" (6).

In this context, 'scientific' generally means quantifiable, and this in turn tends to focus the debate on a single dimension of performance - money. For the reasons given in Chapter 6 this puts the innovation manager at a considerable disadvantage, as Uytterhoeven has recognized so clearly:

"The middle General Manager has to translate abstract goals (in terms of a profit target etc) into concrete actions. The middle

subordinates cannot be judged in abstract terms but only in the light of a multi-dimensional appraisal of performance. Corporate executives tend to look only at the financial results, however, and regard middle General Managers' attempts to explain circumstances as excuses for failure." (7)

Accepting that political behaviour is inevitable in any resource-sharing organization, this sort of attitude is certain to lead to politicking of a particularly divisive sort. Those managers responsible for innovations whose financial benefits are only realisable in the long term, must take what steps they can to protect and promote their position. Indeed, it is an essential part of their task in this environment to promote the cause of the divisions or projects under their control. Once again, however, such action may not be in the interests of the firm as a whole, but the fragmentation of interests is a direct consequence of inadequate measures of performance.

The likely outcome of this behaviour has been described by Argyris and Schoen (8) who couch the problems in terms of organizational learning. In many situations, they argue, the result of a particular organizational action will differ from that which was expected. Enquiry into the reasons for this 'error' may show that it arose in one of two ways. The first is that the strategy adopted by the firm in pursuit of its goal was inappropriate. An understanding of this circumstance, leading to a change in strategy is called 'single-loop learning'. Alternatively it may be discovered that the particular goal being sought is inconsistent with other organizational objectives, and behaviour which leads to the achievement of one will cause others to be unfulfilled. A change in organizational 'norms' which derives from such an enquiry gives rise to 'double-loop learning'.

A good example of a situation which requires a double-loop solution is given by Uytterhoeven:

"In one company, top management emphasized the need for its divisions to have ample productive capacity. In the measurement of performance, however, excess capacity was looked on unfavourably. As a result, division managers added capacity very cautiously, achieving high plant-utilisation rates at the expense of lost sales (which did not show up in the measurement system)" (9).

Here the division managers have adopted a single-loop solution to the problem of maintaining their performance. Their strategy is well adapted to achieving good results in one dimension, but at considerable cost in other respects. Although this attitude is damaging to the overall interests of the firm, such behaviour is forced upon them by the existence of conflicting organizational norms.

This leads on to what is perhaps Argyris and Schoen's most powerful conclusion: unless such conflicts can be exposed and resolved, their effect will be to compel members of the organization to act in ways which reinforce the error. It is not possible to find single-loop solutions to double-loop problems. Dunlop's problems of innovation management are of just this kind.

There is clearly a need within the company to expose, accept and debate the problem of conflicting behavioural norms that have been identified. Discussing how such an outcome might be achieved, Argyris and Schoen argue that organizational enquiries into past problems invariably generate solutions which give rise to new problems and further enquiries. They call this process 'organizational dialectic'. It is organizational dialectic - the pattern of enquiries and emerging solutions - which provide the opportunity for learning. 'Good dialectic' manifests itself in the ability to single- and double-loop

learn, as appropriate.

It has been suggested that Dunlop suffers from a lack of effective double-loop learning. This would seem to stem from lack of good organizational dialectic, a judgement reached by considering the list of questions given in Table 7.1 which Argyris and Schoen offer as illustrating the features of good dialectic. Attention is drawn particularly to the third question in the light of the analysis above.

Argyris and Schoen conclude that:

"the achievement of good dialectic requires organizational deutero-learning. That is, it requires the organization's members reflect on and inquire into their organizational learning system and its effect on organization enquiry" (11).

This I.H.D. project ought to have provided Dunlop with opportunities for single-loop, double-loop and deutero-learning. However, as Chapter 8 makes clear, it is an opportunity which is likely to go both unrecognized and unexploited.

7.4 CONCLUSIONS

Many studies of innovation conclude with a summary 'check-list' for managers of the factors which seem to the author to be influential in success or failure. For two reasons, any thought of following this trend here has been rejected. Firstly, not all influential factors are equally influential, and listing them together tends to equate the most critical with the most trivial. Secondly, it has been argued in this

work that a weakness of many 'prescriptions for successful innovation' is a lack of understanding as to why the recommended techniques are expected to work. In these circumstances the implementation of selected items from the check-list becomes essentially a mechanical procedure of uncertain value.

The opportunity has been taken in this study to comment on many of the prescriptions found in the literature, in the light of both the theoretical models developed and personal observation. These comments should, however, be read in the context of the accompanying discussion and analysis; removing them from the context is liable to be misleading. What this final section offers instead is a restatement and discussion of just two points which seem to be particularly important both for the debate surrounding innovation in general, and for the success of innovation in Dunlop. One concerns the role of venture groups, the other has to do with the measurement of performance.

The systemic analysis would tend to agree with von Hippel (see Chapter 4.2) that the venture group is a robust concept, its particular value lying in the potential it offers for facilitating the transition between the R & D phase and the operational phase. However, herein also lies its danger. Even at the R & D stage a venture group may look like a small operating division. If it is treated as such, it will fail. Either it will simply become a small operating division or it will be unable to succeed at all. In either case, the company will perceive that the high hopes it has for the project have not been realised, and are likely to blame either the individuals involved or the venture concept itself.

Closely allied to this is the question of performance evaluation. It

TABLE 7.1

QUESTIONS INDICATING FEATURES OF GOOD ORGANIZATIONAL DIALECTIC



Aston University

Content has been removed for copyright reasons

Source: Argyris & Schoen (10)

is very likely that a large organization will apply standard criteria for assessing performance throughout the company. There may be justifications offered for this practice in terms of 'fairness' or the impossibility of treating each case separately. It may simply be due to the inertia of the system. The analysis presented here leads to the conclusion that this practice is unsound per se and crippling to the prospects of new ventures.

The reason for this inadequacy is particularly clear in a multi-division organization. What financial evaluation techniques fail to recognize is that the operating division managers have far more information than the planners who control the funds can ever hope to assimilate. This is an inevitable feature of any recursive system, and one must conclude that any highly-centralized resource-allocation procedure is bound to lack effectiveness.

As Andrews observes:

"Preoccupation with final results need not be so exclusive as to prevent top management from working with divisional management in establishing objectives or promulgating plans to meet objectives. Such joint endeavour helps to ensure that divisional performance will not be evaluated without full knowledge of the problems encountered in implementation. When the diversified company becomes so large that this process is impracticable, then new means must be devised. Implicit in accurate evaluation is familiarity with performance as a basis other than that of accounting figures" (12).

These two requirements, the need to avoid treating venture groups as operating divisions and the need to devise multi-dimensional performance measures for them, seem to be the key issues in successful innovation, and they are clearly interlinked. The problem is that to suggest that new enterprises should be assessed by some means other than normal company 'procedures' is extremely radical. This is so because it challenges basic planning principles and consequently

affects the way in which both influence and resources are distributed through the organization.

To state this proposition in its simplest form one would say that the Dunlop experience suggests that the bureaucratic planning and evaluation system which supports the allocation of resources to existing divisions cannot be made to perform this task effectively for new businesses. Furthermore, because new businesses need to be assessed along so many dimensions, no formal reporting system can be adequate on its own. The information load is simply too great.

One cannot expect this to be an attractive conclusion either to the rational-comprehensive school of planning theorists, or to senior managers themselves. In the first case, it is suggested that the ranking of alternative projects against one another, or assessing them against some criterion level according to their projected return is unacceptable, despite what the literature says. Since the available empirical work (as well as one's own casual observation) suggests that venture managers 'doctor' the figures when confronted with this system the a priori information processing view that it is hopelessly insufficient would seem to be vindicated. From a corporate managerial point of view, the idea that it is the informal political system which should determine investment in new products is likely to be unpopular because it exposes judgements much more openly, and clears the way for debate and conflict - the latter being an aspect of behaviour which many organizational cultures are specifically designed to avoid.

A system such as Dunlop now has seems mainly designed for the protection of corporate executives. On the one hand even the most minimal capital expenditure applications have to go through Head Office, but on the other, Divisional General Managers are squarely

responsible for the performance of their divisions. This leaves the Divisional General Manager as the only man at risk. If the planning machinery denies him resources he is free (indeed, obliged) to use his informal contacts to have the decision reversed if he believes firmly enough in the project based on his local knowledge. This is fine if he succeeds, and corporate managers will congratulate themselves on knowing when to take a risk. If the project fails however, they will always be able to point to their formal assessment and criticize the Divisional Manager for arguing against it. In the case of new ventures, which are especially risky, one can predict at least as many failures as successes, which is a position any ambitious divisional manager can be forgiven for seeking to avoid. Hence he is likely to minimize his personal risk by opting for low-risk, low-profit new projects.

How does all this affect Dunlop? In the first place, the company needs to have quite clear what the purpose of its new ventures is. If they are to fill the 'strategic gaps' in Engineering Group they need investment on a scale previously unimagined. If they are 'beachhead operations' to test the market they should not be expected to turn in large percentage contributions to ensure their survival. In either case, Group Management, who have definite responsibility for their performance, must be given commensurate authority. As Connor observes (13):

"Decentralization is not so much organization-chart structure as a way of managing. It is picking the best people and leaving them alone until they ask for help or you see they need it. Determining when and when not to butt in is a critical decision in a decentralized company."

What this does not mean is that corporate management should grant unconditional licence to the divisions. Nor is it the case that

extending their autonomy need leave Head Office feeling that the business is out of control. In a fascinating piece written from the practising manager's point of view, Wrapp (14) comments:

"[A good manager] has a special talent for keeping himself informed about a wide range of operating decisions being made at different levels in the company. As he moves up the ladder he develops a network of information sources in many different departments. He cultivates these sources and keeps them open no matter how high he climbs in the organization. When the need arises, he bypasses the lines on the organizational chart to seek more than one version of a situation."

This is nothing more or less than a practical statement of Beer's Monitoring Loop. It is the principal way in which corporate management can ensure that it has the requisite variety to maintain control whilst meeting Connor's demand above that it allows the divisional manager requisite variety at his level by only intervening when necessary. The central message of the systems model is about this variety balance. The central message of this study is that in Dunlop, this balance is lacking as between the division and its environment and, critically, between divisional and corporate management.

Having made these points of principle, it remains to draw a practical conclusion. A key problem area would seem to be how corporate management take the decision to devote valuable resources to a new venture. Traditional bureaucratic-type resource allocation procedures have been shown to be inadequate because they are not broadly enough based. Venture managers are therefore likely to consistently overstate the potential of their projects in order to obtain funds, subsequently failing to deliver the promised results. In these circumstances it is hardly surprising that corporate executives keep new developments on a tight rein.

It seems reasonable to suggest that if a means could be devised by

which corporate management could effectively discriminate between promising and doubtful projects, they might then be willing to provide venture managers with the autonomy they need to have a chance of success. To accomplish this, some mechanism needs to be built into the evaluation process which enables the complexity obscured by traditional planning methods to be recaptured. One possibility that suggests itself arises out of Beer's concept of 'monitoring', which is simply a means of allowing the control function to develop a higher variety understanding of the activities at the implementation level.

At important decision points in any new development, the manager of a project is likely to be its strongest supporter. He will have a more complete understanding of its current position and future potential than anyone else. The information he provides in support of continuing the project is transmitted to senior management via the command axis of the Beer model and the control function has no independent means of verifying it. This corresponds to normal bureaucratic procedures.

What is needed therefore is a 'monitor' - someone independent of the project team to make the case against proceeding with the venture, whose access to the relevant information gives him a similar degree of understanding to the project manager himself. The decision to proceed with further development or to terminate the venture is then taken by senior management on the basis of the debate between two equally well-informed participants. Alternatively, the role of the 'monitor' might be simply to challenge any point made by the project manager with which he disagrees, without making a positively opposite case himself. This would avoid the risk of a sound proposal being defeated by superior advocacy. A principal attraction of this procedure is that there would be no incentive for other than accurate information about the project

to be presented, since exaggerated claims would be exposed by the other side. Differences of opinion and interpretation will certainly arise, but this will only serve to indicate to management where areas of doubt lie.

Such debate need only be conducted at the appropriate level of recursion. Division-level ventures can be debated by Divisional Management without reference to the Corporate Board, provided the Board applies the same monitoring principle and monitors how well such debates are being conducted within the Divisions. It would have to be made explicit that the future prospects of the individuals acting as 'monitors' do not depend on the outcome of the debate. Their role should be seen as acting in the interests of the division as a whole, rather than (in the case of the venture manager) the individual project. This would assist in overcoming the often unhelpful distinction between success and failure associated with new ventures.

Finally, and of great importance, this process makes explicit how the decision is being taken and who is taking it. Apart from the problem of lack of requisite variety, bureaucratic planning systems obscure the way in which decisions are really made. The fundamental concept underlying such procedures is that of rationality. The belief is that resources can be allocated according to rational and objective criteria. In fact, the degree of error and exaggeration in the forecasts and returns received from divisions, and the way in which these figures are 'doctored' by planners to compensate, renders the entire system invalid. The role of this type of planning is simply to allow decisions taken to be justified by reference to the "facts". In reality, decision-taking in business organizations is a process which relies critically on judgement, not fact, either because the true facts

are not known, or because their meaning is uncertain or disputed. Since uncertainty is a key feature of new ventures, a system of decision-making which accepts it rather than attempting to assume it away shows at least an understanding of the principal problem the venture manager faces.

This process of 'decision-making by debate' is a considerable departure from traditional forms of business behaviour and is unlikely therefore to appeal to Dunlop or anyone else, although it would be most interesting if some trial were done in which, in parallel, some projects were subjected to traditional evaluation techniques and others were monitored in the way suggested here. The fact remains, however, that the problem of finding a way of evaluating new ventures adequately must be faced, and it is one which so far seems to remain unrecognized.

CHAPTER EIGHT

THE OUTCOME OF THE PROJECT

OUTLINE

Although the previous chapter presented the conclusions of the research part of the project, the purpose of the research was itself to support certain broader objectives. In this final comment, the discussion is concerned with how well these objectives have been realised.

The new learning which emerges from the completion of an I.H.D. project is typically limited to conclusions on the immediate research topic, and consequently tends to be regarded as external to I.H.D. itself. This ought not to be the case, because to avoid critical examination of the process of the research, rather than simply its content, is to deny the Scheme a valuable learning opportunity.

It is for this reason that the distinction was made right at the beginning of this work, in Chapter 1.3, between 'the research' and 'the project'. The research is now complete. The remaining task is to examine the project.

The first section looks at how effectively the project was managed, in terms of the relationships that existed between the three participants - student company and university. The second section considers how well each of the three achieved its objectives, as defined by I.H.D. The final section reflects on the fact that the project was not wholly successful, defined in this way, and

explores possible reasons for this in the light of two contributions to the literature on action research.

In every I.H.D. project there are three principal actors - the student, the university, and the sponsoring company - and consequently three sets of pair-relationships as illustrated in Fig. 8.1. For a project to be conducted well, each of these relationships must work satisfactorily, but it would be a reasonable judgement that in this project, none of them functioned well throughout. The reasons for this, and the consequences of it, are examined below.

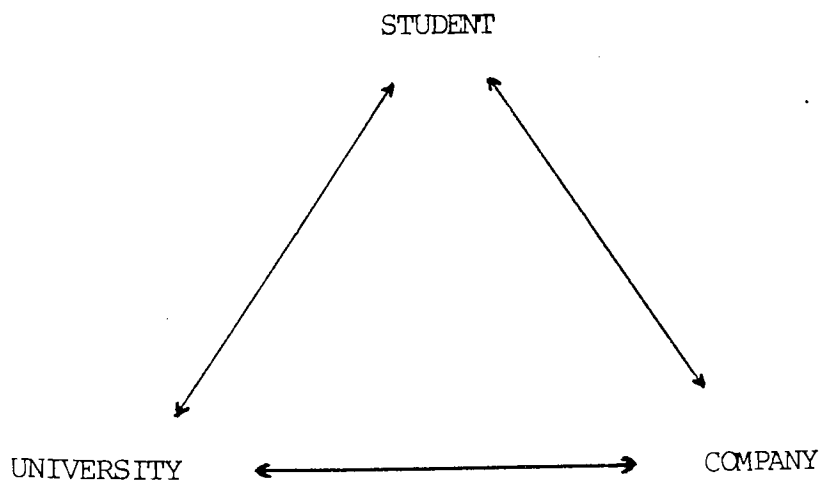


FIG. 8.1

BASIC RELATIONSHIPS IN AN I.H.D. PROJECT

The link between the university and the company is the first to be forged, often long before the student arrives on the scene. As outlined in Chapter 1, the intention is to establish the basis of a project whose fundamental criteria are that it must be of genuine business interest to the company, and must provide the means for a worthwhile piece of research in its own right.

Having made this general point, it would be foolish not to realise that the time lag between the agreement on, and the start of, a project may be up to a year, and between agreement and conclusion, up to four years. What is of commercial interest to a company at the outset may therefore have become irrelevant even before the student begins work. This is a risk inherent in the Scheme.

In my case, however, this was not the problem. The problem was that negotiations concerning the details of the project had been carried out between I.H.D. and a Divisional General Manager, concerning work to be done within a particular sub-division. The most startling consequence of this was that the manager of the sub-division, despite having been nominated as Industrial Supervisor to the project, did not know that I was joining his group until after I had arrived at the company. I.H.D. might argue that they rely on company procedures to ensure that this does not happen. My experience suggests that this is not a reliable arrangement, and perhaps there needs to be some initial contact between tutors and nominated Industrial Supervisors before a project begins. This does not seem unreasonable given the expectation that the relationship between them will last three years. There were, of course, subsidiary problems in my case, such as that the suggested project had already been completed by someone else, and that the Industrial Supervisor left the company just after I arrived. The first of these

points may well have been picked up had the kind of meeting suggested above taken place, although nothing could have been done about the second.

There is of course a risk that university and company staff involved in a project will view it in completely different terms. The business of the company is business, and to that end, the commercial results of the project may be all that matter. On the university's side, at least from the Main Supervisor's point of view, the goal may be seen in more strictly academic terms. Again this is a difficulty inherent in the Scheme, resolved in my case by the failure ever to have a supervisors' meeting at which all the supervisors were present.

Once a project is under way, I.H.D. has a responsibility for ensuring that it, and the student, receive appropriate academic supervision. In order for this guidance to be relevant and effective, two conditions have to be met: the student must be put in touch with a supervisor with suitable expertise, and that supervisor must be willing to take an active interest in the work. Colleagues in I.H.D. have sometimes expressed dissatisfaction in the second area, feeling that a supervisor has not given them as much attention as he would one of his own department's students. However, once the right supervisor was found, I encountered no such problems and invariably received valuable advice. The problem was to find the right supervisor in the first place.

Chapter 2 described the situation that obtained at the beginning of the project. The Main Supervisor suggested was a Civil Engineer, on the logic that pipe was something which Civil Engineers knew about. It is clear now, and should have been clear from the outset, that this reasoning was faulty. The whole concept of the project as originally established was in finding the least cost combination of inputs, subject

to certain constraints. This is a highly general problem, whose solution does not depend on the exact nature of the output. It is a subject upon which operational researchers, materials technologists, even production engineers might have something to say - the relevant expertise is not determined by the end-product being manufactured.

Having once arrived at this position, however, one became somehow 'locked-in'. The reason for this appears to lie in the way that I.H.D. is structured. Having few staff of its own, the department relies heavily on the co-operation of other faculties for supervision. It seems to be felt that to admit that the department originally chosen to supervise a project is not in fact appropriate, and to alter the arrangement, prejudices the ability of succeeding students to obtain help there.

My particular problem went beyond this, however. Even when the focus of the project had changed from a concern with a new kind of pipe to a concern with new products in general (and it was therefore generally agreed that Civil Engineering could not provide adequate supervision) it appeared that no-one in the university was working in this field. This posed two related difficulties. One was that someone had to supervise the project, the other was that some course work had to be found because of the requirement to attend formal classes for a minimum period. As a result, I attended lectures on management accounting (which were of passing interest at best) and I.H.D. felt obliged to undertake supervision itself until the relevance of Systems Analysis to my work became apparent and that Department took it over.

It is, however, on the issue of methodology that I encountered my most constant academic difficulty. It will be recalled that this issue was first raised in Chapter 2.1 under the heading 'A Model I.H.D. Project'.

The model project outlined there has implicit within it a particular view of what constitutes good academic methodology - the so-called "method of science". Checkland (1) has identified the method of science as the unique contribution that western culture has made to the development of knowledge. The basic principle that in order to understand a complex world, one should divide it up into tractable pieces and study each separately has not only been the basis of almost all scientific discovery, it continues, for that very reason, to be the paradigm for research. This is evidenced within I.H.D. by continual pressure to limit one's study to 'manageable proportions' - to focus down on a particular element of the total problem. I was asked the question on many occasions, "What are your hypotheses?". This was something to which there was simply no answer, given my belief that the concept of what constitutes good research implicit in the question was not appropriate to the work I was doing.

What happened during the course of the project was that I was finding myself wanting to take a wider and wider view, whilst being advised to take a successively narrower one. The matter I was considering began with a concern for a particular problem with a new product, then with the management of that product's development, then with the management of new products in general, and finally with the management of new products in relation to the management of the company as a whole. Both I and my tutor were aware of this divergence between the expected course and the actual events. What neither of us had to hand was a language in which the problem could be debated, or any alternative methodology which would suggest a viable course of action.

The failure to resolve this methodological issue led to something of a crisis in the conduct of the project. On the one hand, it was apparent

that the available methodology offered guidelines for action which were misleading, because they led away from what seemed to me to be the interesting and important questions. The alternative - to investigate those questions anyway without any certainty as to how to go about it or what the answers would tell me - laid the project open to the accusations of unguided empiricism which I.H.D.-style action research frequently attracts.

In the event, however, the over-riding imperative proved to be to pursue the important issues as I saw them. This involved deciding on a path to follow, (initially in the light of my Dunlopipe experiences), investigating where it led, then striking out again in the direction these investigations dictated, which frequently meant breaking unfamiliar and often unexpected new ground. This may be an unconventional mode of research, but it does offer the chance of taking a route which has never exactly been followed before. I return to this point in Section 3 of this chapter.

Had one been aware of it at the time, there does in fact exist an alternative to the method of science. This is Checkland's "soft systems methodology" (2) which was developed specifically as a response to his conclusion that the scientific method is not a valid way of studying ill-defined problems in the real world, as opposed to clearly-expressed laboratory studies. Ironically, I.H.D. has recently begun to teach Checkland's approach to new students, although whether it will really be regarded as a legitimate alternative either by staff or students given the pervasiveness of the "method of science" paradigm remains to be seen. The question whether it would in fact have made any difference in my case is, of course, unanswerable.

Finally in this section, I consider my own working relationship with the

company. I.H.D. requires that students spend 30% of their time with the company, 30% at the university and the remainder split between the two as appropriate in the individual circumstances. The normal way of achieving this is to be on-site for say, three days a week, and in the Department for the other two. In fact, students are discouraged from working regular 9-5 hours at their firm, on the grounds that it encourages their management to treat them as ordinary employees who can be given things to do unrelated to their project activities.

My experience again runs contrary to this principle, although it is difficult to say if one can generalise from that experience, because Dunlop strongly impressed the need for strict timekeeping on their other new graduates. Whether this discipline is an unusual feature of Dunlop or whether it would be a common attitude anywhere in industry, it was certainly the case that the relatively junior engineers with whom I was mainly involved at Dunlopipe commented on and perhaps resented my irregular pattern of working. The fact that Dunlopipe management failed to remark either way may be accounted for by how little they were concerned with what I was doing. Subsequently, however, it was agreed that I would work normal factory hours for a specific period whenever I was with the company, and would then spend a period of time away.

The lack of interest displayed by Dunlopipe staff in my work illustrates that apart from the period in Dunlopipe, at no time did my Industrial Supervisor have a direct interest in the results of the project. Even where such an interest existed, the belief that my work would make any difference was conspicuously lacking. As a consequence, there was no one in the company with any genuine motivation to ensure that the project was successful from their point of view. If there was a "company view" of my activity it was that the project was some kind of

training exercise to be got out of the way as quickly as possible so that I could be put into a "real job". The Industrial Supervisor role changed hands many times, and never represented real company involvement - Mr. Bayliss who had the task the longest seemed willing to perform a fairly thankless job simply out of personal interest.

The failure of the initial project as stated (because the work had already been done) began a period of re-negotiation of objectives which was never completed. Any expectation the company had that useful results could be obtained became eroded, which undermined its confidence in the work. These conditions, and the lack of commitment referred to above, created a vicious circle which ultimately led to the company's becoming increasingly detached from the project. Why this happened is the subject of the last section of this chapter.

8.2 THE OUTCOME OF THE PROJECT

The objective of any I.H.D. project is to achieve worthwhile results for the company, the university and the student. How well, then, did the three parties in this project have their goals realised? One can only conclude from the discussion of the previous section that from Dunlop's point of view the project was a painful experience. The basic criterion for an effective project outcome is that something should have changed within the organization. Typically this will be the introduction of a new product or the implementation of new procedures. As far as one can judge, no such changes will be evident in Dunlop Engineering Group as a result of this work.

One should perhaps look into this conclusion a little more deeply. I do not believe that the reason for this failure lies in the lack of insight relevant to the company. Many opportunities existed for the company to learn from its participation in this exercise, although for a number of reasons none was realised. The most fundamental reason was discussed above - a lack of confidence and commitment in the way the project was handled.

As Argyris & Schoen (3) demonstrate so effectively, there is frequently a considerable gulf between espoused theory and theory-in-use. Implicit in the willingness to participate in a research project is an espoused theory which welcomes the opportunity to highlight and criticise past mistakes and expresses a willingness to learn from them. The theory-in-use manifest in the organization was however to obstruct attempts to query past decisions and to deny the opportunity for criticism.

This mismatch inevitably led to conflict. I was attempting to construct a project on the basis of the espoused theory, but these attempts were always rebutted, no matter how apparently logically they were argued. These conflicts were always resolved by "forcing" or "smoothing" (to use Lawrence & Lorsch's language) - never by confronting the differences of view.

Chapter 2.2 (d) defined the objective of this project as "to service a debate about the validities of a range of possible viewpoints...; to improve the quality of debate about possible action". It is clear now that given the company's theory-in-use, this was impossible to achieve. Had the objective been realised, two outcomes would have been evident. Firstly, the company would have consistently challenged and disputed my own analysis of its problems, with a view to our reaching a common understanding. Secondly, within the company itself, the agreed

conclusions would have been discussed to see what changes in the organization's behaviour was demanded by them.

The idea that the purpose of this project was to encourage internal debate recalls the claim made in Chapter 7.3 that it should have provided the company with opportunities for single-loop, double-loop and deuterio-learning. For example, the discussion of different methods of managing innovation might have given rise to enquiry leading to the realisation of the company's objective of managing its diversification efforts more effectively. This would have represented single-loop learning. Enquiry leading to the removal of the conflicting norms confronting Divisional General Managers would have achieved double-loop learning. Finally, enquiry into and debate about the suggestion that neither type of learning was being accomplished would have achieved deuterio-learning.

Thanks to the level of conflict which emerged in the course of this project, however, Dunlop do not in any sense 'own' its conclusions. It would therefore be reasonable to expect the company to deny their legitimacy and consequently to deny the possibilities for learning. This is perhaps one of the most frustrating outcomes of the work. To take just one of the examples above, a significant conclusion of the research is that the Divisional General Manager responsible for controlling the new venture activities is facing a double-bind. This arises from the conflicting demands placed on him that he should secure rapid growth and large future earnings without making losses in the short run. This study should have offered Divisional Managers an opening for exposing these conflicting norms in discussion with Corporate Management. Such opportunities were never recognized within Engineering Group. Instead, the project was consistently seen as

threatening.

From the University's point of view, although no new products have been designed this study has provided some "general conclusions on how things work in practice, and authentic case-study material". Indeed, there are in a sense three case studies here: one concerning the operation of three new product divisions, one about the management of innovation in a large industrial company and one on the conduct of an I.H.D. project. Information on the first of these is largely confined to the Appendices, and little of an analytical nature appears which directly addresses the differences and similarities between Dunlopipe, Energy Engineering and I.A.S. The case study of innovation management is the one developed in detail in what I have called the 'research' part of this thesis. The view of the whole project as a case study is, as suggested in Section 8.1, an unconventional one, and is the reason for writing this chapter.

On the issue of 'general principles', I return to the theme introduced in the discussion of methodology in the previous section. The one major advantage of making a relatively unstructured investigation of a problem area is that it frees one from the constraints imposed by traditional approaches. The resultant conjunction of previously unrelated ideas may then open up hitherto unexplored avenues for investigation. In this project two such avenues appeared which proved to be complementary. The first was the opportunity of comparing and contrasting the conclusions of contingency theory and those of Beer's model of effective organization. Secondly their striking compatibility made the two together a powerful means of analysing the problems of innovation management, the more so because the Beer model addressed issues of policy and structure, both of which the empirical work had indicated were important.

What these theoretical structures allowed one to do was to attempt to look behind the rather prescriptive statements in much of innovation literature and try to understand why certain approaches were being recommended. For example, the reason that venture groups may be successful seems to be that they ease the transition from being a development project to being an operational unit of the company. The same analysis warns, however, that a venture will not succeed if treated like an operating division from the beginning. Why it is tempting to make this mistake was explained in terms of variety, and this in turn led on to a consideration of how managements could recapture an understanding of the complexity of their new businesses that bureaucratic planning systems destroy.

In addition to these major themes, certain subsidiary problems also seemed to become clearer in the context of the analysis conducted here. To give one example, the apparent inconsistency between Burns and Stalker's view of committees as 'pathological' and Lawrence and Lorsch's advocacy of them was seen as a failure to distinguish between employing them to reinforce control and adopting them as part of the co-ordination activity.

One would obviously not claim that the solutions to all the complex problems of innovation management will be revealed by the use of these concepts. It is suggested, however, that on the evidence presented in this study, they provoke important questions and suggest interesting answers, which are worthy of further debate.

The real value of an I.H.D. project for the student lies not so much in the results obtained as in the process of obtaining them. In this sense, the work has been very satisfying. In particular, it has presented a number of opportunities which would not have arisen in any other way - an intensive look at some problems of manufacturing industry from various viewpoints; the chance to learn about new academic disciplines and to acquire new skills in researching, writing, teaching and in the process of conducting an action-research-type investigation itself.

When I began this project, however, I decided that my own personal criterion of whether it had been successful would be whether it had provoked any significant changes within the company. It will be clear by now that the answer to this question seems likely to be "no", despite the fact that the research element of the project has been satisfying. To try and gain some understanding of why this should be, I turned, in a casual way, to the literature on action research, from which two papers stand out as being particularly relevant. The first is by Cherns (4), who considers the definition of the relationship between a client and an outside investigator.

Cherns' view is that although the client will clearly have some idea of what his problem is, the investigator (or 'consultant' depending on the nature of the project) ought not to accept it at face value. This is an encouraging start, since it is precisely I.H.D.'s starting point as explained in Chapter 2.1. Thus the opening stage in the project ought to be one of consultation or negotiation on the nature of the problem.

The investigator should then have discretion to suggest the best solution in the light of his study and to recommend how it should be implemented. The client can, of course, constrain the investigator's role at any of these stages and take the decision himself, but if he does so, he radically alters the nature of the interaction. Cherns illustrates this with the diagram shown in Fig. 8.2.

To make these ideas more concrete, Cherns defines the kind of problem that is likely to be put to the investigator in each case:

Case 1 - Investigator as Technician

Problem (Task): Carry out an attitude survey.

Case 2 - Investigator as Engineer

Problem: Communication across a river.

Solution: Defined by client: Build a bridge.

Method: Left to investigator. (What type of bridge?).

Case 4 - Investigator as Consultant

Problem: Communication across a river

Solution and method: Left to investigator. (Bridge, tunnel, ferry?).

Case 8 - Investigator as Collaborator/Action Researcher

Problem - undefined, just a recognition that the problem exists, which may be described in terms of

- a problem: - high number of quality complaints
- a diagnosis: - poor inspection
- a solution: - better training for inspectors

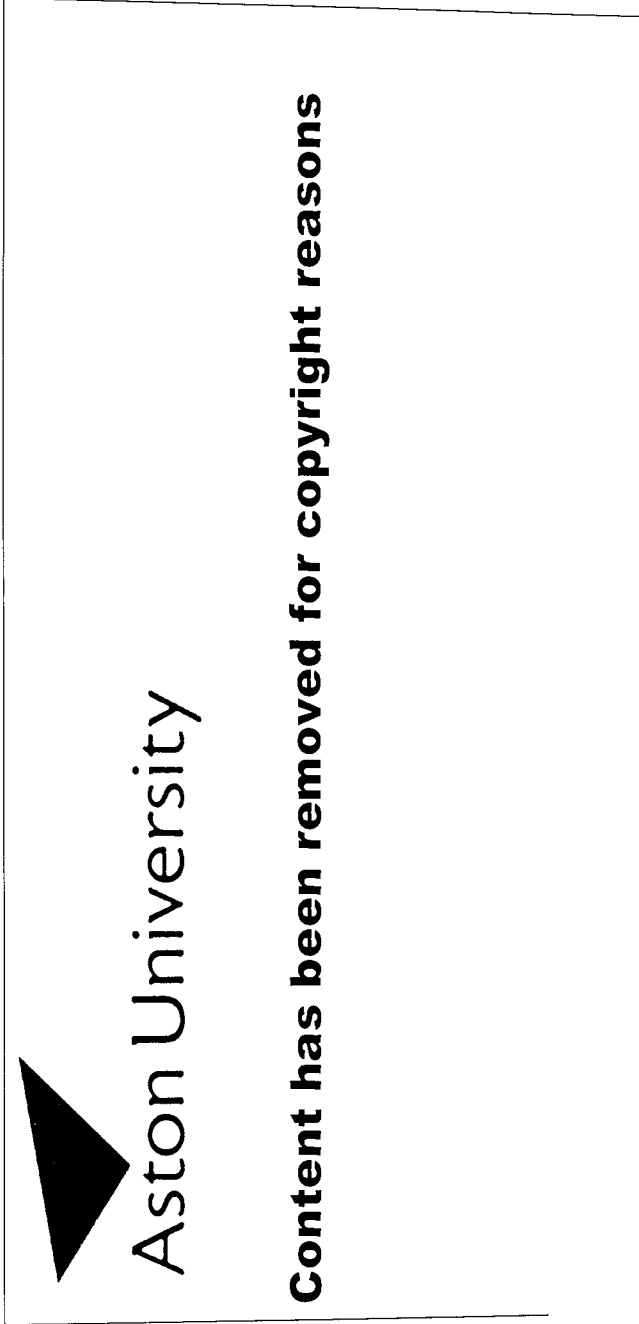
In this last case a good collaborative project will only result if the investigator satisfies himself that the problem stated is the one which really needs to be addressed.

What occurred in this project was that the relationship between investigator and client was never adequately defined. To use Argyris and Schoen's terminology, the espoused theory of all parties was that

FIG. 8.2

TAXONOMY OF BEHAVIOURAL SCIENCE ENGAGEMENTS

Type



Source: Cherns (4)

the project was to be of a collaborative/action research kind. The company's theory-in-use seems to have been that although the nature of the problem was negotiable, the type of solution was not open. This is represented by Cherns' cases 5 and 6, both of which result in a mismatch and a consequent need to negotiate.

Why should this renegotiation have consistently failed? Rapaport (5) identifies two possible reasons, both of which have some relevance here. On the client's side he observes that

"it is a familiar enough manipulation for a given sponsor to seek to use the action researcher in organizational politics, selecting what he likes and rejecting what he dislikes from the diagnostic stages of the work" (6).

On the other hand

if [the investigator] were too brusque or unskilled in pressing his own perception, he might jeopardize the exercise because of resistances that might be erected against the implication of a new perception of what the problem 'really' was" (7).

One of the frustrating but inevitable aspects of conducting projects of the I.H.D. type is that one is continually uncovering warnings of pitfalls after one has already fallen in and has been faced with the problem of how to crawl out again. Perhaps that is just what makes them such valuable learning exercises.

APPENDIX A

THE DUNLOPIPE PROJECT

THE DUNLOPIPE PROJECT

Introduction

Although the last six months has been a little aimless in part, in the sense that my project has twice changed, I have nevertheless had a unique opportunity to study Dunlopipe over this period. The object now is to review what has been learned, and to comment on the Dunlopipe project as it now stands. I shall consider the issues under four headings:

1. Background
2. The pipe
3. The market
4. The organization.

1. Background

Any new development project starts from one of two broad sources:

1. "Discovery push" where the product arises from a technical innovation and a market has to be found or created for it (e.g. pocket calculators).
2. "Need pull" where the process of innovation begins with the identification of a known need (e.g. most drugs).

It is clear, however, that if a firm is planning a programme of new product development, it cannot sensibly choose to adopt a deliberate policy of introducing new products of the first type. The outcome would simply be to spend the firm's resources on random development projects with an unknown probability of commercial success.

The alternative strategy is somehow to identify gaps in the market, and to devote the R&D effort to developing a product that will meet the need which is not currently being satisfied. This, of course, begs the question of how a firm should go about identifying such gaps, and also raises a number of separate pitfalls for a company which wishes to follow such a policy. The first of these is that consumers may not actually want the product which would fill the identified gap. The second is that it might be so small as to be unprofitable to exploit.

It is possible to relate some of these points to the Dunlopipe project by making the initial assumption that the decision to do development work in the pipeline field was the result of deliberate planning. What then is the market need that Dunlopipe is trying to exploit, and how profitable is it likely to be for the company if they succeed?

As Dunlop see it "Dunlopipe offers a unique combination of the mechanical strength of steel pipes with the corrosion resistance of plastic or fibre reinforced steel pipes." That there is a substantial market for corrosion resistant pipes is undoubted given the use of GRP and PVC pipes, and also the wide variety of coating materials employed with other types of pipe. Existing solutions are all somewhat unsatisfactory however. Field-applied coatings are unreliable, and GRP and PVC have question marks over their mechanical properties and their long term performance. GRP pipe is also very expensive. The answer appeared to Dunlop to be an integrally corrosion-protected pipe, based on a material with known and proved mechanical properties - steel. This is what Dunlopipe sets out to be. The final requirement would appear to be that it should be price-competitive. If it is agreed that there is a niche in the market for a product like Dunlopipe, what can be said of the size of the potential market? Dunlop figures note

that:

"The world market for pipelines has been estimated at \$6.67bn for 1976...It is expected to treble in size between 1976 and 1990 (at constant prices). The pipe itself represents 30-35% of this total pipeline system investment."

In other words, the market for pipe in 1976 was worth in excess of \$2bn. Furthermore, the market share that Dunlop would require in order to meet its financial targets was reckoned to be too small to be measurable.

Finally, in this section, one should return to the initial assumption that was made above - that the development of Dunlopipe was based on a definite policy decision to be in the pipe industry. Whether or not this is a correct assumption is unclear. On the other hand, "Pipeline Engineering" is a field which Dunlop have claimed to be interested in because the company predicted that over the long term pipelines would take over from other kinds of transport such as road and rail, for the movement of many goods. As a particular example, it was claimed that it would now be as cheap to pump coal (or perhaps coal dust) from Pittsburgh to Chicago as it is to send it by rail. Only subsidies to the railroads continue to give them the edge. On the other hand, it has also been suggested that the introduction of Dunlopipe into the company (it was bought from an outside research institute) was not in fact the result of the kind of policy decision discussed above, but was a chance discovery. Whilst occurrences of this kind appear to happen rather frequently in the field of a new product development, they do open up another series of issues from a "theoretical" point of view.

Any company which is at all outward-looking will inevitably stumble upon new ideas which it feels might be worth exploiting. When it does, however, it is likely to be faced with a number of decisions which are

potentially difficult to resolve. A company which does not rely entirely on 'serendipity' to produce its new product ideas, necessarily has some sort of R&D policy if it is interested in innovation. This will work partly along the lines suggested above. That is to say, it will be directed at meeting previously identified consumer needs. Clearly, though, no company can contemplate development work in all possible markets, so that the research effort will reflect the long term plans that the organization has for diversification. The problem that then arises when the company happens upon a promising idea, or perhaps generates such an idea itself in the course of other R&D work, is that it may not mesh neatly in with the existing development strategy. If the R&D budget is limited, the firm is faced with the choice either to let the unexpected opportunity pass by, or to divert resources away from existing development projects in order to work on the new find. In the extreme case, it might involve a complete reappraisal of the R&D strategy.

Again returning to relate this line of thought specifically to Dunlopipe, it is evidently necessary to know how the R&D strategy of Engineering Group is created, since only then can the impact that the discovery of the Dunlopipe idea had on the development policy be evaluated. If it is indeed the case that Engineering Group was planning to be 'in pipes' in any case, then the question is one of whether any research work was already being done, and to what extent it was displaced when Dunlopipe was discovered. If the decision to manufacture pipe was not taken until after Dunlopipe appeared, the issue is one of how the Group's R&D strategy was altered to accommodate it.

To sum up this section, the introduction of Dunlopipe into Engineering

Group raises some interesting issues of policy and strategy. At this stage one can only speculate about possible answers, because most of the work achieved to date has been more at the operating rather than the policy-making level. It will become apparent, however, that the general theme of this project concerns the optimum allocation of scarce resources, and the way that the company seeks to achieve this in the promotion of different development projects is certainly something which needs further consideration.

2. The Pipe

To some extent an artificial distinction is being made here in attempting to analyse the three components of the product, the market and the organization separately. The interconnections between them are such that any conclusion drawn under one heading is likely to have implications for the others. The three headings therefore indicate the main thrust of the argument, but the implications will be drawn out where necessary.

Dunlopipe the product is faced with a number of technical difficulties or challenges. The distinction is made between those problems which are holding back the commercial success of the product, and the opportunities which exist for making the pipe more attractive to customers or more profitable for the company. Each of these types falls in one of two further categories. These are the improvements that might be made to the pipe itself, and those which can be made in the method of manufacture.

Of the four categories suggested, the most worrying is weaknesses in the product which inhibit its success. The following come into this

category to a greater or lesser extent:

1. Endsealing
2. Joints
3. Fittings.

The problem of sealing the exposed steel layers once the pipe ends have been cut has now been substantially overcome. One or two minor points remain, such as the length of cure for the sealing compound. As regards joints and fittings, the situation appears to be a complex one. In some applications these do not pose any difficulty. In some they are something of a drawback, and in some they prevent Dunlopipe being considered at all.

The importance that technical problems of this kind pose in new product development is that those which pose the biggest threat to success must be faced and overcome first, and then the development team must work down the order of priority until the product is technically acceptable. In the examples given, the first priority was endsealing, since this was vital in all applications. It is also the first to which an acceptable solution has been found. The decision facing the Dunlopipe team now is what should be tackled next, and the answer is not clear cut. One can cite as many instances in which the absence of Dunlopipe's own joints and fittings is not a disadvantage as one can where it is. How, then, should priorities for development work be decided, and how are they in fact decided? The answer appears to lie in practice with the separate motives of the individuals involved.

The people who actually undertake the technical development work at Dunlopipe are particularly associated with the manufacturing or production side of the operation. A consequence of this orientation is that they tend to be most aware of the problems that occur in the

manufacture of the product as it now exists and they are always searching for ways to make the production process easier or the test results slightly better. Occasionally, as with the endsealing problem, they tackle a fundamental difficulty. The marketing department go out and talk to potential buyers of Dunlopipe and receive comments and criticisms of the pipe which they write up in visit reports.

Occasionally comments filter through such as "We have a problem with endsealing". It is the fact that this link between marketing and development is so weak that prevents a consensus being reached on development priorities.

An experiment was designed to test the effectiveness of this link, which is described in more detail in Section 4. It related to the comments made by prospective customers in the reps' visit reports. The salient points are as follows:

Of 161 comments received, criticisms or worries were expressed about: Joint - 40; Price - 16; Formal approval (NWC etc) - 15; Fittings - 10. Of these four principal concerns, three have been tackled at various times by Dunlopipe's technical department. No work appears to have been done on the development of fittings except in an abstract sense by the research institute. The certification issue had been tackled intermittently since August 1977 when it was stressed as number one priority. The development engineers were given an explicit target - to obtain Agreement Board approval by the end of that year. Whilst it might be thought that this episode is a counter argument to the point made above that there are no clear priorities, further examination shows that this is not the case. At the time that this target was set Dunlopipe had no test rig, no test ends for pressure testing and no samples of pipe available for test. Furthermore, delivery lead times

on the necessary equipment were up to two months. In other words, when a specific goal was set, it proved to be completely unrealistic, and was indeed recognised as such by the engineers at the time. Agreement Board approval has yet to be obtained, nearly two years later.

It does not seem that very much can be achieved in the short run to reduce the cost of Dunlopipe. The bulk of the cost lies in the materials themselves, particularly in the larger diameters. However, two instances serve to illustrate the way in which this question is being tackled. The first relates to the grade of steel. It appears that due to a clerical error, Dunlopipe was being made with grade 4 steel instead of grade 1 for a period of about 9 months. When this mistake was discovered, the natural reaction was to go back to the grade 1. It was pointed out, however, that the test results over the period when grade 4 was used were no different to those obtained with grade 1. It could also be demonstrated on theoretical grounds that grade 4 was adequate for the purpose, a conclusion corroborated by metallurgists both at Dunlop and at the steel company. A doubt which did exist over the aging properties of grade 4 was apparently settled by the metallurgists. The decision was nevertheless made to go back to the more expensive grade 1 steel.

The Dunlopipe engineers have also performed some research on the other main component of the pipe - the resin. They calculated that if a satisfactory method could be found of spraying the resin on to the steel, not only would substantial amounts of resin now wasted by the technique used be saved, but that the whole manufacturing operation could be completed in a third of the time (excluding curing). The drawback arose when the method they found to be the best proved also rather expensive. However, they were assured that since it would cost

little more than the existing system provided it was built into the manufacturing process from the beginning (rather than being introduced as a subsequent improvement) it would be used on the Mark II machinery. The engineers were to be consulted when this equipment was being planned. It now appears that they have not had discussions about any aspect of the new plant, despite the fact, mentioned above, that a substantial proportion of their effort is directed towards improving the production process.

Finally, one must consider the joint. Various attempts have been made in the past to design and manufacture a Dunlop joint. A spigot and socket type joint was made and rejected on the grounds that it was in the first place insufficiently strong, and in the second, that it was difficult to manufacture. Another idea that was tried was a wound steel sleeve, although this never came to be coated with resin, so it has not been tested. A wound fibreglass sleeve leaked when pressurised, and an idea for a high pressure joint tested by an outside firm of consultants suffered from the same fault. The current situation is that the research institute has designed a joint of which little else is known, and that the engineers at Dunlopipe are testing a new form of sleeve coupling which, it is hoped, will overcome the problems that have been encountered previously.

The history of the development work that has been done on a Dunlop joint raises two points. The first is that there seems to have been no consistent programme which set out to produce a coupling of a particular type (eg one for low pressures, or one for high pressures). There have been episodic bursts of activity of which the shortest (the wound steel idea) lasted only a couple of days. Secondly, there seems to have been no systematic attempt to analyse the reasons for the

failures that were encountered, so that not all was learned that might have been learned. This is less true in the case of the work that was undertaken in-house, as is illustrated by the efforts now being made to stop the sleeve coupling splitting. It is nevertheless the case that the engineers do not appear to know the details about the high-pressure joint. It is also likely (although not certain) that they are unaware that included in the study of this joint are twenty or more ideas for joints which could be evaluated within Dunlop.

3. The Market

Before discussing the approach that Dunlopipe is adopting towards its market, it is worth looking in a more general way at the question which must be of greatest concern at the moment. What are the implications of the current state of orders? Although Dunlopipe was launched in May 1978, only one order has been obtained to date.

Studies which have been done on the rate of diffusion of innovations suggest that they filter through the market only very slowly. For example, it took hybrid corn seed, with clearly demonstrable yield advantages, 14 years to become generally acceptable to farmers in the United States. The segment of the market defined as 'innovators' was as little as 2%. Quoting this study, one writer cautions:

"Do not try to apply these figures to your market because the chances are that the percentages will be quite different. But what can be learned from the figures is that the number of innovators in your market probably will be distressingly small. Studies have shown that they usually amount to under 5% of the market".

One of the lessons which Dunlopipe's marketing department seem to have learnt fairly early on is that pipe specifiers are amongst the most conservative of buyers. This is particularly true for two reasons. One

is that many of them, e.g. in the water and sewage industry in this country, are responsible for spending public money. They are therefore reluctant to take the risk of employing an unproved product. Secondly, when GRP pipe was introduced, a number of users were persuaded to take the pipe, only to discover afterwards that there were some unforeseen technical problems with it. This has made the industry especially wary of new technology.

Despite the general comments on the diffusion of new products, and those which relate specifically to the pipe industry, the fact remains that one would expect there to be an innovative group in the market. It appears that this must be below 5% of the total, but then it will be recalled that Dunlopipe needs to capture an immeasurably small proportion of the market in order to be rated successful.

The logical next step is to consider ways in which the company might set about identifying this innovative group. Before this, however, it is useful to look briefly at the marketing effort from the 'other side of the table'. In other words, what are buyers looking for in pipe?

"The professional objectives of purchasing are buying the right quality, in the right quantity, at the right price, from the right source, at the right time". Furthermore, it is important to consider what a pipeline is actually for. It is for the transport of fluids from A to B. It is a transport system, just as is the railway with which it was shown above to be in competition. It is now possible to compare Dunlopipe's performance against these purchasers' ideals. The first is "the right quality". There would be little argument that the pipe itself, as it comes in 6m plain ended lengths, is technically a first class product. The question mark over quality arises when one considers the complete system. Quite simply, there is no unique

Dunlopipe system. What is offered is a high-quality pipe with proprietary joints and fittings of a different design. The answer to the question as to how much of a drawback this is was suggested above. In some applications it is a definite disadvantage, in some, it is not. The issue extends beyond the point of whether these joints and fittings are in fact adequate to the purpose. One must also consider the 'image' that Dunlopipe has in the market. This point has been recognized on a number of occasions. For example, the original market development plan for Dunlopipe (prepared by outside consultants) noted that:

"The area of most concern is, without doubt, associated with joints and site jointing methods. This is where 90% of failures occur in the field and where previous new pipe systems (e.g. GRP, PVC) have not performed well in practice with the result that their rate of market penetration has been considerably reduced. It is clear that some pipe manufacturers have, in the past, tried to introduce new products on a wide scale before their jointing problems have been properly resolved. Although they might have achieved some quite spectacular initial sales, the 'image' of the product has been severely tarnished because of site application/performance problems, and future sales growth has, therefore, been limited. To ensure that problems like this do not occur with Dunlop Pipe and to be in a position to give specifiers/buyers maximum confidence in it, a substantial programme of development work, testing and trials is needed between now and the main product launch".

Also

"It is important to note the following:

- ensure a very firm and confident technical base (especially regarding joints) before launching into any of the expensive marketing action points".

In a letter received from Engineering Group management as early as May 1976, it was observed that:

"substantial losses of water are arising from leaking connecting glands on the major water pipelines... Although designed for a twenty-year life it would appear that ten years is the more normal achievement... Clearly, the development of more efficient jointing systems could well increase our technological strength in this market".

What can be concluded from these examples is that not only could Dunlopipe have capitalized on worries that already existed in the industry had a good joint been developed but more importantly, it was pointed out that the company could be running a significant risk by going to the market without well developed ideas on its own joint. Further examples could be quoted illustrating the importance that consultants and specifiers have attached to this issue.

Moving on through the list of buyers criteria, one comes next to "the right price". On this the conclusion is fairly clear-cut. For most applications, Dunlopipe is too expensive. The main offsetting advantage that the Dunlopipe has against its high ex-works cost is that it is light and easy to handle on site. To quote the market development plan again:

"It may well be that its basic price (£ per metre) could be more than the competitive products, but that total installed cost to the end user could be lower. This is feasible especially if an effective pipe jointing technique is developed which reduces time/labour input compared with conventional practices such as welding and subsequent corrosion protection".

Once again, the importance of the joint to this analysis comes to light.

The final criterion it is worth mentioning is "the right time". In other words, in many circumstances, the delivery times that a supplier is able to offer may be the deciding factor in the placing of a contract. It does seem that Dunlopipe suffers something of a handicap in this respect. Provided that a customer requires a relatively small (by the standards of this market) quantity of pipe, and wants it in diameters for which Dunlopipe have the mandrels available, the company should have little difficulty in meeting delivery targets. Where the obstacles are to be found are where the client wants large amounts of pipe and/or needs diameters that have not been produced before. New pipe

sizes require new mandrels which have perhaps a two or three month delivery period before work can start. Even efficient use of the existing production machinery for long runs of an existing size means employing more than one, and possibly three or four mandrels. In other words, the potential market is restricted to customers who want fairly small orders, and for whom rapid delivery is not of the essence.

The reason for this excursion into the buyers' side of the bargain was as a necessary precursor to the main question posed above - How should one attempt to identify the innovative segment of the market? What the discussion has shown is that in the current circumstances one is looking for innovators in a much more closely prescribed market than at first appears. In order to fit in with the existing state of the product, the following must hold:

1. The customer must want, and be willing to pay a premium for, high-quality, corrosion resistant pipe.
2. The application must be one in which the pressures encountered are within the range of the proprietary joints used.
3. The application must not require anchored joints.
4. The quantities required must be small enough to be within Dunlopipe's production capacity, or a fairly long delivery time must be acceptable.
5. The customer must be willing to accept a non-integral system (i.e. joints and fittings of different construction to the pipe).
6. The customer must not require independent certification of the product.
7. The customer must be sufficiently innovative to be willing to take the risk of trying a relatively unknown product.

What emerges from this list is that the most likely candidates on technical grounds, for example straight runs of water or sewer pipe, are frequently those in which users are unwilling to pay for premium pipe. Conversely, those where price and independent evaluation are

less important (e.g. industrial pipework) are often those which are ruled out technically because, for instance, of the need for high-pressure or anchored joints.

4. The Organization

There are two aspects of 'the organization' which can be looked at with regard to Dunlopipe. One concerns the position that it occupies as an operating division within Engineering Group. The other relates to the internal organization of the project. Their common link is the flow of information and resources.

The way in which a company treats a product at either end of its life cycle is fairly clear cut. In the research, the company commits resources to it with no expectation of a return in the short run. Similarly, an established operation will not long be sustained if it is no longer profitable. The firm has a rather more difficult decision to face, however, in trying to decide how to deal with a fairly newly-launched product. Obviously it will seek some measure of the performance of its new venture. What is less clear is what this performance measure should be.

To explore this issue further, it is worth considering two points. One is why the new product was launched when it was. The other is why management needs to assess the achievement of its various business lines. To the first of these questions there seem to be two possible answers. If development work has been successful, and the product is technically acceptable, and if the initial market studies have shown that there is a position for it, the product is launched with the expectation that it will produce a profit for the company. Alternatively, the firm may be unhappy either with some aspect of the

design, or it may be uncertain as to how the new product will be received in the market. In these circumstances, the product may undergo a kind of 'test marketing' from which the company may not necessarily expect a return. This is because marketing trials of this kind are still regarded as part of the development phase.

In both these cases, all is well if the firm's expectations are realised. When, in the first case, the product takes off, it will be expected to produce a financial return in line with that achieved in the rest of the organization. In the second case, if the product is not well received, the project can be developed further, or abandoned, or sold. The more interesting case arises, however, when the outcome is not as expected. If in the 'test marketing' case the firm's original fears prove groundless and the product is a good one there is no problem. If, on the other hand, a confidently launched product produces disappointing results, then the danger exists that the attitude of the firm's management to that product may compound its difficulties. The reason for this lies precisely in the performance criteria that were mentioned above.

Before pursuing this point, one must consider the second question that was raised previously. No company has unlimited resources. Therefore senior management is continually confronted with the problem of the allocation of scarce resources between competing uses. The more diverse is the company, the more difficult is the problem, particularly when the object of the firm is to maximize profit. If the competing claims could all be expressed in terms of some common denominator the difficulty of ranking those claims would be considerably less.

Although it has been approached in a rather roundabout way, this is obviously suggesting the use of financial performance figures as a way

of deciding which projects receive which amounts of funding over the next period. Broadly speaking, the most profitable lines have the best claim, although there are always individual circumstances to consider. Also, total adherence to a policy of considering past performance is impossible. The firm is concerned mainly with what is likely to happen in the future. Nevertheless, it is true to say that profitability or perhaps profit performance relative to target is the most widely used of the measures of performance that management needs.

It was observed above that profitability is not acceptable as a criterion in an R&D context. Here it is the expectation of a return which is the significant factor, and this has to be judged in other, often complex and uncertain, ways. What though of the hypothetical disappointing product which was considered earlier? For the reasons stated, there is a different form of management control over development projects than exists over commercial ventures. The moment of a confident new product launch has been planned as the moment when a project is removed from its development phase and takes its place as one of the company's operating units. It is at this moment also, therefore, that the project might reasonably be expected to conform to the financial-return-based measures of performance which apply to all other divisions. For example, the new division will be expecting to produce, and senior management to receive, the same operating statements on which other units are judged.

If, however, the product was not the success it was hoped, then insistence on these procedures simply because it is an operating division in name will put pressure on the divisional management to attempt to achieve that which simply cannot be achieved. The division's financial targets will not be met, imposing the additional

risk that it will be kept short of funds. The likely outcome is a vicious circle which may cause the divisional management to take decisions which are aimed at keeping the project alive in the short term but which are not in fact the decisions which would have been made had the long term interest not been obscured by the imposition of inappropriate criteria. What may be necessary in these circumstances is the recognition that the project may have to be kept afloat as if it were once again in its development phase whilst its prospects are reassessed and the reasons for its lack of success analysed. What is most important is that the decision to take this step should be agreed between the project leaders and senior management so that the priorities for the new division can be reappraised without its manager having the pressures of trying to meet impossible targets. Exactly how this theoretical appraisal fits in with Dunlopipe is impossible to say at this stage. The opportunity has not yet arisen to study the way in which the company sets targets for its development projects on the one hand and its operating divisions on the other. Suffice it to say that in the light of the evidence presented in Section 3, Dunlopipe ought not at the moment to be treated as though it were a viable operating division. An alternative suggested strategy is outlined in the concluding section below.

So far only one of the organizational aspects of Dunlopipe has been looked at. The second one to be considered is that internal to the project. It is here that two points that were raised earlier will emerge again. These are the question of the flow of information and the customers' comments experiment mentioned briefly in Section 2.

It will be remembered that the first part of this experiment involved the analysis of marketing department visit reports, from which a total

of 161 comments made by prospective customers about Dunlopipe were listed. The next stage was to involve asking members of the marketing department themselves what they thought their customers' comments were. Finally, marketing were to be asked what technical difficulties they would most like to see overcome and to find out from the technical department what their development priorities were. The objective was to discover the extent to which these various opinions agreed one with another. Unfortunately the experiment is not complete, so that no conclusions can be drawn. However, it is interesting to note some further anecdotal evidence which suggests why the test was thought to be worth performing at all.

A short time ago, it was suggested that Dunlopipe should have a new Development Manager. This idea was not popular in the development department until it was put to the engineers that part of such a manager's role might be to determine the priorities for development work. It became clear that they did not feel that this was being adequately done in the existing organization. For example, would it be better (1) to make as much improvement as possible in the existing manufacturing process, (2) to seek ways of seeking alternative cheaper or more effective ways of manufacturing Dunlopipe (e.g. resin spraying) or (3) conducting more fundamental development work, such as designing and making joints or fittings. Each of these is looked at occasionally. As to which would be of most benefit from a marketing point of view they did not know, nor did they see it as any part of their job to find out.

Apart from not knowing what was wanted, the engineers also had little guidance on the kind of timescale that they should be working to, nor to what level of budget. In other words, instead of working to a brief

("We need to evaluate resin spraying. You have one month and £500 to work with") they find themselves pursuing their own interests for much of the time using materials that they have been able to obtain as free samples from suppliers. Even then, a shortage of labour in the department frequently means that they cannot get the labour they need to manufacture test pipes.

If one had to sum up this situation in a sentence, it would be that the development engineers feel that no-one else understands their problems. It ought equally to be said, however, that they themselves show little inclination to learn about the difficulties faced by other members of the Dunlopipe team. The general impression is one of insularity, which apart from implying that the members of the project are not necessarily all pulling in the same direction, also engenders a condition of low morale. Further evidence of this is offered by the fact that of the five development engineers at Dunlopipe in October, at least four have considered leaving and two have actually gone. Of these, one acted largely as a purchase clerk, the other, quite bluntly, had no job at all. Both were graduate engineers.

It is evident, then, that the object of the experiment was to try and establish, on some crude basis, how well information - both facts and opinions - was transmitted between departments and individuals. In conclusion, it is worth observing that whilst the analysis of the visit reports was in progress, two senior members of Dunlopipe, from different departments, both gave the impression that this was not information that should be available except to those 'upstairs'. One wonders if this is not perhaps as significant as the results themselves might prove to be.

Conclusions

All the conclusions to be offered here are based on the main theme that underlies the whole of the analysis - the importance of the flow of information. One can draw out these conclusions by looking at the nature of the necessary information and the groups of individuals between whom it must pass.

It is logical to begin where Section 1 began, which is with new product strategy. If it is to have a coherent new products policy, the firm needs to have many channels open by which it may receive new product ideas. These may come from research institutes, as did Dunloppe, or they may be thought of by individuals in the company or they may be offered, for example under licence, by another company. The next important step is to have some method of evaluating these ideas when they arrive. This involves not simply knowing about some aspects of the idea but more significantly, 'knowing what you need to know'. In other words, can one develop a standard set of criteria against which all new ideas, from whatever their source, can be rated? Having made the decision to investigate an idea further, it becomes adopted into the firm's portfolio of research projects. At this stage, the company is faced at various times with three difficult decisions:

1. What priority to give the idea (in terms of resource allocation) as compared with other projects in the portfolio.
2. How to decide if and when to terminate the development work.
3. How to decide when the new product is ready for launch.

What should be noted is that these internal evaluation procedures involve transfers of information within the company. The search for likely new products, and the decision about whether and when to launch

concern an exchange of information between the company and its external environment. The problem of dealing with this information thus becomes increasingly complex.

Obviously, the bulk of the development work that is done on a new idea is carried out before it is launched. During this stage, the main stimulus towards improving the product is frequently the discussion that the researchers have between themselves. It is also true, however, that the work of improvement does not stop after the product has been launched on to the market. The difference is that after launch, there is a new input into the process - the reactions of customers. Again, the division is faced with having to handle flows of information both within the organization and between the organization and its environment.

So far, these conclusions have been rather abstract. The final part of this study will therefore concentrate on their implications for Dunlopipe. It will also be possible to make some specific recommendations. These all hinge on the transition from a development project to an operating division. It is obvious from the diffusion idea that a new product is not likely to meet with instant success. This is, of course, well known, and the financial targets set for a new operating division will have taken it into account. There must come a time, however, when the question must be put as to whether the unattainability of these targets is due to the diffusion problem, or to more basic difficulties with the product. It is suggested that Dunlopipe should be subjected to this kind of questioning. The evidence of Section 3 makes a prima facie case for believing that there are in fact a series of problems which limit Dunlopipe's market acceptability. If this case is proven, what action should be taken?

The approach that has been suggested is that Dunlop should remove the expectation that Dunlopipe will meet its targets. It should treat Dunlopipe as if it were a development project. This may be difficult, especially if this expectation has been built into the management structure at all levels. What is even more difficult, indeed impossible, is to return the internal structure of the division to that which existed before the launch.

There are two main reasons why this cannot and should not be done. The first is that it would be a waste of valuable resources. In the development phase, one would not expect there to be a marketing department. It does not follow, however, that the marketing department has no role in the 're-development' stage. There are three reasons. One is whilst it is smaller than was hoped, there is still an element in the market who are prepared to use Dunlopipe. It would be the role of marketing to exploit this. Second, if the redevelopment were successful, it would be damaging to have lost the pre-existing expertise. Third, and most important, the marketing department is that which has direct contact with the customer. It is therefore the means by which valuable information can be passed on to those directly involved in the development work.

The second reason why one could not return to a 'development department' structure is that it is different in kind. The exchange of information in an operating division is likely to take place along much more structured lines than in a development department. Written communication, formally constituted meetings and the 'proper channels' are less necessary in a development team in which most of the information flows are internal and the group is small enough to know what is happening elsewhere by means of informal contacts.

Since the idea of 'structured' communications is likely to have become built-in once an operating division has been established for any length of time, it will probably be necessary to maintain it.

If the idea of 'redevelopment' is considered, it will be important to recognize that everyone involved with the Dunlopipe project will have a specific part to play. More important, however, is that each must know not only what his own role is, but also he must appreciate the position of his colleagues.

Having had the operating constraints removed, project management must reappraise the priorities of the project as a whole. This is likely to be a diversion of attention away from selling pipe, to the consideration of the needs of a complete system. Marketing will be concerned with a detailed analysis of the strengths and weaknesses of Dunlopipe which will serve two purposes. One will be to help formulate the development strategy. The other will be to identify the particular markets that can continue to be exploited in the present state of knowledge. Obviously this sphere of work will expand as the technical constraints are lifted. The technical department will be involved in the implementation of the policy decided upon. It would be valuable if the engineers' own ideas were received in the formulation of this redevelopment policy. In any case, they should be given clear targets which they themselves should help to set. They cannot be expected to perform well if they believe that what they are being asked to achieve is unreasonable. Finally, senior management will have the role that it would adopt in any development regime. That is to say, it must continually re-evaluate the progress of the project in order to remain convinced that it is worth continuing. The kind of criteria to be employed here may be the cost in time and money of opening up the

various markets, compared with the prospect of return when this is achieved. This would also be a useful guideline on which to base the redevelopment priorities.

Apart from the lifting of over-optimistic expectations, the biggest single improvement that could be made in the operation of Dunlopipe would be the creation of formal consultation procedures between those involved at Dunlopipe at all levels. If this could be achieved and adhered to, it would go far to break down the 'insularity' that was referred to in Section 4. This would increase the feeling of involvement, and would have the result that individuals would not be forced to go their own way because of lack of guidance.

What is being suggested is not especially radical. Dunlop itself has recently gone through the re-launch of one of its own new developments - Denovo. What is really required is the removal of some of the attitudes and expectations which have become built into the system over the period of Dunlopipe's development.

M.J.C.

May 1979

APPENDIX B

SOME CONCLUSIONS ON DUNLOPIPE

SOME CONCLUSIONS ON DUNLOPIPE

The last 7 months spent studying Dunlopipe suggests that the problem of new product development falls into two broad categories:

1. 'Strategic' -
 - a) how does a firm decide what markets to be in?
 - b) how does it seek and select new products?
 - c) what consequence follows if it discovers and develops a product which falls outside the field identified in a) ?

2. 'Operational' -
 - a) how should the development team be organized?
 - b) when and how should the new product be launched?
 - c) what level of performance should the firm expect from a new product?
 - d) who should set these performance criteria?
 - e) how should performance be measured?

The 'strategic' points are those which suggest themselves as topics which it would be useful to study in the future. It is on the 'operational' side that one can draw positive conclusions, which are based on the following observations:

1. The product launch took place 6-7 months before the production machinery was commissioned.
2. There is no Dunlop joint and no Dunlop fittings.
3. There is no proprietary joint suitable for high pressure.

4. There is no suitable proprietary anchored joint.
5. The limited number of mandrels implies a low production capacity or long delivery times or both.
6. No independent certification (eg Agreement or NWC) has been obtained.
7. There are no clear development priorities and no identifiable development budget.
8. There is no attempt to relate customers' comments (obtained through the marketing department) to the development work actually undertaken.
9. At least four of the five development engineers at Dunlopipe in October have actively been seeking other jobs. Two have already left.
10. Morale is low at all levels.

The conclusions and recommendations are as follows:-

1. Dunlop as a company seems to be very anxious to launch new products at the earliest opportunity. The earliest opportunity may, however, be too early for the health of the product, as appears to have been the case with Denovo. Both Dunlopipe and Kestrel Seating launches have been regarded (in retrospect) as premature in the eyes of some of those responsible for their marketing.
2. This apparent emphasis on obtaining a commercial return may cause the product to suffer in two ways:-
 - a) Its 'image' in the market will suffer if it is not yet technically acceptable.
 - b) Needed technical development will not be efficiently accomplished because management is preoccupied with meeting the financial targets.
3. Dunlopipe has suffered in both these respects with the following results:-
 - a) The potential market size is much smaller than was originally anticipated because of the technical limitations, and this renders the achievement of original targets impossible.
 - b) The attempt to do what cannot be done is at the cost of neglecting development work.
4. Dunlopipe would benefit from a period of 'redevelopment'

during which time the project would be judged

a) on its success in exploiting that market which does exist

b) on its success in overcoming the technical problems

and the decision whether to continue to sustain it financially should be made on these grounds jointly.

5. The marketing and development priorities during this period should be agreed upon and understood at all levels, as should the extent of the budget and the period over which positive results are expected. These objectives and constraints should be jointly arrived at by all those who will be responsible for meeting them, so that all will agree that they are reasonable.
6. It may be necessary to establish some structured coordinating mechanism (e.g. periodic meetings between departments) so that all the information available in the group is accessible to all involved.
7. "Successful innovators perform the development work more efficiently (but not necessarily more quickly) than failures."

M.J.C.

21 May 1979

APPENDIX C

ENERGY ENGINEERING DIVISION

ENERGY ENGINEERING DIVISION

My four months at Energy Engineering Division (EED) were completely different to my time at Dunlopipe. I had come to the decision that the only satisfactory way of becoming involved in the running of a division was to become a temporary full-time employee. Indeed, the Manager of the division, Mr. John Spencer, made it clear that he would have it no other way. He was very willing to cooperate in my studies provided that I would work for him full time, for a specific period to do a specific job.

We eventually agreed that I would start work there in June and stay until the end of September (he originally suggested the end of the year). He had it in mind to start a service organization for EED's products and he wanted me to set the wheels in motion. This would involve planning the paperwork, considering spares stocks and scheduling commissioning and servicing work for two service engineers. In return, I would be involved in the divisional review and planning meetings and would be able to ask the people in EED whatever I wanted to know.

Being somewhat more advanced in its product and market development, EED does have a more formal structure than does Dunlopipe. I shall describe this first to present a picture of the organization. I shall then go on to give an account of what happened in the division while I was there, attempting to highlight some of the interesting points that arose.

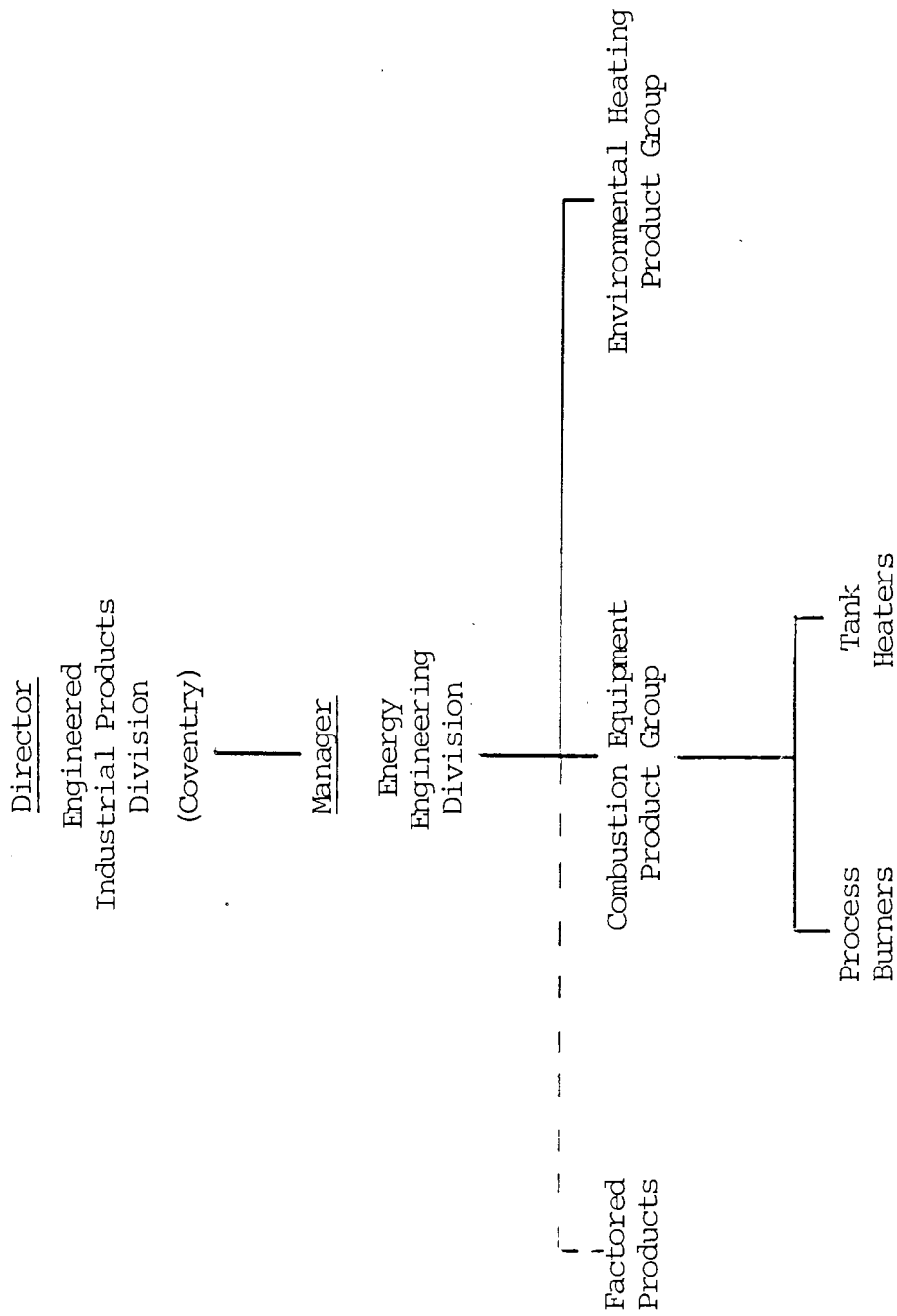


FIG. 1

ENERGY ENGINEERING DIVISION - ORGANIZATION STRUCTURE

Energy Engineering Division is itself divided into two 'product groups'. Of these, the Combustion Equipment product group is further subdivided into Process Burners and Tank Heaters. This is illustrated by the diagram of its management structure (Fig.1). A third 'product group' has one manager dealing with factored products (mainly air conditioners) not manufactured at Rugby.

For each of the two main product groups there was a regular 'Review Meeting'. There was a review meeting every Friday with each product group taking its turn once a fortnight, under Mr. Spencer's chairmanship. Also present were the relevant product managers, the manufacturing manager, the buyer, the accountant and myself. In the early stages I was really there as an observer. Later, when the service organization was active, I would report back on any problems we had encountered. Minutes were kept of all these meetings. They make an interesting and useful catalogue of the workings of the division.

When I first arrived the whole division was in something of an upheaval. On my first visit, two weeks or so before I joined the division, everyone was involved in stocktaking. Subsequently, many members of the division found themselves undertaking individual projects. Things were further complicated by the absence of the manufacturing manager on a lengthy course.

It was against such a background that I came to work at Rugby. Mr. Spencer, the divisional manager, was overseeing the manufacturing operation himself. The technical manager, Mr. Kirk, was designated 'troubleshooter'. He put up a list of half a dozen technical problems with EED installations on his notice board and spent the next months trying to settle them (with success). The buyer and the stock controller together with the accountant and some clerical help from

Coventry were trying to create a formal stock control system in the aftermath of the stocktake. Finally, two of the product managers were engaged in writing instruction manuals for their equipment.

When Mr. Rand, the manufacturing manager, came back from his course he found that he, too, had his project. While Mr. Spencer continued to hold the reins of production, Mr. Rand dealt with technical queries from customers and quotations for air conditioning equipment. He also sat in on the new 'Design Action Team'. This was all in addition to his main brief to consider new tooling for burner production.

Although these various projects were set up with the aim of 'improving the efficiency of the business', there were still complaints. In particular there were worries that master files containing all the details of a particular job were being mislaid. Also, with many people spending part of their time away from the office, messages were not getting through and enquiries and letters were sometimes left unanswered.

Partly with this in mind it was generally agreed that a new discipline needed to be introduced in office systems. In order to discuss how this could best be achieved, Mr. Spencer set up a group to take an overall view of the communication and control systems within the division. This was to be chaired by the accountant, Mr. Brian Allen. In the memo which contained the terms of reference of this group, Mr. Spencer added a characteristic comment:

"Needless to say this is an additional short-term activity and should not be allowed to slow down the progress of other projects or our normal day-to-day working."

Looking back it is difficult not to lose sight of the fact that orders were being received, made and despatched. The business still had to be

run despite all these additional projects.

The Communications Review Meetings were relatively short-lived. At the first meeting there was much discussion of the two main issues - the master files and communication with customers. Later it was agreed that master files would not be moved from a newly-created Administration Office. The minutes record that "a strict system for answering letters should be implemented". A progress chart was to be drawn up so that everyone could see at a glance what stage any order had reached, and finally a telex machine was to be ordered.

The last remaining problem was to ensure that what was actually sent out to the customer was what he had ordered. A number of journeys had to be made to replace wrong or faulty parts. However, it was generally believed that when the stock control system was working a complete parts list could be made up for each job which could then be checked on despatch. By now, however, the momentum behind the Communications Review movement had exhausted itself and the meetings petered out. They had aired difficulties, but apart from joining the queue for the installation of a telex line, one could point to little in the way of concrete achievement.

Turning away from these special tasks to the day-to-day business, the early summer was a slack time for Environmental Heating. Most of the discussion in this field was directed to two points. One was the likely sales of the various environmental heating products in the early months of the heating season. The other concerned the stock levels of unit heaters.

The first of these issues highlighted a number of problems in the relationship between sales and production. For the relatively new

Overhead Radiant Tube, it looked as though more orders were being taken than forecast. There was considerable discussion about whether enough components would be available, especially valves and wiring harnesses. Nor was it certain that there was sufficient production capacity in the factory. The problem was compounded both by the industrial action taken by the AUEW (unpopular though this was at Rugby) and by the absence of a welder through injury. Indeed, this injury was itself caused by having to lift the completed radiant tubes onto lorries for despatch. This was a job that everyone tried to avoid, especially as quantities began to increase.

The question of the appropriate stock levels was another which raised interesting issues. Mr. Langford, the Product Group Manager, was pressing for quite large stocks of unit heaters. His argument was that there was little to choose between Dunlop and its competitors on price. However customers often left ordering their heaters until the last moment, so that they would buy from whoever could deliver quickly. Messrs. Spencer and Allen were attempting to reduce the amount of money that was tied up in stocks everywhere in the business. Unit heaters had to accept their share of the reduction. There were thus two opposing forces - what was good from the marketing point of view and what was financially desirable. This was an example where a difference of view about what was good commercial policy was settled by what was evidently a process of negotiation. It was friendly but forceful on both sides.

On the combustion equipment side, sales were not going as well as had been hoped for and some customers were unhappy about their tank heater installations. Nevertheless, the business was evolving with the development of new markets (especially overseas) and new products.

No formal product development programme existed at EED. Partly this was for economic reasons, partly it was because the emphasis was on consolidating the existing business. On the other hand, the 'design team' (which seemed to include anyone with relevant expertise whatever their job title) was always ready to try and meet the needs of an individual customer or to find a way to improve existing products. For example, a forced draught burner would have been a logical extension to the range of combustion equipment. One was eventually designed and manufactured quite quickly. A particular customer was so keen to have one that he installed the prototype in his factory and immediately ordered others.

Although it might seem ideal to do development work only in response to customer demand (where the market is guaranteed) it does have another side. In these circumstances the work often has to be done quickly. If the product does then fail in some respect, it does so in the customer's works rather than on the test bench. Problems of this sort did happen for example with the T-72 tank heater. My first job in the service organization was to accompany a service technician to a factory where several tank heaters had to be commissioned. The whole of the first day was spent modifying the equipment because a previous installation had shown it to be unsatisfactory.

Another source of service problems was mistakes in manufacture and despatch. Sometimes parts were missing so that a job could not be commissioned. On one occasion the customer had the wrong gas train and on another, all the valves leaked. In the most serious case, the use of the wrong type of nut and welding rod led to serious corrosion problems within days of a heat exchanger having been installed.

When faults like this did occur, it was often difficult to obtain

accurate details of the equipment that had been supplied. Wiring diagrams might be missing or fail to correspond with what had actually been done. Even where the original specification was in the master file it was not necessarily an accurate guide to the equipment that was sent. Substitutions were possible on many components and there was a constant problem of keeping track of revisions to drawings.

Despite these difficulties much went right, and there was a general feeling that the division knew its business. The successful sequence of obtaining, manufacturing, despatching and commissioning an order went largely unremarked. It was also assumed that everyone was competent at his job and people were not looking over one another's shoulders. The attitude that was taken to my role in the organization showed this well. Although I could ask for any help I needed, it was assumed from the beginning that I would pull my weight.

In this atmosphere, people were generally unafraid to admit mistakes. Reasons were sought for them, but not culprits, and one of the factors pointed to most often was poor communication. The examples quoted above show that this was where much of the blame lay, but if EED correctly identified the lack of relevant information as a source of their troubles, what they were actually doing from day to day illustrated an opposite point.

To demonstrate this, I shall return to the Communications Review meetings. The object of these meetings was to try and ensure that the right information was available when it was needed. The desire for control of the master file system was to prevent individuals from 'hoarding' information. The teleprinter was needed to avoid mistakes in the transmission of telex messages via Coventry. The progress chart was to keep everyone up to date with where each job was in the system.

What the meetings mainly achieved was a discussion of the points of concern. The new master file system was never rigidly applied. The progress chart was quickly forgotten. The effort of generating this extra information was greater than its value to the business. In the same way, when the usefulness of talking about the problems seemed less than the importance of the job immediately at hand (which happened after about four weeks) the meetings simply died out of their own accord.

A similar fate befell the stock control system. There were occasions on which the need to go to the stores and take out an urgently needed component was greater than the need to keep track of where the parts went. One case in which this was immediately recognized was that of fasteners. No attempt was made to control their issue. The benefits of knowing when and to whom they had been issued were far less than the cost in terms of time and trouble of obtaining that information.

Sometimes, perhaps, they might run short of a particular nut or bolt, but this was still not enough to tip the balance.

Taken as a whole there is no doubt that EED is 'communication-minded' and that this reflects Mr. Spencer's general management approach. On the day of my first visit, Mr. Spencer interrupted our conversation because he had arranged to speak collectively to the men on the shop floor. I went with him and listened while he told them of the division's (and hence their) success in meeting all the delivery dates that had been promised in that month - the first time they had done it.

In the following four months he held another two of these sessions. One was a review of the division's financial performance over the previous half-year and a projection of how the final end-of-year

results would look. The second was a presentation on the future of EED over the next few years. He had made the same presentation to the company chairman. This was a considerable contrast with the attitudes at Dunloppe and in the same way, its effects were felt throughout the organization.

For this reason I could not help but be surprised by the formal planning and forecasting process (a company-wide requirement for all divisions). This was certainly not the result of an objective appraisal by the EED personnel of how sales, costs and profits would develop over the next five years. Rather, estimates were drawn up and then negotiated through the various levels of management so that the right sort of picture emerged at the end. It seemed to me that a lot of effort was being put into preparing figures that the planners would know were optimistic and would themselves revise downwards again.

Throughout this description of events at EED there appears to be a common thread. It is the element which I commented was missing from my original observations about Dunloppe. Mistakes were made, fasteners ran out, meetings were abandoned. It is not that no-one knew how to avoid these things, it is that everyone accepted them as the price of action. Certainly, procedures could have been followed to the letter, and there was a time at EED when there were so many meetings that people began to fear that they would need to have 'meeting planning meetings'! All this eventually gave way to what was recognized as the ultimate purpose of it all, which was to actually achieve something in the commercial world.

APPENDIX D

INDUSTRIAL AUTOMATED SYSTEMS LTD

INDUSTRIAL AUTOMATED SYSTEMS LIMITED

INTRODUCTION

IAS is Engineering Group's latest acquisition. Located in Lichfield, the company is principally concerned with the manufacture of electronic control systems. A system for controlling the flow of cooling water in a methanol plant and one for controlling the flow of materials in cigarette factories are examples of the type of equipment produced.

My initial brief was to look at the company's stock control and goods receiving procedures. The company was facing production difficulties because components were not always available when needed. It was felt that better procedures would improve things.

An examination of the problem suggested that many other interlinked factors were involved. These are discussed under the headings:

1. The Market
2. The Technology
3. The Organization

A brief discussion of igniters is also included.

INDUSTRIAL AUTOMATED SYSTEMS LTD

SUMMARY

A. Systems

1. The Market

1. IAS is competitive only where its purpose-built systems are cheaper than those of competitors or cheaper than the cost of modifying competitors' standard units.
2. This has advantages:
 - a) High quality systems
 - b) Customer can specify exact functions
 - c) Customer can maintain standardization of components with his existing plant
3. The disadvantages are:
 - a) Difficulty of estimating contract costs in advance
 - b) Low profit margins on many contracts
 - c) Customer may impose costly design mods. at a late stage
4. The capital equipment market is 'lumpy'. This imposes problems of production planning.
5. The capital equipment market is sensitive to external economic factors, e.g. the level of interest rates.

2. The Technology

1. The move towards 'programmable logic' type systems and away from hard-wired panels will mean that the design and engineering input will grow relative to shop-floor construction time.

2. The Texas Instruments agreement is technically and competitively useful, but there will still be customers who will insist on other manufacturers' equipment being used.

3. The Organization

- 1 The points outlined above cause considerable tension in the organization. There is conflict between the engineers' need to design the best equipment and the conduct of a sensible buying and stockkeeping regime.
- 2 This problem is generated by the nature of the business, but is compounded by a lack of willingness on each side to understand the other's point of view.
- 3 The symptom of this lack of co-operation is a consistent shortage of components, and a consequent inefficiency in manufacturing.
4. Improved paperwork systems might help, but they are not the real answer.

4. Conclusions

The points above seem to be symptoms of 'growing pains'. The company is the wrong size at the moment for its kind of business. If it were larger, it might be able to compete in the field of standard system designs. It would also be able to go for larger contracts where the competition from standard systems would be lower. In addition, a greater production capacity would smooth out some of the problems of the 'lumpiness' of orders.

All these points would make production planning and materials procurement easier, and this would reduce current tensions. The problem then is that the firm is already short of engineering skills. Both the new technology and the growth of the firm will make the position more difficult.

This situation might be eased by amalgamating IAS with Plant and Equipment Division, although this may well be at the cost of losing some of the existing talent and much goodwill. Given the firm's expertise in the new microprocessor technology, IAS looks to have an optimistic independent future, if the current problems of growth can be overcome.

B. Igniters

The igniters business is much smaller but steadier. There seems to be agreement, however, that the market has declined in recent years. Management hopes that more business will be forthcoming from the continent, and some new units are being developed, preparatory to a sales drive in the near future.

Because the business is steadier and apparently less competitive, there would seem to be some scope for increased work on igniters to fill some of the slack periods on the systems side.

Apart from some problems over the supply of torch bodies, and some rather complex paperwork, the igniters business appears to work well. It is doubtful, however, whether it could survive alone.

1. THE MARKET

A. Systems

IAS is rather unusual in the electronic systems market. The majority of manufacturers in the field apparently manufacture a range of standard systems capable of certain functions. A customer either accepts the constraints of the standard design or requests certain modifications to it. IAS has no such standard units. All the control cabinets and desks that the company produces are one-offs to meet a particular end use. The result is that IAS is seldom or never competitive in standard applications. The available market is limited to those tasks for which the cost of modifying competitors' standard equipment is greater than building a completely purpose-built system.

There are both advantages and disadvantages in this situation. The principal benefit is that the customer can have a system to do exactly what it is he wants. In particular, he can specify which manufacturers' components are to be used in order to standardize with his existing plant. These benefits to the customer are nevertheless very onerous for the manufacturer. First, accurate estimating of the cost of the contract is difficult. When there is strong competitive pressure, quotations are submitted which are known to be on the low side, perhaps incorporating many 'best case' assumptions. Having awarded the contract to IAS on the basis of this quotation, many customers appear to feel that they then have the right to impose design changes. These might be quite significant and impose extra costs in

design and manufacture. Customers nevertheless seem to expect the quoted price and delivery to be adhered to. It appears that it is the practice of some manufacturers to allow some modifications at no extra cost, but this has in fact been allowed for in their original tender. IAS do not operate in this way. As a consequence, protracted negotiations over the final price have sometimes occurred which have continued long after the job has been completed.

Another major problem is that lead times can be very long between a customer's first approach and the eventual placing of a contract. To begin with, there are likely to be long periods of discussion over final designs, prices and deliveries. Even when these are agreed, there can be delays while the customer obtains a final capital sanction. Funds that were provisionally allocated early in a financial year may be delayed until the following year if contract details have taken a long time to finalize.

This problem of lead times appears particularly severe at IAS. This is because the nature of the work is 'lumpy' and at the same time, the company's manufacturing capacity is limited. This makes work scheduling a difficult art. If, as happened recently, several contracts are finished together, there is a gap until a new job is won. If the sales team are then too successful, and several large orders fall in together, the strain on designing and manufacturing capacity becomes impossible. Ideally, perhaps, one would like to find an area in which small contracts are placed more frequently. These would be a useful source of income in slack periods, but could be passed over when large orders were obtained.

Finally, it is in the nature of the market for capital equipment that it is rather sensitive to changes in the economy as a whole. In

current circumstances, for example, low demand and expensive money are likely to mean that potential customers will make do and mend, rather than invest in new plant. Whether it is even conceptually possible for a company such as IAS to avoid this situation is doubtful.

B. Igniters

There seems to be a general agreement that the market for igniter equipment has declined badly in recent years. Orders are now being received for torches in ones and twos, and for odd spares. In the past, contracts worth thousands of pounds seem not to have been uncommon. This situation has been traced by some to the departure of a particular manager from the company some time ago. Apparently he not only designed much of the equipment but also had many contacts in the user industries. It is probably also true for example, that power stations, who might have used quantities of this equipment, have been built with decreasing frequency since the oil crisis reduced the growth in energy demand. In these circumstances it would appear that industrial and overseas markets will have to be the prime targets if the situation is to improve.

Although turnover in igniters is limited, there is a fairly steady flow of orders. This provides a limited amount of work, but does not nearly compensate for the troughs in systems demand. Increasing the amount of igniters work would help fill this gap without creating the undesirable side effect of placing additional strains on the design office. When a systems contract did fall in the effect would simply be to extend igniters' delivery times and it seems unlikely that this would represent a strong competitive disadvantage.

2. THE TECHNOLOGY

A. Systems

The reason for considering the issue of technology separately is that it has an important effect on the company in various ways. Hitherto, IAS has specialized in the building of so-called 'hard-wired' systems. These have required not only considerable design skills, but also a high level of shop-floor expertise. Indeed, it is recognized that IAS-built panels are of the highest quality. The trend now seems to be moving towards the 'programmable logic module' type of system. Here, the expertise required is in designing and programming the system, and shop-floor input, both in terms of time and skill, is relatively more limited.

The company clearly recognizes this trend. This is indicated by its recent signing of a dealership agreement with Texas Instruments. Nevertheless, this course has created its own problems, and others remain to be tackled.

The problem that has been created one would hope to be the easiest to resolve. It is that to date, relations with Texas have been rather unsatisfactory. In the time that I was working in the Buying Office, the number of items that had to be returned as faulty became a standing joke (although the engineers responsible for the relevant contracts had other reactions). This difficulty was compounded by the fact that Texas delivery times were both long and unreliable. Furthermore, the Texas paperwork system does not allow individual items to be despatched ahead of the rest of a stock order, even if they are needed urgently. It does seem to be possible to obtain service exchange items via the

right contact. Finding the right contact is, however, another story, since Texas seem to be reluctant to speak to customers on the 'phone.

It was observed above that IAS was short of designers and engineers. This is a problem that seems to be faced by the whole industry, and for IAS it may well become worse. This arises both from the fact that the new technology has relatively more engineering involvement and for the reason that with demand for these skills greater than supply, trained engineers can afford to be choosy. IAS has recently made attempts to recruit such people, but without any great response, particularly locally.

Finally, it should be noted that there is a great deal of competition between different manufacturers of the basic hardware modules. By opting for a Texas franchise, IAS have identified themselves with one of the market leaders. This will allow the company to become familiar with all the capabilities of the equipment. Nevertheless, such identification does represent a step away from the philosophy outlined above. One of the advantages claimed for IAS in hard-wired units was the flexibility to specify any manufacturer's components. In a recent contract for Fort Dunlop, Tyre Group specified a non-Texas system. This was duly built, but at the additional cost of having thousands of pounds worth of Texas Instruments stock lying unused in the stores.

B. Igniters

One's impression was that the igniters technology was not very complex, and that it had not changed very much over the years. Minor modifications had been made with experience, but some relatively old products still in stock remained serviceable. The intention has been for some time to introduce some new units into the igniters range. The object was apparently to have an improved product to market on the continent. Despite the length of time that the idea had been under discussion, the actual design and building of the prototypes was undertaken in a great rush during the spring and early summer. An attempt was made to complete fifty pre-production units in time for a sales drive during the summer, and a good deal of pressure was applied to try and meet this target.

Almost inevitably, when producing a new product from scratch, problems were encountered, both in the design and in obtaining components. The original deadline was missed, an outcome for which each department blamed the others. In view of the comments made in Section One, this sales effort is welcome. On the other hand, it must be said that the preparatory development work could have gone more efficiently.

3. THE ORGANIZATION

A. Systems

Although IAS and Igniters Ltd began as separate entities, and have become so again, the company was run as a single unit when I was there. Nevertheless, the problems facing the two businesses within the

organization were different enough to warrant dealing with them separately. On the systems side, the situation I was originally asked to tackle was symptomatic.

It has already been noted that the company has considerable problems in work scheduling as a result of the type of business they are in. In addition, their quotations are kept low in order to be competitive. For this reason, it is important that when a contract is obtained, it is completed in the most efficient way. This has often not happened in the past, with the result that the contract has made a loss. The reason that was suggested for this state of affairs was that the components needed to build the job had either not arrived by the start date, or had arrived and had been lost. In the first case, the engineers claimed that the problem was due to inefficient buying. In the second the works claimed it was poor storekeeping. My task was to discover what was really going on.

The engineers and others used to complain with some justification that not enough effort was put into anticipating their needs. Told that a particular part they had specified was not a standard stores item, their invariable response was to express disbelief, as if no sensible company would fail to stock such a common item. Having discovered that the item would have to be specially ordered, they complained that not enough effort was made to ensure that it arrived when promised.

Furthermore they believed that someone somewhere would always have what they wanted ex-stock or on short delivery, and they objected to the buyer accepting long delivery quotes.

The buyer, for his part, had a series of equal and opposite grievances, also with some justification. He argued that the engineering

department had a book which listed all standard parts, but that the engineers simply would not use them. They would make assumptions about what was in stock and fail to order necessary items early enough. There were also numerous omissions in the parts lists drawn up for contracts, and frequent changes of specification. If only the designers could come up with a complete schedule of parts and then stick to it, he would be able to attend to the task of obtaining them on time.

Each set of arguments heard in isolation was quite convincing, and the evidence was equally contradictory. For example, there was a deadline set on the procurement of parts for the new igniters prototypes. The buyer made strenuous efforts to meet it despite the very limited notice which he had been given. Apart from some special parts from Germany for which there was a single source and for which no alternative was available, everything that was on the original specification (and was not subsequently altered) was available to meet production's target date.

On the other side, the engineers believing the buyer was simply being stubborn, occasionally searched for long delivery items themselves. Quite often they found them. When challenged, the buyer made two points. The first was that he could not be expected to spend a large proportion of his time covering up for the engineers' inefficient requisitioning. The second was that he had established a system of ordering from a group of preferred suppliers from whom he had negotiated favourable discounts. It was necessary to use these suppliers to prevent budget overruns.

The truth of the matter seems to have been that each of the parties wanted to act in accordance with what they believed to be their respective professional 'best practice'. The designers demanded the freedom to design into their equipment whatever components they thought best. It has to be admitted that their demands reflected not only professional judgement, but also an element of prejudice for or against certain manufacturers and suppliers. They believed that the buying and stock-keeping system was simply a service whose function was to procure these items as and when required. If design modifications were necessary at a late stage, the buyer would have to work that much harder to meet their deadlines.

This was not how things appeared to the buyer. His objective was to minimize the level of stockholding and the cost of bought-out components subject to what he regarded as an adequate level of service to the business. There is little doubt that he regarded his efforts to accommodate the engineers as beyond all reasonable expectations. Any further problems they brought upon themselves.

The real problem was that the two departments did not co-operate adequately, and communications between the two frequently broke down. A final example will illustrate this. Some mods had to be done to drawings for the new igniter units. The suppliers rep had arranged to call and collect them. They were in fact ready for him, but the buyer did not know this. When the rep arrived, the buyer was called to see him. As he was walking up the corridor he saw one of the engineers and told him, "Mr. X is here". The engineer did not know who Mr. X was and affected indifference to the news. The rep went away without the drawings and each department blamed the other.

The general attitude of non-co-operation was reflected in the problem of the missing parts. On several occasions the works foreman complained that certain parts for a contract had not arrived. Stores records showed that they had been received and issued to the job. The goods inwards procedure in the stores was very sound. The only conclusion was that either the storeman or the foreman had lost the items in question. The existing paperwork system could not establish which. The only evidence on the subject was that on two occasions when this claim was made, the items were found in the works, despite the foreman's claim that he had conducted a thorough search.

In all this, it was, of course, possible to take a view as to the justice of the various cases. The buyer had in the past been instructed to act in the way the engineers wanted and to accommodate them, whatever his opinions. Similarly, it was possible to trace through the flow of components and to devise a system of paperwork which would establish whose responsibility any particular item was at a given time. It was clear, though, that IAS was not a happy organization.

Management was obviously aware of these circumstances and formed its own view of the problem. The solution taken was to change the structure of the organization in order to reduce the more direct conflicts. The outcome of this effort remains to be seen.

B. Igniters

The organization of the igniters business was rather different from that of systems. To begin with, nearly all the necessary parts were

available ex-stock, apart from the torch tubes themselves which were bought out. The supplier was a Tamworth firm called Automated Systems Engineering (ASE) which used to be an associate of IAS.

When a customer's order came in, a parts list was issued detailing all the necessary components. This was fine in theory, except that the sales office would make amendments to their parts lists without informing the stock control (buying) office of the changes. It often required a good deal of coming and going to discover exactly what it was that the customer wanted. The problem was exacerbated by an intricate and complex series of part reference numbers which had been introduced to allow the introduction of a computer which had not yet materialized. The part numbers were intended to provide detailed information on the type of product for which it was used. In fact, what happened was that there proved to be too few numbers in the (eight digit!) sequence to allow for all components to have a unique number and comply with the numbering rules. This provoked further confusion between the sales and manufacturing arms of the business.

Procurement of the bought-out torch bodies was dealt with by the buyer, a remarkable procedure which he handled with skill. These contracts went to ASE for historical reasons, although it became quite clear that the company was unable, on any normal criteria, to handle the work. The consequence was that delivery promises were continually being broken, and that the IAS buyer was compelled to act as ASE's production planner. Every week, (and often more frequently), he would draw up a 'priority list' which detailed the order in which ASE was to do the work. The hope must have been eventually for ASE to catch up with itself and take over the scheduling task itself. This never looked

like happening.

The arrangement did have certain advantages for IAS. First, it allowed rush orders to be planned into the work pattern with little difficulty. Second, it was felt unlikely that any other company would do the work at the price. Whether the benefits will continue to outweigh the disadvantages, I doubt, especially if the igniters side is to grow.

Otherwise, the operating procedures on the igniters side seemed taut and well-run. The system had its idiosyncracies and these were the subject of criticism, especially from the accountant, who found that the referencing of one piece of paper to another on the same contract left something to be desired. This was true to an extent, but the only real solution would have been to scrap the whole system and start again, including the part number sequence. This was such a huge task that nobody was prepared to take the idea seriously.

4. CONCLUSIONS

If there is a common problem of which all these incidents are symptoms, it would appear to be 'growing pains'. IAS seems to be, at the moment, the wrong size for the mix of business it finds itself with. In systems, the available market is limited by two factors. First, the customer must require a custom-built system. Second, it must be of a particular size: either large enough to take up a large amount of the firm's production capacity or small enough to accommodate alongside other contracts in progress at the same time.

Intuitively, it seems likely that it is in the smaller systems that the

competition from manufacturers with standard packages would be greatest. Because it operates at this end of the market, IAS therefore finds that its margins are squeezed if it is to compete. This in turn demands that when contracts are won, they are built to timetable with no time or cost over-runs, a requirement that is made exceedingly difficult by the fact that all units are purpose-built. This pressure is almost bound to result in a very high degree of co-operation, or its reverse.

As the company grows, it may be able to remove the root cause of these pressures. First, it may be able to establish a standard range of its own, and second, it will be able to compete for larger contracts where opposition comes only from other individual designs. Unfortunately, this is going to create its own problem, which is how to attract the necessary expertise in design and engineering.

There is, of course, another option. That is to recognize explicitly the contribution that IAS' skills could make to Plant and Equipment Division and formally amalgamate the two in Coventry. This would open up new markets for IAS, and would relax the scheduling problems. It may also be easier to attract skilled personnel to an established industrial centre. On the other hand, it may be that the existing skills would be lost. IAS personnel identify strongly both with the locality and with the existing local management and would certainly be hostile to the prospect of such amalgamation.

It does seem that the company could have a viable independent future. There is optimism both over the new igniter units, and over the prospect of increasing capacity by moving to a new factory. In

addition, the company does seem to be at the forefront in the application of microprocessor technology. Given the right skills, one could support this optimism, although it is clear that there is still some growing to be done.

M.J.C.

October 1980

REFERENCES

Chapter Two

1. van Rest D.J., Address to New Students, October 1980, reprinted in IHD Newsletter no. 13, 1980. Dr. van Rest is a Senior Tutor at IHD.
2. ibid.
3. Adapted from "Schema of a Research Project", Chart issued by IHD, May 1978.
4. Checkland P.B., "The Problem of Problem Formulation in the Application of a Systems Approach". Lecture to the First International Conference on Applied General Systems Research, State University of New York, Binghamton, August 1977.

Chapter Three

1. Burns T. & Stalker G.M., The Management of Innovation, Tavistock, 1961.
2. ibid., p.96.
3. Burns T., "Industry in a New Age", New Society, 31 January 1961.
4. Burns & Stalker, op.cit., p.120.
5. ibid., p.121-122.
6. ibid., p.252.
- 7.. Lawrence P.R. & Lorsch J.W., Organization and Environment, Division of Research, Harvard University Graduate School of Business Administration, 1967.
8. Lawrence P.R. & Lorsch J.W., "Differentiation and Integration in Complex Organizations", Administrative Science Quarterly, v.12, no.1, June 1967.
9. Lorsch J.W., "Introduction to the Structural Design of Organizations" in Kast F.E. & Rosenzweig J.E. (eds.), Contingency Views of Organization and Management, Science Research Associates, 1973.
10. ibid., p.183.

11. ibid., p.184.
12. ibid., p.189.
13. Lawrence and Lorsch, Organization and Environment, p.190.
14. Thompson J.D., Organizations in Action, McGraw-Hill, 1967.
15. ibid., p.56.
16. ibid., p.70.
17. ibid., p.71.
18. ibid., p.78.
19. Allen S.A., "Corporate-Divisional Relationships in Highly-Diversified Firms", in Lorsch J.W. & Lawrence P.R., Organization Planning, Irwin/Dorsey, 1972.
20. ibid., p.20.
21. ibid., p.21.
22. ibid., p.23.
23. Galbraith J., Designing Complex Organizations, Addison Wesley, 1973.
24. Galbraith J., "Organization Design - An Information Processing View", in Lorsch & Lawrence, Organization Planning.
25. ibid., p.59.
26. See diagrams in Galbraith, Designing Complex Organizations, p.15 and "Organization Design", p.59.
27. Galbraith, Designing Complex Organizations, p.17.
28. ibid.
29. Kast F.E. & Rosenzweig J.E., Contingency Views of Organization and Management, Science Research Associates, 1973, p.ix.
30. Miles R.E. & Snow C.S., Organizational Strategy, Structure and Process, McGraw-Hill, 1978.
31. ibid., p.259.
32. Longenecker J.G. & Pringle C.D., "The Illusion of Contingency Theory as a General Theory", Academy of Management Review, v.3, July 1978.
33. Espejo R., "Cybernetic Praxis in Government: The Management of Industry in Chile 1970-1973", Working Paper no. 174, University of Aston Management Centre, 1980, p.9.

34. Burns, op.cit.
35. Child J., "Organizational Structure, Environment and Performance", Sociology, v.6, 1972.
36. Davies C., Demb A. & Espejo R., Organization for Program Management, Wiley, 1974, p.14.
37. The model is developed in detail in Beer S., Brain of the Firm, Allen Lane, 1972 and The Heart of Enterprise, Wiley, 1979.
38. Beer, The Heart of Enterprise, p.32.
39. Ashby W.R., An Introduction to Cybernetics, Chapman and Hall, 1956.
40. Davies, Demb & Espejo, op.cit., p.17.
41. Beer, The Heart of Enterprise, p.315.
42. ibid. These two phrases are the titles of Chapters 8 and 9 which deal with the Control and Intelligence functions respectively.
43. Davies, Demb & Espejo, op.cit., p.33.
44. Galbraith, Designing Complex Organizations, p.19.
45. Espejo R., "Information and Management: The Cybernetics of a Small Company", Working Paper no. 125, University of Aston Management Centre, 1979, p.7. Although the model itself is Beer's, the names given here to the five functions are due to Espejo.
46. Thompson, op.cit., p.78.
47. Beer, The Heart of Enterprise, p.217.

Chapter Four

1. O.E.C.D., The Conditions for Success in Technological Innovation 1971.
2. Ray G.F. & Uhlmann L., The Innovation Process in the Energy Industries, Cambridge University Press, 1979.
3. Marquis D.G., "The Anatomy of Successful Innovations", in AMA, M Advancing Technology, Volume 1: Strategies and Tactics of Product Innovation, American Management Association, 1972.

4. Severiens J.J., "Product Innovation, Organizational Change and Risk", SAM Advanced Management Journal, Fall 1977.
5. Kelly P. & Krantzberg M., Technological Innovation - A Critical Review of Current Knowledge, Advanced Technology and Science Studies Group, Georgia Tech, 1975, p.9.
6. Child J., "Organizational Design and Performance", Working Paper no.53, University of Aston Management Centre, 1976, p.17.
7. Fast N.D., "The Future of Industrial New Venture Departments", Industrial Marketing Management, v.8, no.4, November 1979, p.1.
8. Hanan M., "Venturing Corporations - Think Small to Stay Strong", Harvard Business Review, May/June 1976.
9. Oates D., "Diversification through Venture Management", Management Review, February 1971.
10. Rothwell R., "From Invention to New Business via the New Venture Approach", Management Decision, v.13, no.1, 1975.
11. Hanan, op.cit.
12. Child J., Organization - A Guide to Problems and Practice, Harper & Row, 1977, pp.102-103.
13. Gardner J.B., "Innovation through New Ventures - New Venture Concept in BOC", R & D Management, v.3, no.2, 1973.
14. Vernon A., "A New Business Venture", R & D Management, v.4, no.2, 1973/74.
15. Peterson R.W., "New Venture Management in a Large Company", Harvard Business Review, May/June 1967.
16. von Hippel E., "Successful and Failing Internal Corporate Ventures - An Empirical Analysis", Industrial Marketing Management, v.6, no.3, 1977.
17. Hanan, op.cit.
18. ibid.
19. Rothwell R., "The Characteristics of Successful Innovators and Technically Progressive Firms", R & D Management, v.7, no.3, 1977.
20. von Hippel, op.cit.
21. Oates, op.cit.
22. Hlavacek J.D. & Thompson V.A., "Bureaucracy and New Product Innovation", Academy of Management Journal, v.16, 1973.
23. Kraushar P.M., "Organization for Corporate Development", Long Range Planning, June 1976.

24. Montgomerie G.A., "Industrial Innovation and the Interdisciplinary Approach", Proceedings of the IEE, v.124, no.1, January 1977.
25. Dunn D.T., "The Rise and Fall of Ten Venture Groups", Business Horizons, October 1978.
26. Fast N.D., "The Future of Industrial New Venture Departments", Industrial Marketing Management, v.8, no.4, November 1979.
27. Fast N.D., The Rise and Fall of Corporate New Venture Divisions.
28. Horwitch M. & Pralahad C.K., "Managing Technological Innovation", Sloan Management Review, Winter 1976.
29. Hlavacek J.D. & Thompson V.A., "Bureaucracy and Venture Failures", Academy of Management Review, v.3, no.2, 1973.
30. Pessemer E.A., "Managing Product Innovation", in Baker M.J. (ed.), Industrial Innovation - Technology, Policy, Diffusion, Macmillan, 1979.
31. George W.W., "Task Teams for Rapid Growth", Harvard Business Review, March/April 1977.
32. Lawrence P.R. & Lorsch J.W., "Organizing for Product Innovation", Harvard Business Review, January/February 1965.
33. Souder W.E., "Effectiveness of Product Development Methods", Industrial Marketing Management, v.7, no.5, October 1978.
34. Hill R.M. & Hlavacek J.D., "The Venture Team - A New Concept in Marketing Organization," Journal of Marketing, v.36, July 1972.
35. See, for example: Cooper R.G., "Identifying Industrial New Product Success: Project NewProd", Industrial Marketing Management, v.8, no.2, April 1979; Freeman C., Success and Failure in Industrial Innovation, University of Sussex, 1972; Rothwell R., "The Characteristics of Successful Innovators and Technically Progressive Firms", R & D Management, v.7, no.3, 1977.

Chapter Five

1. Oakley N.H., The Torque Hose Actuator - A Study in the Development of a New Product, University of Aston Ph.D. Thesis, 1978, p.206.
2. Twiss B., Managing Technological Innovation, Longman, 1974, p.206.

3. Burns T., "Research, Development and Production, Problems of Conflict and Co-operation", IRE Transactions on Engineering Management, March 1961.
4. ibid.
5. Pettigrew A.M., The Politics of Organizational Decision-Making, Tavistock, 1973, p.20.
6. Biggadike R., "The Risky Business of Diversification", Harvard Business Review, May/June 1979.

Chapter Six

1. Mintzberg H., 'Strategy-Making in Three Modes', California Management Review, v.16, no.2, Winter 1973.
2. Ackoff R.L., A Concept of Corporate Planning, Wiley 1970.
3. ibid., p.12.
4. ibid., p.15.
5. Steiner G.A. and Miner J.B., Management Policy and Strategy, Macmillan, 1977.
6. Drucker P.F., Management: Tasks, Responsibilities, Practices, Heinemann, 1974, p.125.
7. Drucker P.F., 'Entrepreneurship in Business Enterprise', Journal of Business Policy, v.1, no.1, 1970.
8. Drucker P.F., Managing for Results, Heinemann, 1964, p.190.
9. ibid., p.192.
10. Mintzberg, op.cit.
11. Steiner & Miner, op.cit, p.200.
12. Collins O. & Moore D.G., The Organization Makers, Appleton, Century, Crofts, 1970.
13. Braybrooke D. & Lindblom C.E., A Strategy of Decision, Free Press, 1963.
14. Cyert R.M. and March J.G., A Behavioural Theory of the Firm, Prentice Hall, 1965.
15. ibid. p.26.

16. ibid, p.121.
17. Lindblom C.E., 'The Science of Muddling Through', Public Administration Review, v.19, 1959, reprinted in Ansoff H.I. (ed.), Business Strategy, Penguin, 1969.
18. ibid.
19. Lindblom C.E., The Policy-Making Process, Prentice-Hall, 1968, p.27.
20. Ansoff H.I., Corporate Strategy, Penguin, 1968, p.20.
21. Christensen C.R., Andrews K.R. & Bower J.L., Business Policy : Text & Cases, R.D. Irwin, 1973, p.129.
22. ibid. p.451, (emphasis added).
23. Smalter D.J. & Ruggles R.L. Jr., "Six Business Lessons from the Pentagon", Harvard Business Review, March/April 1966, reprinted in Ansoff H.I. (ed.), Business Strategy, Penguin, 1969.
24. Pryor M.H. Jr., "Anatomy of A Merger", Michigan Business Review, v.16, no.4, July 1964, reprinted in Ansoff, op.cit.
25. ibid.
26. Ansoff, op cit., p.33.
27. Allison D., "The Management Style of Patrick Haggerty" in A.M.A., Managing Advancing Technology, Vol. 1: Strategies and Tactics of Product Innovation, American Management Association, 1972.
28. Steiner G.A., Top Management Planning, Macmillan, 1969, p.47.
29. Litschert R.J., "The Role of The Corporate Planner in Strategic Management" in Glueck W.F., Strategic Management and Business Policy, McGraw-Hill, 1980.
30. Lorange P., "The Planner's Dual Role", Long Range Planning, March 1973.
31. Ackoff, op.cit.
32. ibid., p.132.
33. ibid., p.132.
34. Andrews K.R., The Concept of Corporate Strategy, Dow Jones-Irwin, 1971.
35. Ackoff, op.cit., p.20.
36. Rossiter P.M., "Corporate Planning at Dunlop", Long Range Planning, v.12, February 1979. At the time he wrote this article, the author was Manager of Corporate Planning, Dunlop Limited.

37. Ackoff, op.cit., p.23.
38. Rossiter, op.cit.
39. ibid
40. ibid.
41. Oakley M.H., The Torque Hose Actuator - A Study in the Development of a New Product, University of Aston Ph.D. Thesis, 1978, pp.81-82.
42. Andrews, op.cit., p.28.
43. Ansoff, op.cit., p.21.
44. ibid., p.42.
45. Grinyer P.H. and Spender J-C. "Recipes, Crises and Adaptation in Mature Businesses", International Studies of Management and Organization, v.9, no.3, 1979.
46. Ackoff, op.cit.
47. Glueck W.F., Strategic Management and Business Policy, McGraw-Hill, 1980, p.11.
48. Hedberg B. & Jonsson S., "Strategy Formulation as a Discontinuous Process", International Studies of Management and Organization, v.7, no.2, 1977.
49. Thomas H., Econometric Analysis : Studies in R & D in the Electronics Industry, University of Edinburgh Ph.D. Thesis, 1970, quoted by Freeman C., The Economics of Industrial Innovation, Penguin, 1974, p.231.
50. Rossiter, op.cit.

Chapter Seven

1. Burns T. & Stalker G.M., The Management of Innovation, Tavistock, 1961, p.125.
2. Bright J.R., "Some Management Lessons from Technological Innovation Research", Proceedings of Conference on Technological Innovation, University of Bradford Management Centre, 1969.
3. Kelly P. & Krantzberg M., Technological Innovation - A Critical Review of Current Knowledge, Advanced Technology and Science Group, Georgia Tech, 1975, p.179.

4. Bateson G., Jackson D.E., Haley J. & Weakland J.H., "Towards a Theory of Schizophrenia", in Bateson G. (ed.), Steps to an Ecology of Mind, Paladin, 1973.
5. Hlavacek J.D., "Toward More Successful Venture Management", Journal of Marketing, v.38, no. 4, 1974.
6. Littler D., "The Process of Innovation", in Littler D. (ed.), The Management of Innovation, Proceedings of a Seminar held at Liverpool University, 7 December 1977.
7. Uytterhoeven H.E.R., "General Managers in the Middle", Harvard Business Review, March/April 1972.
8. Argyris C. & Schoen D.M., Organizational Learning - A Theory of Action Perspective, Addison-Wesley, 1978.
9. Uytterhoeven, op.cit.
10. Argyris & Schoen, op.cit., p.145.
11. ibid., p.43.
12. Andrews K.R., The Concept of Corporate Strategy, Dow Jones-Irwin, 1971, p.205. (Italics in original).
13. Connor J., "Secrets of Controlled Diversification", Management Review, v.63, no.10, October 1974.
14. Wrapp H.E., "Good Managers Don't Make Policy Decisions", Harvard Business Review, September/October 1967.

Chapter Eight

1. Checkland P.B., Systems Thinking, Systems Practice, Wiley, 1981.
2. ibid.
3. Argyris C. & Schoen D.M., Organizational Learning - A Theory of Action Perspective, Addison-Wesley, 1978.
4. Cherns A.D., "Behavioural Science Engagements - Taxonomy and Dynamics", Human Relations, v.29, no.10, 1976.
5. Rapaport R.N., Three Dilemmas in Action Research, Tavistock Institute, 1970.
6. ibid., p.10.
7. ibid., p.16.

BIBLIOGRAPHY

- ACKOFF R.L., A Concept of Corporate Planning, Wiley, 1970.
- ALLEN D.H. and NOVEMBER P.J., "A Practical Study of the Accuracy of Forecasts in Novel Projects", The Chemical Engineer, No. 227, June 1969.
- ALLEN S.A., "Corporate-Divisional Relations in Highly-Diversified Firms" in Lorsch J.W. and Lawrence P.R. (eds.), Studies in Organizational Design, Irwin/Dorsey, 1970.
- ALLISON D., "The Management Style of Patrick Haggerty" in A.M.A., Managing Advancing Technology, Vol. 1: Strategies and Tactics of Product Innovation, American Management Association, 1972.
- ANDREWS K.R., The Concept of Corporate Strategy, Dow Jones-Irwin, 1971.
- ANSOFF H.I., Corporate Strategy, Penguin, 1968.
- ANSOFF H.I. (ed.), Business Strategy, Penguin, 1969.
- ANSOFF H.I., "Towards a Strategic Theory of the Firm" in Ansoff H.I. (ed.), Business Strategy, Penguin, 1969.
- ANSOFF H.I., "The Concept of Strategic Management", Journal of Business Policy, v.2, no.4, 1972.
- ARGYRIS C., "The Impact of the Formal Organization on the Individual" in Pugh D.S., Organization Theory, Penguin, 1971.
- ARGYRIS C. & SCHOEN D.M., Organizational Learning - A Theory of Action Perspective, Addison-Wesley, 1978.
- BAKER M.J. (ed.), Industrial Innovation: Technology, Policy, Diffusion, Macmillan, 1979.
- BAKER M.J., "Industrial Buyer Behaviour and the Adoption of Innovations in Baker M.J. (ed.), Industrial Innovation - Technology, Policy, Diffusion, Macmillan, 1979.
- BAKER M.J. & EL SHERBENY A.F.M., "Innovation Attributes and the Adoption of New Industrial Products." Paper presented at conference "Innovation Studies in the U.K.", 30 May - 1 June 1979.
- BATESON G., JACKSON D.D., HALEY J. and WEAKLAND J.H., "Towards a Theory of Schizophrenia", in Bateson G., Steps to an Ecology of Mind, Paladin, 1973.
- BEER S., Brain of the Firm, Allen Lane, 1972.
- BEER S., "Fanfare for Effective Freedom". Third Richard Goodman Memorial Lecture, Brighton Polytechnic, 14 February 1973.
- BEER S., The Heart of Enterprise, Wiley, 1979.
- BERG N., "Strategic Planning in Conglomerate Companies", Harvard Business Review, May - June 1965.

- BESSANT J.R., A Study of Inputs and their Influence on Technological Innovative Activity, University of Aston Ph.D. Thesis, 1978.
- BIGGADIKE R., "The Risky Business of Diversification", Harvard Business Review, May/June 1969.
- BOWER J.L., "Planning and Control: Bottom-Up or Top-Down", Journal of General Management, v.1, no.3, 1974.
- BOWER J.L., "The Business of Business is Serving Markets", American Economic Review, v.68, no.2, May 1978.
- BRAYBROOKE D. & LINDBLOM C.E., A Strategy of Decision, Free Press, 1963.
- BRIGHT J.R., "Some Management Lessons from Technological Innovation Research", Proceedings of Conference on Technological Innovation, University of Bradford Management Centre, 1969.
- BURNS T., "Research, Development and Production: Problems of Conflict and Co-operation", IRE Transactions on Engineering Management, March 1961.
- BURNS T., "Industry in a New Age", New Society, 31 January 1963.
- BURNS T. & STALKER G.M., The Management of Innovation, Tavistock, 1961.
- CAHN R.W., "Case Histories of Innovations", Nature, v.225, 21 February 1970.
- CAMERON D., "Appraising Companies for Acquisition", Long Range Planning, v.10, no.4, August 1977.
- CARTER C.F. & WILLIAMS B.R., "Characteristics of Technically Progressive Firms", Journal of Industrial Economics, v.7, no.3, March 1959.
- CHANNON D.F., "Strategy Formulation as an Analytical Process", International Studies of Management and Organization, v.7, no.2, 1977.
- CHARNS M.P., "The Theories of Joan Woodward and James Thompson" in Lorsch J.W. & Lawrence P.R. (eds.), Organization Planning, Irwin/Dorsey, 1972.
- CHECKLAND P.B., "A Systems Map of the Universe", Journal of Systems Engineering, v.2, no.2, 1971.
- CHECKLAND P.B., "Science and the Systems Paradigm", International Journal of General Systems, v.3, 1976.
- CHECKLAND P.B., "The Problem of Problem-Formulation in the Application of a Systems Approach", Lecture to the First International Conference on Applied General Systems Research: Recent Developments and Trends, State University of New York, Binghamton, August 1977.
- CHECKLAND P.B., "The Origins and Nature of 'Hard' Systems Thinking", Journal of Applied Systems Analysis, v.5, no.2, 1978.

- CHECKLAND P.B., "Techniques in 'Soft' Systems Practice; Part 1: Systems Diagrams - Some Tentative Guidelines", Journal of Applied Systems Analysis, v.6, 1979.
- CHECKLAND P.B., "Techniques in 'Soft' Systems Practice; Part 2: Building Conceptual Models", Journal of Applied Systems Analysis, v.6, 1979.
- CHECKLAND P.B., Systems Thinking, Systems Practice, Wiley, 1981.
- CHERNS A.B., "Behavioural Science Engagements: Taxonomy and Dynamics", Human Relations, v.29, no.10, 1976.
- CHILD J., "Organizational Structure, Environment and Performance", Sociology, v.6, 1972.
- CHILD J., "Managerial and Organizational Factors Associated with Company Performance", Journal of Management Studies, v.12, 1975.
- CHILD J., "Organizational Design and Performance", Working Paper No.53, University of Aston Management Centre, 1976.
- CHILD J., Organization - A Guide to Problems and Practice, Harper & Row, 1977.
- CHRISTENSEN C.R., ANDREWS K.R. & BOWER J.L., Business Policy: Text and Cases, R.D. Irwin, 1973.
- COLLINS O. & MOORE R.G., The Organization Makers, Appleton, Century, Crofts, 1970.
- COMMANDER M.W., A Study of New Product Market Search and User Adoption, University of Aston Ph.D. Thesis, 1978.
- CONN R.L., "The Failing Firm/Industry Doctrines", Journal of Industrial Economics, v.24, no.3, March 1976.
- CONNOR J., "Secrets of Controlled Diversification", Management Review, v.63, no.10, October 1974.
- COOK L.G., "How to Make R & D More Productive", Harvard Business Review, July/August 1966.
- COOPER A.C., "Small Companies Can Pioneer New Products", Harvard Business Review, September/October 1966.
- COOPER R.G., "Identifying Industrial New Product Success: Project NewProd", Industrial Marketing Management, v.8, no.2, April 1979.
- CYERT R.M. & MARCH J.G., A Behavioural Theory of the Firm, Prentice-Hall, 1963.
- DAFT R.L., "A Dual-Core Model of Organizational Innovation", Academy of Management Journal, v.21, no.2, 1978.
- DAVIES C., DEMB A. & ESPEJO R., Organization for Program Management, Wiley, 1979.

- DESSLER G., Organization and Management: A Contingency Approach, Prentice-Hall, 1976.
- DOLLAND S., "Factors Affecting Industrial Innovation in the U.K.". Paper presented to Conference "Innovation Studies in the U.K.", 30 May - 1 June 1979.
- DRUCKER P.F., "Twelve Fables of Research Management", Harvard Business Review, January/February 1963.
- DRUCKER P.F., "What Communication Means", Management Today, March 1970.
- DRUCKER P.F., "Entrepreneurship in Business Enterprise", Journal of Business Policy, v.1, no.1, 1970.
- DRUCKER P.F., Management: Tasks, Responsibilities, Practices, Heinemann, 1974.
- DUNN D.T., "The Rise and Fall of Ten Venture Groups", Business Horizons, October 1978.
- ECONOMIST, "Dunlop Run Flat", The Economist, 10 February 1979.
- EDEN C. & SIMS D., "Problem Definition Between Clients and Consultants", Centre for the Study of Organizational Change and Development, University of Bath, 1977, (mimeo).
- EDWARDS J.P., "Strategy Formulation as a Stylistic Process", International Studies of Management and Organization, v.7, no.2, 1977.
- ESPEJO R., "Cybernetics in Management and Organization", Working Paper No.76, University of Aston Management Centre, 1977.
- ESPEJO R., "Information and Management: the Cybernetics of a Small Company", Working Paper No.125, University of Aston Management Centre, 1979.
- ESPEJO R., "Cybernetic Filtration of Management Information", Working Paper No.126, University of Aston Management Centre, 1979.
- ESPEJO R., "Cybernetic Praxis in Government: the Management of Industry in Chile 1970 - 73", Working Paper No.174, University of Aston Management Centre, 1980.
- FAST N.D., The Rise and Fall of Corporate New Venture Divisions, UMI Research Press, 1978.
- FAST N.D., "The Future of Industrial New Venture Departments", Industrial Marketing Management, v.8, no.4, November 1979.
- FAST N.D., "Key Managerial Factors in New Venture Departments", Industrial Marketing Management, v.8, no.3, June 1979.
- FIELD R., "The Technical Strategy of CBS", in AMA, Managing Advancing Technology, Volume 1: Strategies and Tactics of Product Innovation, American Management Association, 1972.

- FREEMAN C., The Economics of Industrial Innovation, Penguin, 1974.
- GALBRAITH J.R., "Organization Design: An Information Processing View", in Lorsch J.W. & Lawrence P.R. (eds.), Organization Planning, Irwin/Dorsey, 1972.
- GALBRAITH J.R., Designing Complex Organizations, Addison-Wesley, 1973.
- GARDNER J.B., "Innovation through New Ventures - New Venture Concept in BCC", R & D Management, v.3, no.2, 1973.
- GEORGE W.W., "Task Teams for Rapid Growth", Harvard Business Review, March/April 1977.
- GLUECK W.F., Strategic Management and Business Policy, McGraw-Hill, 1980.
- GRINYER P.H., "The Anatomy of Business Strategic Planning Reconsidered", Journal of Management Studies, May 1971.
- GRINYER P.H. & SPENDER J-C., "Recipes, Crises and Adaptation in Mature Businesses", International Studies of Management and Organization, v.9, no.3, 1979.
- HAKE B., New Product Strategy, Pitman, 1971.
- HALL P., "The Geography of the Fifth Kondratieff Cycle", New Society, 26 March 1981.
- HANAN M., "Corporate Growth through New Venture Management", Harvard Business Review, January/February 1969.
- HANAN M., "Venturing Corporations - Think Small to Stay Strong", Harvard Business Review, May/June 1976.
- HANDY C.B., Understanding Organizations, Penguin, 1976.
- HEDBERG B. & JONSSON S., "Strategy Formulation as a Discontinuous Process", International Studies of Management and Organization, v.7, no.2, 1977.
- HERZBERG F., "The Motivation-Hygiene Theory", in Pugh D.S. (ed.), Organization Theory, Penguin, 1971.
- HILL R.M. & HIAVACEK J.D., "The Venture Team - A New Concept in Marketing Organization", Journal of Marketing, v.36, July 1972.
- von HIPPEL E., "Successful and Failing Internal Corporate Ventures - An Empirical Analysis", Industrial Marketing Management, v.6, no.3, 1977.
- von HIPPEL E., "A Customer-Active Paradigm for Industrial Product Idea Generation", in Baker M.J. (ed.) Industrial Innovation - Technology, Policy, Diffusion, Macmillan, 1979.
- HIAVACEK J.D., "Toward More Effective Venture Management", Journal of Marketing, v.38, no.4, 1974.

- HLAVACEK J.D. & THOMPSON V.A., "Bureaucracy and New Product Innovation", Academy of Management Journal, v.16, 1973.
- HLAVACEK J.D. & THOMPSON V.A., "Bureaucracy and Venture Failures", Academy of Management Review, v.3, no.2, 1973.
- HORWITCH M. & PRALAHAD C.K., "Managing Technological Innovation", Sloan Management Review, Winter 1976.
- KAST F.E. & ROSENZWEIG J.E., Contingency Views of Organization and Management, Science Research Associates, 1973.
- KELLY P. & KRANTZBERG M., Technological Innovation - A Critical Review of Current Knowledge, Advanced Technology and Science Studies Group, Georgia Tech, 1975.
- KHANDWALLA P.N., "The Techno-Economic Ecology of Corporate Strategy", Journal of Management Studies, v.13, 1976.
- KRAUSHAR P.M., "Organization for Corporate Development", Long Range Planning, June 1976.
- LANGRISH J., Wealth from Knowledge - A Study of Innovation in Industry, Macmillan, 1972.
- LANGRISH J., "Studies of Innovation: A Fresh Look". Paper presented to Conference "Innovation Studies in the U.K.", 30 May - 1 June 1979.
- LAYTON C., Ten Innovations, George, Allen and Unwin, 1972.
- LAWRENCE P.R. & LORSCH J.W., "Organizing for Product Innovation", Harvard Business Review, January/February 1965.
- LAWRENCE P.R. & LORSCH J.W., "Differentiation and Integration in Complex Organizations", Administrative Science Quarterly, v.12, no.1, June 1967.
- LAWRENCE P.R. & LORSCH J.W., Organization and Environment, Division of Research, Harvard University Graduate School of Business Administration, 1967.
- LEACH R., "Organization Structure and Innovation", Proceedings of Conference on the Management of Technological Innovation, University of Bradford Management Centre, 1969.
- LEE L. & DOBLER D.W., Purchasing and Materials Management: Text and Cases, Tata McGraw-Hill, 1971.
- LILLICO T.M., Managerial Communication, Pergamon, 1972.
- LINDBLOM C.E., The Policy-Making Process, Prentice-Hall, 1968.
- LINDBLOM C.E., "The Science of 'Muddling Through'", in Ansoff H.I. (ed.) Business Strategy, Penguin, 1969.
- LITSCHERT R., "The Role of the Corporate Planner in Strategic Management", in Glueck W.F., Strategic Management and Business Policy, McGraw-Hill, 1980.

- LITTLE D., "The Process of Innovation", in Littler D. (ed.), The Management of Innovation, Proceedings of a Seminar held at the University of Liverpool, 7 December 1972.
- LONGENECKER J.G. & PRINGLE C.D., "The Illusion of Contingency Theory as a General Theory", Academy of Management Review, v.3, July 1978.
- LORANGE P., "The Planner's Dual Role", Long Range Planning, March 1973.
- LORSCH J.W., "Introduction to the Structural Design of Organizations" in Kast F.E. & Rosenzweig J.E., Contingency Views of Organization and Management, Science Research Associates, 1973.
- LORSCH J.W. & LAWRENCE P.R. (eds.), Studies in Organization Design, Irwin/Dorsey, 1970.
- LORSCH J.W. & LAWRENCE P.R. (eds.), Organization Planning, Irwin/Dorsey, 1972.
- LORSCH J.W. & LAWRENCE P.R., "Environmental Factors and Organizational Integration" in Lorsch J.W. & Lawrence P.R. (eds.), Organization Planning, Irwin/Dorsey, 1972.
- MANSFIELD E., Industrial Research and Technological Innovation: An Econometric Analysis, Longman, 1969.
- MANSFIELD E., RAPOPORT J., SCHNEE J., WAGNER S. & HAMBURGER M., Research and Innovation in the Modern Corporation, Macmillan, 1972.
- MARCH J.G. & SIMON H.A., Organizations, Wiley, 1958.
- MARQUIS D.G., "The Anatomy of Successful Innovations", in AMA, Managing Advancing Technology, Volume 1: Strategies and Tactics of Product Innovation, American Management Association, 1972.
- MEALIEA L.W. & LEE D., "An Alternative to Macro-Micro Contingency Theories - An Integrative Model", Academy of Management Review, v.4, 1979.
- MILES R.E. & SNOW C.S., Organizational Strategy, Structure and Process, McGraw-Hill, 1978.
- MINTZBERG H., "Strategy-Making in Three Modes", California Management Review, v.16, no.2, Winter 1973.
- MINTZBERG H., "Strategy Formulation as a Historical Process", International Studies of Management and Organization, v.7, no.2, 1977.
- MINTZBERG H., "Patterns in Strategy Formation", International Studies of Management and Organization, v.9, no.3, 1979.
- MONTGOMERIE G.A., "Industrial Innovation and the Interdisciplinary Approach", Proceedings of the IEE, v.124, no.1, January 1977.
- MURRAY J.A., "Toward a Contingency Model of Strategic Decision", International Studies of Management and Organization, v.8, no.4, 1978.

McGREGOR D., "Theory X and Theory Y" in Pugh D.S., Organization Theory, Penguin, 1971.

NICHOLLS J.R. & BROADBENT D.A., "The Role of Marketing in Evaluating Acquisitions", Long Range Planning, v. 12, no.1, February 1979.

OAKLEY M.H., The Torque Hose Actuator: A Study of the Development of a New Product, University of Aston Ph.D. Thesis, 1978.

OATES D., "Diversification through Venture Management", Management Review, February 1971.

O.E.C.D., The Conditions for Success in Technological Innovation, OECD, 1971.

PARK F., "The Technical Strategy of 3M" in AMA, Managing Advancing Technology, Volume 1: Strategies and Tactics of Product Innovation, American Management Association, 1972.

PARKER D.C., "How Managements Innovate", Management Today, September 1978.

PESSEMIER E.A., "Managing Product Innovation", in Baker M.J. (ed.), Industrial Innovation - Technology, Policy, Diffusion, Macmillan, 1979.

PETERSON R.W., "New Venture Management in a Large Company", Harvard Business Review, May/June 1967.

PETIT T.A., "Systems Problems of Organizations and Business Policy", Academy of Management Proceedings, 1972.

PETTIGREW A.M., The Politics of Organizational Decision-Making, Tavistock, 1973.

PETTIGREW A.M., "Strategy Formulation as a Political Process", International Studies of Management and Organization, v.7, no.2, 1977.

PITTS R.A., "Strategies and Structures for Diversification", Academy of Management Journal, v.20, no.2, June 1977.

PRYOR M.H. (Jr.), "Anatomy of a Merger", Michigan Business Review, v.16, no.4, July 1964, reprinted in Ansoff H.I (ed.), Business Strategy, Penguin, 1969.

PUGH D.S., Organization Theory, Penguin, 1971.

PUGH D.S., HICKSON D.J. & HININGS C.R., Writers On Organizations, Penguin, 1971.

QUINN P., "Strategic and Operating Management in Industry", CBI Review, no.16, Spring 1975.

RANDLE C.W., "Problems of R & D Management", Harvard Business Review, January/February 1959.

RAPAPORT R.N., Three Dilemmas in Action Research, Tavistock Institute, 1970.

- RAY G.F. & UHLMANN L., The Innovation Process in the Energy Industries, Cambridge University Press, 1979.
- REEKIE D., On the Shelf, Centre for the Study of Industrial Innovation, 1971.
- ROBERTSON A., "Technological Innovation and the Management of R & D", Management Bibliographies and Reviews, v.3, 1978.
- ROSSITER P.M., "Corporate Planning at Dunlop", Long Range Planning, v.12, February 1979.
- ROTHWELL R., "From Invention to New Business via the New Venture Approach", Management Decision, v.13, no.1, 1975.
- ROTHWELL R., "Intracorporate Entrepreneurs", Management Decision, v.13, no.3, 1975.
- ROTHWELL R., "The Characteristics of Successful Innovators and Technically Progressive Firms", R & D Management, v.7, no.3, 1977.
- RUBENSTEIN A.H., "Setting Criteria for R & D", Harvard Business Review, January/February 1957.
- SANDERS G., "Some Thoughts on Project Groups", Industrial and Commercial Training, June 1976.
- SALTER M.S. & WEINHOLD W.A., "Diversification via Acquisition", Harvard Business Review, July/August 1978.
- SCHENDEL D.E. & HATTEN K.J., "Business Policy or Strategic Management?", Academy of Management Proceedings, 1972.
- SEILER R.E., Improving the Effectiveness of Research and Development, McGraw-Hill, 1965.
- SEVERIENS J.J., "Product Innovation, Organizational Change and Risk", SAM Advanced Management Journal, Fall 1977.
- SIMON H.A., "Decision-Making and Organizational Design", in Pugh D.S. (ed.), Organization Theory, Penguin, 1971.
- SMALTER D.J. & RUGGLES R.L., "Six Business Lessons from the Pentagon", Harvard Business Review, March/April 1966, reprinted in Ansoff H.I. (ed.), Business Strategy, Penguin, 1969.
- SMYTH D.S. & CHECKLAND P.B., "Using a Systems Approach: the Structure of Root Definitions", Journal of Applied Systems Analysis, v.5, no.1, 1976.
- SOUDER W.E., "Effectiveness of Product Development Methods", Industrial Marketing Management, v.7, no.5, October 1978.
- STEINER G.A., Top Management Planning, Macmillan, 1969.
- STEINER G.A. & MINER J.B., Management Policy and Strategy, Macmillan, 1977.

- STOTLAND J.A., "Planning Acquisitions and Mergers", Long Range Planning, v.9, no.1, February 1976.
- SUSBAUER J.C., "U.S. Industrial Intracorporate Entrepreneurship Practices", R & D Management, v.3, no.3, 1973.
- TECOZ H.F., "Company Growth Policy", Management International Review, no.4/5, 1970.
- TEUBAL M., "On User Needs and Need Determination: Aspects of the Theory of Technological Innovation", in Baker M.J. (ed.), Industrial Innovation - Technology, Policy, Diffusion, Macmillan, 1979.
- THOMAS R.E., Business Policy, Philip Allan, 1977.
- THOMPSON J.D., Organizations in Action, McGraw-Hill, 1967.
- TWISS B.C., Managing Technological Innovation, Longman, 1974.
- TWISS B.C., "Changing Corporate Attitudes to Innovation - A Case Study" in Baker M.J. (ed.), Industrial Innovation - Technology, Policy, Diffusion, Macmillan, 1979.
- UHLMANN L., "The Typology Approach in Innovation Research" in Baker M.J. (ed.), Industrial Innovation - Technology, Policy, Diffusion, Macmillan, 1979.
- UTTERBACK J.M., "Product and Process Innovation in a Changing Competitive Environment" in Baker M.J. (ed.), Industrial Innovation - Technology, Policy, Diffusion, Macmillan, 1979.
- UTTERBACK J.M., ALLEN T.J., HOLOMON J.H. & SIRBU M.A. Jr., "The Process of Innovation in Five Industries in Europe and Japan", IEEE Transactions on Engineering Management, v.EM23, no.1, February 1976.
- UYTERHOEVEN H.E.R., "General Managers in the Middle", Harvard Business Review, March/April 1972.
- VERNON A., "A New Business Venture", R & D Management, v.4, no.2, 1973/4.
- WALSH M.E., "Common Sense in Project Management", Journal of Systems Management, May 1978.
- WARR P., "Action Research", Memo no. 160, Medical Research Council Social and Applied Psychology Unit.
- WEBB M.R., "Improve Project Leadership With the Aid of a Communication Infrastructure", Electronics and Power, July 1978.
- WILSON A., The Assessment of Industrial Markets, Cassell, 1973.
- WILSON A. & MACFARLANE I., "Research as an Aid to the Industrial Field Salesman", Industrial Marketing, August 1977.
- WRAPP H.E., "Good Managers Don't Make Policy Decisions", Harvard Business Review, September/October 1967.