Plastics Products: Good Design, Innovation and Business Success

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The Open University

DESIGN INNOVATION GROUP

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PLASTICS PRODUCTS:

GOOD DESIGN, INNOVATION

AND BUSINESS SUCCESS

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CONTENTS

FOREWORD

This is the first of a series of reports on the contribution of good product design and technical innovation to the competitiveness of British manufacturing industry and how product design and innovation is managed and practiced in successful firms, both in the U.K and abroad.

This report is the result of an investigation of design and design management in firms making plastics products carried out during 1980-81 by Dr. Vivien Walsh while she was a Research Fellow with the Open University Design Innovation Group. She is currently a Lecturer in Innovation at the Department of Management Sciences, University of Manchester Institute of Science & Technology, but remains as an active member of and consultant to DIG.

Other sectors investigated by DIG in the pilot phase of its work were the pedal cycle and passenger car industries. A separate report on design and innovation in the U.K cycle industry is to be published and material from both these investigations has been used as the basis for printed and audiovisual teaching material for the Open University undergraduate course T263 *Design: processes and products* (see Roy and Cross, 1983; Walker et al., 1983).

Further sectors, including electronic office equipment, office furniture, building products and heating and ventilating equipment are being investigated in the main phase of the project. This aims to generate distance continuing education materials on the management and practice of successful product design and innovation for teachers and practitioners of design.

Robin Roy
Co-ordinator, Design Innovation Group.

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Many other individuals and organizations contributed to the project in a variety of ways: with information and advice; helping to collect and analyse data; commenting on drafts and preparation of the final report. We are most grateful to them all.

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Picture credits:

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SUMMARY

This report gives the results of an investigation into the contribution of good design to the competitiveness of firms which manufacture plastics products. For this investigation eight 'Design-Conscious' firms, which had won Design Council Awards or other industry awards or prizes for good design, were compared with a 'Representative' sample of forty-one firms randomly selected from the British plastics products industry. The firms made a variety of consumer and intermediate products ranging from housewares, packaging and toys to automotive components and plumbing systems, either as 'own brands' and/or to customers' orders.

The main source of information was a series of interviews, covering management policies; design, production, quality control and marketing practices, conducted with appropriate staff in the selected firms. Most of the Representative firms were initially visited in 1979 for an earlier investigation and then recontacted in 1980 - 81. The Design-Conscious firms were all visited in 1980-81.

The firms' business performance over the period 1973-79 was calculated from company reports deposited at Companies House.

Further details of the two samples and the methods used are given in Section 1 and Appendices 1 and 2. Section 2 gives a brief overview of the plastics products industry as a context for the rest of the report. The main findings and conclusions of the investigation are given in Sections 3 to 5 and are summarized below.

The Design-Conscious firms on average grew considerably faster and were more profitable than the firms in the Representative Sample. More specifically, the firms which had won design awards for their products performed better than the Representative firms in respect of three business indicators - return on capital, turnover growth and capital growth - and the differences were statistically significant. The Design-Conscious firms also showed a higher profit margin on their turnover than the Representative firms, but here the difference was not statistically significant. There were also some commercially successful Representative firms, who did not devote much effort to product design, but adopted some other strategy (e.g. automation). In addition there was one highly Design-Conscious firm whose overall business performance was worse than the average Representative firm.

These findings suggest that the successful management and practice of design, as reflected in firms winning design awards for their products, increases the chances of business success, but it cannot guarantee it. It is necessary also to interpret this result taking into account the difficulties of reliably assessing the business performance of firms and in the light of the various factors, not only the ability to produce award-winning designs, that

differentiated the Design-Conscious from the Representative firms. Some of these differences are outlined below together with the strategies and design practices common to the Design-Conscious firms which marked them out from the typical Representative firm.

The Design-Conscious firms were on average larger than the Representative firms, all employing over 100 people and having established an effective management structure. They were much more likely than the Representative firms to have most of their business in 'own brand' products and to specialize in consumer goods. The Design-Conscious firms all had a formal long-term planning procedure, a highly active marketing policy and a commitment to the expansion of their business rather than mere survival; features present in most, but not all, of the Representative firms.

The Design-Conscious firms differed considerably from the majority of Representative firms in their understanding and management of product design. Although most of the firms in the Representative Sample considered product design to be important to their business, over a third believed that design was not worth much time, effort or money. The Design-Conscious firms went beyond a generally positive attitude towards design; they deliberately aimed to expand their business through a strategy of producing well-designed 'up-market' products of high unit value and quality. This involved a commitment to good design not only at the highest levels but throughout the firm. This was reflected in the recruitment of greater than average numbers of design and quality control staff, and the involvement of talented designers at senior levels in the firm and/or as outside consultants. In the Design-Conscious firms skilled designers were seen as an investment in the same way that many Representative firms viewed investment in advanced plant and machinery. It was notable also that managers and designers in the Design-Conscious firms tended to be enthusiasts for plastics as a material and designed their products to make best use of the specific properties of plastics. This was in contrast to some Representative firms whose staff still tended to view plastics as a cheap substitute for other materials and therefore continued to use the same designs that were appropriate for wood, metal or ceramics.

Although most of the firms visited had active marketing policies and marketing staff, the salient feature of the Design-Conscious firms was the close integration between design and other business activities, especially marketing. Market intelligence provided the Design-Conscious firms with ideas for new products and great emphasis was placed in obtaining feedback from purchasers or end-users in order to improve on (or if necessary to abandon) a prototype design. These firms tended also to employ technically qualified people in their marketing departments in order to get effective communication with and feedback from customers. Their designers preferred to work in three dimensions and interacted at an early stage with production and marketing staff in the development of a new product. This attention to interaction and feedback

reflected the broad understanding of design among staff in the Design-Conscious firms. In these firms 'design' meant more than just shape or appearance - a view typical of firms in the Representative Sample - it meant products that are fitted to use; can be made efficiently; are safe and durable; and, especially, products that will sell and make a profit. In the Design-Conscious firms the use of good design as a key part of their corporate strategy extended beyond the product to coordinated packaging design, extensive use of a company logo and special displays in shops and other outlets.

Traditionally competition in plastics products has been mainly on the basis of price. This investigation indicates that attention to 'non-price factors', especially product design, can be important ingredients of business success. But this does not mean that price is not relevant. Perhaps the most significant finding of the investigation is that for the successful firms 'good design' meant correctly balancing the performance, quality and novelty of products against their price. In both the Design-Conscious and Representative Samples, successful firms recognised the crucial importance of designing and making products that offered the customer good *value for money*. Often this lesson had been learned through visually attractive or innovative products which had failed in the market for being too expensive for what they offered to the customer (or conversely cheap products which were of too low a performance or quality). Thus the Design-Conscious firms deliberately set out to increase the value of their products by designing for good performance, appearance, durability etc. and by innovations in design. But most also designed for efficiency of production and use of materials to reduce costs and all priced their products flexibly in order to compete on value for money in different markets and market sectors. Many Representative firms, on the other hand, paid relatively little attention to product design and more to innovations in production technology in order to compete mainly on price.

The results of this investigation clearly indicate that good design can not only be achieved but can increase a firm's chances of business success, even in an industry that was dogged for years by the image of cheap goods in inferior materials. The investigation suggests however that moving up-market through product quality, design and innovation is not the only strategy for success, nor is it a guaranteed one. The best practices in the industry indicate that the chances of success are improved if design is well integrated with other business activities, especially marketing, quality control and production, in order to ensure value for money as the basis of good design.

Finally, it is worth noting that this investigation supports the conclusion of several other recent reports and studies that Britain's competitiveness should not be equated with low wages and cheap goods. It indicates that competitiveness is gained from increased *investment*, not just in more productive plant and equipment, but in the human resources needed for the effective management and practice of product design and innovation.

1. INTRODUCTION

1.1 Design, innovation and competitiveness

The decline in Britain's share of world trade, the decreased international competitiveness of British manufactured goods and the increased penetration of imports onto the British home market have caused widespread discussion and concern (e.g. see Blackaby, 1979; Pavitt, 1980; Glyn & Harrison, 1980). Problems of price and productivity received most attention in discussions about British competitiveness and economic performance until the late 1970s, and government policies aimed at improving Britain's position in world markets have focussed on these factors (e.g. see Posner, 1961, 1978).

However, the importance of 'non-price' factors, including product design factors associated with increased value, such as reliability, appearance, ease of use and maintenance, comfort, safety and technical specification and performance, have all been emphasised in a number of recent reports and studies. The Corfield report (NEDO, 1979) stressed in particular the importance of good *design*, while the Finniston Report (Committee of Inquiry into the Engineering Profession, 1980) and Pavitt (1980) have argued that technical *innovation* is one of the most important factors in competitiveness.

Design and innovation are, however, not entirely 'non-price' factors, since they both contribute to price competitiveness. Designing for economic manufacture and process innovations optimise energy and material consumption, increase labour productivity and thus reduce the costs of manufacturing products. However, the implications of the above reports and studies are that good design and technical innovation are both more important than price alone in purchasers' decisions to buy. Rothwell (1980; 1981) drew this conclusion in relation to the textile machinery and agricultural equipment markets, while Moody (1980) pointed to the importance of design in users' decisions to buy medical instruments.

This report presents some of the findings of a project being conducted by the Design Innovation Group at the Open University. The origins and methods of the project have been outlined in an earlier paper (Roy, Walker & Walsh, 1980). The Group's research has focussed attention on the factors leading to commercially successful, design-based incremental innovation, mainly in consumer goods, since most previous studies (e.g. SPRU, 1972; Langrish et al., 1972; Rothwell, 1977) in this area have concentrated on more radical, technology-based innovation, mainly in capital goods.

The Group has been examining selected sectors of manufacturing industry whose products are covered by the Design Council's annual Awards and/or the Design Centre Selection schemes. The pilot stage of the project has concentrated on three consumer industries; namely, plastics products, bicycles, and passenger

cars. These sectors differ in size, age, structure and technology, but have all been suffering from increased import penetration in the U.K. while still including notable examples of British firms with reputations for good product design and/or highly successful in commercial terms. This report discusses findings in the plastics products industry. It builds on an earlier investigation of the plastics processing industry conducted by the main author while working at the Science Policy Research Unit, University of Sussex (Walsh *et al.*, 1980). A paper by Roy (1983) discusses conceptual models of design, innovation and competitiveness and reports on a preliminary analysis of the Group's findings in the bicycle industry.

1.2. Method of investigation

The major source of information for this study was a series of interviews in firms whose principal business was making plastics products. Two samples were chosen some of whose characteristics are summarized in Table 1.

The first was a 'Representative Sample' of forty-one firms chosen randomly from the approximately 2000 firms in scope to the Rubber & Plastics Processing Industry Training Board (RPPITB). The firms ranged in size from one with five employees to ones with over two thousand staff and they made plastics products for a wide variety of end uses ranging from lids and stoppers, toys and packaging to engineering components and plumbing systems. The sample was designed to be representative of the British plastics processing industry; that is of those firms whose *principal* activity is converting plastics into finished products or components to their own design ('own brand' manufacture) and/or to a customer's order ('trade moulding'). British Leyland, as a major end-user of plastics automotive components (some of which it produces in-house), was also visited. Further details of the plastics industry may be found in Section 2.

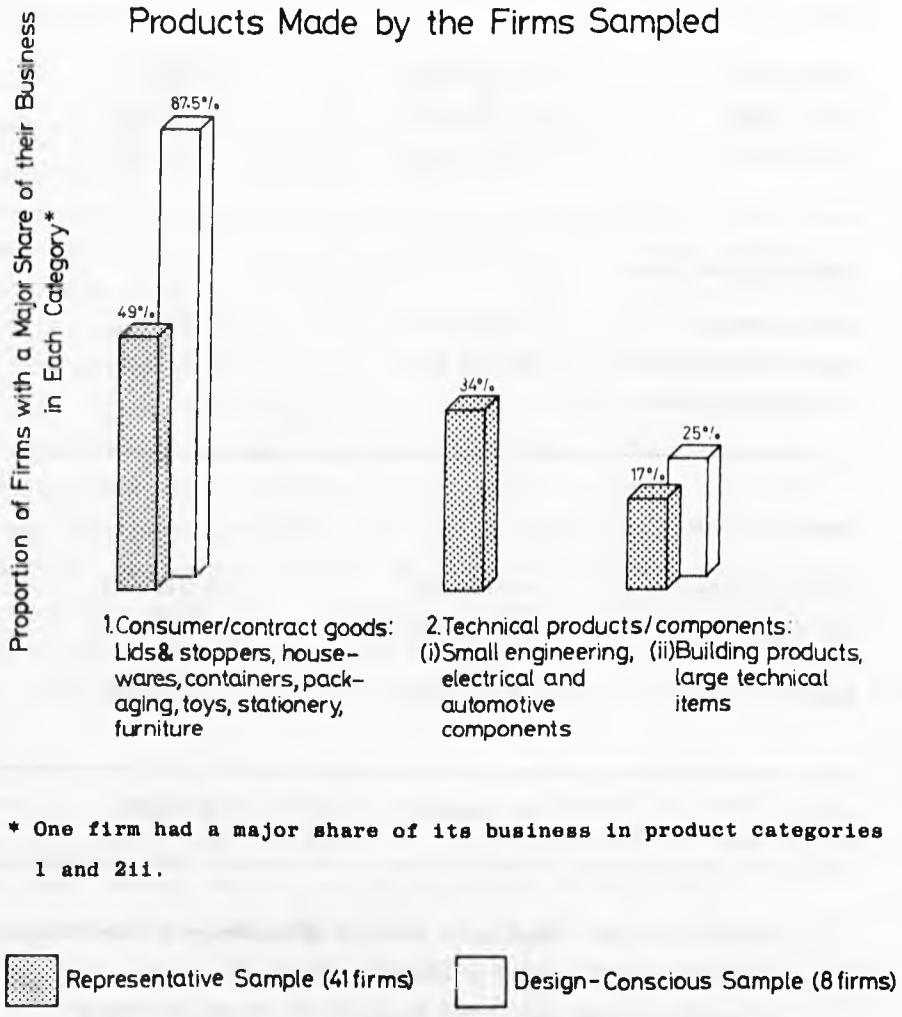
The second sample - the 'Design-Conscious Sample' - consisted of eight manufacturers of plastics products chosen for their reputation for good design. Each of these firms had won one or more design awards of some kind for its products: for example one of the Design Council Awards * for excellence in design; a listing in the Design Council's Index of well-designed British goods (now renamed the Design Centre Selection); or a relevant industry award, such as the Institute of Packaging 'Starpack' Award or 'Toy of the Year'. The majority of

*The Design Council is a government-funded body whose aim is to help improve the standards of product design in the British engineering and consumer goods industries. It gives annual Awards for British-made goods in five categories; Consumer & Contract Goods; Engineering Products; Engineering Components; British Motor Industry; Medical Equipment - and lists well-designed consumer and contract goods on the Design Index (or Design Centre Selection).

Table 1 Characteristics of the firms in the two samples.

	A. Representative Sample	B. Design-Conscious Sample	Total Sample
Size of firm:			
Under 100	12 (29.3%)[5]	0 (0%)	12 (24.5%)
100 - 499	22 (53.6%)	5 (62.5%)	27 (55.1%)
Over 500[1]	7 (17.1%)	3 (37.5%)	10 (20.4%)
Ownership of firm:			
Independent	17 (41.5%)	2 (25%)	19 (38.8%)
Subsidiary/Division of company group	24 (58.5%)	6 (75%)	30 (61.2%)
Type of firm:			
Trade moulder[2]	24 (58.5%)	1 (12.5%)	25 (51.0%)
Own brand maker[3]	12 (29.3%)	6 (75.0%)	18 (36.7%)
Both[4]	5 (12.2%)	1 (12.5%)	6 (12.3%)
Total	41 (100%)	8 (100%)	49 (100%)

1. Including firms comprising several divisions or subsidiaries only some of which made plastics products.
2. Defined as firms with >60% business in trade moulding
3. Defined as firms with >60 business in own brands
4. Defined as firms with 40% - 60% business in each category.
5. In the British plastics products industry as a whole there is a higher proportion of small firms (about 90% have under 100 employees) and a smaller proportion of medium and large firms (about 9% have 100-499 and about 1% over 500 employees). See Section 2.



*** One firm had a major share of its business in product categories 1 and 2ii.**

Figure 1

the Design-Conscious firms made consumer or contract goods; for example, packaging, toys, housewares, flooring, photographic darkroom equipment, furniture and netting. One Design-Conscious firm's main business was building products and two produced some building products or technical components as well as consumer goods. One Design-Conscious firm (Fisher Price) was American-owned and another (Van Leer) was Dutch-owned, but both manufactured in Britain. One foreign firm (the Danish toy manufacturer, Lego) was included in the Design-Conscious sample and was visited as a pilot study for the next stage of the project in which international comparisons between British and world-leading overseas firms will be made. A full list of the Design-Conscious firms and their awards is given in Table A1 in Appendix 3.

A total of forty-nine firms were contacted representing a wide range of firm sizes, types and forms of ownership (Table 1) and variety of product end-uses (see Figure 1). Semi-structured interviews were conducted with management, design and marketing staff, and with the technical director in firms which had such a post. In some cases the managing director, marketing manager or technical director was also in charge of design. Visits to firms lasted between half a day or less to one or more whole days. Interviews in some of the firms which had been visited in connection with an earlier investigation were conducted by telephone.

A checklist of questions about the firm's goals, strategies, planning, marketing policies, design activity, employment policies, research and development, product and process innovation and quality control was used to guide the interviewer. The questions on design covered such aspects as the personnel involved, their attitudes to design, the decision-making process, responsibility for design, the process of evolution of a new product design, and inputs from and outputs to other processes and activities in the firm such as marketing, research and development, production and quality control. The checklist of questions used in this investigation is given in Appendix 1. *

The intention was to compare and contrast the management, organisation, planning, design and related activities of plastics firms specifically selected for their reputation for good product design with a random sample of firms representative of the industry. It was hoped that any particular activity, factor or policy that distinguished the Design-Conscious firms from the general practice in the industry, would emerge from a comparison of the two samples. The method used to analyse the data from the two samples is outlined in Appendix 2.

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* The checklist was based on checklists and questionnaires developed at the Science Policy Research Unit for studies of technical change and skilled manpower needs in the plastics and engineering industries, but considerably modified to take into account the focus of this study on the design process. (see Senker *et al.*, 1976; Senker, 1979; Walsh *et al.*, 1980).

In addition to interviews, data on profits, capital and turnover were obtained from company reports deposited at Companies House, in order to try to establish whether success in design is correlated with indicators of business success. Firms were also asked whether they ascribed their success, or failure, to any particular factor, and how important they thought price and other factors were in their competitiveness.

The principal results of the analysis of the data collected are presented and discussed in the main body of the report; a more detailed breakdown of the results may be found in Appendix 3.

Work on this project is continuing. Further work on plastics will include an investigation of overseas firms with a reputation for good design and a strong competitive position in the U.K. market.

2. THE PLASTICS PRODUCTS INDUSTRY

This section gives only a brief overview of the plastics products (or processing) industry. Further details of its development, structure, products and trade performance may be found in Walsh *et al.* (1980) and in a Design Innovation Group background report on the plastics industry (Walsh, Bruce and Roy, 1983) from which the material in this section is derived.

2.1 Structure of the plastics industry

The plastics products industry supplies components, products, packaging materials and semi-finished items to the distributive and retail trades and to other industries. About 80% of processed plastics are supplied as components etc. to other sectors and only 20% are finished products for sale to consumers. The chemical industry supplies the plastics processing industry with chemical additives and 2 million tonnes of plastics materials, while the engineering industry supplies machines, moulds and dies.

Packaging and building products between them account for about half the total U.K. consumption of plastics and together with plastics components were the areas showing most growth in sales in the period 1963-80 (Figure 2). Other major end uses include toys, housewares, furniture, automotive components, electrical and electronic goods, and paints and adhesives (together accounting for just over one third of the plastics consumed in the U.K). The firms visited for this study between them made a complete range of products

There is not really a plastics products industry as such. About 4500 U.K. firms are engaged in the processing of plastics, but over half of them have some other principal activity, such as production of footwear, cable, motor vehicles or domestic electrical appliances, and carry out plastics processing as an in-house or in-company subsidiary activity. This presents certain problems in obtaining information about firms making plastics products. The Rubber & Plastics Processing Industry Training Board for example covers only the 2000 firms with plastics or rubber processing as a *principal* activity. Also firms in scope to the RPPITB are not precisely the same as firms classified by Minimum List Heading (MLH) 496 of the Standard Industrial Classification (SIC) used in the Department of Trade's Business Monitors. The MLHs are arranged chiefly by end use or function, such as floor coverings, toys or stationery, and not by material used. The production of plastics products is thus one of the most diffuse of the sectors covered by official statistics: it is included in seventeen MLHs in addition to MLH 496 (*'Plastics products not elsewhere specified'*). This naturally presents some difficulty in obtaining precise statistics derived from government sources (see Walsh, Bruce and Roy, 1983 for further details).

The total output of the plastics products sector was estimated at approximately

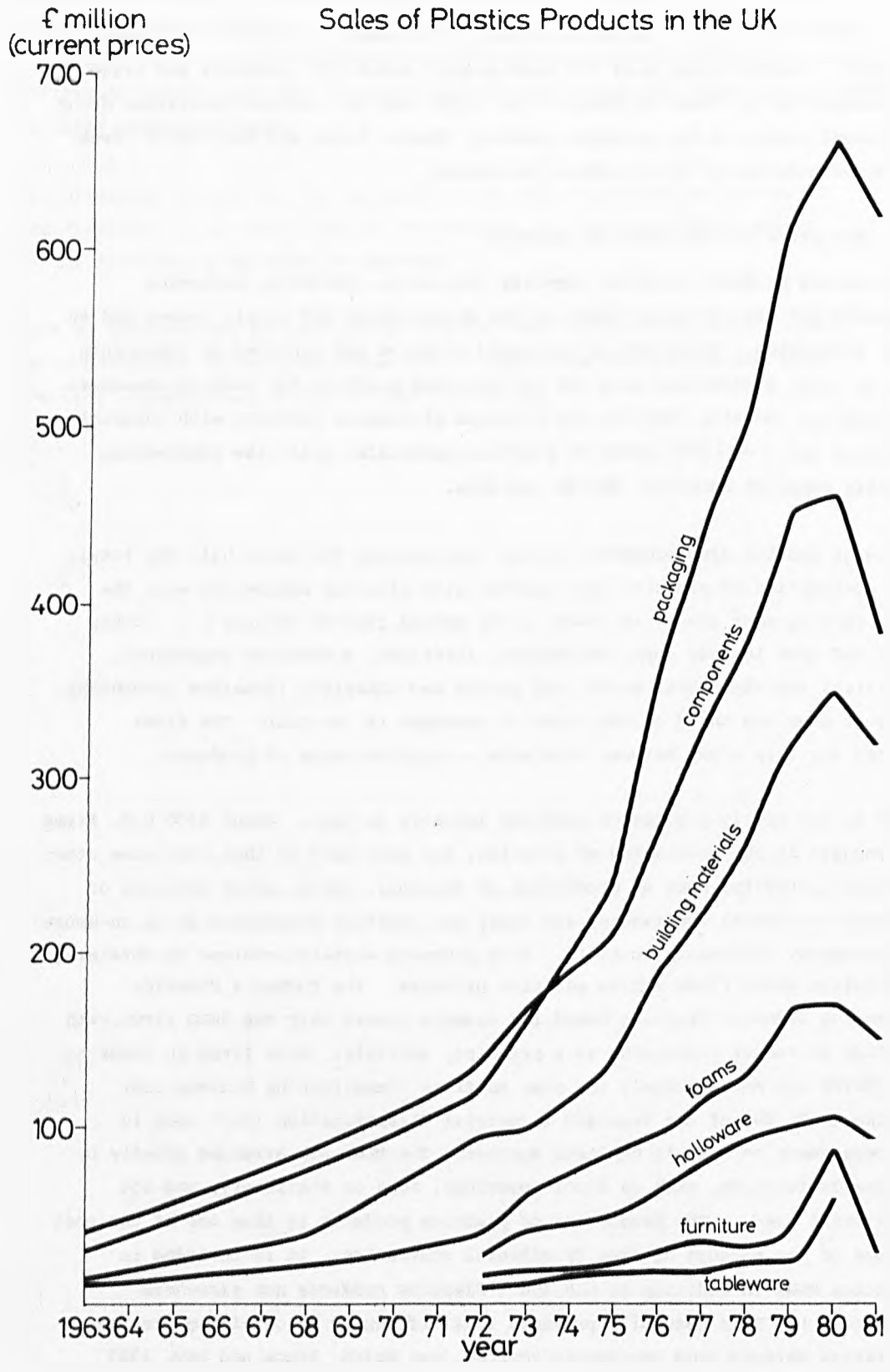
£ million
(current prices)
Sales of Plastics Products in the UK
700
600
500
400
300
200
100
packaging
components
building materials
foams
holloware
furniture
tableware
1963 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81
year

Figure 2

£4000 million in 1981, about half of which came from establishments classified to MLH 496. Approximately 150,000 people are employed by firms in scope to the RPPITB, while it is estimated that total employment in plastics processing is about 250,000 (NEDC, 1981).

Small firms dominate the plastics products industry. For this study, a small firm was defined as one employing fewer than 100 people, while a large firm employed 500 or more. Medium firms were those employing 100 - 499 people. In 1979 90% of firms classified to MLH 496 employed fewer than 100 people, while only 6 had over 1000 employees (Business Statistics Office, 1979). MLH 496 only gives detailed information on firms with more than 25 employees, which poses another problem in interpreting government statistics for a sector dominated by small firms: half the firms in scope to the RPPITB employ 25 or fewer people.

The small plastics firms make a major contribution to output and exports. Firms employing fewer than 100 people account for a greater proportion of the sector's output, sales, capital expenditure, value added and exports than their share of the sector's total employment. (In contrast, the motor industry for example includes about 1600 small firms with under 100 employees, but the three largest produce 56% of output). The large plastics processing firms (with over 500 employees) only account for about 20% of sales, output and capital expenditure. (see Walsh, Bruce and Roy, 1983).

The plastics products industry includes many firms which mould plastics only under contract to their customers, and often to the customers' exact design and specifications. These firms are known as 'trade moulders' or converters and represent the majority of firms, although not the largest part of the industry in terms of employment, since trade moulders tend to be small firms.

A majority of the Representative Sample of firms visited in this study had about two thirds of their business in trade moulding. The majority of the firms in the Design-Conscious Sample had most of their business in making their own brands of products and were thus not typical of the industry as a whole in this respect.

2.2 Developments in plastics products

The plastics materials sector (part of the chemical industry) and plastics products sector are essentially post World War II industries. They were fairly insignificant until after 1950, although nearly all today's commercially important plastics were first introduced onto the market before 1945. A majority of the firms we visited were founded in the ten years 1945 - 1955, when the 'plastics boom' began. Production of plastics was one of the fastest growing sectors of industry up to 1972, with net output increasing at an average annual rate of 11.7% between 1935 and 1972, and at 15% between 1963

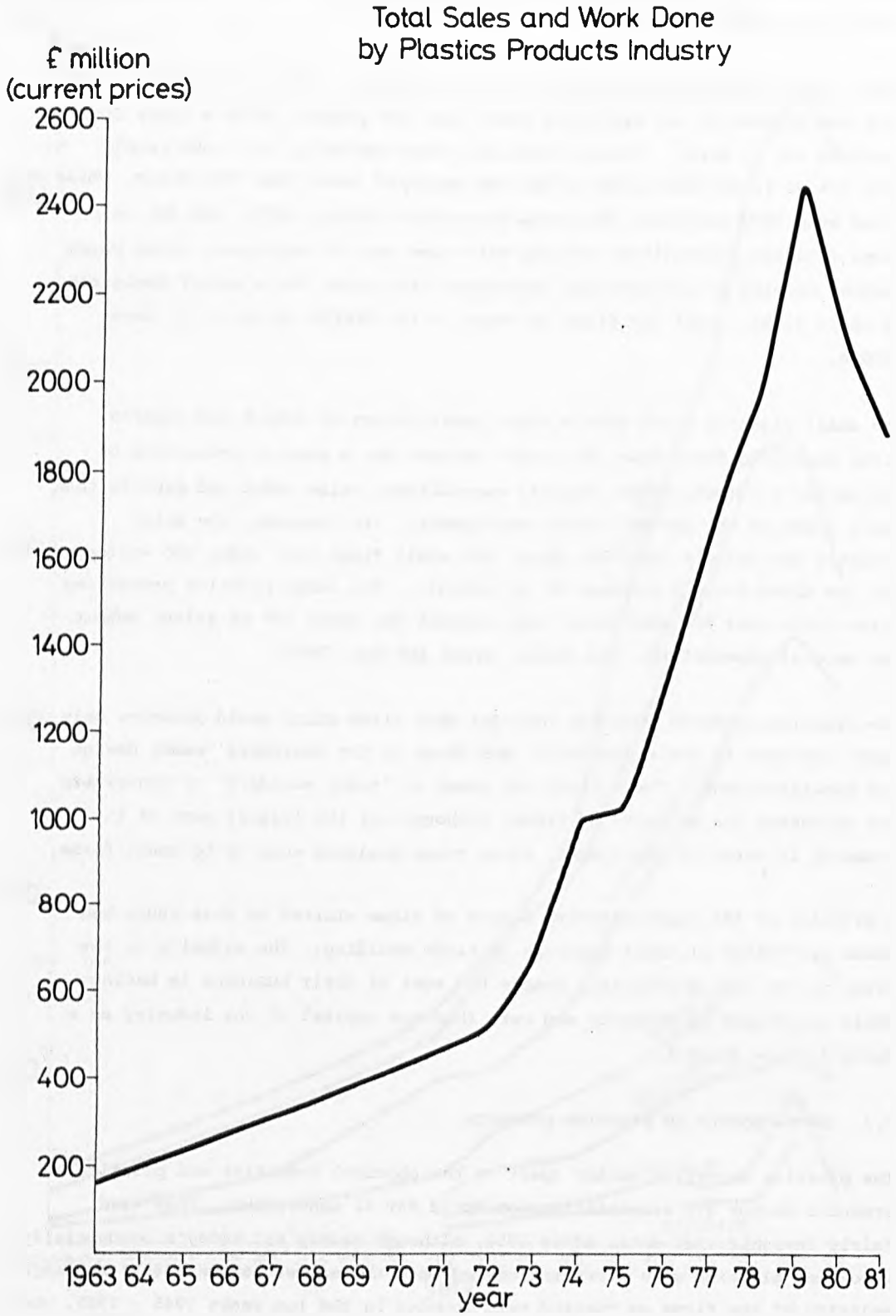
Total Sales and Work Done
by Plastics Products Industry
£ million
(current prices)
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
1963 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81
year

Figure 3

and 1972. Indeed, according to Sudjic (1980), 'plastics had caught the imagination of designers, manufacturers and even the public ' and 'the sixties were the golden age for plastics..... This was the modern world, and for a while fashion went crazy with a rather naive version of an all plastics future'.

Since then the market has fluctuated. For example in 1975, the year following the oil crisis of 1973 - 4, there was drop in the use of plastics indicated by reduced sales, output and new market development. The industry recovered between 1975 and 1979, but since then has experienced a fall in total sales output and employment (Figure 3). Per capita consumption of plastics, after rising steadily in the period 1975-79, also showed a marked fall in 1980 (NEDC,1981).

During the 1950s, the early years of the plastics boom, the growth was almost all in products such as polyethylene housewares, lids, containers, toys and minor components. Many entrepreneurs, often skilled toolmakers, started in business to exploit this demand: they often rented or bought second-hand machines and typically had garages or workshops under railway arches as their premises. There are still hundreds of small firms which have not changed essentially since then. Plastics products thus started with the image of being 'cheap and nasty' substitutes for products made from other ('real') materials. The main reason was that the firms making them had little concern for appearance, poor understanding of plastics materials and lacked expertise in various stages of the process. Many early plastics products were made from plastics unsuitable for the proposed end-use.

Subsequently plastics have become chosen materials for a wide range of end uses for which their properties are superior to other materials. Understanding of polymer science and technology and of processes for making plastics products have developed and the variety of plastics materials suitable for different end uses has increased. Polypropylene was the only bulk-tonnage polymer to be commercially introduced after World War II, although a few specialist end-use polymers were also available. The trend in plastics materials since the 1950s has been to produce new grades of existing polymers using various additives and fillers and mixtures of polymers and co-polymers such as ABS.

The poor image has however taken a long time to alter, and to some extent still persists. But the diversification and expansion of some of the early firms, and the establishment of new firms based on the production of more 'technical' products, for example, engineering components made from polymers such as polyamide (nylon) or PPO (Noryl), and investment in more sophisticated equipment, has played a major role in improving the products of the plastics processing industry, and consequently in improving the image of those products, and of the industry itself.

Firms are still being founded today in the same way as those immediate post-war

firms, but a majority of the newer ones have started out with an interest in more precisely specified 'technical' products or well-designed 'up market' consumer goods, and consequently with an interest in innovation in products and machinery and a tendency to employ more highly qualified staff. Toolmaker - entrepreneurs are still typical founders of plastics processing firms, but are more likely to be setting up in business to exploit a particular skill, technique, discovery or idea than their 1950s counterparts. As is shown in the rest of this report, they are also more likely to be active in marketing and to place strong emphasis on design and development, employing consultants where they have no expertise of their own.

2.3. Current and future trends

The post-war rapid growth in the use of plastics ended in the late 1970s (Figure 3). The recession in manufacturing since 1979 was a major factor in the decline, but in addition the oil crisis had pushed up the price of plastics, and saturation was beginning to occur in the markets for many plastics products. In particular, market saturation was taking place in the substitution of plastics for other materials, the major contribution to the earlier growth in output of plastics products.

After 10-20 years of life the failures of some plastics consumer products, like fading colours, crazed finishes and structural cracks, had become apparent. The safety of plastics was also being questioned. The processing of PVC was found to be associated with an otherwise rare form of liver cancer and polyurethane foam used in furniture was found to give off toxic fumes in a number of major fires (including the Manchester Woolworths disaster in 1979). Throughout the 1970s a major pre-occupation of the industry was with improvements in detailed design and the appropriate use of materials to avoid such product failures as those mentioned above; introduction of fire retardent grades of plastic; development of biodegradable grades in response to the environmental concern of the early 1970s; and process innovations in the manufacture of plastics materials to minimise hazards such as exposure to vinyl chloride monomer. A few firms began to introduce computer control of the moulding operation or robot handling of the product.

By the late 1970s, according to a market research report from Market Behaviour, plastics 'had lost their cheap and cheerful image' and were now seen as 'tough, hardwearing, hygenic and colourful' - and products were now being chosen because they were made of plastics, not despite being made of plastics (Sudjic, 1980). The Design Conscious firms which we visited echoed this view. Most of their designers were strongly committed to plastics as a preferred material and believed that plastics products could now be marketed as symbols of modern good taste, even - or especially - in the previously archetypal 'cheap and nasty' housewares market.

Thus the plastics materials industry has been concentrating on improving plastics materials, while the plastics products industry has been improving plastics goods via good design and a more efficient use of the variety of plastics available, in an attempt to counter the effects of market saturation and higher prices (Walsh, 1982).

3. DESIGN PRACTICES AND MANAGEMENT POLICIES

This section of the report presents the results of the information collected during the interviews with the forty-nine plastics firms from the 'Design-Conscious' and 'Representative' samples described earlier in Section 1.2. In Section 4 the business performance of the firms surveyed is assessed using data obtained from company reports deposited at Companies House.

3.1 Management and corporate strategies

(a) Firm size and planned expansion

Survival is the most important thing to the smallest firms. Although a quarter of the small firms in the Representative Sample are run by entrepreneurs with plans for expansion, technological advance and the development of more own brand products, the remaining three-quarters are owned and managed by people content to make an adequate living. But in both cases they nearly always have to operate on a very short-term basis, often with primitive facilities and premises and outdated equipment, at least until they are secure enough to consider implementing longer term strategies.

Firms tended to adopt expansion strategies only when they grew beyond about 100 employees and passed from small to medium in size or became part of company groups. This transition was also associated with longer term, formal planning, the adoption of an active marketing policy, the manufacture of own brand products, and consequently some kind of explicit design activity carried out by specialists (see Figure 4 and Appendix 3 Table A2). That is not to say that small firms never plan or design and market their own products, but such activities are not formalised. The owner - entrepreneur will typically make all decisions, do the manpower, investment and product planning and even make all the marketing approaches single-handed. Over 90% of the small firms were trade moulders (defined as firms with at least 60% of their business in trade moulding) whose products were usually designed by their customers; but all trade moulders made at least one or two own brands, and design of these would often be done by the owner - entrepreneurs together with all their other tasks.

Approaching the size of about 100 employees, firms began to feel the need to make the transition to some sort of formalized management structure. People would be appointed, or recruited, to roles such as personnel manager, production manager, technical director and marketing manager in addition to the managing director. All the firms in the Design-Conscious Sample were medium or large in size (see Appendix 3 Table A3) and had successfully made this transition, in some cases only recently.

Goals, Planning and Marketing Policies of Different Sizes of Firm in the two Samples

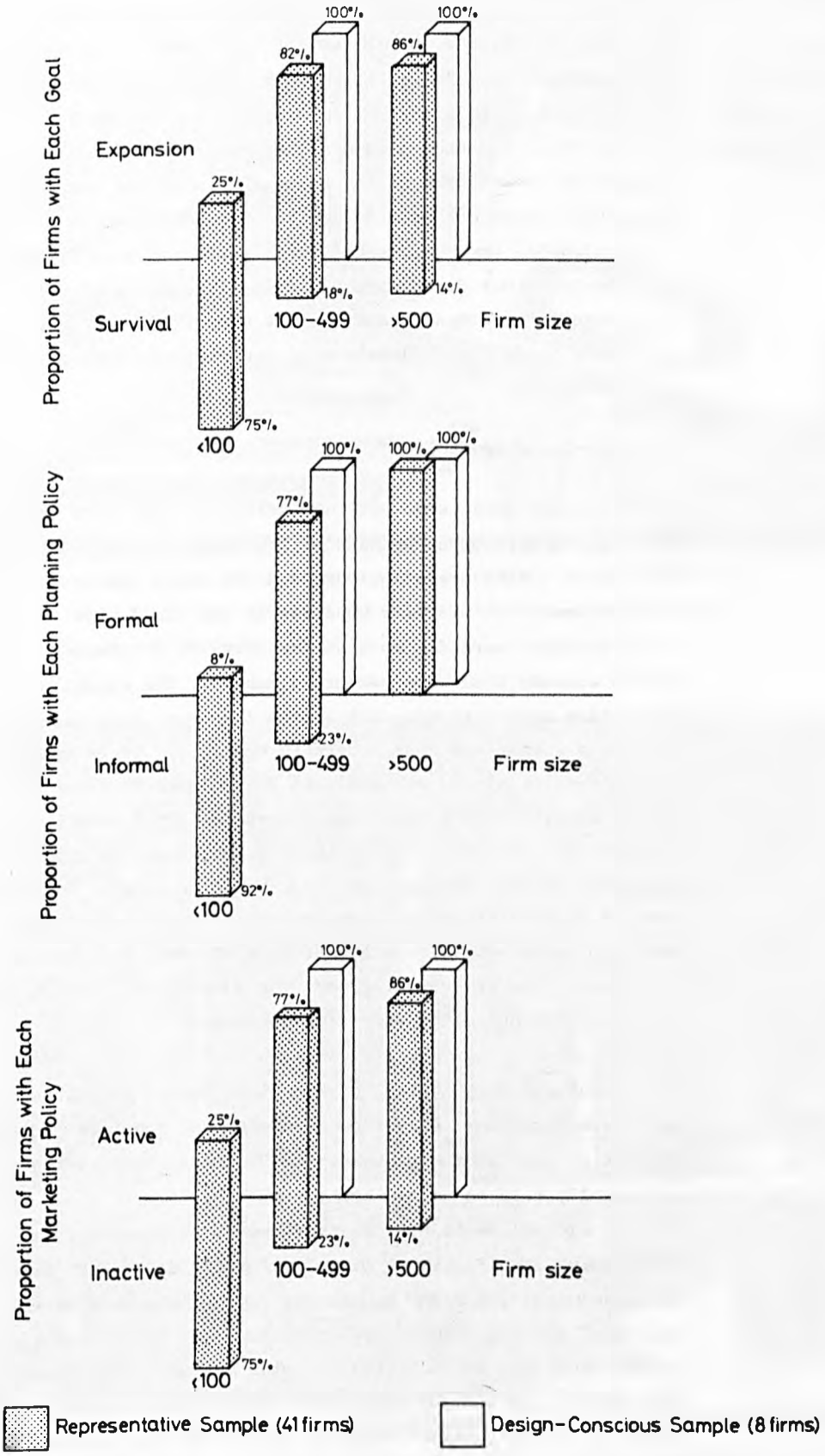

Figure 4

(b) Subsidiaries and independent firms

Parent and holding companies can have a strong influence over subsidiary firms or divisions. Nearly 60% of the firms in the Representative Sample were subsidiaries (see Table 1). However several of these were parts of companies with interests in areas not related to plastics products, or companies which viewed their plastics products operations as of secondary importance. Such holding companies can contribute to the plastic moulding subsidiary's failure, while a go-ahead parent can provide capital for investment and stimulate managerial and technological innovations and the practice of good design. Three-quarters of the Design-Conscious firms were also subsidiaries or divisions of company groups. But in these firms company headquarters supported their efforts to make high quality plastics products frequently with centralized research, design and development services.

(c) Own-brand products

A key feature associated with expansion and long-term strategy was the decision to develop a business in 'own brand' products (see Appendix 3 Table A3). Both trade moulders and own brand producers (defined as firms with at least 60% of their business in own brands) felt very strongly that trade moulders were far more at the mercy of the market and the ups and downs of the economy than were own-brand makers. The establishment of own-brand production may be risky; but in the long run, once established, it was seen as a more secure and less uncertain business. Trade moulders found that the struggle for business survival, in an environment over which they had little control, was a major preoccupation. Once they began making own brands they could build up stocks of their own products at times when machinery would otherwise be idle for lack of trade-moulding orders. The development of some kind of specialist design activity, being strongly related to the move into own-brand manufacture, was therefore also seen as a feature associated with expansion, long-term strategy and the adoption of a management structure, an active marketing policy and formal planning.

These features were typical of the eight Design Conscious firms visited in this investigation: only two - Crayonne and Van Leer - did trade moulding as most or part of their business. Van Leer makes packaging (see Fig.10), not usually sold as an own brand; but the firm is not a typical trade moulder either, as it does a large amount of necessary research, design and development itself, either directly for its customers or speculatively. Crayonne makes own brand housewares (see Figure 6) as well as doing trade moulding, and since about 1979, the firm has considerably expanded the ranges developed and marketed as joint ventures with retailers. For example the 'Mrs B', 'Working Kitchen' and 'St. Michael' ranges of housewares are presented as the branded products of Woolworths, Timothy Whites and Marks and Spencer respectively, although designed by Crayonne's designers and design consultants.

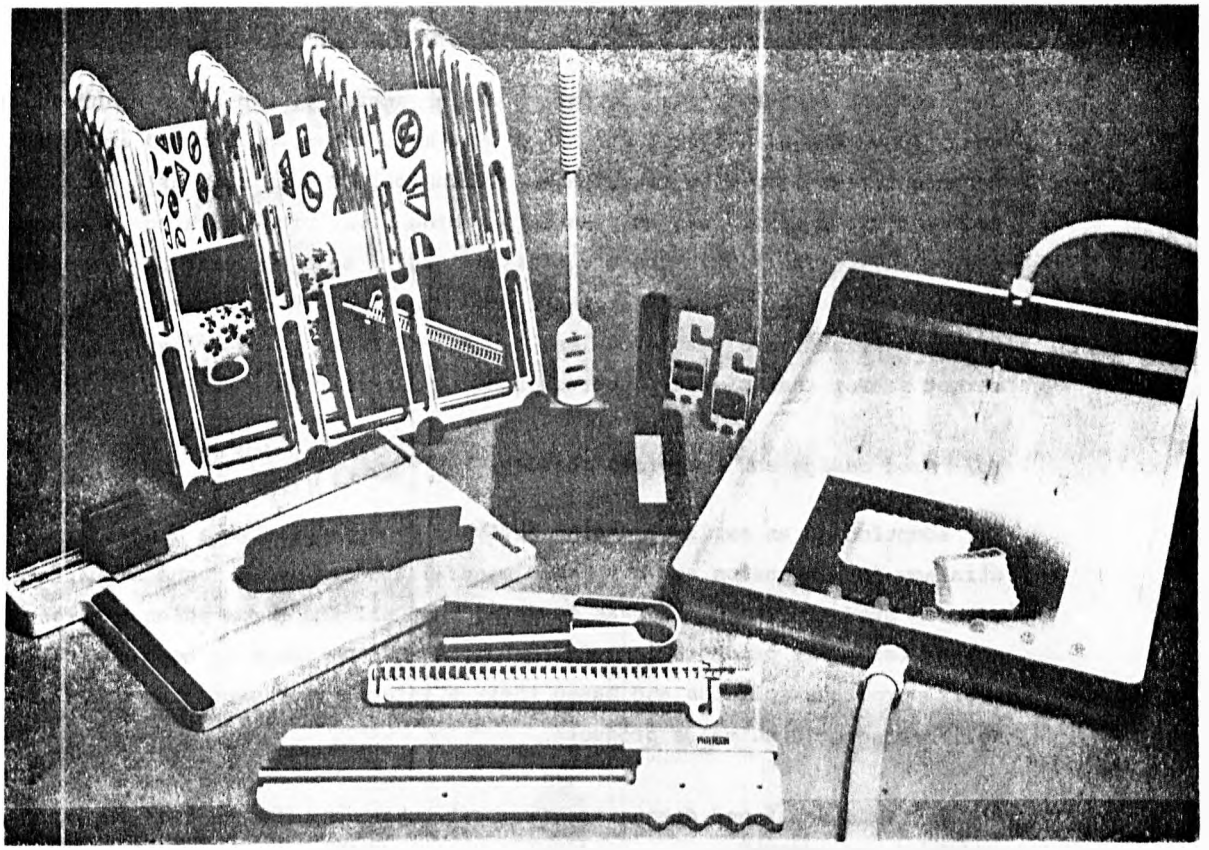

Figure 5 Eleven items of darkroom equipment made by Paterson Products Ltd. which won a Design Council Award (Consumer & Contract Goods) in 1979.

(Photograph: Design Council).

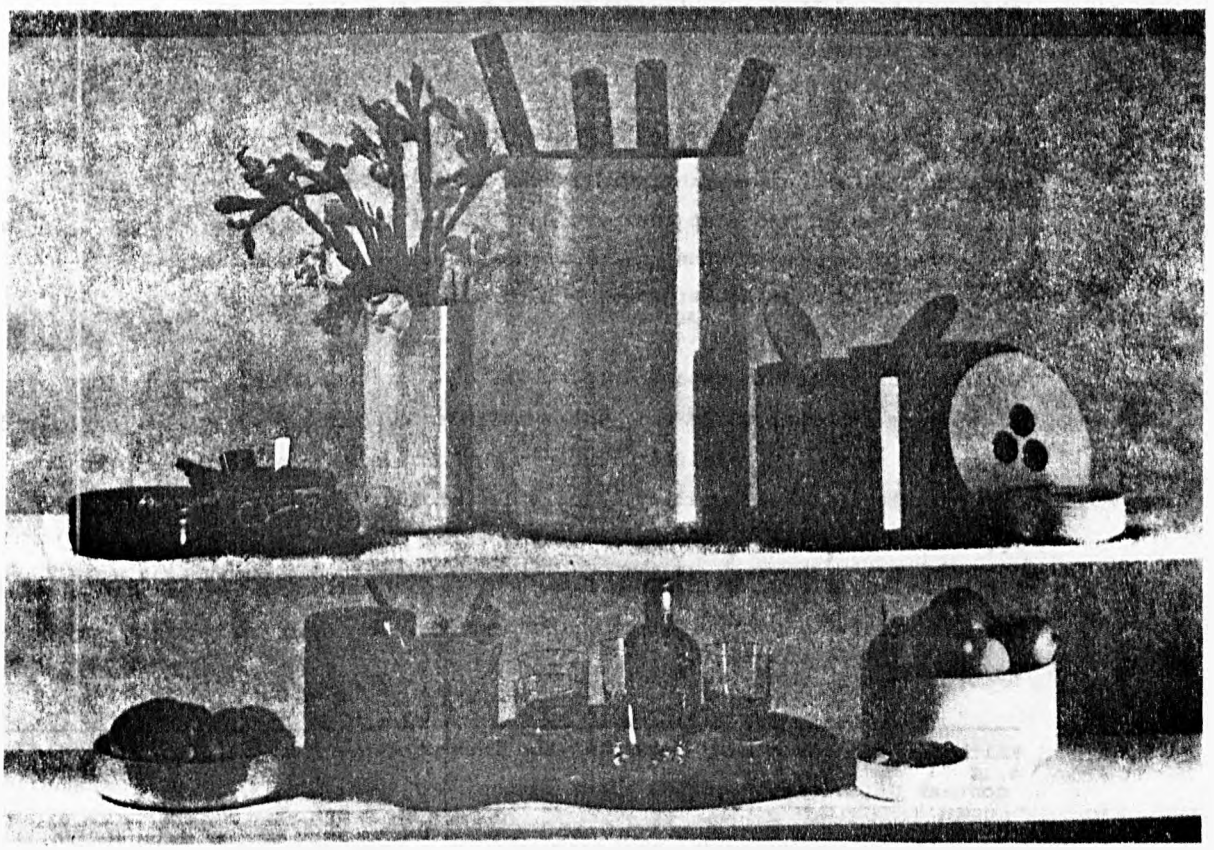

Figure 6 'Input' range of ABS containers designed by Conran Associates and made by Crayonne Ltd. The 21 items won a Design Council Award (Consumer & Contract Goods) in 1974. (Photograph: Design Council).

Such company features as a specialist design activity, own-brand manufacture and a long-term strategy of expansion were more often to be found among the Representative Sample in firms making 'technical' items, such as automotive and electrical components or plastic plumbing (i.e. product category 2 in Figure 1). The Design-Conscious firms largely made consumer and contract goods, such as housewares, furniture and toys (i.e. product category 1 in Figure 1), and were thus even less typical of firms in their particular market sector than of the plastics products industry as a whole.

(d) Good design and corporate strategy

The adoption of an explicit design activity by specialists, a long-term strategy for expansion and own brand manufacture are by no means a guarantee of good product design. It was striking that all the firms which had won awards for their products included an explicit commitment to good design in their corporate policies and based their strategies for expansion on making well designed, high value products.

Most of them mentioned design spontaneously when asked about their company goals. * For example:

'Our aim is to prove that British design can be good',

said Eric Taylor, Design Director of Paterson Products, manufacturers of photographic darkroom equipment for which the firm had won three Design Council Awards (Figure 5).

'Our main goal is to make well designed furniture',

said Mrs. C. Scheer, Marketing Director of Hille International, contract furniture makers and also Design Council Award winners (see Figure 14). These and other firms in the Design-Conscious sample were committed to good design both at the highest level and throughout the firm.

Firms which wanted to expand adopted various strategies and combinations of strategies in order to do so. These included automation of processing in order to reduce costs; diversification into new products or markets; and moving 'up-market' into high quality, high value products (see Figure 7 and Appendix 3 TableA4). It was the firms which planned to move 'up market' (or enter the market at the 'quality' end in the first place) who were committed most particularly to good design. For example, Mr. Dixon, marketing executive

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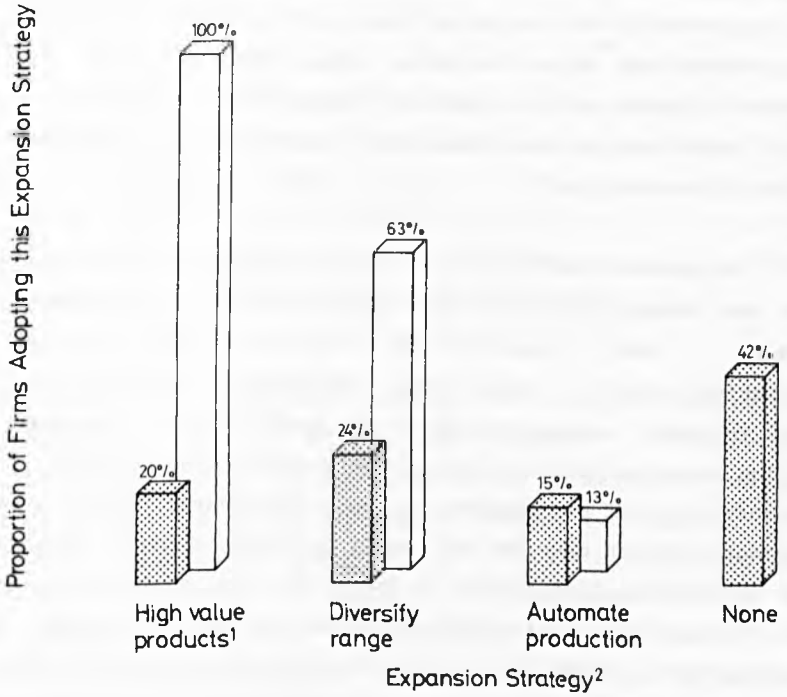
*Although of course they knew that the interview was being conducted in the context of an investigation about design.

Strategies for Expansion Adopted by the Firms in the Two Samples



1. i.e. 'up-market' products with a high value/unit weight achieved through greater design effort and/or higher quality polymers.

2. Several firms in the Design-Conscious Sample simultaneously pursued more than one major strategy for expansion.

Representative Sample (41 firms)

Design-Conscious Sample (8 firms)

Figure 7

at Crayonne, manufacturers of a range of Design Council Award winning plastics housewares (Figure 6) said,

'Our goal is always to move up market on the basis of good design'.

By 'up market' products, firms meant products with a higher value per unit weight than 'down market' ones. They were made to more precise specifications, had a more technical end-use or were made with more attention to visual appeal. In each case more effort was made in their design. Firms which made products of more expensive polymers (another factor which increases the value to weight ratio) were usually also those which spent more time and effort on design, to optimise material use.

As the Representative Sample included a cross section of the industry, there were some design-conscious firms in that sample too,including four firms with products included at some time on the Design Council's Design Centre Selection (or Design Index)*. Three firms, for example, mentioned that their company goals included 'increased quality via good design'; 'improved quality and image'; and 'an improved position as quality and precision moulders'. Healey Mouldings, a manufacturer of pan handles and other housewares, won an export award for small manufacturers and gave as the reason for success their 'meeting or exceeding the best international standards of design quality, style and reliable deliveries'. GPG Products part of the Guinness group and maker of crates and barrels, took the decision in about 1977 to launch an up-market range of plastic housewares as a result of a market survey which indicated that 'customers recognise quality plastics and superior design' and are prepared to pay more for good design 'if the ratio of quality and price' is acceptable (see Section 3.5 below on 'Value for money'). However, only some 20% of firms in the Representative Sample seem to adopt the strategy of moving up market through increased product design effort, compared with 100% of those in the Design Conscious Sample (see Figure 7). The latter were explicitly committed to the philosophy - and the practice - of expansion by increasing their market for high quality, high value, well-designed products. Their deliberate encouragement of good design, reflected in the recruitment of specialist staff, was seen as an investment in very much the same way that other firms saw their investment in automated process equipment.

3.2. Marketing policies and practices

The majority of firms visited had strong views on marketing. The larger firms all had quite extensive departments and elaborate training programmes. Over 60% of the firms in the Representative Sample, and *all* the Design-Conscious firms, had very active marketing policies (see Figure 4).

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* GPG Products Ltd; Meccano Ltd; Rotalac Plastics Ltd; R.A.Smith Plastics Ltd.

They would, for example, take pains to interact closely with their customers, participate in trade exhibitions and generally attempt to understand their market and the competition.

Firms' approaches to marketing were closely related to their type of business, so that all but one of the own brand manufacturers were active in marketing (see Appendix 3 Table A5). The own brand manufacturer inactive in marketing went bankrupt during the course of the study. On the other hand, nearly 60% of the trade moulders were classified as being inactive in marketing, which typically meant doing little more than placing an entry in the telephone Yellow Pages and waiting for customers to contact them. Firms' marketing activities were seen as crucial to their success by those that had moved into own brands from trade moulding, and those that planned to do so.

The Design-Conscious firms might possibly have been expected to rely on their own high standards of design to sell their products. In the event, however, all the Design-Conscious firms placed a high value on marketing and market research. When asked about their methods of product design, for example, the identification of a market opportunity as a result of market or consumer research, or feed-back from customers or experts, was usually mentioned as the starting point. Examples of 'experts' in this context are architects, in the case of Hille, contract furniture makers; builders, in the case of Marley, makers of plastic plumbing and drainage systems and plastics floor-coverings of all kinds ; or civil engineers, in the case of Netlon, makers of extruded plastic mesh for reinforcement of building and earth structures as well as for packaging and a wide variety of other applications.

Eric Taylor, Design Director at Paterson, often becomes aware of an opportunity for a new product because many of the staff are enthusiastic amateur photographers and are users of the company's products, while Netlon developed its civil engineering products because customers were using the firms' existing plastic netting for heavy duty uses, for which it was inadequate. Hille also employed or retained architects,and Netlon civil engineers,as consultants, to liaise with the experts in their own field.

(a) Prototype testing and test marketing

Feedback from the market continues throughout the development stage of a new product, with consumer tests of prototypes, test marketing and continued discussions with relevant experts.

The consumers or 'experts' in the case of the toy manufacturers visited - Fisher Price Toys and Lego - are children. Both these firms are foreign-owned and were part of the Design-Conscious Sample. Fisher Price runs a nursery for staff and

Figure 8 Plastic toys made by Fisher Price Toys Ltd. On the right is the 'Alpha Probe' spaceship. (Photograph: Vivien Walsh).

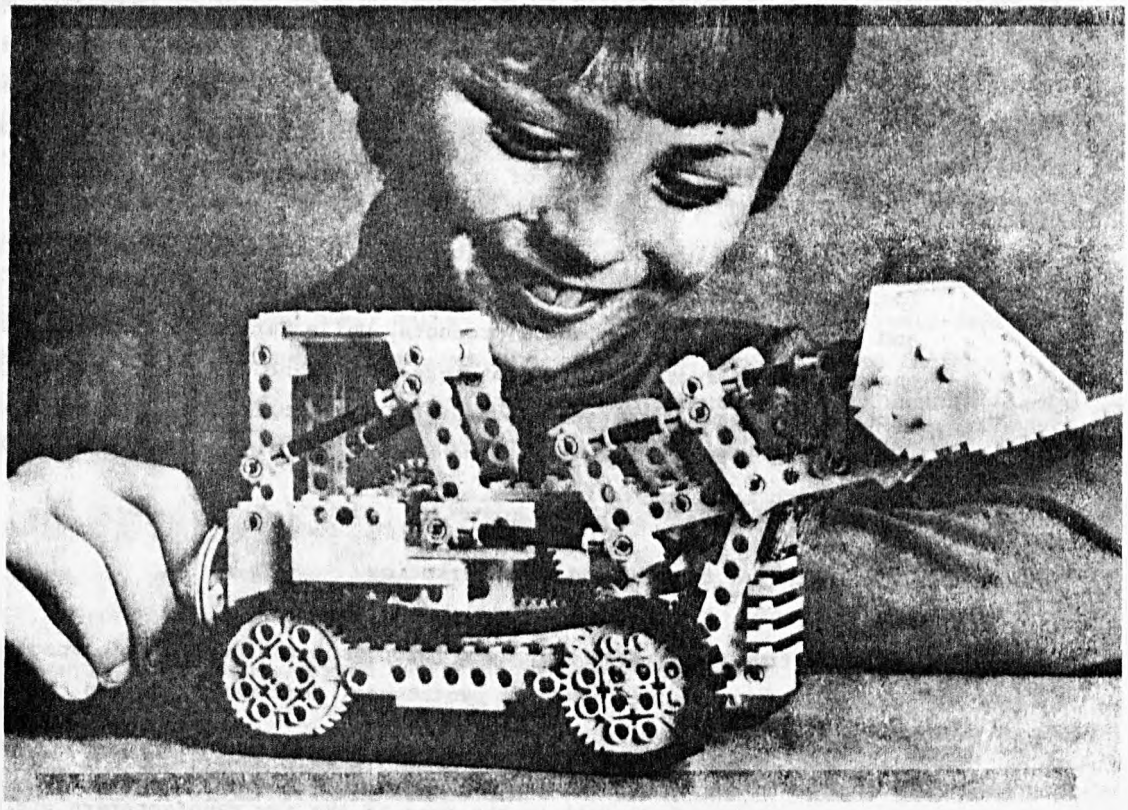

Figure 9 Model made from one of Lego's range of 'technical' construction sets. (Photograph: Lego (UK) Ltd.).

and local children, while Lego employs the services of school children, either in their own homes, at school or on visits to the company. In both cases the children play with the firms' prototypes over a period of months. If children reject a prototype, the project ends. If they like it, then the hours of concentration given to the toy and the variety of things they do with it are used as measures of its market potential (Figures 8,9). At Fisher Price, for every 30 prototype toys designed and given preliminary approval by the marketing department, about 20 are approved in the nursery, and from those some 15 are selected for production on the basis of cost and 'play value' (see Section 3.5 below on pricing policy).

(b) Marketing staff

Firms planning to move 'up market' had definite views on the choice of personnel in their marketing department. It was felt that one factor that gave them the edge over their competitors was the ability of the marketing department to 'speak the same language' as their customers.

Firms involved in exports meant this literally, and recruited linguists to their marketing departments. But many firms, in addition, trained technically qualified people in marketing skills so that they would understand exactly what their customers wanted. It was argued that a major factor in the early poor image of plastics, not entirely eradicated today, was the poor match of material and use, resulting from lack of understanding of possibilities and requirements by buyer and seller, and lack of communication between them. Examples included cheap toys that broke in a day, housewares that cracked, and washing up bowls that softened or became deformed in contact with hot water.

The technically qualified staff in question varied in skills and experience with the markets they were in. The toy manufacturers employed child psychologists and people with training or experience in education for liaison with schools and nurseries. The makers of 'up-market' housewares employed industrial designers and interior decorators and Crayonne, for example, entered joint marketing projects with stores. Some makers of 'own brand' engineering components recruited graduate engineers and plastics technologists into their marketing department. The maker of photographic equipment employed photography enthusiasts. The manufacturer of plastic plumbing and drainage systems had a chemist, draughtsmen and tool-makers in marketing.

(c) Corporate image and good design

The Design-Conscious firms made a particular point of marketing their company image, their whole range of products and their brand name as well as (or even rather than) individual items. As part of the promotion of a corporate image, Lego, Fisher Price, Crayonne, Marley and Netlon have special displays in stores

Figure 10 'Valerex' polyethylene industrial container designed and made by Van Leer (UK) Ltd. It won an Institute of Packaging Starpack Silver Award in 1980. (Van Leer (UK) Ltd.).

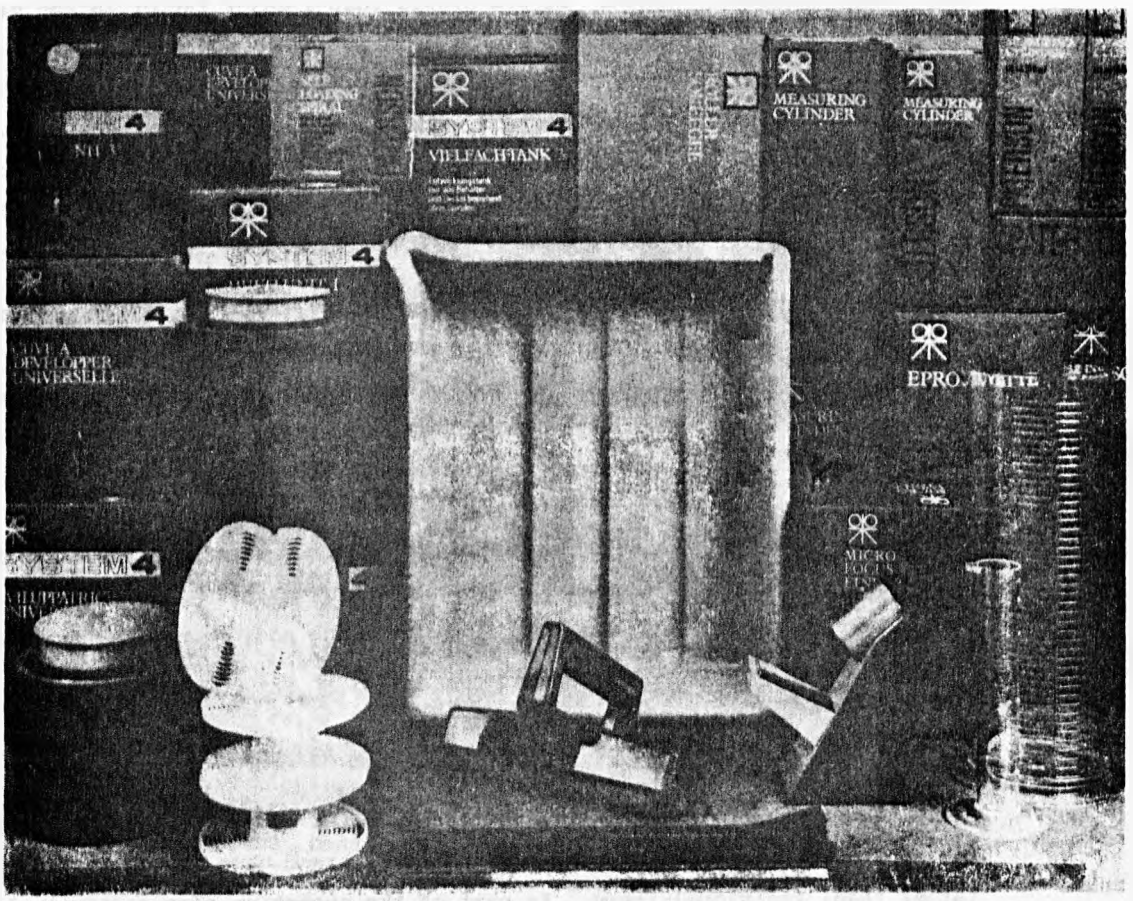

Figure 11 Coordinated packaging for Paterson's range of darkroom equipment which won a Design Council Award (Consumer Goods) in 1971. (Photograph: Design Council).

(sometimes a 'store within a store') which displays a whole range in one place. The manufacturer thus exercises some control over the way the retailer promotes the product. Paterson sells mainly to smaller outlets (photographic shops) rather than big stores, but also likes to promote the idea of special displays for its products. A minimum range of standard colours has strengthened the corporate image, although it was originally adopted to economise on materials during the 1974-75 plastics shortage. Lego further promotes its company and brand image through a Lego Club, with its own magazine, club rallies and design competitions.

Packaging represents a major end use of plastics but may not seem to provide the packaging *manufacturer* with much scope for design, since that is often specified by the packaging firms' customers. Van Leer nevertheless won a packaging industry design award for its products (Figure 10). Much of its product development is done in collaboration with its customers.

Most of the Design-Conscious firms believed packaging to be an important aspect of their marketing activity and the promotion of their company image. For example, Fisher Price, Lego, Crayonne and Paterson all pay particular attention to their packaging design, the use of company colours and logo, the multi-language pack, and the presentation of 'matching' items. Ranges of co-ordinated housewares or photographic equipment, for example, promote the idea of collecting for adults as the promoters of toys do for children. Lego has won design awards for both its products and its packaging , while Paterson's packaging attracted favourable comments from the Design Council in connection with their awards for the firm's products (Figure 11).

(d) Marketing, design and commercial success

Several firms pointed out that all aspects of marketing, including packaging, are vital to sell their products, particularly if they are promoting an 'up market', good design image. But they also point out that, while market knowledge and marketing proficiency may play a crucial role in deciding the outcome of a new product launch, the product must be good in the first place. By 'good', firms mean the attributes that increase *value*: the product may be of higher quality than competing products (e.g. stronger, longer lasting, better looking, more reliable or made to higher specifications); it may allow the user to do something previously impossible; it may reduce the customer's costs; or may meet user needs better than competing products. This supports the conclusions of other work on product success. Cooper (1979), for example, shows that the single most important dimension leading to new product success is 'product uniqueness and superiority'. Thus a bad product will not usually sell even with good marketing. But even a good product needs good marketing.

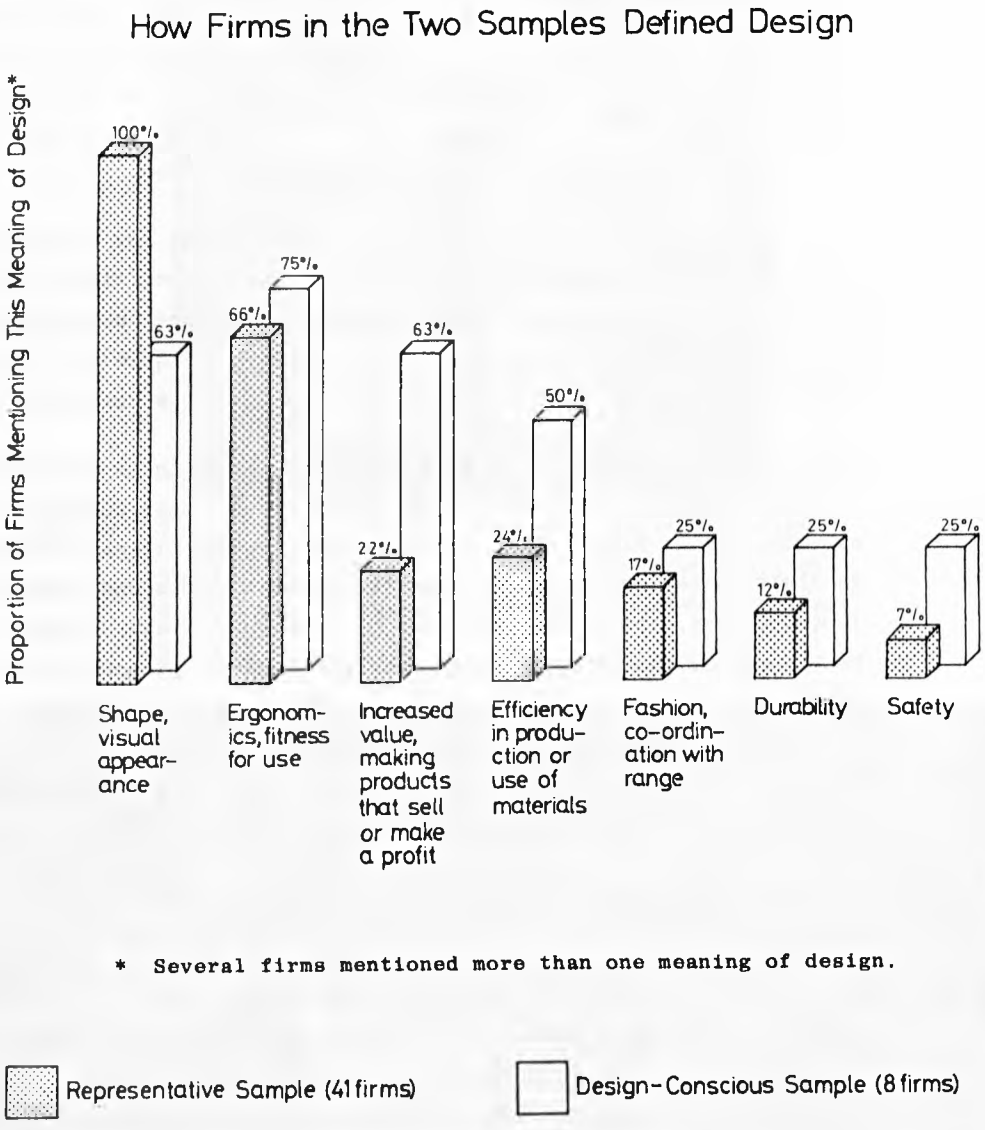
How Firms in the Two Samples Defined Design
Proportion of Firms Mentioning This Meaning of Design*
100%
63%
66%
75%
22%
63%
24%
50%
17%
25%
12%
25%
7%
25%
Shape, visual appear-ance
Ergonom-ics, fitness for use
Increased value, making products that sell or make a profit
Efficiency in produ-ction or use of materials
Fashion, co-ordin-ation with range
Durability
Safety
* Several firms mentioned more than one meaning of design.
Representative Sample (41 firms)
Design-Conscious Sample (8 firms)

Figure 12

Several firms we visited emphasized, however, that even a well designed and aggressively marketed product will not necessarily succeed if it does not offer good *value for money* - in other words if its price is too high for what it offers the customer. The issue of value for money is an important point which is discussed further in section 3.5 below.

Some of the most successful firms we visited, both commercially and in terms of winning awards for design, had a very aggressive marketing policy as well as a philosophy of producing good value for money. Lego, for example, when asked why they did better commercially than many of their competitors said 'we're the best' and 'we have a good nose for the market'. They adopted the policy very early on of trying to break into the German market, as a test of their strength and ability: 'We thought if we could beat the German toy manufacturers on their home market, then we could do anything'. Fisher Price is also a toy firm that goes in for aggressive marketing, spending a lot of time, effort and planning aimed at increasing their market penetration.

3.3. Design management and practices

(a) What firms mean by design

The Design Innovation Group has developed a working definition of 'design' as the configuration of elements, materials and components that give a product its particular attributes of function, appearance, durability, safety etc. Firms were asked how they defined design and a very wide variety of answers was given (see Figure 12).

The Design-Conscious firms tended to define design in terms of *several* factors. 'Fitness for use or function' was mentioned by three-quarters of these firms, followed by 'visual appearance' and 'increasing value'/'making something that sells'/ 'making something to make a profit', both factors being mentioned by two-thirds of the Sample. Next in frequency was efficiency in production and use of materials, mentioned by half the firms, and finally, safety (especially mentioned by the toy manufacturers); durability; fashion and coordination with range, each referred to by a quarter of the Design-Conscious firms.

Among the Representative Sample, on the other hand, 'design' was taken to mean 'visual appearance' by all the firms. One third of these firms defined design in terms of visual appearance alone. The rest defined design as visual appearance plus fitness for use or function. A further third of the Representative Sample firms between them additionally referred to the attributes mentioned by the Design-Conscious firms. In marked contrast to the Design-Conscious firms, only a few Representative firms defined design as 'increasing value' in order to make products that sell or make a profit.

Attitude to Design of Firms in the Two Samples

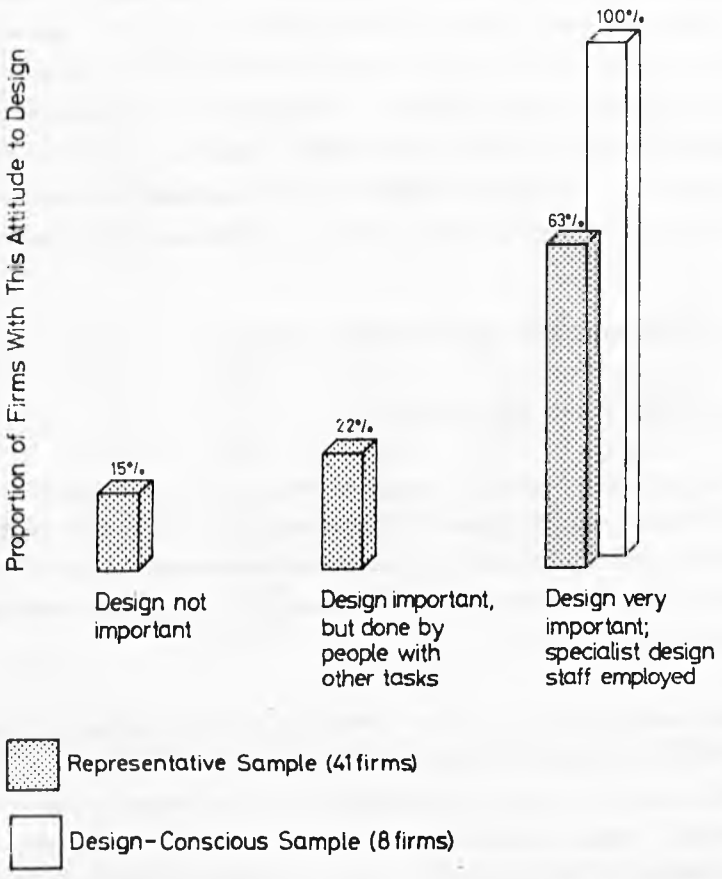

Figure 13

The Design-Conscious firms thus generally understood design more broadly than the firms in the Representative Sample and tended to include considerations of fitness for function and use, ease of manufacture, value for money, marketability and profit as well as (or sometimes instead of) visual appearance when *first* developing product specifications. Associated with this attitude was the mention of planning and co-ordination in connection with design. Planning the whole process means that ideas and knowledge about properties of materials, appearance of the product, its function, the optimum shape of the product for processing the polymer and for most efficient production and operation of the mould, and the product's potential market, can all be fed into the system at an early stage and acted upon before decisions have provided unnecessary additional constraints.

(b) Attitudes towards design

We saw earlier, in Section 3.1, that all the Design-Conscious firms had adopted a corporate strategy of growth based wholly or partly on moving up-market through attention to good product design, whereas this strategy was adopted by only one fifth of the firms in the Representative Sample (see Figure 7).

It is not surprising therefore that all the Design-Conscious firms considered design to be 'very important' and employed staff specializing in product design. However, nearly two-thirds of the Representative Sample firms also claimed that they considered design to be 'very important', or even 'vital', and likewise employed specialist design staff (see Figure 13). These firms would typically be the medium and larger ones, that is firms with over 100 employees, firms specializing in own brands, and parts of company groups (see Appendix 3 Table A6). It may be that some of these Representative firms are paying a degree of lip service to the importance of design (given that they knew that they were being interviewed about design) or view it merely as one factor in their corporate strategy rather than the key factor, as in the case of the Design-Conscious firms.

There is nevertheless a substantial minority of plastics processors in the Representative Sample who still think design is not an activity worthy of much time, effort or money. Most of these firms are trade moulders given orders or specifications by their customers. A third of the Representative Sample had this attitude (see Figure 13). Some of them appeared to be unaware that any design activity took place at all. In other cases people with other principal functions in the firm did product design as an additional job.

(c) Who does design?

The 'back of a cigarette packet' was often mentioned as a place for new product design in these Representative firms. In practice this meant that a toolmaker for example would do the design in conjunction with making the mould. They would usually place most emphasis on convenience of mould operation (e.g. by rounding corners on the product) within rather loose and very basic

specifications about function or use. Considerations of appearance or maximum convenience for the end user would typically be secondary.

Design was one of the functions typically taken on by the owner/managing director in the small plastics firms, but this did not necessarily mean that design was not considered important: who did designing was a function of firm size. One trade moulder who made a few own brands, for example, was a tool-maker turned draughtsman turned entrepreneur who was also a bee-keeper in his spare time. He designed own brand plastic replacements for metal components used in bee-keeping and honey production, said he 'loved design' and wished he could delegate all his *other* tasks. In three other cases the owner was a skilled draughtsman who made engineering drawings for the (contract) toolmaker to work to.

Managing Directors planning expansion and the adoption of a management structure would typically delegate design tasks as well as marketing, production and personnel management. Sometimes, a technical director would be appointed with responsibilities for research, design, development and quality control. More often the marketing manager would take responsibility for new product design and the employment of specialist designers or liaison with consultants. It was noticeable that the Design-Conscious firms all had very senior staff responsible for design, typically a director or senior manager with access to the company board. At Hille the joint chair-person, Ray Hille, is a designer, as are her daughters, the sales director and marketing manager. As noted earlier, design is considered important throughout these firms, However, it was unusual, even in the Design-Conscious firms, to have a Design Director - responsible only for design - with a status equivalent to directors of production, marketing, finance, etc., as recommended by Sir Kenneth Corfield in his report *Product Design* (NEDO, 1979). Eric Taylor at Paterson was an exception: in his case responsibility for design alone was one of the most senior positions in the firm. He commented, 'Design is not the icing, but the first nut and bolt'. This commitment had resulted in Paterson being exceptionally successful in gaining accolades, not only for the design of its products, but also for the management of the design function; the firm had won Design Council Awards in 1971, 1973 and 1979 and the Royal Society of Arts Award for Design Management in 1973.

Depending on size, the firms which thought design 'very important' would employ individuals or a whole department to carry out design tasks in the firm. The majority of firms in the Representative Sample which said they had separate design departments were in practice referring to conventional drawing offices staffed with draughtsmen whose main task was to design tools. Clearly the tool or mould determines the shape and configuration of the product, but tool designers are rarely concerned with product design attributes other than ease of moulding. Only a few firms in the Representative Sample seem to employ industrial designers or design engineers, and one technical director

even said 'we haven't got any arty types', a term apparently covering any kind of designer other than a time-served tool-maker, engineer or draughtsman.

The Design-Conscious firms, on the other hand, all employed specialist, highly qualified or experienced product designers, or well known outside design consultants. For example, Crayonne retained Conran Associates and Hille retained Robin Day, and both firms employed their own designers as well. At Lego members of the design team are recruited through competitions. Applicants for vacancies in the design department are asked to build models with Lego bricks, and the most imaginative or creative get the jobs, regardless of age, sex, qualifications or background (although in practice many turn out to have a design background of some kind, particularly in architecture).

The Design-Conscious firms all employed at least 2%, and a third 3% or more, of their staff as full-time designers (see Table 2).

Table 2 Employment of qualified staff and specialist designers in the two Samples

A. Representative Sample	≤ 2% total staff with higher qualifications[1]		≥ 3% total staff with higher qualifications
Number (%) firms	23 (56.1%)		18 (43.9%)
B. Design-Conscious	< 2% total staff specialist designers[2]	2-3% total staff specialist designers	>3% total staff specialist designers
Number (%) firms	0(0%)	5 (62.5%)	3 (37.5%)

Notes: 1. All staff with a degree, HNC or equivalent including those whose tasks involve design work.

2. Counting only total employees in country of manufacture.

In the large company groups teams of designers were often employed in a central research, design and development office which serviced the group's various divisions and subsidiaries, sometimes world-wide.

Although some designers had no formal qualifications and so could not be included in the total number of staff with higher qualifications (degree, HNC or equivalent), it is nevertheless interesting to contrast the proportion of specialist designers in the Design-Conscious firms with the employment of all qualified staff in the Representative Sample (see Table 2).*

In the Representative Sample fewer than 45% of firms employed 3% or more staff with higher qualifications, whose tasks may include design. The majority of these firms had 2% qualified staff or less, while nearly 40% employed 1% or less staff with higher qualifications.

The nature of the qualifications and the experience of full-time design staff, in the firms where they were employed, naturally varied greatly with the nature of the products made. Designers of precision engineering components, for example, were likely to be engineers, whereas designers of housewares, were more likely to have a background in industrial design.

(d) What designers do

In the Design-Conscious firms most of the designers liked to work in three dimensions at the earliest possible stage rather than relying on two-dimensional sketches or drawings. Eric Taylor, chief designer of photographic darkroom equipment at Paterson, said it was very important to have something to look at, hold and try out when a new product design was being discussed, either within the design team or with marketing and production people. At Paterson full-size prototypes are built by hand before detailed drawings are made and in fact toolmakers often work from the final prototype rather than an engineering drawing, when making the mould. The final prototype and manufactured product look, or even are**, identical in every way (except for the very small mark which indicates that an object has been injection or blow moulded rather than hand made). At Paterson, a new product evolves via two or three,or sometimes as many as six, mock-ups each representing modifications proposed by the managing director, marketing and production team, the design group and indeed any member of staff with an interest in the design.

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* We were not able to directly compare the proportion of designers in the Design-Conscious firms with those in the Representative Sample because some of the latter firms were unable to estimate the number of job-equivalents in design: design was carried out by staff as part of their jobs and not by full time designers.

** Depending on whether the prototype is made from the same materials as used in manufacture.

The modifications result from trials in the darkroom of function and of ease and convenience in use, together with considerations of efficiency of production and use of material and ideas about 'what looks right'. The company's policy is that 'the best darkroom products are designed in the darkroom'.

At Hille, furniture manufacturers, hand-made prototypes are made from preliminary sketch designs. Contract work for example in offices , schools, airports and other public buildings, represents a major part of the firm's market. Hille therefore likes to obtain the opinions of leading architects and other specifiers by inviting them to a conference to view and discuss a new prototype. Many modifications result from these discussions: for example, one of the firm's recent new chairs was made wider.

Crayonne's Physical Development Department makes models of new plastic housewares for discussion with customers (in the case of joint development work with stores like Marks and Spencer), or with potential retailers (e.g. Habitat) and produces samples for final consumers (in the case of own brands). Consumer trials may range from the spontaneous reaction of people stopped in shopping centres etc. and asked for their comments on new designs to trials of prototypes in selected homes. Comments on the prototypes lead to modifications - for example in the grip of a grater, the width of a colander or the angle of a bowl - and sometimes result in an item being dropped altogether from Crayonne's range. However, the model makers at Crayonne only get to work after the initial sketches have been discussed at length by the management committee (which has responsibility for new product design and consists of the Managing Director, Personnel Director, Production Director and heads of Marketing, Sales and Physical Development), further sketches made and finally working drawings produced. Where development is being done jointly with major customers, joint 'brain-storming' meetings are held before the working drawings are produced. Until 1979 Conran Associates did the detailed design work for Crayonne, providing sketches for discussion with the management committee and producing the working drawings from which prototypes, and eventually moulds, were made. In 1979 the design studio Benchmark was established as an investment venture by the Airfix Group, of which Crayonne was a part, and which recruited David White, Conran's director of product design.

At Lego, when new product ideas are being developed, one of the first activities is to make mock-ups for discussion with the managing director, production and marketing staff. Two people are employed solely on the 'trouble shooting' job of spotting errors in the models. Such errors might be dimensional - new Lego components have to fit with all existing components, often in several ways - or might relate to the most rational and efficient method of manufacture. After costing is accepted, prototypes are made using a 'trial'

Figure 14

Polypropylene chairs designed by Robin Day for Hille International Ltd. The company's first moulded chair won a Council of Industrial Design Award in 1964 and in its various versions has sold over 10 million units.
(Photographs; Hille International Ltd.).

tool* and then 'consumer tested' with children, as described in Section 3.2.

Fisher Price, another toy manufacturer, adopts similar procedures, although perhaps discussing at greater length on the basis of sketches and drawings before going to the model making stage. At both firms a new toy stands no chance of reaching the market without an enthusiastic response from children, however strongly the designers, marketing staff or costing department champion it. Design modifications are usually made after observing the ways in which children improvise with the prototypes and other toys.

(e) Plastics as a material

Many of the Design-Conscious firms were committed to the use of plastics as a material. It is very difficult to produce good designs if the material specified is believed to be inferior, a second choice, 'cheap and nasty', or even as good as but no better than an alternative material. Paterson, for example, 'believed in plastics from the beginning'. Lego and Fisher Price both started as makers of wooden toys but began to make toys in plastics in the early 1950s, when sales of plastics consumer products were first taking off. Crayonne deliberately set out to make *well designed* housewares in plastics, hitherto a type of product almost synonymous with poor quality. Hille was one of the first firms to exploit the plastic material, polypropylene, in making its now very widely used, Award-winning designs of moulded chairs: 'at last the perfect material' (see Figure 14).

Netlon plastic mesh was a novel product made possible by an innovation in extrusion technology that relied on the particular properties of plastics to weld together when still soft (see Figure15). Netlon mesh is now made from a variety of plastics for a very wide range of applications from fruit and vegetable packaging and garden netting to snow fencing and kidney machine filters. The firm has won a number of awards and prizes, including two Queen's Awards (for Technological Innovation and Exports) and a Design Council Award. All its garden products are included on the Design Centre Selection. (Figure 16).

In contrast, some of the firms visited in the Representative Sample designed a plastic product in essentially the same way as the metal, ceramic or wood item it was replacing. Others paid more attention to the specific properties of plastics,which sometimes require quite a different shape for optimum performance, but few were champions of plastics as materials in the way that the Design-Conscious firms were.

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* A low cost mould that is capable of making only a few thousand mouldings, usually cast not machined, and made in light alloy not hardened steel.

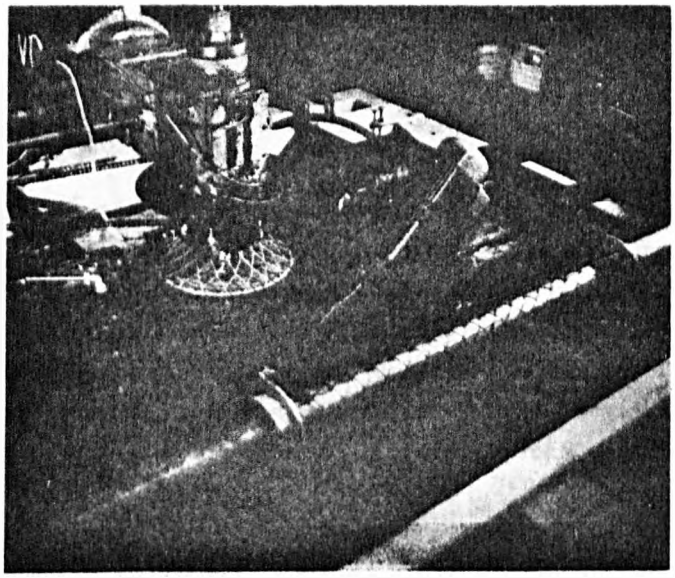
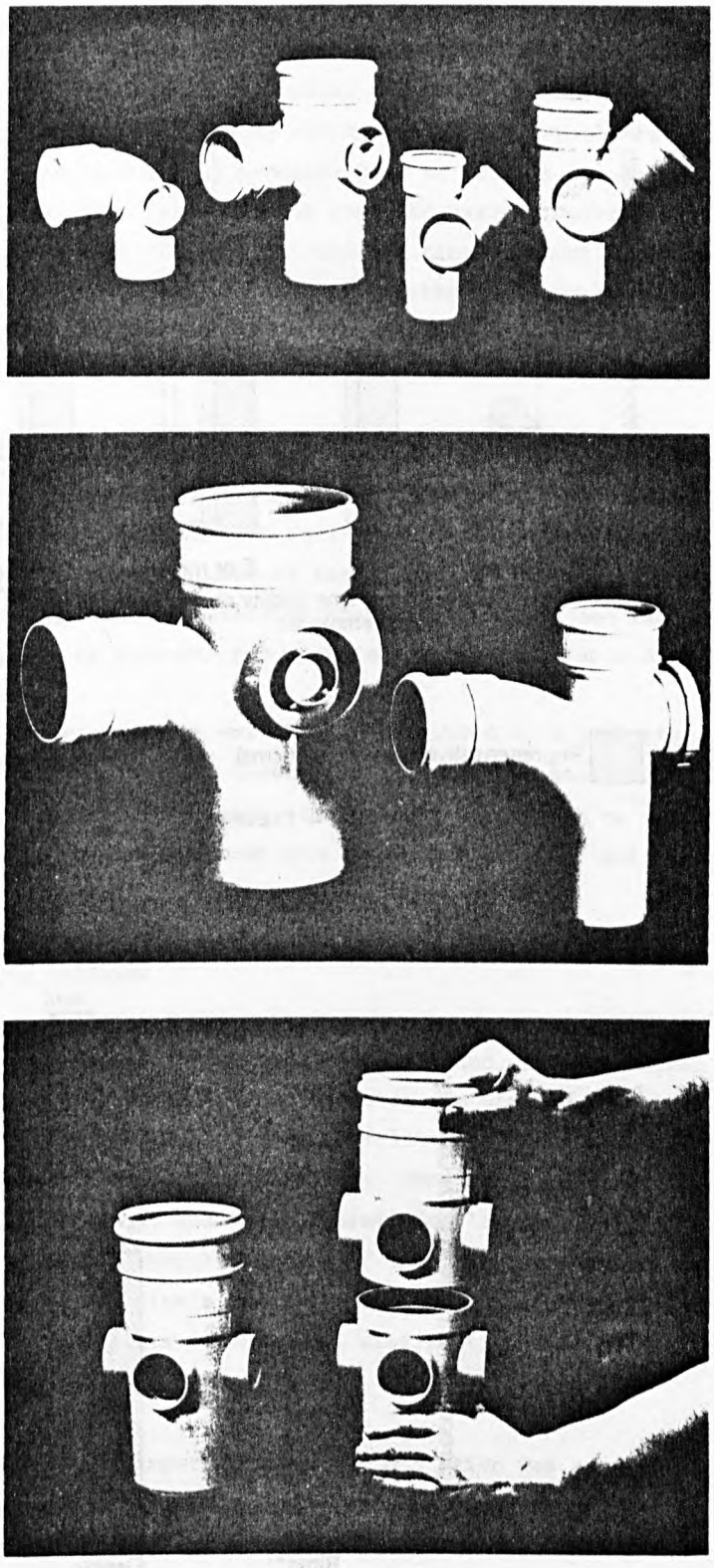


Figure 15 Netlon plastics mesh being extruded. As the extrusion head rotates the filaments of soft plastic weld together to form a mesh (Photograph: Netlon Ltd.).

Figure 16 Range of extruded garden mesh designed and manufactured by Netlon Ltd., which won a Design Council Award (Consumer & Contract Goods) in 1973. (Photograph: Design Council).



Discharge pipe fittings made from unplasticised pvc by Marley Extrusions Ltd.

Employment of Quality Control Staff and Quality Tests

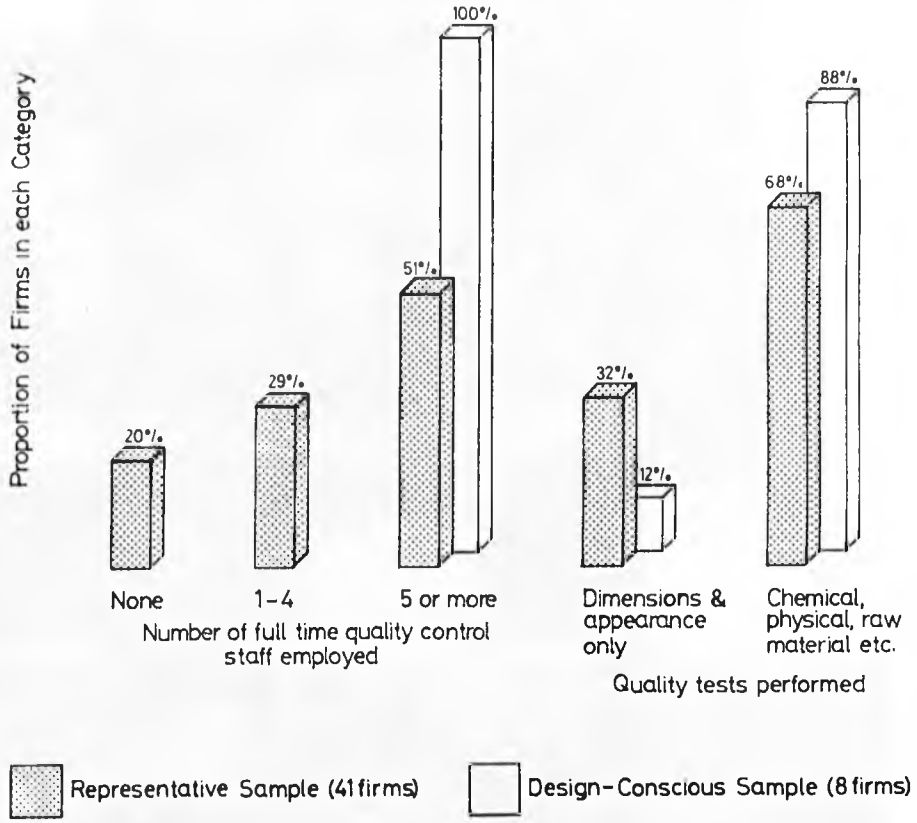
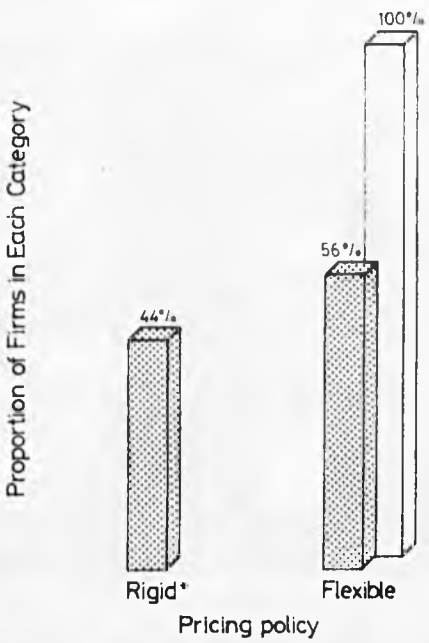


Figure 17

Pricing Policies of Firms in the Two Samples



* **Lego's description of its pricing policy is in the 'rigid' category, but its actual practice is in the 'flexible' category.**

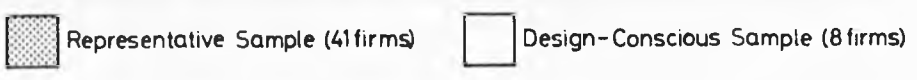


Figure 18

3.4. Quality control policies

Quality Control (QC) has been a vital factor in the success of well-designed, high value products for the top end of the market. Moulders of technical items, for example building products made to British Standards or similar specifications, have for some time employed quality control staff to conduct various tests on the raw material and the final product. But the plastics industry in general was slow to adopt quality control, relying on operators and packers to notice unsatisfactory moulding, or waiting for customers to complain (Walsh *et al.*, 1980).

This situation has however changed since the mid 1970s. In the Representative Sample 80% of the firms employed at least one person on quality control and over half employed five or more full-time QC staff (see Figure 17). Not surprisingly the manufacturers of technical products employ more QC staff and also tend to do more extensive chemical, physical and raw material testing than the makers of consumer products (see Appendix 3 Table A7).

The Design-Conscious firms were highly committed to a high standard of quality control and all employed at least five full-time QC staff (Figure 17). All, except one, used the full range of test procedures both on raw material and final product, even though most were makers of consumer and contract goods.

3.5. Pricing policies

The competitiveness of a particular firm's products in the market depends on a mixture of price and 'non-price' factors (NEDO, 1977). Coombs *et al.* (1981) have pointed out that non-price factors can be divided into *technical* (or 'intrinsic') factors, which are those related to the attributes of the product itself (i.e. its technical performance; appearance; durability; quality of finish; safety; etc.), and *non-technical* (or 'associative') factors,which are those related to the characteristics of the firm and its promotional and service activities (i.e. the firm's reputation; its ability to deliver on time; its after-sales service; its advertising, distribution and sales promotion activities, etc.).

Firms were asked how important they thought price was as a factor in their competitiveness relative to various specified 'non-price' factors, both technical and non-technical (see Appendix 1 for details).

(a) Rigid and flexible pricing policies

In the industry as a whole, as reflected by the Representative Sample, nearly half the firms had 'rigid' and just over half had 'flexible' pricing policies (see Figure 18). Those with rigid policies would calculate their costs, add

on the profit they wanted and market the product. About customers who thought their prices were too high, comments like 'if they don't like it they can go elsewhere' were typical of firms with rigid pricing policies. Some firms used computer programmes to calculate prices.

Firms with flexible pricing policies would take into account the price and quality of similar products, and how much they wanted the job if they were in a tendering situation, when establishing prices. They would trim profits in an attempt to capture a certain market share and increase them if they were in a monopoly. To these firms, price was seen as an important factor in competitiveness.

Pricing policies were strongly related to own brand manufacture. Own brand moulders were more likely to have rigid pricing policies and trade moulders, who were more often tendering for work, to have flexible ones. The exceptions in each case were the medium-sized firms with definite strategies and formal planning procedures. Thus, the trade moulders with a reputation for expertise in a particular kind of moulding were confident that customers would prefer to come to them and could afford rigid pricing policies. Only one third of own brand manufacturers had flexible pricing, but those were the firms pursuing an aggressive marketing policy as part of an expansion strategy (see Appendix 3 TableA8).

The Design-Conscious were nearly all own brand manufacturers, but they *all* had flexible pricing policies. Timothy Whites (the hardware store) even sell two identical quartz clocks made by Crayonne side by side, with a 20% price differential: one is sold under the store's own 'Working Kitchen' brand name, the other under the slightly more up-market 'Crayonne' own brand. Thus, the Design-Conscious firms were not typical of the industry as a whole but of that group of firms with which they also shared the attributes of active marketing, medium to large size and expansion strategies. They varied their prices to establish their share of the market. Indeed pricing policy could be seen as an aspect of marketing policy.

(b) Value for money

Does this mean Design-Conscious firms think price is the most important factor in competitiveness? On the contrary. Some of them suggested that price was more important for some products and markets than others. Thus Hille and Marley both observed that price was more important in Britain than elsewhere in the furniture and flooring markets respectively, while Netlon had found price more critical for selling netting for packaging than for other end uses. But, with these qualifications, all the Design-Conscious firms argued very strongly that quality, design or performance were much more important than price in securing markets.

Thus typical comments were:

'Quality is much more important than price';
'Quality sells';
'Durability is most important';
'Performance and design are most important. Our prices are quite high';
'We're not frightened to charge more for a good standard';
'We aim for technical excellence and sometimes forget about profit'.

The factor that gave each of them the edge over their competitors was seen as being a design or quality factor, not a cheap price. Indeed, most of the firms in this sample charged relatively high prices for their products. But this was not in contradiction to their pricing policy. All Design-Conscious firms qualified their comments about the importance of non-price factors with reference to value: 'It mustn't be *too* expensive'; 'You can't go over the top'; 'Value is the most important thing'; 'Design and value are most important'; and 'A product will flop if it doesn't do enough for the price'.

The firms were all price-conscious, but their policy was to provide value for money. They believed they could charge more than their competitors, but only if the produce was better designed, innovative and/or of higher quality, and therefore of greater value to the purchaser.

This is in agreement with the observation by Archer (1974) that the value of a product to a buyer (i.e. its worth in respect of its attributes, usually expressed as what a buyer is prepared to pay in order to own it) may often be increased significantly for a relatively smaller financial cost to the manufacturer by increasing the effort spent on design (thereby improving the products attributes of performance, appearance, novelty, reliability etc.). This enables the manufacturer to sell the product at a higher price while still offering value for money to the buyer and a profit for himself (see Figure 19).

Lego had a more rigid pricing policy, in principle, than the other Design-Conscious firms, saying they competed only on the basis of 'non price' technical and non-technical factors such as 'being the best', having an aggressive marketing approach and a strong patenting position. But even Lego have been known to adopt a more flexible approach to pricing in response to a serious competitive threat. For example, the company introduced a cheaper version of Lego in Italy in about 1972 in response to the 'very cheap, poor quality but nicely packaged' rival 'Plastic City'. Here too, though, value for money was the issue: Lego attempted to secure its Italian market share on the basis of a better product, but the whole campaign was waged on both sides at a rather lower price level than was usual for Lego. Cheaper alternatives to Lego made from other plastics have usually failed, however, (without Lego's

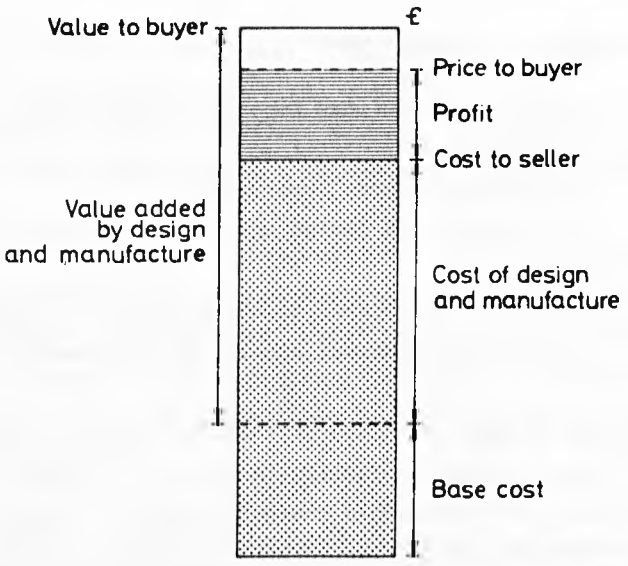


Figure 19 Price, cost and value of a product. In order to sell successfully and profitably, value to the buyer must exceed the price, which must in turn exceed the cost of designing and making the product. (Adapted from Archer (1974)).

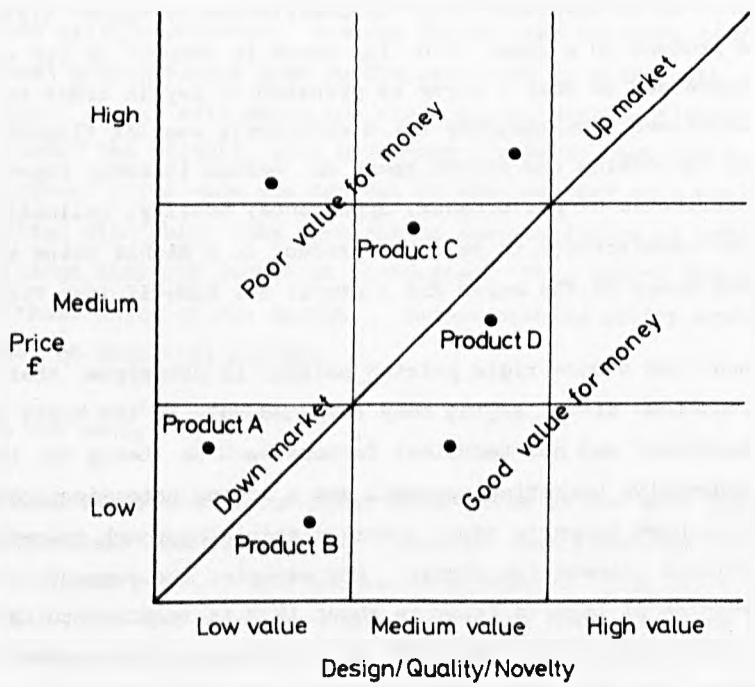


Figure 20 The mix of Price and Design/Quality/Novelty determines a product's value-for-money in different market sectors.

intervention) because the bricks are either too rigid or too flexible. Lego bricks are made out of expensive ABS* plastic, a better material for 'grip' and durability than is used in cheaper rivals. The choice of ABS was the result of a thorough examination, with consumer trials, of alternative materials and their properties.

Several firms learned about value for money the hard way. For example, an early Crayonne product was a box designed to hold jewellery. But 'we didn't do enough market research in those days' and the product was a failure because, for the price, customers preferred to buy an antique wooden box. Paterson's bleep photographic darkroom timer was a flop: 'It was a nice design but didn't do enough for the price'. Fisher Price go ahead with new product development on the basis that the *balance* is right between the price they need to charge on one hand and the hours of concentration children put into playing with a particular toy and the variety of things the toy does, on the other hand. They call this 'play value'. They found that the Fisher Price garage, for example, was too expensive for what you could do with it, as the tooling and assembly costs were rather high. They were obliged to reduce their profit margin on this item considerably, but offset it by charging more for a more simply-made toy that nevertheless had a lot of 'play value'. Parents often talk about Fisher Price toys as though they were acting in an advertisement and they appear to be prepared to pay quite high prices for something that will keep their children amused for a long time. 'Think as a mother would ' is a key Fisher Price slogan. Robustness also contributes to play value. Fisher Price toys withstand an extraordinary amount of punishment because the quantity of plastic used is greater, and the grade higher than in many competing toys.

The particular balance of price and design quality, and hence value for money, of a firm's products within a particular market sector can contribute to its commercial failure as well as to its success (see Figure 20). For example Airfix Industries, which used to make Meccano construction toys from both plastic and metal as well as plastic model kits, collapsed financially in 1981. It was the only toy firm visited in this investigation which said explicitly that its first priority was 'to keep prices to a minimum; improved quality comes second'. Nevertheless the firm was criticized in the press for not providing good value for money. Meccano in particular, because it was made in an old and inefficient plant in Liverpool, had to be sold at a price too high for what it offered in 'play value'. And despite a worldwide following of enthusiasts, Meccano was seen as outdated after the success of rivals such as Lego (Klarenberg and Woudhysen, 1981).

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* acrylonitrile butadiene styrene copolymer

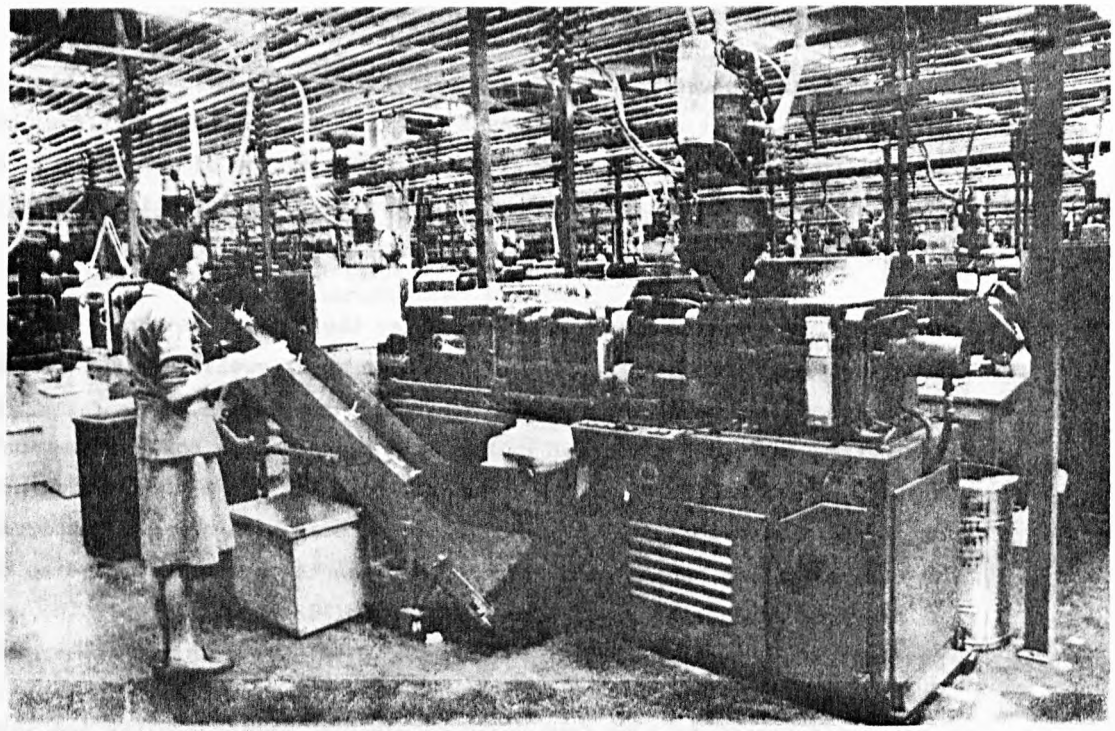

Figure 21 Moulding at the Lego Group's factory, Billund, Denmark. (Photograph: Lego (UK) Ltd.).

Figure 22 Lego space sets have become one of the firm's most successful products. Their ABS components are designed to be compatible with all other Lego sets. (Photograph: Lego (UK) Ltd.).

Innovation in product design and/or technology is another important way in which the value of a product, and hence its competitiveness, may be increased. In the case of toys, for example, adaptations of a space theme, following the success of the 1977 film 'Star Wars', has been a key to market success.

Lego introduced space sets in 1979 (Figure 22) - 'We knew we were onto a winner' - while in 1980 Fisher Price introduced a toy spaceship, the Alpha Probe (Figure 8). Other toy firms followed. Brittains (a British firm which makes plastic model soldiers and animals) launched a range of space models and Palitoy introduced the Action Man Space Ranger. All four are award-winning and commercially successful firms*. Meanwhile Meccano,despite being listed on the Design Index,was seen as being the same as it had been in the 1950s. Meccano introduced 'pocket money' or 'impulse-buy' sized sets and Airfix brought out model kits on a space theme at the end of 1980 - as a result of the intervention of Benchmark, the Airfix Group's new design studio - but it was too late to stave off receivership in January 1981.

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* Brittains and Palitoy were not visited for this investigation. Both firms have won 'Toy of the Year' Awards for their products.

4. GOOD DESIGN AND BUSINESS SUCCESS

For businessmen/women and policy-makers perhaps the most important question is 'were the Design-Conscious firms commercially more successful than the firms in the Representative Sample?' In other words, 'does good design pay?'.

Unfortunately these are not simple questions to answer. Firstly, while there are several ways of measuring the business performance of a company, none are completely satisfactory. In some cases the indicators can be quite misleading. Low profits may be due, for example, to inter-company transfer pricing, whilst high returns on capital may be the result, not of sustained commercial success, but very low rates of investment. Thus data on profits, capital investment and sales should really be interpreted in the light of knowledge of the firms concerned, their ownership and their attitudes and dynamics (see Walsh *et al.*, 1980). Secondly, the business success or failure, even of a Design-Conscious company, may be due to other factors than the successful management and practice of product design. Thirdly, awards and prizes for design often are given to individual products, whereas a company's business performance is dependent on its whole product range.

Nevertheless, despite these reservations, we attempted to compare the business performance of the Design-Conscious and Representative firms over the seven-year period 1973-79. We used data on profits, capital and turnover given in microfiche copies of company reports deposited at Companies House (Department of Trade), or in the case of Lego, the Danish counterpart, Aktieselskabs Registeret. Although complete data was available for all eight Design-Conscious firms, it was only possible to obtain company reports for 32 of the 41 firms in the Representative Sample and in some cases certain data (e.g. turnover) or reports for certain years were unavailable. (Fortunately the nine missing companies did not distort the 'representativeness' of the remaining firms in the Representative Sample as they included similar proportions of small, medium and large firms; trade moulders and own brand makers).

All the available data was recorded on computer file for subsequent analysis (see Appendix 2 for details).

Business success indicators were developed in accord with the definitions provided by the National Economic Development Office (NEDO, 1976)* and with reference to the Business Ratio Reports published by Inter-Company Comparisons Ltd. (e.g. ICC, 1980).

**Profit* is profit before payment of tax and interest charges. It includes dividends, interest, royalties and rents.

Turnover is total sales reported by the company itself. It includes exports and sales by overseas subsidiaries and intergroup sales.

Capital Employed is an indication of the net capital resources available to a company for its operation (i.e. total assets less current liabilities). It includes all shares and loan capital; all amounts set aside as reserves or as provision for long-term liabilities; minority interests in subsidiaries; bank overdrafts and short-term loans; for subsidiaries, any intergroup balances which appear to be loans; goodwill, except for example following a merger where to include it would destroy comparability.

For *each company* in both samples we calculated.**

1. Return on capital = $\frac{\text{Total profit (\& loss) before tax (1973-79)}}{\text{Total capital employed (1973 - 79)}}$

2. Profit margin = $\frac{\text{Total profit (\& loss) before tax (1973-79)}}{\text{Total turnover (1973-79)}}$

where profit, capital employed and turnover are in *current prices* and any years for which the necessary data was unavailable were eliminated.

3. Turnover growth = $\frac{\text{Average turnover 1973-79}}{\text{Turnover in 1973}} - 1$

4. Capital growth = $\frac{\text{Average capital employed 1973-79}}{\text{Capital employed in 1973}} - 1$

where turnover and capital employed are in *constant 1979 prices* and averages were calculated over the number of years for which data was available, usually seven.

The Design-Conscious and Representative firms were then compared using the means (averages) of the above four business indicators. The results of this analysis are shown in the first two columns of Table 3 and in Figure 23.

It can be seen that over the period 1973-79, the Design-Conscious firms performed better than the Representative firms across all four business indicators employed. This suggests that the Design-Conscious firms were more profitable and grew faster than the Representative firms. Such apparent differences can however be misleading. For example eliminating one major

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** Other indicators (e.g. net turnover, capital and profit growth 1973-79; profitability growth) were also calculated, but these have certain deficiencies and so are not included here, although on several of these (e.g. profit growth) the Design-Conscious firms performed statistically significantly better than the Representative firms(see Appendix 2).

Table 3 Business performance of the firms in the two Samples

Business indicator +	Means for period 1973-79		Statistical probability of difference occurring by chance
	A. Representative Sample	B. Design-Conscious Sample	
1. Return on capital [Profits / Capital]	6% * (8%) †	11%	13% (15%) †
2. Profit margin [Profits / Turnover]	-2% ** (6%) †	7%	32% (37%) †
3. Turnover growth [Average Turnover / 1973 turnover - 1]	23% ** (15%) †	43%	4% (3%) †
4. Capital growth [Average capital / 1973 capital - 1]	17% * (12%) †	19%	18% (14%) †

Notes: + Indicators 1 & 2; 3 & 4 were statistically correlated (i.e high return on capital usually went with a high profit margin; high turnover growth almost always was accompanied by high capital growth).

* 32 firms for which data was available

** 29 firms for which data was available.

† Results with one firm which made large losses removed from the Representative Sample.

We are grateful to Dr. John Towriss, Research Fellow Design Innovation Group, for performing the analysis of the data employed here.

lossmaking firm from the Representative Sample resulted in quite different mean values for return on capital and profit margin (the figures in brackets in Table 3). It is necessary therefore to test whether the better performance of the Design-Conscious firms is *statistically* significant.

In order to do this a statistical test* was applied which involved ranking the firms in the two samples according to their business performance on each indicator and calculating the probability that the differences in the rank orders could have occurred by chance. The results of this statistical testing is shown in the final column of Table 3 (see Appendix 2 for further details of the computer analysis involved). The statistical analysis indicates that the better performance of the Design-Conscious firms is almost certainly significant with respect to turnover growth (the probability of the difference having occurred by chance is only 4%). The better performance of the Design-Conscious firms in return on capital and capital growth is probably significant, while the difference in profit margin could well have occurred by chance (32% probability) and cannot be considered statistically significant. This last result appears to contradict the idea advanced earlier (Section 3.5b) that good design will increase the sales value of a company's product range, without substantially increasing manufacturing costs, hence giving higher profit margins.

Overall, however, this analysis does suggest that good management and successful practice of product design, as indicated by awards and prizes for good design, is related to business success, at least in the plastics products industry.

However, when interpreting this result it is important to bear in mind the qualifications noted earlier in this section about business indicators and the various factors underlying business performance** In particular it is important not to isolate the successful management and practice of design from other business activities. It was noticeable, for example, that the Design-Conscious firms

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* This was the non-parametric Mann-Whitney 'U' test (Seigal,1956) which does not require assumptions to be made about the distribution of the business indicators in each sample.

** Firm size is often considered to be an important factor in business performance. However analysis of the data taking firm size into account produced no real differences in the results (see Appendix 2).

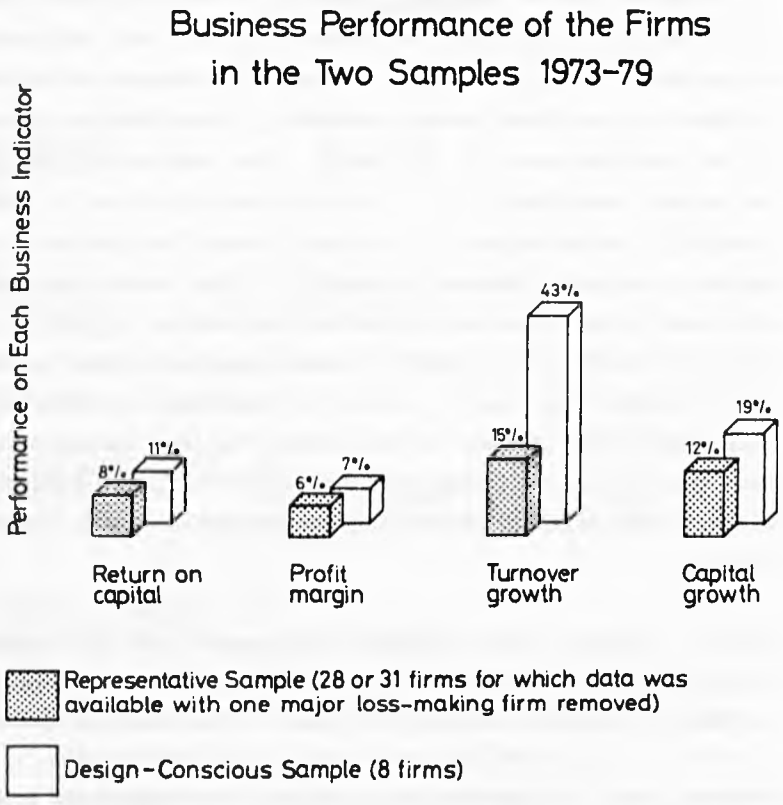
Business Performance of the Firms
in the Two Samples 1973-79
Performance on Each Business Indicator
8%
11%
6%
7%
15%
43%
12%
19%
Return on capital
Profit margin
Turnover growth
Capital growth
Representative Sample (28 or 31 firms for which data was available with one major loss-making firm removed)
Design-Conscious Sample (8 firms)

Figure 23

tended to put effort into and be good at most, if not necessarily all, aspects of their business. They were the medium and larger firms with a company strategy aimed at long-term expansion rather than mere survival. In particular they were generally good at, and had the necessary resources for, extensive marketing activities; effective communication with users; prototype testing and test marketing; good market intelligence, and so on. They used this market information as an important input to the design process, alongside considerations such as design for production and pricing their products to offer value for money. And they linked design and marketing to help build up a good company image, for example in packaging and displaying their products.

In the plastics products industry moving up-market by paying attention to quality and design would appear to be one route to business success, but not the only strategy, nor a guaranteed one. Thus, the two firms in the Design-Conscious Sample which had consistently won awards for their whole product range - Paterson & Netlon - were among the most profitable in terms of both capital and turnover of all the firms surveyed. However, two other firms which also had several design accolades - Lego and Hille - had a lower return on capital than the average Representative firm, (see Appendix 3 Table A9), although Lego had achieved higher than average growth in both turnover and capital and Hille's relatively poor performance over the period can largely be explained by a large loss in 1974.

Moreover, as mentioned in Section 3.1, there were four firms in the Representative Sample which could be viewed as 'design-conscious' to some extent in that one or more individual products from their range had at some time been selected for the Design Index (or Design Centre Selection). These firms displayed a wide range of business performance*, on average poorer than that of the firms in the Design-Conscious Sample, and included Meccano Ltd. which made large losses before going into liquidation in 1979 (for reasons discussed in Section 3.5).

Thus being consistently 'excellent' in the management and practice of design, rather than just intermittently 'good', may be a more certain route to business success. But other strategies can be equally successful. For example, the most profitable firm of all those surveyed, with a higher return on capital and

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* In order to assess the statistical effect of these 'Design Index' firms on the results presented here, they were transferred from the Representative to the Design-Conscious Sample and the data reanalysed. The results were not importantly affected.

turnover than the most successful Design-Conscious firm, was a medium-sized manufacturer of low priced lids and stoppers etc. which could not be described as remotely design-conscious. It relied on a strategy of automating production rather than good design; its high profits were chiefly due to its low production costs. In general the Representative firms relied more on a strategy of reducing production costs to compete on price rather than increasing product value through design.

Moving up-market through quality and good design can therefore be seen as one strategy which a firm in the plastics industry may adopt in order to increase its chances of business success. But the strategy is probably only likely to succeed if it is based on a real commitment to good design at top management level and on skilled designers, allied to and integrated with good marketing and production practice, and forming part of a product innovation strategy.

It would be interesting to review the firms' business performance in a few years time to see whether a strategy of design excellence is a better commercial proposition in the long term and, especially, how the firms in the two samples fared in the recession that hit British industry in general, and the plastics industry in particular, in the period since 1979.

5. CONCLUSIONS

Plastics products have taken a long time to acquire a reputation for quality, value or good design and, indeed, have not yet been entirely successful in doing so. There are still some firms producing the 'cheap and nasty' products typical of the industry's early years, apparently without any perspective of improvement. However, an increasing number of firms have achieved both commercial success and a well-deserved reputation for making well designed, high value, high quality plastics products and a study of these firms is instructive in revealing the best practices in the industry.

The plastics firms which had won awards for good design were on average more successful on a variety of business indicators than the firms representative of the industry as a whole. These Design-Conscious firms have successfully negotiated the problems of expansion and typically employ more than 100 people. Unlike the majority of plastics firms they make their own brands and have established an effective management structure. They pursue an active marketing policy, have a well developed system for quality control and follow a long-term strategy based on a commitment to good design not only at the highest levels of the firm, but throughout it. The deliberate encouragement of good design is reflected in the recruitment of specialist design staff, the use of talented design consultants, or both. Skilled designers are seen as an investment in much the same way as other firms regard their investment in the most advanced plant and machinery.

In the sample representative of the plastics industry as a whole, although two-thirds of firms claimed that they considered design to be 'very important' and employed specialist designers, only a minority actually based their corporate strategy on quality and design excellence, while over one third did not think design worthy of much time, effort or money, and at the most employed people to carry out design activities as a secondary part of their jobs. It is worth noting, though, that almost all the firms with a negative or casual attitude to design were trade moulders whose main business was making products for outside customers. Often neither moulder nor customer took responsibility for or discussed design - but somehow a product emerged.

Marketing is regarded as a vital complement to the development and promotion of good design, if the resultant products are to be commercially successful. Design-Conscious firms employ marketing staff who are specialists in the fields in which the firms' products are used. Detailed market research and feedback from consumers provides the firm with ideas for new market opportunities, and often provides the design evaluation needed for successful new product development. Their designers interact with production staff, marketing staff and end-users at an early stage in the design of a new product

in order that they can optimise the manufacture as well as the performance and saleability of the product. This reflects their very broad concepts of 'design' as more than just shape or appearance, but meaning products which are fitted to use; can be made efficiently; are safe and durable; bolster the company's image; and, especially, will sell at a profit. Design-Conscious toy-makers, for example, try out their prototypes in on-site nurseries or play rooms, while the Award-winning furniture manufacturer organises conferences of architects and interior designers for constructive criticism of its prototypes.

In the plastics industry modelling in three dimensions at an early stage helps the evolution of a new design by giving people something to look at, hold and try out. Successful designers of plastics products are enthusiasts for plastics, believe their properties to be superior to other materials for a variety of end uses and are committed to working with them: again, still a minority view in the Representative firms.

Commercially successful firms with a reputation for good design do not rely on price to compete (as do a majority of firms in the industry, especially the smaller ones) but they do not ignore price and rely only on design and quality either. In many cases they have learned this lesson from the experience of products that failed in the market because they were too expensive for what they offered to the buyer. Value for money is the key to their success. Their encouragement of quality, good design, and also product innovation, is intended to add extra value to the product and thereby to add to saleability and profit.

The results of this investigation clearly indicate that good design can not only be achieved but can increase the chances of business success, even in an industry that was dogged for years by the poor image of cheap, shoddy, goods in 'substitute' materials. However, the investigation also indicates that good design is not enough on its own to ensure a firm's success. The successful management and practice of product design forms part of, and has to be integrated with, a firm's total business activities, including in particular quality control, production, pricing and marketing.

The way in which design is most appropriately used will also vary from industry to industry and product to product. In the plastics products industry good design has successfully been used as a way in which firms can move 'up-market' into high quality, high value, and sometimes novel, products. In other industries design effort may most successfully be used in order to reduce the costs of products in order to bring them within the range of a wider market, or to make them more reliable, or to create technologically innovative products for new markets.

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APPENDIX 1

CHECKLIST OF QUESTIONS USED IN INTERVIEWING

The following checklist of questions was used to guide the interviewer in a semi-structured 'discussion' interview with management,design, production and marketing staff in the firms sampled. The interviewer noted down the answers on an interview form during and soon after the interview.

Plastic Products Manufacturers: Checklist of Questions

A. *Background information about the firm*

1. Could you give me some historical background information about your firm?

   (When it was founded, and under what circumstances, eg by a toolmaker who diversified into plastics processing or by an entrepreneur who wanted to exploit an idea, or by an end-user of plastics products).

2. Does the company specialise in:

   (a) own brand or trade moulding (how much of each)?

   (b) particular end-uses, e.g. homewares, toys, engineering components?

   (c) particular size products?

   (d) particular materials - bulk or engineering polymers?

   Can you supply a catalogue or list showing the range of products currently being manufactured by your company for home and export markets?

   Who is your customer? (e.g. wholesaler, store, other industry)

   What proportion of your business is injection moulding? Other plastics processing? Other activities?

3. Can you set out an organisation chart for the company showing its major departments, divisions, subsidiaries, etc.

   Are there aspects of the company's organisation which do not appear on the chart?

4, Is the company independent or part of a larger parent organisation?

5. Are there formal departments or sections responsible for Research and Testing; Design and Development; Production; Marketing and Sales; Finance?

If not, do you do these jobs in your firm?

Who does them?

6. How many people are employed in the company in total (UK, overseas)?

How many work in:

Research
Development
Design
Quality Control and Testing
Marketing, Promotion and Sales.

What qualifications (if any) do they have? (and in which field).

What are the qualifications of your managers?

7. Do you employ outside consultants in design, quality control, other areas?

8. Does the company set goals in terms of turnover, profitability, market share, etc?

If yes, what are these goals?

What strategies does the firm employ for achieving these goals (e.g. automation; diversification; introduction of more technical or 'up market' products)?

9. What is the approximate annual turnover of the company?

What are the approximate annual expenditures (or if unavailable, estimates of % of turnover) on:

- Research
- Design and Development
- Marketing and Sales
- Quality Control and Testing

10. What is your procedure for planning?

Do you have a formal, written, planning procedure?

How do you budget? (annually?)

How is plan performance and budgeting monitored?

Is development work on new and improved products incorporated in formal plans?

B. *Design and Innovation*

(Questions for senior management, design and marketing staff)

11. What do you understand by the term 'design' in this company? (e.g. engineering; appearance/styling; innovation; etc.)

12. Who is responsible for design?

    What degree of seniority does this job have? (e.g member of board, access to top management, etc).

13. Does the company have an explicit philosophy or policy regarding product design? (e.g. technical excellence in product development; high quality of materials; high quality of engineering; company.colours across product range; extensive use of company logo, etc. internally or externally).

14. What have been the most important developments in the design of the kind of products you make (e.g. homewares) in the past 20 years?

    What have been your company's most important innovations over the past 5 - 10 years (product, process or other)?

    Are there any new designs of products in your area of the market that are important but not produced by your firm? If yes, why?

15. Do you consider that there is still scope for radical innovation in the design of products in your area of the market?

    If yes, what direction is this change likely to take?

    Or do you think that radical product innovation will be in the area of <u>new</u> kinds of products?

    What direction is this likely to take ?

    (a) in the industry

    (b) in your firm

16. Is there a department or individual in the firm with responsibility for developing or investigating major innovations in the design of products in your area of the market?

    If so, are they considering any such innovations for future introduction?

C. *Management of New Product Development*

(Questions to senior management, design and marketing staff)

17. How is the decision made to begin the development of a new product or product range?

Who is normally involved in the decision?

Is it based on, for example:

- need for something new and more profitable to add to existing range.
- existing products becoming obsolete technically or in style and appearance.
- pressure from competitors, or ideas from monitoring their products.
- developments in production technology.
- innovations in design, materials etc.
- feedback from customers, end-users, salesmen, dealers, etc.
- information from market surveys and forecasts.
- information from literature searches.
- in-house design studies.

18. What methods are employed to obtain information for the development of new and improved products? (Market surveys and forecasts; feedback from dealers, salesmen, customers etc.; in-house design studies; literature searches; monitoring competitors' products, etc.)

19. Is there a formal or informal system of monitoring or review in the product development process?

    If yes, have projects been drastically altered or abandoned as a result of a review?

D. *Design Aspects of New Product Development*

(Questions for designers and draughtsmen)

20. Briefly describe the organisation and operation of the design and development department/section/job?

21. Briefly describe how you would normally go about designing a new or an improved product or product range. Give examples *(or focus around a case-history).*

    Do you design and/or make your own moulds? (What proportion do you buy-in?)

    What methods would you normally use when designing (a) products and (b) moulds?

- engineering calculations
- drawing and sketching
- making scale-models, mock-ups and prototypes
- consulting handbooks and other literature
- other activities.

Is design of products and tools done by the same or separate people/ departments?

22. Are any particular aids to designing used?

- systematic design methods
- computer aided design
- any other techniques

23. Are you normally expected to design to a detailed specification drawn up in advance?

Who is involved in drawing up the specification? (inside or outside your firm)
What might it include? (market as well as technical requirements?)

24. During the past decade have tool, machine or materials suppliers or end-users made a significant contribution to the improvement of your products?

If yes, give examples.

25. In the same period has research, development or invention by people outside the company made a significant contribution to the improvement of your products?

If yes, give examples.

E *Factors in Competitiveness*

(Questions to management, marketing and design staff)

26. What are your most successful products (in terms of sales, profitability or any other measure - please say which)?

27. What are your least successful products (using the same criterion as before)?

Why are these still kept in your range?

28. Has there been a tendency for your product range to increase or decrease over the past 5 - 10 years?

In what areas has the range increased/decreased?

29. Why do you think imports of plastics products are greater than exports of plastics products made in Britain?

(to building materials makers) Why do you think imports of plastics building materials have increased more rapidly over the past few years than have exports?

(to makers of packaging items) Why do you think imports of packaging items are greater than exports and have been increasing more rapidly over the past few years?

30. When you introduce a new or improved product, how do you go about establishing its price? What do you take into account?
Do you develop new products to a predetermined price target?

Do you negotiate prices? Do you tender for jobs?

31. How important a factor do you consider *price* to be in determining the competitiveness of your products (a) on the UK market, and (b) in major export markets (eg USA, Europe, Africa, Asia)?

To what extent does price competitiveness vary for different types of plastic product in your market area?

32. What factors *other than price* do you consider to be of major importance in selling your products against those of your competitors (and products in wood, ceramic, fabric, metal or other materials)?

Have you any comments on the importance of the following technical factors as determinants of competitiveness in various sectors of the market (toys, homewares, building supplies, stationery, technical components, packaging etc):

- Technical specification and performance
- Quality of finish and detailed design
- Overall appearance and style
- Durability and reliability
- Safety and/or non-toxicity
- Colour range
- Range of comparible or matching products or accessories or components available
- Anything else

Likewise have you comments on the following non-technical factors as determinants of competitiveness?

- Reputation of the firm
- Dealer organisation
- Delivery to time and availability in wide range of outlets
- After-sales service and availability of spare parts
- Advertising and sales promotion
- Well-designed brochures, handbooks, etc.
- Anything else

Are these factors different in different markets (UK and export markets)?

33. Do you use any imported tools, materials or machines?

If yes, why? Give examples.

Do you plan to increase/decrease your use of imported parts and accessories in the future?

F. *Production Methods*

(Questions to senior production manager or engineer)

34. Has the company introduced any important changes in production methods over the past 5 - 10 years? (e.g automation; computer control; robotics).

If yes, please briefly describe the changes

Why were they introduced? (e.g to make a bigger profit; to make a better quality product; to overcome a labour shortage; to give more control over the process).

35. Is there scope for major changes in production methods in the future? (e.g automation; computer control; NC machinery; robot handling).

If yes, what form might these changes take?

Has the company plans for the introduction of such changes in the future?

36. Have developments in product design, materials, etc. affected production methods significantly over the past 5 - 10 years? Are your products designed specifically with ease of manufacture in mind? If yes, how important is this relative to other design considerations?

Is there any interaction/feedback between the product designers, toolmakers and designers, production engineers, customers, quality control staff and materials suppliers *at the design stage*?

Or at any other stage?

37. Approximately what proportion of the total ex-works cost of your products are accounted for by production costs? (Different for different products)?

G. *Quality Control and Testing*

38 What tests do you do?

- raw material
- dimensions and appearance of product
- physical tests eg drop tests on product
- chemical tests eg action of solvent on product
- safety of working environment
- safety of product in use

Do you have a separate quality control department? laboratory? qualified staff?

Do you employ outside consultants in this area?

39. Are your products covered by British Standards? Government Regulations?

40. To what extent do you rely on your customers and suppliers for quality control?

H. *Marketing and Sales Promotion*

41. Which aspects of your marketing and sales promotion activities are most critical in obtaining sales (at home and abroad)?

- Advertisements and press releases
- Visits by sales representatives
- Visits by people not primarily employed as representatives (e.g. designers, technical people)
- Demonstrations
- Stands at trade fairs
- Design and consultancy work for customers
- Entry in Yellow pages

42. Are there any areas of marketing, sales promotion and after sales service where you consider that you have important advantages over competitors? (Or they have over you)?

APPENDIX 2

METHOD OF DATA ANALYSIS

The information from the interviews in the firms from the Representative and Design-Conscious Samples was coded for analysis, as follows:

1. Size of firm	a = under 100 employees b = 100 - 499 " c = over 500 "
2. Goals	s = survival e = expansion
3. Strategy	1 = none 2 = up market; more technical; good design 3 = diversification 4 = automation
4. Type of firm	1 = trade moulder (60% or more of firm's business) 2 = own brands (60% or more of firm's business). 3 = both (40% - 60% of each)
5. Formal planning	1 = yes 2 = no
6. Ownership	g = part of company group or subsidiary i = independent
7. Pricing policy	F = flexible R = rigid
8. Marketing policy	a = active i = inactive
9. Quality control	1 = no-one specifically employed on QC 2 = 1 - 4 people specifically employed on QC 3 = 5 or more specifically employed on QC a = mechanical and/or chemical and/or raw material tests done (e.g impact, toxicity etc) b = only dimensions + appearance examined

10. Attitude to design

1.= not important

2.= important, but no-one employed solely on design

3.= very important, staff employed solely on design

A matrix for each of the two Samples was then constructed of the type shown below:

Company	Size	Goals	Strategy	etc.
1	a	s	2	
2	a	e	4	
3	b	s	1	
4	a	e	3	
etc.	etc.	etc.	etc.	

From the matrices it was possible to construct the Tables shown in Appendix 3 and hence the various charts and tables in the main text. For example, a table of goals by size of firm could be constructed by counting the number of firms with survival goals and under 100 employees, with expansion goals and 100 - 499 employees, and so on. The analysis was in fact done by hand, but could easily be done by computer, using a correlation analysis programme.

More data was collected than has been analysed for this report. For example, questions were asked about the type of polymer(s) usually used; the degree of automation and mechanization of production technology; and the age of the firm. The material analysed for this report was chosen on the basis of its relevance to the role of design in a firm's success; the importance that the firms themselves placed on design-related activities such as marketing and pricing policies; or as a result of the correlations that emerged from the analysis. Some data are not included because a few firms were not prepared to answer the relevant questions on grounds of commercial secrecy. Examples of such questions were those on expenditure on R & D, design and marketing, and questions about future products and business strategy.

Analysis of business performance data

Data on the business performance of the firms in the two Samples was obtained from microfiche copies of company reports deposited at Companies House, London. The data was initially recorded onto a microcomputer disc. It was then checked, up-dated and transferred onto the VAX11/780 minicomputer operated by the Design Discipline at the Open University (Figure A1 shows the kind of information stored for each company). For each company the following business indicators were calculated: *net* turnover, capital and profit growth; *average* turnover, capital and profit growth; profits/capital; profits/turnover; average profits/capital growth; average profits/turnover growth. (These indicators are shown at the bottom of Figure A1). From these indicators four were selected as the most reliable and widely accepted measures of business performance; namely, profits/capital; profits/turnover; average turnover growth and average capital growth. Profit growth, for example, was not used because profits are too variable and the measure was thus too dependent on what profits happened to be in the first year (1973). Correlation analysis of the various indicators confirmed that the four selected measures were related and consistent (see Figure A3 which shows the high correlations between item 4 (profits/capital) and 5 (profits/turnover) and between 7 (turnover growth) and 8 (capital growth)).

Differences between the means of the various indicators for the two Samples were tested for statistical significance using the non-parametric Mann-Whitney 'U' test which does not require any assumptions to be made about the distribution of scores. (Figure A2 shows part of the printout of the statistical analysis).

In order to test the robustness of the results, statistical analysis was performed for a variety of different conditions, namely:

(i) Representative Sample v Design-Conscious Sample.
(ii) Representative Sample with one major loss-making company removed v Design-Conscious Sample.
(iii) As (i) with Design Centre Selection firms in the Representative Sample transferred to the Design-Conscious Sample.
(iv) As (i) with trade moulders removed from Representative Sample.
(v) Various tests for the effect of firm size: i.e permations of small, medium, large Representative firms v medium, large Design-Conscious firms.

None of the variations tested produced markedly different conclusions from those produced under conditions (i) and (ii), which therefore are the results presented in Table 3 Section 4 of the report.

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**********************************************************
*    COMPANY FINANCIAL PERFORMANCE ANALYSIS ROUTINE      *
**********************************************************
```

COMPANY REGISTRATION NUMBER 1			[ALL FIGURES IN THOUSANDS]		
	YEAR BY YEAR PRICES			CONSTANT (1979) PRICES	
DATE	TURNOVER	PROFITS	CAPITAL	TURNOVER	PROFITS	CAPITAL
1979	4869.	369.	4293.	4869.	369.	4293.
1978	4359.	182.	3252.	5107.	213.	3810.
1977	4633.	340.	3254.	5890.	432.	4137.
1976	4229.	662.	3728.	6016.	942.	5304.
1975	3018.	403.	2361.	4940.	660.	3865.
1974	4010.	787.	2081.	8191.	1608.	4251.
1973	1808.	266.	1318.	4409.	649.	3214.

Net Turnover Growth= 0.1043 Net Capital Growth 0.3356 Net Profit Growth= -0.4312
Average Turnover Growth= 1.2773 Average Capital Growth 1.2833 Average Profit Growth= 1.0730
Ratio of Profits/Turnover= 0.1118 Ratio of Profits/Capital= 0.1483

Figure A1 Business performance data and business indicators recorded for one firm.

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**********************************************************
*    COMPANY FINANCIAL PERFORMANCE ANALYSIS ROUTINE      *
**********************************************************

*****************************************
  AVERAGE TURNOVER AS A RATIO OF YEAR 1
*****************************************
REPRESENTATIVE SAMPLE          DESIGN CONSCIOUS SAMPLE
MEAN            1.23           MEAN                1.43
NO IN SAMPLE     29            NO IN SAMPLE           8
VARIANCE       0.391           VARIANCE            0.519

-----------------------------------------
 MANN-WHITNEY 'U' STATISTIC=  70
 'Z' STATISTIC=   -1.6971
-----------------------------------------
*************************************************
  AVERAGE CAPITAL EMPLOYED AS A RATIO OF YEAR 1
*************************************************
REPRESENTATIVE SAMPLE          DESIGN CONSCIOUS SAMPLE
MEAN            1.17           MEAN                1.19
NO IN SAMPLE     32            NO IN SAMPLE           8
VARIANCE       0.249           VARIANCE            0.055

-----------------------------------------
 MANN-WHITNEY 'U' STATISTIC= 101
 'Z' STATISTIC=   -0.9129
-----------------------------------------
*****************************************
  RATIO OF PROFITS TO TURNOVER
*****************************************
REPRESENTATIVE SAMPLE          DESIGN CONSCIOUS SAMPLE
MEAN           -0.02           MEAN                0.07
NO IN SAMPLE     29            NO IN SAMPLE           8
VARIANCE       0.206           VARIANCE            0.002

-----------------------------------------
 MANN-WHITNEY 'U' STATISTIC= 103
 'Z' STATISTIC=   -0.4796
-----------------------------------------
*****************************************
  RATIO OF PROFITS TO CAPITAL EMPLOYED
*****************************************
REPRESENTATIVE SAMPLE          DESIGN CONSCIOUS SAMPLE
MEAN            0.06           MEAN                0.11
NO IN SAMPLE     32            NO IN SAMPLE           8
VARIANCE       0.025           VARIANCE            0.005

-----------------------------------------
 MANN-WHITNEY 'U' STATISTIC=  94
 'Z' STATISTIC=   -1.1496
-----------------------------------------
```

Figure A2 Part of computer printout of statistical analysis of business performance for the two samples.

****
*** CORRELATION MATRIX ***
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	1	2	3	4	5	6	7	8	9	10	11	12
1	1.00	0.70	0.44	0.94	0.68	0.12	-.82	-.72	0.44	0.21	0.42	0.29
2	0.70	1.00	0.10	0.67	0.91	-.11	-.58	-.44	0.12	0.00	0.07	-.05
3	0.44	0.10	1.00	0.62	0.14	0.58	0.02	-.03	0.99	0.73	1.00	0.84
4	0.94	0.67	0.62	1.00	0.71	0.19	-.63	-.56	0.62	0.32	0.60	0.41
5	0.68	0.91	0.14	0.71	1.00	-.13	-.57	-.51	0.15	-.02	0.11	-.03
6	0.12	-.11	0.58	0.19	-.13	1.00	0.04	0.10	0.55	0.95	0.57	0.93
7	-.82	-.58	0.02	-.63	-.57	0.04	1.00	0.91	0.03	0.05	0.05	0.03
8	-.72	-.44	-.03	-.56	-.51	0.10	0.91	1.00	0.00	0.12	-.01	0.04
9	0.44	0.12	0.99	0.62	0.15	0.55	0.03	0.00	1.00	0.73	0.99	0.82
10	0.21	0.00	0.73	0.32	-.02	0.95	0.05	0.12	0.73	1.00	0.73	0.96
11	0.42	0.07	1.00	0.60	0.11	0.57	0.05	-.01	0.99	0.73	1.00	0.84
12	0.29	-.05	0.84	0.41	-.03	0.93	0.03	0.04	0.82	0.96	0.84	1.00

KEY TO MATRIX CODES
1 .Net Turnover growth
2 .Capital Employed growth
3 .Net Profit growth
4 .Average Turnover as a ratio of year 1
5 .Average Capital as a ratio of year 1
6 .Average Profits as a ratio of year 1
7 .Ratio of Profits to Turnover
8 .Ratio of Profits to Capital Employed
9 .Net Profit/Turnover ratio growth
10 .Average P/T as a ratio of year 1
11 .Net Profit/Capital ratio growth
12 .Average P/Capital as a ratio of year 1

Figure A3 Correlation matrix between the twelve business indicators calculated for the two Samples.

APPENDIX 3

ADDITIONAL RESULTS OF DATA ANALYSIS

The Tables in this Appendix provide a more detailed analysis and breakdown of the main results,which are presented graphically in the main body of the text.

Table A1 The firms in the Design-Conscious Sample

Name	Awards, prizes, recommendations, etc. for design
Crayonne Ltd.	Design Council Award 1974 Design Index/Design Centre Selection 1973 -
Fisher-Price Toys Ltd.	Design Centre Selection 1981-82 National Assn.of Toy Retailers: Educational Toy Award.
Hille International Ltd.	Design Council Awards 1962, 1965, 1968 Design Index/Design Centre Selection 1961 - Royal Society of Arts award for Design Management 1965. Royal Society of Arts bicentennial medal 1972.
Lego System A/S	National Assn. of Toy Retailers: Toy of the Year Award 1974, 1975, 1979; Special Gold Award 1976; Best Packaging Awards. Institute of Marketing Award 1976. *Toys International:* Top Brand Award 1980, 1981; Top Toy Award 1980, 1981.
Marley Extrusions Ltd./ Marley Floors Ltd.	Design Centre Selection 1981-82/ Design Index 1964 -
Netlon Ltd.	Design Council Award 1973 Design Index/Design Centre Selection Queen's Award for Technological Innovation 1975. Prince Philip Award for Plastics in Service of Man 1978. Queens Award for Export Achievement 1982.
Paterson Products Ltd.	Design Council Awards 1971, 1973, 1979 Design Index/Design Centre Selection Royal Society of Arts award for Design Management 1973.
Van Leer (UK) Ltd.	Institute of Packaging Star-pack Silver Award 1980; Star-pack Award for technical innovation 1977; Eurostar Award 1977/

Table A2. Goals, planning and marketing policies of different sizes of firm in the two Samples

A. Representative Sample	Number of employees <100	100 - 499	>500	Total
Goals:				
Expansion	3 (25%)	18 (81.8%)	6 (85.7%)	27(65.9%)
Survival	9 (75%)	4 (18.2%)	1 (14.3%)	14 (34.1%)
Planning:				
Formal	1 (8.3%)	17 (77.3%)	7 (100%)	25 (61.0%)
Informal	11 (91.7%)	5 (22.7%)	0 (0%)	16 (39.0%)
Marketing:				
Active	3 (25.0%)	17 (77.3%)	6 (85.7%)	26 (63.4%)
Inactive	9 (75.0%)	5 (22.7%)	1 (14.3%)	15 (36.6%)
Total	12 (100%)	22 (100%)	7 (100%)	41 (100%)

B. Design-Conscious Sample	Number of employees <100	100 - 499	>500	Total
Goals:				
Expansion	0	5 (100%)	3 (100%)	8 (100%)
Survival	0	0	0	0
Planning:				
Formal	0	5 (100%)	3 (100%)	8 (100%)
Informal	0	0	0	0
Marketing:				
Active	0	5 (100%)	3 (100%)	8 (100%)
Inactive	0	0	0	0
Total	0	5 (100%)	3 (100%)	8 (100%)

Table A3. Sizes of different types of firm in the two Samples

A. Representative Sample	Number of employees <100	100 - 499	>500	Total
Trade moulder	11 (91.7%)	10 (45.5%)	3 (42.9%)	24 (58.5%)
Own brands	1 (8.3%)	7 (31.8%)	4 (57.1%)	12 (29.3%)
Both	0	5 (22.7%)	0	5 (12.2%)
Total	12 (100%)	22 (100%)	7 (100%)	41 (100%)

B. Design-Conscious Sample	Number of employees <100	100 - 499	>500	Total
Trade moulder	0	0	1 (33.3%)	1 (12.5%)
Own brands	0	4 (80.0%)	2 (66.7%)	6 (75.0%)
Both	0	1 (20.0%)	0	2 (12.5%)
Total	0	5 (100%)	3 (100%)	8 (100%)

Note: Trade moulders - firms with at least 60% business in trade moulding
Own brands - firms with at least 60% business in own brands
Both - firms with 40% - 60% business in trade moulding and own brands.

Table A4. Strategies for expansion adopted by firms in the two Samples

Strategy	A. Representative Sample	B. Design-Conscious Sample
High value products [1]	8 (19.5%)	8 (100%)
Diversify range	10 (24.4%)	5 (62.5%)
Automate production	6 (14.6%)	1 (12.5%)
None	17 (41.5%)	0 (0%)
Total	41	8 [2]

Notes: 1. i.e. 'up-market' products with a high value per unit weight achieved through greater design effort and/or higher quality polymers.

2. Several firms in this sample identified more than one major strategy being pursued simultaneously (e.g. automation *and* high value products).

Table A5 Marketing policies of different types of firms in the two Samples.

A. Representative Sample	Number (%) firms *active* in the market	Number (%) firms *inactive* in the market
Trade moulders	10 (41.7%)	14 (58.3%)
Own brands	11 (91.7%)	1 (8.3%)
Both	5 (100%)	0 (0%)
Total	26 (63.4%)	15 (36.6%)

B. Design-Conscious Sample	Number (%) firms *active* in the market	Number (%) firms *inactive* in the market
Trade moulders	1 (100%)	0 (0%)
Own brands	6 (100%)	0 (0%)
Both	1 (100%)	0 (0%)
Total	8 (100%)	0 (0%)

Note: Trade moulders - firms with at least 60% business in trade moulding
Own brands - firms with at least 60% business in own brands
Both - firms with 40% - 60% business in trade moulding and own brands.

Table A6. Attitude to design of different types, sizes and ownership of firms in the two Samples

A. Representative Sample	Design *not important*	Design *important*, but done by people with other tasks	Design *very important*; specialist design staff are employed
Type of firm:			
Trade moulder	6 (25.0%)	7 (29.2%)	11 (45.8%)
Own brands	0 (0%)	0 (0%)	12 (100%)
Both	0 (0%)	2 (40.0%)	3 (60.0%)
Number employees:			
Under 100	4 (33.3%)	5 (41.7%)	3 (25.0%)
100 - 499	1 (4.5%)	4 (18.2%)	17 (77.3%)
Over 500	1 (14.3%)	0 (0%)	6 (85.7%)
Ownership of firm:			
Independent	5 (29.4%)	6 (35.3%)	6 (35.3%)
Subsidiary/part of company group	1 (4.2%)	3 (12.5%)	20 (83.3%)
Total	6 (14.6%)	9 (22.0%)	26 (63.4%)

B. Design-Conscious Sample	Design *not important*	Design *important*, but done by people with other tasks	Design *very important*, specialist design staff are employed
Type of firm:			
Trade moulder	0	0	1 (100%)
Own brands	0	0	6 (100%)
Both	0	0	1 (100%)
Number employees:			
Under 100	0	0	0
100 - 499	0	0	5 (100%)
Over 500	0	0	3 (100%)
Ownership of firm:			
Independent	0	0	2 (100%)
Subsidiary /part of company group	0	0	6 (100%)
Total	0	0	8 (100%)
All firms	6 (12.2%)	9 (18.4%)	34 (69.4%)

Table A7. Quality control in firms making different categories of product.

A. Representative Sample	Consumer & contract goods	Small 'technical' components	Large 'technical' & building products
Full-time QC staff:			
None	6 (31.6%)	2 (14.4%)	0 (0%)
1 - 4	6 (31.6%)	6 (42.8%)	0 (0%)
5 or more	7 (36.8%)	6 (42.8%)	8 (100%)
Tests performed :			
Dimensions and appearance only	8 (42.1%)	5 (35.7%)	0 (0%)
Chemical, physical raw material, etc. tests	11 (57.9%)	9 (64.3%)	8 (100%)
Total	19 (100%)	14 (100%)	8 (100%)

B. Design-Conscious Sample	Consumer & contract goods	Small 'technical' components	Large 'technical' & building products
Full-time QC staff:			
None	0	-	0
1 - 4	0	-	0
5 or more	7 (100%)	-	2 (100%)
Tests performed:			
Dimensions & appearance only	1 (14.3%)	-	0
Chemical, physical, raw material, etc. tests	6 (85.7%)	-	2 (100%)
Total	7 (100%)	-	2* (100%)

* One firm (Netlon) made products in two categories.

Table A8. Pricing policies in different types & sizes of firm with different goals & marketing policies.

A. Representative Sample	Number (%) firms with *rigid* pricing	Number (%) firms with *flexible* pricing
Type of firm:		
Trade moulder	8 (44.4%)	16 (69.6%)
Own brands	8 (44.4%)	4 (17.4%)
Both	2 (11.2%)	3 (13.0%)
Number employees:		
Under 100	4 (22.2%)	8 (34.8%)
100 - 499	9 (50.0%)	13 (56.5%)
Over 500	5 (27.8%)	2 (8.7%)
Goals:		
Survival	3 (16.7%)	11 (47.8%)
Expansion	15 (83.3%)	12 (52.2%)
Marketing:		
Inactive	4 (22.2%)	11 (47.8%)
Active	14 (77.8%)	12 (52.2%)
Total	18 (100%)	23 (100%)

B. Design-Conscious Sample	Number (%) firms with *rigid* pricing	Number (%) firms with *flexible* pricing
Total	0 (0%)	8 (100%)

Table A9 Business performance of the Design-Conscious firms

Company	Average for period 1973-79			
	Return on capital	Profit margin	Turnover growth [2]	Capital growth[3]
Marley Extrusions Ltd.	21.9%	13.4%	1.10	1.11
Paterson Products Ltd.	19.9%	10.2%	1.19	1.01
Netlon Ltd.	14.8%	11.2%	1.28	1.28
Crayonne Ltd.	10.9%	8.6%	1.21	1.30
Van Leer (UK) Ltd.	10.8%	4.5%	1.02	1.21
Fisher Price Toys Ltd.	7.6%	3.9%	3.15	1.22
Lego System A/S	4.8%	1.9%	1.54	1.61
Hille International Ltd.	0.9%	0.6%	0.94	0.81
Mean	11.5%	6.8%	1.43	1.19
Mean: Representative Sample[1]	8%	6%	1.15	1.12

Notes: 1. Data with one major lossmaking firm removed.
2. Average turnover 1973-79/Turnover 1973.
3. Average capital 1973-79/Capital 1973.