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MANAGING DESIGN PROJECTS IN SMALL AND MEDIUM SIZED FIRMS

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ABSTRACT *This paper presents initial results of a major study of the benefits and costs of investment in design in small and medium sized manufacturers. It shows that UK manufacturers which received a government subsidy to employ a professional design consultant for product, engineering, packaging and graphic design projects recovered their total investment in an average of fifteen months, as well as gaining other indirect benefits. However, problems in using and managing the design consultants was a factor in a quarter of the projects that were not implemented or produced disappointing commercial results. The problems most associated with project failure was inadequate briefing of the consultant and internal disagreements about the aims or value of the projects. Severe design management problems were most common in firms with under fifty employees and especially affected firms with under ten employees. Thus, while small firms often lack in-house specialist skills such as design, such firms require additional help and advice if they are to use external resources effectively.*

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Introduction

In 1983 Britain became a net importer of manufactured goods for the first time since the Industrial Revolution. By 1988 the UK's trade deficit in manufactures reached £14.4 billion, nearly half of which was due to the deficit in cars, textiles, clothing and consumer electronics - all products with a high technical and/or design content[1]. This poor competitive performance of British manufacturing industry has been widely studied and discussed for over three decades. For much of this time attention has focussed on the issues of productivity and prices in determining Britain's economic performance. Over the past decade, however, there has been an understanding of the growing role of `non-price factors', such as product quality, prompt delivery and marketing effort, both in international competitiveness and the business performance of companies[2].

One of the most important factors in competition and business performance is how well a company's products are designed. The term 'design' is often misunderstood because it includes disciplines ranging from engineering, product and industrial design to fashion and textiles, graphics and communications, interiors, exhibitions and architecture. What is common to all these types of design is that they involve creating concepts, plans and instructions, usually in response to a brief provided by a firm or client, that enable a two or three dimensional object that did not exist previously to be made. Everything from an aircraft to wallpaper has to be designed and the design of the object is the specific configuration of elements, materials and components that give it its particular attributes of function, looks, etc. and determines how it is to be made.

Design therefore affects not just non-price factors such as the product's performance, reliability, appearance, safety, ease of use, etc., but design also affects price factors through its influence on how easy the product is to manufacture and its life-cycle costs to the user[3]. This recognition led to a significantly increased Government interest in the role of design in improving the performance of British industry. Following a seminar on `Product Design and Market Success' chaired by the Prime Minister in 1982, there have been several Government initiatives to promote management awareness of the benefits of good design and to support design investment in British industry.

The most important of these initiatives was the Funded Consultancy Scheme/Support for Design (FCS/SFD) programme which aimed to promote the use of professional design expertise in small and medium sized firms. The programme derives from the fact that Britain has perhaps the strongest design consultancy industry in the world[4] yet British industry, and especially smaller firms, is not making proper use of this national resource. The FCS therefore provided funds to enable small and medium sized manufacturing firms to engage a professional design consultant

for a limited period at zero cost or at a subsidized rate to help with the development of new or improved products, components, packaging, product graphics or technical literature. SFD, which suceeeded the FCS, extended the scheme to the service sector with reduced levels of subsidy. The programme began in July 1982 and by April 1987 had involved nearly 5000 projects and £22.5m of Department of Industry funding before it was incorporated in 1988 into the DTI's wider `Enterprise Initiative'[5].

It is in this context that a team from the Design Innovation Group at the Open University and the University of Manchester Institute of Science and Technology, has almost completed a three-year study of the benefits and costs of investments in professional design expertise in small and medium sized manufacturing companies in the UK. This study of the `Commercial Impacts of Design' surveyed a sample of firms that took part in the FCS/SFD programme to provide its main source of data. The aim was to provide information on the commercial returns on investments in design projects at the product level rather than to evaluate the FCS/SFD programme as such. The results to date indicate that the financial case for individual firms investing in the production of new and improved designs is strong. Over 90% of firms that put their designs into production recovered their total project investment, including all design/development, tooling, marketing, etc. costs, through improved sales and profits. The mean payback on the investment (including the subsidy which averaged 10% of the total) was fifteen months with nearly half of the projects paying back within one year. There is also evidence of improved international competitiveness. A quarter of projects resulted in British firms capturing sales from their foreign competitors, and another 10% either started exporting for the first time or increased their exports[6].

Such financial information may be needed to convince decision-makers in industry of the benefits to be gained from the use of professional design for product development. However simply deciding to use professional design expertise is not enough. Our previous research[7],[8] and that of many others[9],[10] has shown that investments in the design of new or improved products are unlikely to yield commercial benefits unless the process of product development is properly organized and managed and is integrated with other business activities. This paper therefore concentrates on the some of the design management aspects of the Commercial Impacts of Design study, in particular the problems experienced by small and medium sized firms when dealing with design consultants. More details of the commercial benefits, costs and risks of design investments will be given in other publications on this research project.

Organizing and managing design

During the past decade many studies have shown that research, design and development activities have often led to the production of inappropriate products too late for the market

because of organizational problems and poor project management. For example, in a previous paper for this journal[11] one of the authors of this paper (Potter) showed how the outcome of several major research, design and development projects in fast trains, including British Rail's failed Advanced Passenger Train, was as dependent on organisational structure and project management as on technical expertise. Another earlier study conducted by the Design Innovation Group showed that `design-conscious' firms, which had won awards, prizes and citations for good product design, were more likely than other firms to be commercially successful, but only because they were also better managed. Those design-conscious firms with a relatively poor commercial performance displayed inadequacies in design project management or a failure to integrate and support product development with other key areas of their business, such as marketing, production and quality control. The most successful firms in that study - such as Netlon, an innovative British manufacturer of plastic mesh, and Lego ,the famous Danish toymaker - were not only good at the technical and design aspects of product development. They combined design skills with other strengths: such as a strategy for growth based on continually expanding their range through product innovation and improvement; gathering market intelligence from many sources and using this to provide detailed briefs to design and development staff; and an organisational structure that promoted cooperation between all those concerned with product development[12].

The latter two features of these successful firms are of particular importance. Our own previous work[13] and that of others[14] has shown that providing design and development staff with a detailed marketing brief at the beginning of any product development project is one of the key ingredients of successful design management. The importance of coordinating the work of different staff involved in design and development has also been stressed in many studies[15] and official reports. This is to ensure that all the market, technical, production and other factors are properly considered in the design and also to speed up the product development process. For example the Corfield Report[16] noted that in many engineering firms design work was isolated, resulting in the need for costly and time consuming adaptations to ensure that the product met market and production requirements. The Finniston Report[17] advocated that `the work of engineers and managers in research, design, development and production is integrated and linked to the market strategy', but found that such integration was often missing in British firms. Similarly, a NEDO Design Working Party recommended a `multi-disciplined process for product development' with `engineers, industrial designers, marketing, manufacturing, R&D and finance all working together throughout the life of a product development programme'[18].

Managing design in smaller firms

Although there is general agreement on the need for effective management of research, design and development, most studies have focussed on larger firms. For example the concepts of multi-disciplinary project teams and matrix management, widely advocated as solutions to the problem of coordination, are mainly based on the experiences in very large Japanese and American corporations. Studies of product development in small and medium sized firms tend to consider them to face different management problems to those of larger organisations. Oakley acknowledges that small firms `have to face many of the problems associated with product design in large companies', but `the emphasis may be different. Lack of expertise and generally limited resources may be the major constraints affecting small companies, in contrast to the resistance to change and organisational inflexibility that often characterise larger firms'[19]. Rothwell and Zegveld[20] argue that one of the main advantages of small and medium sized enterprises in undertaking technical innovation is good internal communication, but they often suffer from lack of skilled staff, shortage of finance and poor links with external sources of expertise and information.

So while smaller companies may possess some advantages in managing design and innovation, they have to cope with other problems and constraints. They usually lack key skills, but are often reluctant to seek outside help. When they do seek help it is often at an inadequate level. They may also be inexperienced in dealing with professional experts, especially those with skills outside their area of experience, such as industrial or graphic designers. Managers of small and medium sized firms are usually fully occupied keeping their business going and have little time to properly brief designers and manage design projects. And of course they face the perennial problem of obtaining the finance to undertake product development, particularly if this involves a risky innovative product.

Managing design and product development in the smaller firm is not easy and, given the focus on design management in large firms, is a task that is poorly researched and understood. The Commercial Impacts of Design study has provided a considerable amount of empirical information on the design management problems faced by small and medium sized firms. Before presenting some of our findings to date it is necessary to provide some details of the study.

The Commercial Impacts of Design study

The sample

The sample is drawn mainly from the approximately three thousand companies that took part in the Department of Trade and Industry/Design Council `Funded Consultancy Scheme' (FCS) from

June 1982 to March 1985 plus some from the `Support for Design' (SFD) programme which succeeded FCS. Over 90 companies have been visited and a further 130 postally surveyed. This paper gives some results from about two-thirds of the in-depth company interviews and postal survey returns.

The survey has been designed to provide a sample representative of the distribution of small and medium sized firms across all thirteen sectors of UK manufacturing. As the FCS was restricted to firms and subsidiaries with 30-1000 employees and the SFD to firms with 1-500 employees, the majority of firms in the study employ 20-500 people, with 16% employing less than 20 people and 5% employing over 500 staff.

Over 70% of the firms sampled employed full-time in-house design and development staff. In 17% of firms design and development was carried out by senior managers or other individuals whose main job was not design and in 16% design was done externally by sub-contractors, consultants or customers. Comparison of this data with that from other surveys indicates no important differences in the human resources devoted to design and development between the firms in our study and other small and medium sized UK manufacturers. In other words these firms may be considered as typical of small and medium sized UK manufacturers in their use of design staff and the results should be generally applicable.

Design inputs and outputs

The focus of the research is on the design projects carried out in the sample firms. All the projects involved inputs of expertise from professional design consultants and usually also from in-house staff whose full-time job was research, design or development. In addition about half of the projects involved design and development inputs from managers or others whose main job did not involve research, design or development work. The input of design expertise from the consultants and the in-house designers to the projects covered a wide range. Over a third (38%) involved various product and industrial design skills; a similar proportion (37%) were either engineering design or combined engineering and industrial design projects; the remaining quarter involved mainly graphic design skills.

Most (79%) of the projects involved outputs of new or redesigned products or components, ranging from railway points, wind turbines, lasers and electronic components to kitchenware and shoes. The remaining fifth (21%) were packaging and graphics projects, ranging from food packaging to the design of technical manuals. Also included are a few technical feasibility studies and projects which produced a range of concepts rather than a specific design.

Business aims

In the majority of cases the business aims behind the various projects could be described as `pro-active'. Two-fifths (43%) of firms aimed to enter new market with a new design (e.g a plastics moulder wanted to diversify into making plastic wheelbarrows). A similar proportion (42%) wanted to increase their market share with an improved design (e.g a manufacturer of mining equipment wished to redesign a coal dust suppression unit to reduce its complexity and cost).

A minority of firms were being `reactive'. 14% wished to maintain their market share (e.g by reducing costs), while a fifth (20%) were responding to customer feedback or to competition (e.g a crash helmet maker needed to redesign its old-fashioned product to compete with the `flair and style' of Italian helmets).

The main reasons for applying for an FCS/SFD subsidy were financial. Nearly half (45%), predominantly small firms, said that either they did not have the resources or wish to risk their own money. A similar proportion (43%) said they did not have the expertise in-house to do the work. Others said they wanted an independent view on their design problem or wanted the extra design input to speed up development.

A third (33%) were honest enough to admit that they only applied because the subsidy was available - often this meant a lack of clear aims and management commitment to the project, which usually led to consultant problems, such as those discussed below.

Implementation

Two-thirds (67%) of the FCS/SFD-subsidied designs were put into production. This is very similar to the figure of 68% implemented projects from a parallel Department of Trade and Industry survey[21]. Like the DTI, we found a higher rate of implementation of packaging/graphics projects (75%) than product/engineering ones (59%). This is not surprising given that the FCS only provided fifteen to thirty days subsidised consultancy (and the SFD considerably less) - only sufficient for a small contribution to most product/engineering projects, but often enough for a packaging/graphics project.

The most common reasons for non-implementation were financial or technical. In half of the non-implemented cases either the project was not considered commercially viable (e.g the design was considered too expensive for market acceptance) or there were technical difficulties in development.

More worrying was the fact that a few firms (7%) simply could not afford to implement the design proposals even though judged commercially viable. This indicates the difficulty that some

small firms have in obtaining the funds to develop and put new designs into production. Some examples are given later in the paper.

Managing design consultants

Although the main focus of the study was on the commercial returns on design, it has provided useful information on design management and in particular on the relationships between a firm and external design consultants. In nearly three-quarters (73%) of cases, the respondents mentioned no real problems with either managing the design consultant or reasons to complain about the quality of the consultant's work. Given that 70% of the firms had no previous experience in using a design consultant, and only 22% used design consultants frequently, this is an encouraging result. However, 27% did have problems or complaints, of which 11% were considered to be `major' problems. About a quarter (22%) of projects that were not implemented were because the firm was dissatisfied with the design consultant's proposals. Table 1 shows the types of problems experienced by firms in using design consultants.

Table 1 here

The reasons for these problems have been categorised into three groups, although in many cases there were significant overlaps between these groups. The first category was where the firm felt that the consultant's work was of a poor quality or otherwise unsatisfactory. The second involved deficiencies from the consultant's side in relating to the firm's requirements. Thirdly there were deficiencies in the firm itself in briefing and managing the consultant.

There were clear associations between the various types of problems experienced and the financial success of the design projects concerned. 55% of all projects, and over 90% of the implemented projects, recovered their design, development and implementation costs through profits on sales and the average time taken to pay back the investment was 15 months from product launch. For the projects that involved problems with the consultant a mixed picture emerges. Project implementation rates were, interestingly, no different on average (Table 2a), but the proportion of implemented projects that made a loss was higher and the average payback period was 20% longer (Table 2b).

Table 2 here

However, analysing the problems in more detail revealed a considerable variation in project success. Table 2(c) uses a combined indicator for implementation and financial return. 60% of the projects in firms which had no consultant problems produced a profit on the total investment. Where companies had infrequent contacts with the consultant, the percentage of profitable projects dropped marginally to 57%, but where the designer's work was viewed as poor, this

proportion dropped to only 20%. Two categories of problems produced no profitable projects at all - where the firm itself had internal disagreements or difficulties concerning the project and where there was a poor brief for the consultant.

Problems with quality of design work

It is perhaps not surprising that poor design work from the consultant was strongly associated with project failure. An example of this, involving a consultant electronic engineer, concerned the design and development of a lightweight electronic transformer for low voltage lighting. The company viewed the results as unsatisfactory because the design produced an incorrect and unstable output voltage. However, the consultant considered that a technical development job like this needed more than the 30 days of subsidised resources available under the FCS to get anywhere. Since the company was not willing to pay the consultant to continue the project without subsidy the dispute between them remained unresolved and the project was abandoned.

Another cause of unsatisfactory design work mentioned by a few firms (11%) was that of jobs being passed on to an inexperienced junior consultant who was not even present at the initial briefing meeting with the firm. For example, in one food packaging project: `the job was passed on to a young chap straight out of college ...(he) went in wrong direction, took a long time and produced only one design in a "take it or leave it" attitude'. In another case a firm, which wanted to launch its shatterproof, laminated glass mirrors onto the retail market, engaged a famous firm of design consultants through the FCS to help define design and market options. The project was a failure because the job was passed on to an inexperienced consultant, who did not understand the unique technical features of the product, but treated the project mainly as one of aesthetic design. Consultant problems such as these were associated with a high project failure rate.

In a similar number of cases (11%) where unsatisfactory designs resulted, there was a clash between the firm and consultants on the purpose of the project. For example, in a project involving the design of a programmable electronic controller: `(the consultants) had a burning desire to get involved with things we didn't want them to do. It used a lot of our time getting them to focus down on the brief'. In another firm making stationery products: `The designer almost totally ignored the brief. He seemed to want to do something "different and original" and his desire to do something new and creative overrode all considerations of meeting the brief'. The firm's managing director ended up doing the design work in association with a supplier and the resultant products were a considerable success.

There is, as one manager put it, a `danger of designers doing things to impress their peers' rather than meeting the client's requirements. To some extent it is part of a design consultant's job to educate the customer in the use of design, but it is not part of a their job to please themselves or

other designers in preference to what is wanted by the client. Interestingly, three of the four companies that experienced this problem (such as the stationery manufacturer just mentioned) were able to go on and produce a commercially successful product. It was a problem that delayed implementation rather than significantly contributing to project failure rates.

Consultant or company problem?

In the above cases, the fault lay mainly with the consultant or consultancy. However, in many cases the firm contributed to the problems experienced.

A good example of this is provided by a company making remote control units, for use in factories involving dangerous operations. There had been numerous complaints from customers that the unit was difficult to use and, on a factory floor, the control buttons and mechanisms could be accidentally pressed. The company had to redesign the casing and controls quickly and so an industrial designer was employed through the FCS scheme. The consultant produced drawings of alternative designs and then made up a cardboard mockup of the one the company choose. The casing was designed to be vacuum formed in plastic and to incorporate joystick controls. However, there were problems when the firm's pattern-maker tried to make up the new control unit. The designer's drawings produced two halves of a box that would not fit together and, even when this was corrected, the choice of materials and manufacturing method were inappropriate. The company had to glue extra bits of plastic into the casing to strengthen it! Moreover, the consultant had underestimated the tooling cost of his design. Despite this clearly unsatisfactory design work, the company did not view the outcome as entirely the consultant's fault. The firm's management felt that in briefing the consultant they had put too much emphasis on cost savings, and in retrospect they felt they should have commited enough resources to do the job properly from the start. As the firm's chairman observed: `Everyone knew that the injection moulding technique was best, rather than the less expensive vacuum forming process that was used. We ended up with an inferior product which didn't compete. The consultant should have said "You're wasting your time trying to do it cheaply"'. In the end, however, the poor work produced by the consultant had a beneficial effect: it stimulated the company's in-house designers to redesign the control unit themselves with entirely satisfactory results.

Underlying many of the examples of unsatisfactory design work there was often a deeper problem of poor communications between company and consultant. In some cases this was viewed as the consultant or consultancy firm's fault - some were criticised as being over-commited, hard to get hold of and (in one case) abroad most of the time. But in many cases it was simply that the importance of regular contacts was not appreciated by the firm itself. One company admitted that the `not a very good job' a consultant produced had a lot to do with their lack of close

contacts and that: `this was a failure of our organisation; we don't monitor consultants closely enough'. Regular contact between consultant and company was an aspect mentioned as important by a number of firms who did not experience problems with their project because they had already learnt this lesson, as well as by companies that learnt it the hard way through their project. This is summarised by the Technical Manager of a consumer electronics firm that regularly used consultants who said: `the difference between success and failure is frequent meetings and discussion...don't let the consultant go away for two or three weeks and get on with it, they will probably produce something you don't want'.

Whereas good contact between consultant and in-house staff was had a major influence on whether the consultant's proposals were implemented by the firm, there was surprisingly little difference in the ultimate success rate of projects that had communication problems and those that had not (Table 2c). However, the payback period was longer, which does suggest that communications problems can reduce the financial effectiveness of design work, but not to the point of making the work entirely unprofitable.

Another factor stressed by companies with previous experience of managing consultants was the importance of a clear and agreed design brief. As Table 2c shows, none of the projects where there was an inadequate brief were profitable. This finding reinforces previous studies undertaken by the DIG and others which have found that one of the factors most significantly determining the success of product development projects is management's provision to the design team of a detailed brief and market specification[22,23]. A number of firms in our study learned through their project of the importance of a thorough brief. For example, a supplier of automotive components used the FCS to help design a powered car seat adjuster. The consultant's design was not implemented because the firm had failed to mention a key factor in the brief, namely that powered car seats, unlike manual ones, have to withstand adjustment under load. The company had to spend considerable in-house time developing a satisfactory mechanism. There were many other comments concerning the importance of the brief, including:

`We had reservations about the complexity and production costs of the design... we were as much to blame for not getting terms of reference right' (fire fighting equipment);

`Company had insufficient expertise to prepare a proper brief. We now know that consultants vary a lot and all are only as good as the brief they are given in a specialist field (hi-fi loudspeakers);

`We have learned about the need to brief consultants properly. Without adequate operating parameters, they can't solve the problem' (coal mining equipment).

An important indirect benefit of the FCS/SFD programme has been that through it many small and medium sized companies have learnt how to prepare a brief for consultants. 26% of the companies interviewed specifically said that the experience had taught them how vital a good brief is to the success of a design project and helped them appreciate what a brief should contain.

As well as inadequate briefing, a few firms admitted that the problems with consultants were largely due to internal management problems, in particular disagreements about the aims or value of the project. In one case involving a manufacturer of umbrella frames, a designer had been brought in by a senior manager to develop a folding child's cot against the wishes of others in the firm. In another case the Technical Director who had engaged the design consultant to improve an engineering firm's range of crane grabs left and the Board was unwilling to invest in any design work other than that required to meet immediate customer orders. Not surprisingly, this was another factor associated with almost certain project failure (Table 2c).

Overall, the analysis of consultant problems suggests that the most serious problems are not with the consultants or consultancies themselves, but with the management of consultants by the commissioning firm. It is problems in this latter area that are associated with very high project failure rates.

Design management problems and firm size

One striking result from the survey is the strong correlation between the size of a firm and its likelihood of experiencing problems in using or managing design consultants. The average size of firms that experienced `serious' problems was 57 employees, compared with an average of 105 for firms that experienced `some' problems and 161 for the firms that had no substantial problems (Table 3).

Table 3 here

Table 4 takes this analysis one stage further. A ratio of representation was calculated, which is the ratio between the proportion of problems and the proportion of firms in each size sector. A ratio of 1.0 means that the particular type of problem is present in firms of that size in the same proportion as in the whole sample. A ratio above 1.0 indicates that the problem occurs more frequently than in the sample as a whole and a ratio below 1.0 indicates that the problem occurs less than in the sample as a whole (down to 0, where it is totally absent).

Table 4 here

This data suggests that serious problems with consultants are very much concentrated in firms with under 50 employees and that consultant problems are especially serious in the very small firms of up to 10 employees. Less serious problems are to be found in firms of 51-150 employees.

In firms of up to 500 employees, the frequency of problems with consultants is much lower and there were no problems at all in firms of over 500 employees. This has important implications for the Department of Trade and Industry's current `Design Initiative', which subsidises design consultants in firms with under 500 employees. Advice on managing design projects and consultants clearly needs to be targetted mainly towards small firms.

Time and Resources for Managing Design

A perpetual problem for the small company is cash flow and lack of time and resources to devote to research, design and development. To many of the small companies in the survey, the FCS/SFD subsidy was a very welcome contribution to an often grossly under-resourced product development project.

An example from our study is that of Checkline Business Machines. This company, which only directly employs six people, was one of the pioneers of the electronic cheque writing machines now commonly found at supermarket checkouts. To fund the design and development of the `Chequewriter', the firm's managing director had to do all the usual things to raise the necessary capital. His house guaranteed a bank loan and he had to enter a venture capital agreement with another company. The SFD grant, which was one of several sources he drew upon to put together a funding package for the project, involved an consultant working on the industrial design of the machine. However, funding was extremely tight, and relations with the venture capital company became strained. Time and money were lost before another company was found to partner the project, which provided much needed R&D and production capabilities. Like many small electronics companies, Checkline only just about survived. Although it has reasonable sales, and is now making more advanced point-of-sale machines, most of the chequewriting market has been taken by the major electronics companies. Point-of-sale chequewriting, `Switch' and other facilities becoming a major electronics market had been correctly anticipated by this small company. The lack of backing from financial institutions meant that this story was one of mere survival rather than the real business success it could have been.

But although many small firms face immense struggles to raise finance for design and product development, as Table 5 shows, the smaller firms (up to 50 employees) in our study were less likely to make a loss on their design projects than the medium sized ones. This might have been because more small firms went bankrupt between starting their project and our trying to contact them three to four years later. But even making some allowances for this, it is important for financial institutions to recognise how good investments in design projects can be in small firms.

Table 5 here

Managing design and company growth

As was noted earlier in this paper, studies of design management view small firms as being good at coordinating inputs to product development from marketing, design, production, etc. due to their informal structures. However, these small firm methods of integration need to change as the firm grows. For example, in one small company visited, which employed 70 people producing air cleaning equipment, the technical director complained that he was grossly overworked just managing the current design projects. `The individuals in engineering, sales, production and marketing do not have an ethos of team work. If one of them produces an idea that is replaced by someone else's idea it is resented. Hence a lot of time is wasted [placating people by] following up development dead ends'.

Another example is provided by an electronics company which had developed from the music recording interests of its founder. He had a network of contacts in the recording industry and a wide knowledge of the technology involved. He personally initiated new products and updates, knew exactly what the market wanted and kept a watchful eye on product development, involving relevant individuals and getting departments to cooperate where necessary. The company grew in fifteen years from its founder's hobby into the leader in its field, employing 250 people. But then the founder sold out. Nobody knew the technology and the market as well as he did; nor was there an organisational structure for product development through which anyone had been trained to replace him. After a period of crisis the firm was taken over by an overseas company in the same business that did possess the expertise to organise product development. The company is now highly successful and in 1990 won a Queen's Award for Export Achievement.

These examples show that, although small firms may be innovative due to their more informal structure and strong leadership, changes have to be made to cope with growth. In an earlier study by the Design Innovation Group of the plastics industry, it was noted that the transition to formalized management structures occurred when a firm reached about one hundred employees and the firms identified as `design-conscious' and commercially successful were the ones that had successfully made this management transition[24]. Once a firm grows above such a threshold, the small-firm ways of co-ordinating new product development are likely to become impractical and will inhibit growth.

In summary, the small company does not simply have to develop a more formalized management structure in advance of growth, but a structure that permits teamwork in product development. Blending the formation of specialist engineering, production, finance, marketing and sales departments with the needs of coordination can be difficult and painful.

Conclusions

Our study of the Commercial Impacts of Design, and a parallel study by the DTI, show that the UK Government's programmes of subsidized design consultants have helped many thousands of small and medium sized manufacturers to make use of professional designers, often for the first time. The experience has improved understanding of and attitudes towards design and encouraged nearly half of these firms to employ consultant designers for subsequent projects at their own expense and/or to increase their in-house design staff. The study shows that the development of new and improved products, components, packaging, etc. using professional design expertise is likely to be a good financial investment for UK manufacturing. Over two-thirds of the projects were implemented and of these over 90% were commercially successful with payback periods averaging fifteen months.

However the study also shows that about a quarter of the design projects studied either failed to be implemented or produced disappointing commercial results. Problems in using and managing the design consultants was one important factor associated with such `failed' projects. Some problems, such as poor contacts between the firm and the consultant during the project, tended to delay rather than prevent successful implementation. However there were two major areas of concern. First, many projects suffered from inadequacies in the quality or suitability of the design proposals produced by the consultant. Sometimes this was due to a lack of relevant technical skills on the part of the consultant, but often it was linked to the other main problem area - namely deficiencies in the way in which the consultant was selected, briefed or managed. Inadequate briefing of the design consultant and internal disagreement by the firm's management about the aims or value of the project were both strongly associated with project failure.

This and other research provides some guidance on how such design management problems might be avoided.

First and fairly obviously, the firm must be clear about why it wants to undertake the project and how it fits into the company's strategy.

Second, the firm should take care to find a suitable design consultant, for example by meeting with and discussing the project with more than one consultancy and reviewing the prospective consultant's work. Some larger firms may go so far as to brief several consultancies and choose on the basis of their initial proposals. It is important for the firm to ensure that the consultant briefed is the one that actually does the work.

Third, a comprehensive written brief is usually essential to any successful design project, especially one involving external expertise. Our previous work has shown that in successful firms the brief tends to be drawn up by a group of people representing key

areas rather than by one individual, so that it includes not just performance and cost requirements but information on customers and users and production and time constraints[25].

Fourth, regular contact between the consultant and the in-house staff involved in the project is important and the responsibility for ensuring that this occurs lies with the firm rather than the consultancy.

Finally the firm's management and staff involved in the project must be commited to carrying it through. Several example of projects have been given in this paper of projects which only yielded commercial returns because the firm was willing to persist with the work even if the consultant's proposed design was unsatisfactory.

Severe problems of design management were much more likely to occur in the firms with under fifty employees and especially affected the smallest firms with under ten employees. Firms in the study with over 500 employees were virtually free of consultant problems. This suggests that, while small firms are most in need of external help to make up for a lack of in-house specialist skills such as design, such firms require additional help and advice if they are to use external design resources effectively.

Such difficulties in managing outside experts are however just one of many problems that beset small firms when attempting to introduce new and improved products. Several firms in the study faced difficulties in raising finance for product development, especially when innovative technologies or novel design ideas were involved. Other small firms had problems when they grew in size in making the transition from informal to more formal methods of project management needed to coordinate inputs from different individuals and departments in product development. The most appropriate method of coordination depends on the nature of the firm, but our previous work has shown that project managers, development committees of senior staff, ad hoc groupings of departmental personnel and formal project teams all can work successfully[26].

It is therefore encouraging that the `Enterprise Initiative', introduced by the DTI in 1988, provides subsidies to enable small and medium sized firms to employ consultants to provide expert help with whole range of business activities, including not only Design but Business Planning, Marketing, Manufacturing Systems, Quality, and Financial and Information Systems.

However, such programmes can only reach a small proportion of manufacturing industry and, despite evidence of a beneficial impact on Britain's trade performance from our study of design projects which received Government support, they are likely to make a relatively minor contribution to relieving the growing trade deficit in manufactured products.

References

[1]NEDC `UK Trade Performance', Paper attached to NEDC(89)9 (London, National Economic Development Council, 1989).

[2]R.Roy and S.Potter with R.Rothwell and P.Gardiner, Design and the Economy (London, The Design Council, 1990).

[3]V.Walsh, R.Roy and M.Bruce, `Competitive by Design', Journal of Marketing Management, 4, 2, 1988, pp201-216.

[4]B.McAlhone, British Design Consultancy: Anatomy of a billion pound business (London, The Design Council, 1987).

[5]R.Shirley and D.Henn, Support for Design: Final Evaluation Report, Assessment Unit, Research and Technology Policy Division (London: Department of Trade and Industry, 1988).

[6]R.Roy, S.Potter with C.Capon The Benefits and Costs of Investment in Design: a summary of results (Working Paper WP-12, Milton Keynes, Design Innovation Group, 1990).

[7]S.Potter, `Successfully managing research, design and development', in: T.M.Khalil & B.A.Bayraktar (eds.) Management of Technology II (Georgia, Industrial Engineering and Management Press, 1990) pp281-91.

[8]V.Walsh, R.Roy and M.Bruce (1988) op cit

[9]M.Oakley, Managing Product Design (London, Weidenfeld and Nicolson, 1984).

[10]J.Pilditch, Winning Ways (London, Harper and Row, 1987)

[11]S.Potter, `High speed rail technology in the UK, France and Japan. Managing innovation - the neglected factor', Technology Analysis and Strategic Management, 1, 1, 1989, pp99-121.

[12]R.Roy, `Product design and company performance', in: M.Oakley (ed.) Design Management: a Handbook of Issues and Methods (Oxford, Basil Blackwell, 1990), pp35-62.

[13]R.Roy, D.Walker and N.Cross, Design for the Market (Watford, Engineering Industry Training Board Publications, 1987).

[14]BSI, `Draft British Standard: Guide to Managing Product Design', Technical Committee QMS/4 Document 87/67900, (London: British Standards Institution, 1988).

[15]D.Winstanley and A.Francis, `Fast forward for design managers', Engineering, March 1988, pp133-135.

[16]NEDO, Product Design: Report by K.G.Corfield (London, National Economic Development Office, 1979).

[17]Committee of Inquiry into the Engineering Profession, Engineering our Future (the Finniston Report) (London, HMSO, 1980).

[18]J.Pilditch, `Design', Paper by J.Pilditch, Chairman of the Design Working Party (London, National Economic Development Office, 1986).

[19]M.Oakley (1984) op cit p111

[20]R.Rothwell and W.Zegveld, Innovation and the Small and Medium Sized Firm (London, Francis Pinter, 1982).

[21]R. Shirley and D. Henn (1988) op cit.

[22]R. Roy, `Design for Business Success', Engineering, January 1987, pp 16-17.

[23]R. Roy and D. Walker, Case studies: A & R Cambridge: Hewlett Packard (Unit 2 of course P791 `Managing Design'), (Milton Keynes, The Open University Press, 1988).

[24]V. Walsh and R. Roy, `Plastics products: good design, innovation and business success', Report DIG 01 (Milton Keynes, Design Innovation Group, 1983).

[25]R.Roy (1990) op cit.

[26]S.Potter (1990) op cit.