The Benefits and Costs of Investment in Design: Using Professional Design Expertise in Product, Engineering and Graphics Projects

Other

The Open University/UMIST

Design Innovation Group

THE BENEFITS AND COSTS OF INVESTMENT IN DESIGN:

Using Professional Design Expertise in Product, Engineering and Graphics Projects.

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The Design Innovation Group

The Design Innovation Group (DIG) was formed at the Open University in 1979 to research into the factors relating to the success and failure of design and new product development in manufacturing industry. DIG now has active members at the UMIST School of Management and at Sheffield Business School as well as at the Open University.

DIG is a member of the Open University's *Centre for Technology Strategy* and UMIST's *Centre for Research on Organisations, Management and Technical Change*.

Major projects have included investigations into the practice and management of design and innovation in several industrial sectors, the 'Commercial Impacts of Design' project detailed in this report, a study of client-design consultant relations and an examination of the commercial returns and international impacts of 'green' product design. The research work of the group has been incorporated into OU undergraduate courses, including *T263 Design: Processes and Products; T362: Design and Innovation,* the Open Business School course *P791 Managing Design* and the postgraduate course *PT619 Quality Techniques.*

A list of publications by the Design Innovation Group may be obtained from the Design Innovation Group Secretary at the address at the foot of this page.

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SUMMARY

This report contains the results of a three year ESRC-funded research project to investigate the commercial impacts of investing in design. This analysis is based upon a survey of 221 product, engineering, industrial and graphic design projects in small and medium-sized UK manufacturing companies that received a small Government subsidy to employ a design consultant[1].

About half the projects were for the design or redesign of products; a third were for projects involving engineering design or engineering and industrial design; the remainder were for packaging, technical literature and other product-related graphics. The products covered by the survey were as diverse as wind turbines, lasers, electronic components, kitchenware, textiles, furniture and shoes. The projects sampled represented a balanced cross-section of British manufacturing industry. If anything, the sample was biased towards companies with the least experience of using design consultants. The financial benefits reported are therefore likely to be conservative compared with companies more experienced in using professional designers.

Key Results

* Around 90 per cent of the implemented projects made a profit.

* The average payback period being 15 months from product launch. 48 per cent of the implemented projects recovered their total costs within a year or less of market launch.

* The average cost of the successful projects was around £60,000; those that failed lost an average of only £8,300.

* Where comparisons with previous, less design-oriented, products were possible, sales increased by an average of 41 per cent.

* A quarter of the projects opened up new home markets and 13 per cent resulted in new or increased exports. A further 36 per cent had other international trade benefits, largely through strengthening British goods in the UK market against competition from imports.

* Other benefits included reduced manufacturing costs, stock saving, increased profit margins and improvements in a company’s external image.

Profits and other benefits

Of the design projects that were launched on to the market (implemented), 89 per cent paid back their total project investment and made a profit. Nearly 90 per cent of these successful projects achieved the payback period of three years generally required by small and medium-sized companies; indeed the average payback period was 15 months from the launch of the product.

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[1] Subsidies were provided through the Department of Trade and Industry’s *Funded Consultancy Scheme/Support for Design* programme which supported some 5 000 projects between 1982 and 1987 at a cost of approximately £22.5m.

Where it was possible to calculate the increase in sales resulting from the redesign or repackaging of an existing product, this averaged 41 per cent. A quarter of projects enabled a company to enter a new home market while 13 per cent resulted in new or increased exports. A further 36 per cent had other international trade benefits, largely through strengthening British goods in the UK market against competition from imports. Exports were strongest among projects involving engineering design or engineering/industrial design expertise, where an average of 40% of the product sales were exported compared with an overall average of 19 per cent.

Table 1: Costs and payback of implemented projects

	Mean total project cost*	Mean payback period from market launch	Percentage profitable
Type of design expertise			
Product design	£54,100	15.9 months	97%
Engineering/ engineering and industrial design	£64,000	15.0 months	86%
Graphics/packaging	£37,900	11.5 months	100%

* Including all research, design and development, tooling, marketing, etc.

Great care was taken to check that better design was the main reason for achieving the results reported. Only 15 per cent of firms said that factors other than design were responsible for the majority of the commercial outcome.

How risky is design?

Of course, not all the projects succeeded. But the loss involved in those that failed was generally small, as most of the failures occurred prior to production starting. Some two-thirds of projects were fully implemented.

The design process itself occupies only a small proportion of the total investment in a new product, but commits some 80 per cent of the cost over the total manufacturing life cycle (DTI, 1991). In this survey of small and medium-sized firms, the average cost of projects that were not implemented was just £8,300. The average cost of implemented projects was £60,500, including all design, development, tooling and launch expenditure (quickly recovered in the vast majority of circumstances).

Predictably, this research showed that graphics and packaging design projects were the most likely to be successful, as the additional development work to put them into production was relatively inexpensive. However, once implemented, product and engineering projects were almost as likely to show a profit as graphics. For all types of design, once projects were implemented the financial risks were low.

Of the projects that failed, the largest single cause was inadequate briefing of the design consultant, which was particularly a problem among smaller firms. Other problems included the failure to maintain adequate contact between the company and consultants and, in a minority of cases, the selection of an inappropriate design consultant.

Almost half the companies in the survey increased their use of professional in-house or consultant designers following their experience with the subsidised consultant. Significantly, many of the companies whose projects did not make a profit were sufficiently convinced about the importance of design that they too increased their spending on it. A third of the firms said that the consultancy project had improved attitudes towards design and, in particular, they felt that they had learned key design management skills, especially how to select, brief and manage professional designers.

1 DESIGN AND COMPETITIVENESS

In 1990 Britain's trade deficit in manufactured goods was £11.4 billion, nearly half of which was in goods with a high technical and/or design content, such as cars, textiles, clothing and consumer electronics. 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 been focused on the issues of productivity and prices in determining 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 in both the international competitiveness and the business performance of companies (Roy et al 1990). One of the most important 'non-price' 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 (Figure 1). 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 determine how it is to be made.

Figure 1: Main areas of design

Source: Shirley and Henn 1988, Annex B.

Design therefore affects not just non-price factors, such as the product's performance, reliability, appearance, safety, ease of use etc., but it affects price factors also, through its influence on how easy the product is to manufacture and its life cycle cost to the user (Walsh, Roy and Bruce, 1988).

The Commercial Impacts of Design (CID) project arose from the previous work of the Design Innovation Group (Roy, 1989; Design Innovation Group, 1985; Bruce, 1985; Walsh & Roy, 1985; Roy, Walker & Walsh, 1981) and that of others (e.g. NEDO, 1979; Rothwell, Schott & Gardiner, 1983; Lorenz, 1986; Pilditch, 1987) and an invitation from the Economic & Social Research Council and the Design Council to bid for funds to undertake research on how 'non-price factors', especially design, affect the international competitiveness of British industry.

During the 1980s there had been significantly increased U.K. Government interest in the role of design in helping to arrest the declining competitiveness of British manufacturing industry. Following a seminar chaired by the then Prime Minister Margaret Thatcher on 'Product Design and Market Success' held at 10 Downing Street in January 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* programme (see Appendix 1) which began in July 1982 and by April 1987 had involved nearly 5000 projects and £22.5 million of Government funding before it was incorporated in 1988 into the DTI's wider *Enterprise Initiative*.

The programme derives from the fact that Britain has perhaps the strongest design consultancy industry in the world (McAlhone, 1987), yet British industry, and especially smaller firms, is not making proper use of this national resource. Yet despite official support for design, our previous studies have found that many British managers, especially in small and medium sized firms, remain sceptical of the value of investing in professional design expertise. In such firms design is often carried out as a part-time activity by those specialising in another field (Walsh and Roy 1985). This attitude was typified when the 1990 recession began to bite, with design consultancies suffering more than industry and commerce as a whole; This suggests that design work was among the first to face cost-cutting by firms.

One reason for the scepticism about the value of design work was that there is no precise information or existing literature on the benefits, costs and risks of specific design investments at the product or project level. Such information is needed if industrial managers are to assess the commercial value of design and decide how much to invest in design relative to other demands on funds. It is also needed by bodies such as the Design Council and the Department of Trade and Industry (DTI) who wish to promote the effective use of design in British industry.

It was in this context that the Design Innovation Group (DIG) conducted this study of the commercial impacts of investment in professional design.

2 METHODOLOGY OF THE STUDY[2]

The main aim of the research was to assess the risks and returns of investment in professional design at a product or project level.

To achieve this aim the main objectives of the research were to assess:

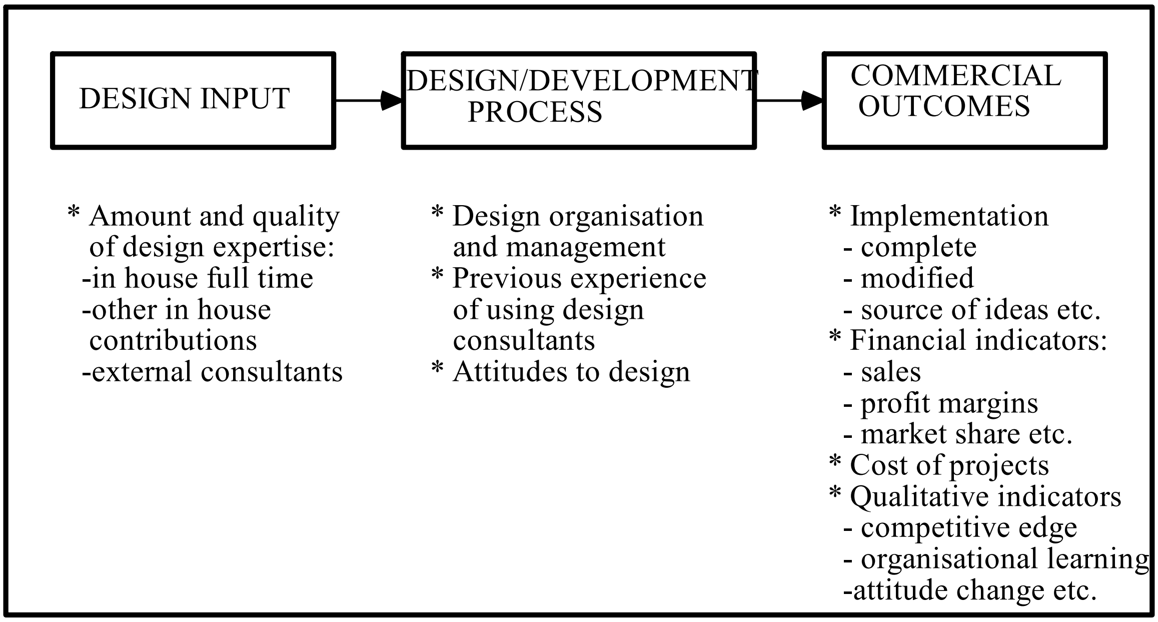
- -the inputs of money and of research, design and development expertise in specific design projects in manufacturing firms;
- -the commercial outcomes of those design projects in terms of implementation, financial benefits, costs and risks, international trade effects and indirect benefits and impacts.

To understand and interpret this product-level information it was also necessary to obtain data on:

- -the commercial environment of the firm;
- -design management practices that had a major influence on the commercial outcomes;
- -managerial attitudes towards professional design.

This process may be viewed as a simple three stage model as shown in Figure 2.

Figure 2: The Commercial Impacts of Design research model



The research team were fortunate to have access via the Design Council to a large number of firms which had recently injected professional design expertise into specific projects. Our survey sample was drawn mainly from the approximately 3000 companies that took part in the Department of Trade and Industry/Design Council ‘Funded Consultancy Scheme’ and ‘Support

[2]Full details of the methodology of this study are contained in Appendix A.

for Design' (SFD) programme. These two schemes enabled small and mediuim-sized manufacturing firms to engage a professional design consultant for 15-30 days at zero cost or at a subsidised rate to help in the development of new or improved products, components, packaging, product graphics or technical literature.

Although the FCS/SFD provided an excellent way of sampling firms that had undertaken a project involving inputs of professional design, the aim was not to evaluate the programme - this was being done by the DTI (Shirley and Henn, 1988). Thus we studied the whole project, not just the design consultant's (sometimes relatively minor) contribution, and the sample was designed to be representative of small and medium-sized firms across all sectors of UK manufacturing rather than of firms within the FCS/SFD.

Firms were sampled according to the distribution used by the Department of Trade and Industry in their assessment of the impact of the Manufacturing Advisory Service, which was based on Business Monitor statistics on the number of firms manufacturing with 60 - 1,000 employees, which was the closest match available to the FCS.

Both in-depth face-to-face interviews and postal questionnaires were used in this research. In the face-to-face survey, a total of 91 interviews were completed and a total of 133 postal questionnaires were received of which 130 were entered into the database.

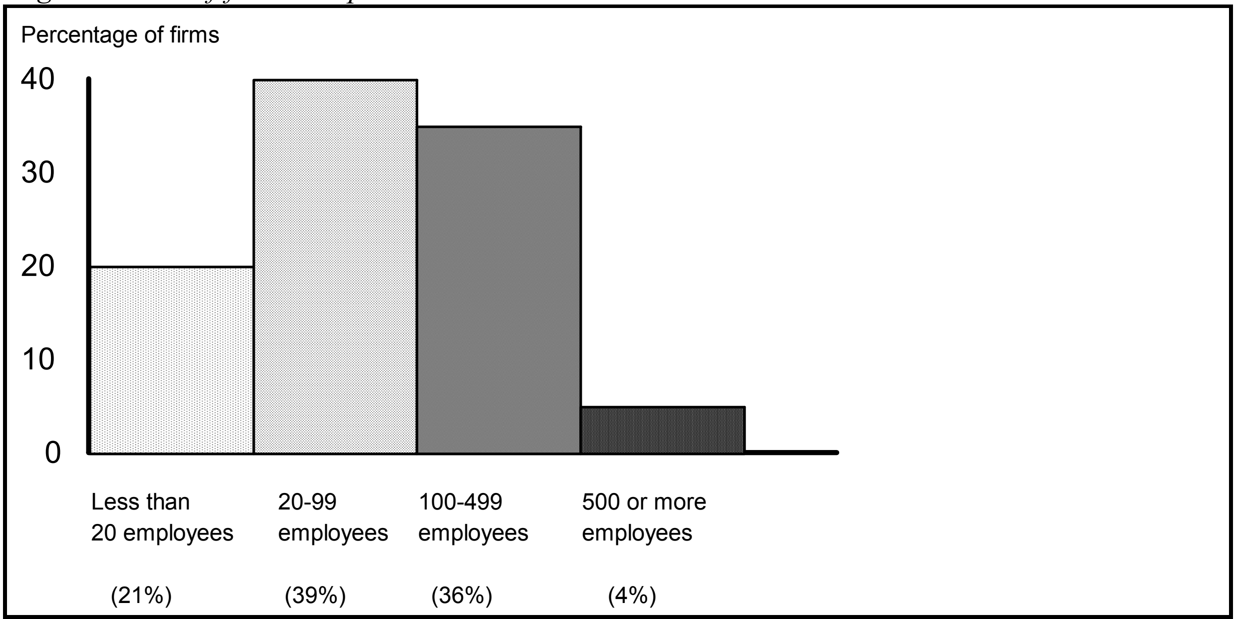
3 THE FIRMS AND PROJECTS

Before presenting the results of our Commercial Impacts of Design study, it is important to note how the statistics are presented. In this report, the results are largely presented as percentages, with details of sample size noted. It must be emphasised that the sample on which the results are based varies depending on the response rate and on whether the question was included in both postal and face-to-face questionnaires. Given that 91 face-to-face and 130 postal questionnaires were analysed, any sample size greater than 91 must include both types. In general, where the sample size is 91 or less only face-to-face questionnaires were involved unless indicated otherwise. As detailed in Appendix A, statistics based on face-to-face questionnaires alone contain a degree of bias towards projects that were implemented and successful, since a greater proportion of non-implemented projects were surveyed postally. This bias is strongest at a detailed sub-sample level and has been taken into account when presenting and interpreting the results.

3.1 Size of the firms surveyed

A total of 221 firms and projects were surveyed representing design and product development work in small and medium-sized firms across the whole of UK manufacturing. Figure 3 shows the distribution of companies in the survey according to how many people they employed.

Figure 3: Size of firms sampled



Sample size: 209 (12 'no answers' excluded)

As the FCS was restricted to firms and subsidiaries with 30-1000 employees and the SFD to firms with 1-500 employees, 60% of firms in the study were small, employing under 100 people. Some of the firms visited were very small indeed; Figure 4 shows half the workforce occupying half the manufacturing space in one company visited. In a few cases we surveyed firms that consisted of only one person.

Figure 4: The workfloor of a typical small company surveyed.

This was a project involving the innovative design of a spa bath for the elderly and people with disabilities. This photograph shows production of conventional glass fibre spa baths.

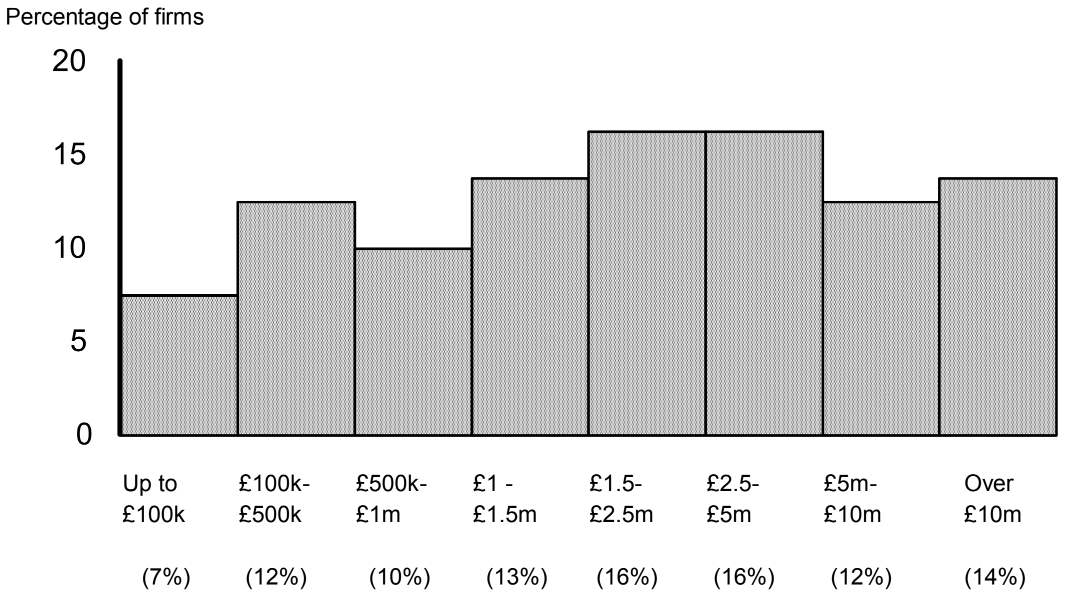
36% of the firms surveyed were medium-sized companies with 100 - 500 employees. These tended to have more specialist premises and had more formalised structures than the smaller firms. One example of such a firm is shown in Figure 5 This is a company with 300 employees that manufactures audio mixing consoles for the music recording industry. Their project involved both engineering and industrial design work to replace the old wood and steel consoles with a new modular design in moulded plastic suitable for the modern electronics it was to house.

Figure 5: Assembling the modular audio mixing console

A few firms had 500 - 1,000 employees and two firms included in the survey had over 1,000 employees.

Another way to classify the size of a firm is by turnover. Figure 6 shows the firms according to their most recent annual turnover. Again this shows that some companies were very small indeed. Of the 69 companies for which we have turnover data (only gathered in the face-to-face sample), the smallest had an annual turnover of only £18,000 per annum and the largest £110 million (the latter was in our small comparison sample and did not take part in the FCS).

Figure 6: Size of firm according to turnover



Sample size: 69 (22 'no answers' excluded)

3.2 Who does design and development?

At the time of the FCS/SFD project, design and development was undertaken in over half of the firms by full-time in-house research, design and development (RD&D) staff, either alone (14%) or with other internal and/or external inputs (41%). In a third of firms design and development was carried out by managers or other individuals whose main job was not RD&D, either alone (17%) or with external inputs (15%). In 10% design was done externally by consultants, sub-contractors or customers, and 5% had no prior design/development experience (see Table 2).

Comparison of this data with that from other surveys (e.g Walsh and Roy 1985; Neal & Associates 1988) indicates no major differences in the human resources devoted to design and development between the firms in our study and other small and medium-sized UK manufacturers. The results from our survey should therefore be generally applicable. If there is any bias in the sample it is towards firms that devote slightly fewer resources to design/development work and are somewhat less experienced in using consultants than other small and medium-sized UK manufacturers.

Table 2: Analysis of people undertaking design and development work at the time of the FCS/SFD project (percentage)

Design/development work done by:		Nature of FCS/SFD project (by input of design expertise): Product Design or Eng & Industrial Design (n=31)	Engineering Design (n=30)	Graphic and Packaging Design (n=23)	All Projects (n=84)
Full time in-house RDD staff with inputs from other in-house staff &/or external consultants, suppliers, customers, etc.	(n=34)	42	60	13	41
Full-time qualified in-house RDD staff alone	(n=12)	13	27	0	14
Other in-house staff (whose main job was not RDD) with inputs from consultants &/or suppliers, customers, etc.	(n=13)	13	0	39	15
Other in-house staff (whose main job is not RDD) alone	(n=14)	26	10	13	17
External consultants &/or suppliers, customers, etc. alone	(n=7)	0	0	31	8
No-one (no previous design/ development experience)[3]	(n=4)	6	3	4	5
Totals	(n=84)	100	100	100	100

Sample: 84 face-to face interviews (pilot survey excluded).

Although the FCS/SFD project was not necessarily representative of the general products of the firms surveyed, it is interesting to note how people who undertook design and development work varied with the type of design project involved. For graphics projects, the use of consultants was widespread, with 70% of the graphics work undertaken either by consultants alone or together

[3] This is the view of the companies that the work in producing their products did not really constitute a design process as such, although obviously product configuration, materials selection etc. were sorted out.

with managers or other in-house staff. This reflects the fact that few firms have enough graphics work to require an in-house graphic designer.

The opposite was true for projects involving engineering or engineering and industrial design, where the focus was very much on in-house staff. This reflects the need for in-house resources to undertake engineering design work. With product design there is a wider mix of inputs, although it is interesting (and perhaps disturbing) to note that over a quarter of this category involved managers or other in-house staff whose main job was not research, design or development working alone.

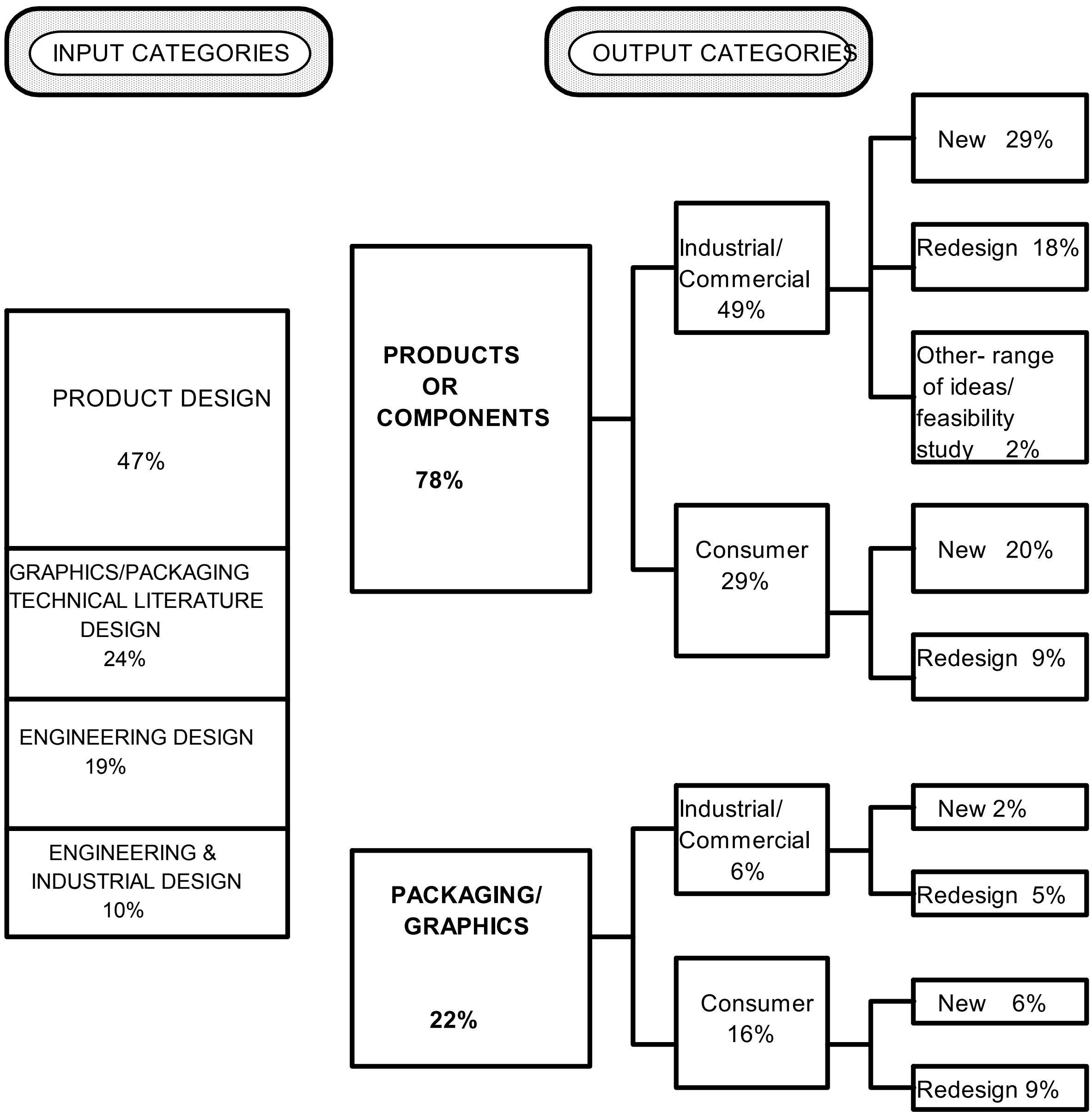
For most firms, the FCS/SFD project was the first time they had employed a professional design consultant. Over two-thirds (68%) of firms had not previously employed a design consultant in any capacity whatsoever. In addition, a number of other firms were employing a design consultant in a new discipline for the first time (for example a company experienced in employing engineering design consultants used the scheme to employ a graphic designer for technical literature).

The experiences and results from this survey therefore very much represent firms in the early stages of the learning curve in using and managing external professional design expertise.

3.3 Different types of projects

Each project was classified in terms of the the inputs of design/development expertise involved and the type of design output that resulted (See Figure 7). As well as the inputs from the design consultants, most projects involved inputs to design/development work from qualified RD&D and/or other in-house staff.

Figure 7: Design input and output categories in the CID survey



Sample: 221

Note: some graphics projects were used to generate product outputs, hence why there are 24% graphics inputs and 22% graphics outputs.

The input of design expertise from the consultants and the in-house staff to the projects covered a wide range. Almost half (47%) involved various product design skills (e.g textiles, ceramics, furniture); 29% involved either engineering design (e.g electrical, mechanical) or combined engineering and industrial design expertise (e.g electronics plus styling/ergonomics); the remaining 24% involved mainly graphic design skills, ranging from packaging to the design of technical literature.

Over three-quarters (78%) of projects involved outputs of new or redesigned products or components. The survey contained examples across the full spectrum of British manufacturing industry, ranging from high-tech electronics and traditional mechanical engineering to consumer products such as kitchenware and shoes (see Figure 8 for illustrations).

Figure 8: Examples of products included in the CID survey

(Left) A product design project involving the redesign of concrete planters and street furniture in order to widen the company's range and increase overall sales.

(Right) A microplate washer for laboratory use. This engineering and industrial design project led to a new product from a company that specialised in laboratory equipment.

The remaining 22% were packaging and graphics projects, which produced outputs ranging from food packaging to the design of technical manuals (see Figure 9). Also included were a few (2%) technical feasibility studies and projects which produced a range of concepts rather than a specific design. An example of a technical feasibility study was a marine electronics company that needed to investigate the potential for fibre optical lines to replace conventional wiring. In this particular case the result was a negative one, with the consultant concluding that fibre optics were insufficiently robust for marine application. Examples of projects leading to a range of design ideas include a consultant who suggested a number of design elements for high-quality cardboard boxes and another that suggested window designs to be applied to a number of tents.

Figure 9: Examples of graphics,projects in the CID survey

(Left) Repackaging of organic pest control products. This was previously sold in plastic bags, which major retailers would not stock. The new cylinder packaging has been very successful and the packaging design has subsequently used for other products.
(Right) Technical literature for a coated aluminium manufacturer. The design project was a response to improvements that competitors had made in their technical literature. The results helped the company to maintain a high quality of customer service which was seen as crucial in a highly competitive market.

3.4 Project Costs

Data was gathered on the total investment involved in the project. A key influence on total investment was whether a project was implemented (i.e. put into production) or not. When projects were not implemented, the costs were considerably lower because no tooling, plant or other production costs were involved. For implemented projects, the mean total investment, including all design, development, plant, tooling, marketing and other costs, was £60,500 and £8300 for non-implemented projects. In both cases, this includes the FCS/SFD subsidy which, according to the DTI, averaged about £4,500 (Shirley and Henn 1988).

Concentrating on the implemented projects, there was a clear relationship between project cost and the type of design input (Table 3).

Table 3: Project costs (£)

	Graphics & Packaging Design	Product Design	Engineering Design/Engineering & Industrial Design	All Projects
Implemented[4] Projects (n=98)	37,900	54,000	64,000	60,500
Non-Implemented Projects (n=28)	4,000	6,600	11,600	8,300

Sample: 126

This pattern is not surprising. In general, the more technical a project becomes, the more expensive it is. With the FCS/SFD contribution being between £2,000 and £5,000, non-implemented product and graphics projects lost little more than the government subsidy. For engineering projects, firms usually had to put in more of their own resources before deciding whether to proceed to production.

3.5 Project aims and market strategy

Firms were asked for the business aims behind their project. The business reasons for undertaking the design project can be divided between *proactive strategies,* where a company is seeking to use design improvements to win new markets or expand an existing market, and *reactive strategies,* where the company is acting in response to the actions of others.

Such business aims feed through to marketing objectives which should set the criteria for the type of design used. However a proactive marketing stance does not necessarily require a radical, innovative design. Equally, in a quickly changing market, a radical design approach may be needed even in reactive situations.

[4]Implemented projects are defined as those put into production.

Example from our survey of different mixes of marketing strategies and consequential design approaches are given in Table 4.

Table 4: Examples of marketing strategies and design approaches used by firms in the CID survey

(A) Product development: a firm building fire fighting tugs had devised a method of calculating and testing the vibrations in the fire fighting masts of their tugs. Maintenance of market share was the firm's intention as vibrations in the fire fighting masts are potentially dangerous and unacceptable to customers.

(B) Product update: clothing and footwear are obvious examples of products where frequent updates are very necessary. One example involved a company which maintained market share by employing a consultant to redesign a range of shoes for the younger man.

(C) Product and Market Development: a textile firm that designed a range of workwear for the professional market (banks, building societies, etc.) aimed to increase its market share by developing both product and market.

(D) Variations of Product: a supplier of car-park access equipment used a consultant to design had a range of semi-automatic car park equipment in an attempt to increase market share.

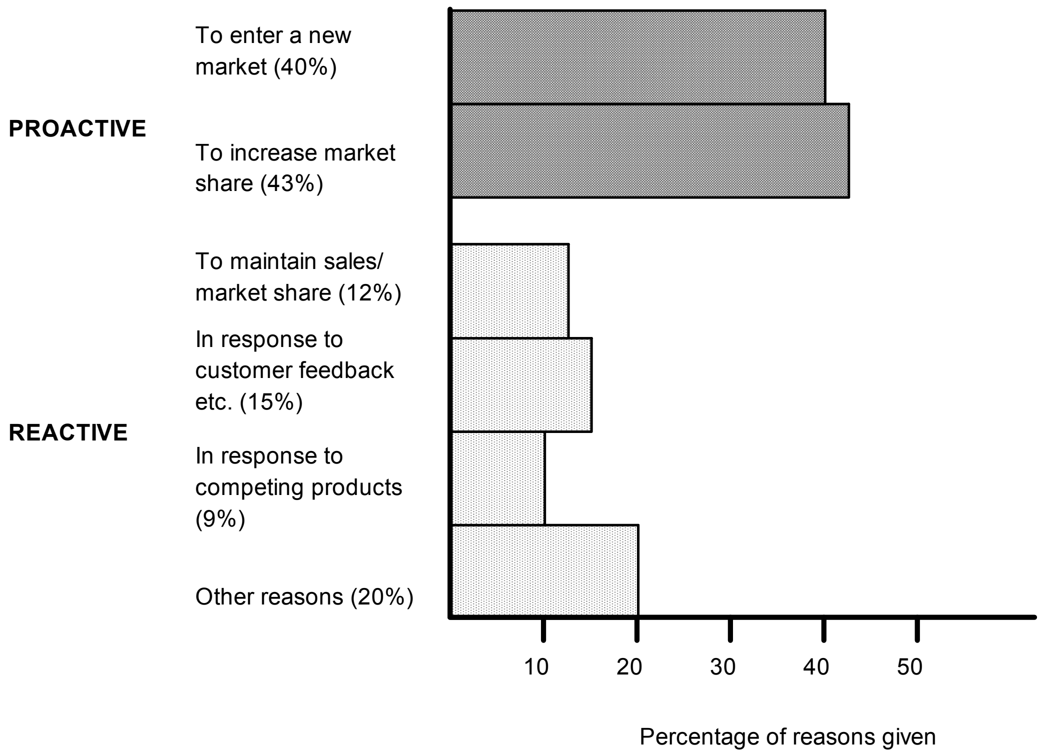
(E) Innovation: a cheque writing machine for supermarkets was designed and developed to enter a new market with a new product.

(F) Market Gap: a new design of frame tent was sought that would be as easy to assemble as a ridge tent but as roomy as a frame tent to exploit a market gap.

(G) Re-packaging: a company sought to relaunch a retail range of hair care and cosmetic products. The packaging redesign was a crucial part of this major marketing exercise and was intended to provide a 'flagship' for the company's image.

In total, 53% of the firms surveyed had reasons for undertaking their design project that could be described as pro-active. 23% were undertaking their project for a mixture of proactive and reactive reasons with just under a quarter (24%) undertaking the project for reactive reasons alone (see Figure 10).

Figure 10: Reasons for undertaking the design project



Sample :221

Note: as firms gave more than one reason, the percentages cannot be added together. The overall proactive/reactive/mixed split is as detailed in the text.

Most firms followed a mainly proactive strategy. Thus 40% of firms aimed to enter a new market with a new design and a similar proportion of companies wanted to increase their market share with an improved design. For example, a plastics moulder wanted to diversify into making plastic wheelbarrows.

A minority of firms were being mainly reactive. 12% simply wished to maintain their market share rather than win new business. For example, a pump manufacturer wished to halt declining sales with a quieter design and a manufacturer of mining equipment aimed to redesign a dust supression unit to reduce its complexity and cost without seeking to increase sales. A quarter (24%) were responding to customer feedback or to competition. In many cases, smaller firms relied on being suppliers to larger companies. Such component manufacturers may have been required by one of their large customers to improve or modify their design. An example of this was a manufacturer of car seat adjustment mechanisms. This company previously only manufactured manual seat adjusters, but with the car industry increasingly demanding powered seat adjustment, this company had to develop a powered mechanism. However, for other companies, the introduction of a competing product was often the spur for design change. For example, a crash helmet maker needed to redesign its old-fashioned product to compete with what the firm viewed as the ‘flair and style’ of Italian helmets (Figure 11). In another case a firm used in-house and design consultants to redesign a lorry engine and cab as its competitors were making lorries with more power.

Figure 11: The motorcycle helmet redesign project.

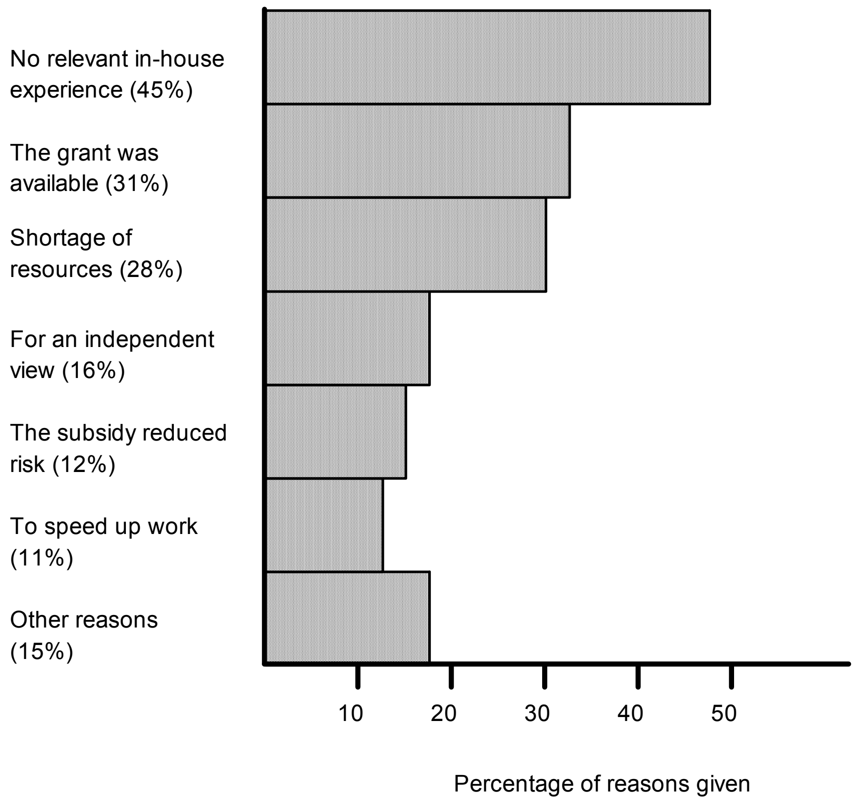
The original design is on the left.

There were other reasons for investing in design - a common one being to improve company image by producing more modern, stylish or better packaged products.

Although in most cases a clear link did exist between the business and marketing aims of the company and the nature of the design project, in some firms this link was vague, and such poorly-defined projects were prone to failure.

Firms were also asked why they were using the FCS/SFD to employ a professional designer. This also produced multiple responses, but most were concerned with money and expertise (see Figure 12).

Figure 12: Reasons for applying for a subsidy to employ a design consultant



Sample 91 face-to-face interviews
(Note: most firms mentioned more than one reason)

The largest number (45%) simply said they did not have the expertise in-house to do the work. For example, the marine electronics company mentioned earlier wanted to explore the use of fibre optics; another company used a consultant to explore CAD systems. A number of firms did not have anyone with graphics skills to redesign packaging or technical literature.

40% said that either they did not have the resources or wish to risk their own money. 16% wanted an independent view on their design problem and 11% wanted the extra design input to speed up development. Nearly third were honest enough to admit that they only applied because the subsidy was available.

Overall, the firms in the sample were very clear as to why they were employing professional designers; essentially this was to improve their market and business performance and many firms did not have the expertise to carry out the design work in house. However, only a few appeared to view the design project as a opportunity to change product strategy, company image or product range based on a more professional approach to design. The implications of this are discussed in section 7 of this report.

4 PROJECT OUTCOMES

The outcomes of the projects were analysed at several levels - implemention, financial risks and returns, and indirect impacts. Outcomes therefore ranged from complete successes, through various types of partial success, to bad failures

4.1 Measures of Project Success and Failure

A simple distinction between projects that were implemented and those not implemented is too simple a measure of 'success' or 'failure'. It is perfectly possible to have a project that was not implemented, or even one that was implemented and made a loss, but which the firm viewed as a success because it had important indirect or long-term benefits. This is why further analysis took place of both the implemented and non-implemented design projects. Probably the best case of this from our study is a company which makes packaging products. Their FCS project, which aimed to diversify the company's business into gift products, was a 'fairly serious disaster. The product was wrong in almost every way - size, design, price and basic concept.' The project lost the company nearly £190,000 - the biggest loss in our entire sample. But this company also said that although, in retrospect, the 'direct outcome was a waste of time', it was necessary to 'keep at it'. They emphasised the importance of persisting in order to produce a successful product. As our interviewee said, 'getting it wrong doesn't mean we shouldn't have done it. The indirect outcome is a £1.5m business after three years, 14 jobs and good growth prospects'.

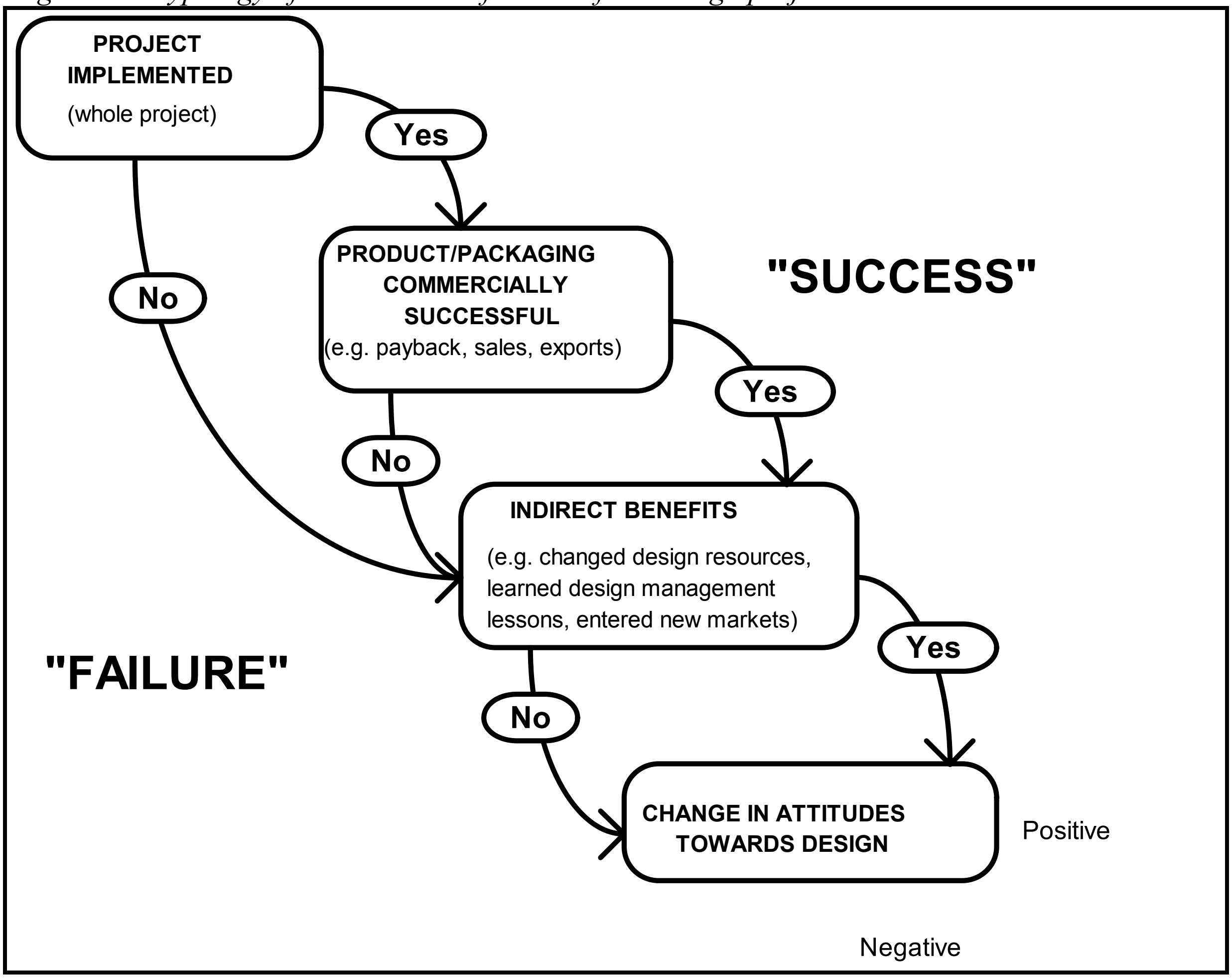
In another case a packaging project in a food company failed because of external financial reasons. However, when that company's fortunes improved and it came to undertake a new packaging project they knew how to use design consultants and of the potential impact that professionally designed packaging could have on the market. They viewed their original 'failed' project as a 'success' because it taught them how to use design effectively.

Figure 13: Food packaging projects.

The FCS-assisted project (left) was for a range of chilled foods. This project was not implemented due to financial problems. However through this work, the company learnt to value the contribution of a professional graphic designer. Later, when the firm had recovered and a new range of frozen foods was planned, they re-employed the design consultant to work on the packaging of the new range.

In order to allow for both financial and less quantifiable and indirect benefits of design work, a typology was developed, which is shown in a simplified diagrammatic form in Figure 14. This was used to categorise firms according to different measures of 'success' and 'failure', firstly by implementation, then by the financial returns and trade effects and finally the importance of the indirect benefits that resulted.

Figure 14: Typology of 'success' and 'failure' of the design projects



The diagram in Appendix B provides more detail how the information gathered from our survey was used to allocate firms to these categories. Overall, only 19% of the projects surveyed were classified as total failures (Figure 15). The following sections (with the rest of this section focussing on commercial aspects and section 5 on indirect impacts) examine the various indicators of success and failure that were used in our analysis.

Figure 15: Summary of 'success' and 'failure' analysis

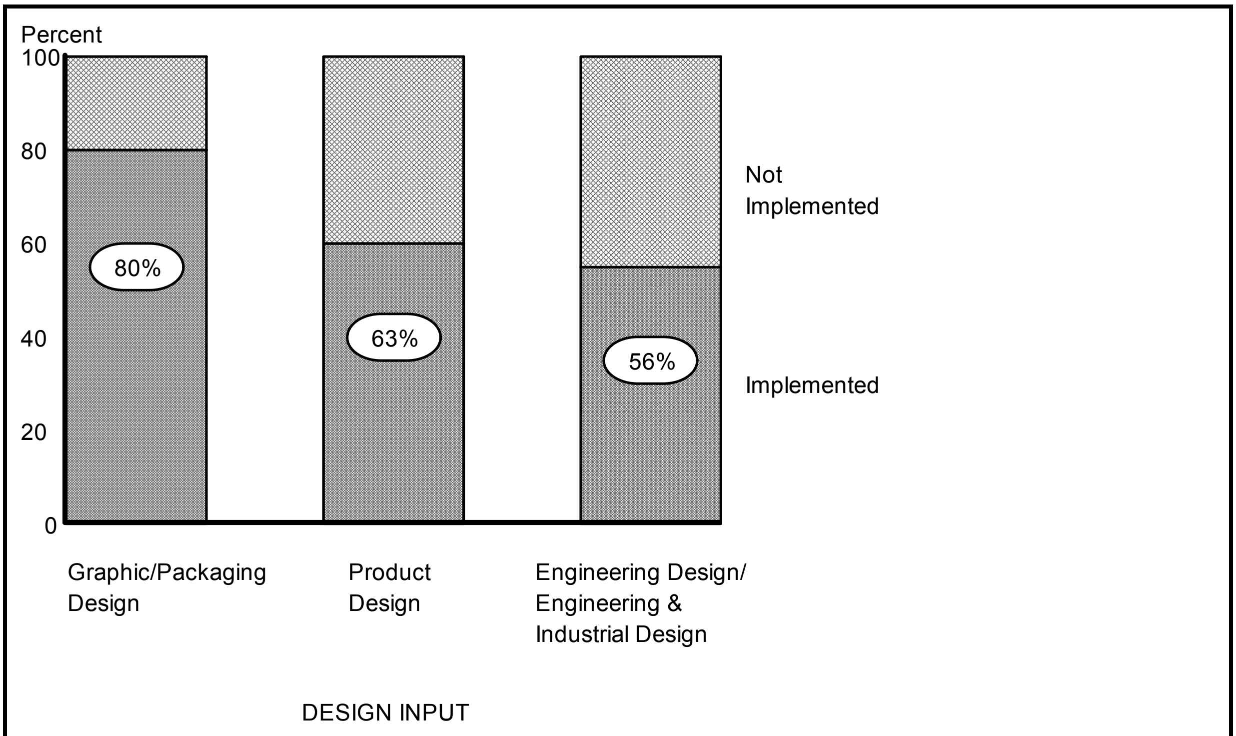
	With indirect benefits	Without indirect benefits
Project commercially successful	**COMPLETE SUCCESS 50%**	**PARTIAL SUCCESS 10%**
Project made a loss	**PARTIAL SUCCESS 21%**	**FAILURE 19%**

Sample size: 178 with quantitative or qualitative data.

4.2 Implementation of the design projects

Two-thirds (65%) of the FCS/SFD-subsidied designs were implemented by being put into production. This is similar to the figure of 68% implemented projects from a parallel survey conducted by the Department of Trade and Industry (DTI) (Shirley and Henn 1988). Like the DTI, we found a higher rate of implementation of packaging/graphics projects than product or engineering/engineering & industrial design ones (Figure 16). This statistically significant (chisquare $p<0.03$) difference is not surprising given that the FCS only provided 15-30 days subsidised consultancy (and the SFD considerably less). This was insufficient for most product/engineering projects, which usually required much additional design/development effort by the firm, but often enough to complete design work for a packaging/graphics project.

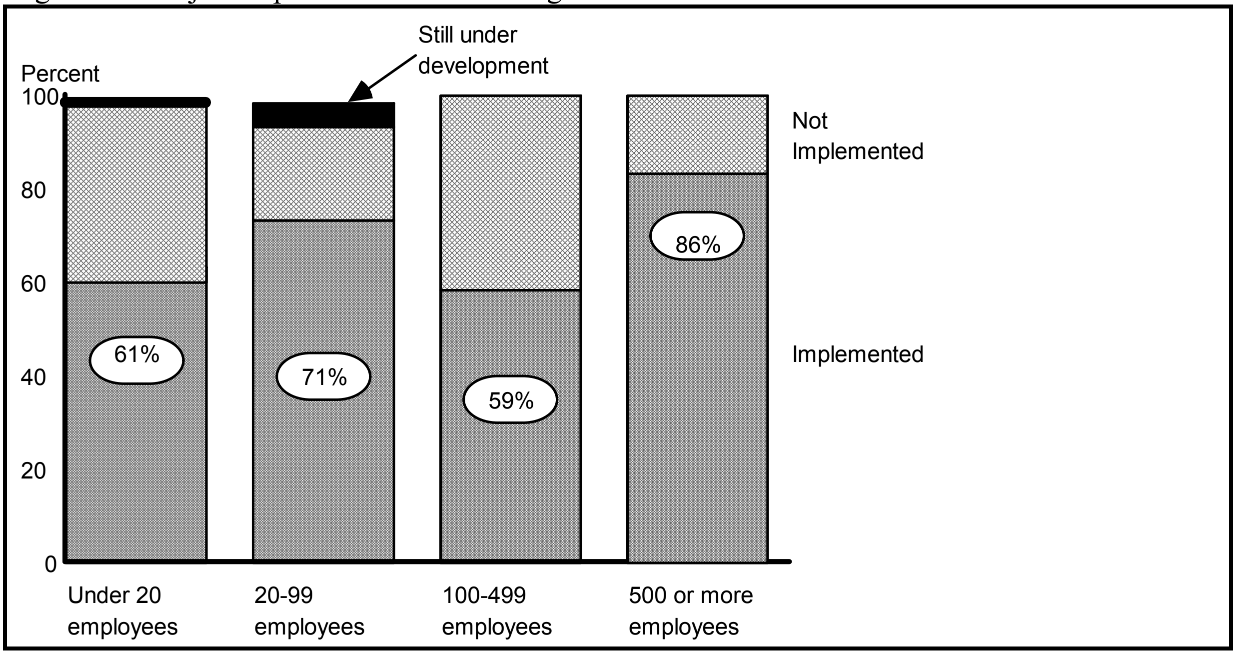
Figure 16: Implementation by project type



Sample: 221

Larger firms did have a higher implementation rate than small and medium sized enterprises (Figure 17), although there does not appear to be a simple correlation with size. Rather the largest (over 500 employees) have a higher implementation rate of 86% with smaller firms being in the 60 - 70% range.

Figure 17: Project implementation according to firm size



Sample: 207 (in 14 firms the number of employees was not known)

The relatively low implementation rate among the very smallest firms could be associated with the difficulties such firms have in managing design consultants, which is discussed in section 6.3 of this report.

4.3 Financial returns on the design projects

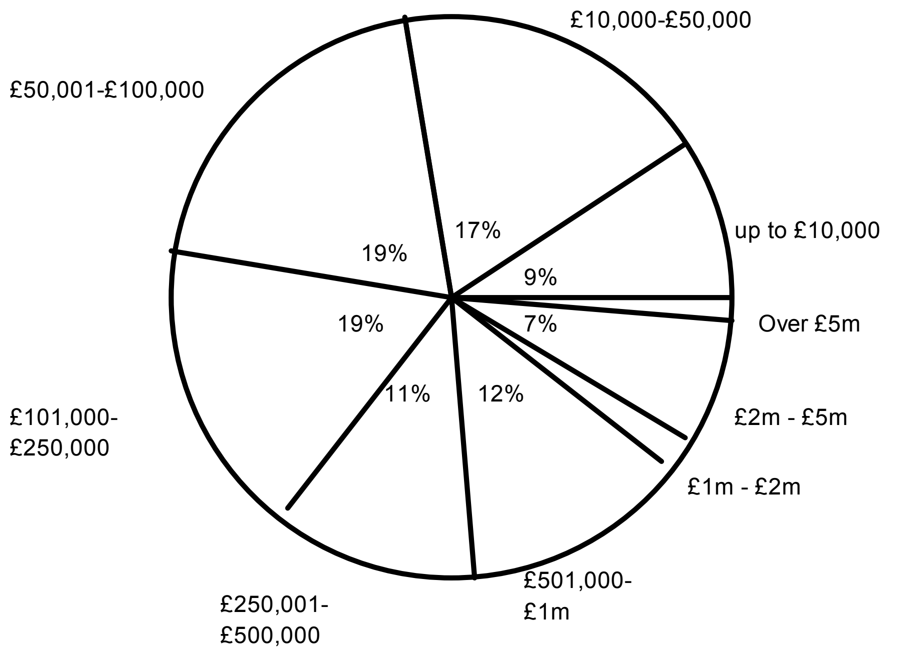
Several recent studies, including those by the DTI and the Design Council, have surveyed firms participating in the FCS/SFD programme (e.g. Shirley and Henn 1988; Michael Neale and Associates 1988; Design Council 1986). But this is the only research to have succeeded in producing data on the financial benefits, costs and risks of design and product development projects. As noted in section 3.4, information was gathered, wherever possible, on the costs of the design work and of all the subsequent costs of developing that design through to its market launch. A variety of measures of financial performance at the product level were also obtained. These largely consisted of figures for sales, gross profit margin and exports, although in some cases information on manufacturing costs, market share and other financial measures were also gathered.

We obtained sufficient data on costs, sales and profit margins to calculate the payback or loss on 94 projects and partial or qualitative information for 85 others. For redesigns/updates we managed in some cases to obtain good data comparing sales, profits, etc. before and after the project. If firms did not have, or were unwilling to release, commercial data on their FCS/SFD project, we used a number of qualitative indicators. The main one was indicating on a scale from 1 to 5 the degree of success of the project according to the criteria of sales, profit margin, market share, etc. We also asked the interviewees if the company viewed the project overall as a success or not.

4.4 Commercial Performance, Payback and Risk

As was noted earlier, two-thirds of the FCS/SFD projects were implemented. For the products where sales figures were obtained, the average sales were £940,300 per annum. However, this average figure was strongly influenced by a relatively small number of firms with very high sales. Figure 18 shows this distribution, which indicates that a more 'typical' sales figure would be in the range of £10,000 to £250,000. The small sample of comparative firms (not included in these figures) produced very much higher figures for sales, which was part of the rationale for choosing them.

Figure 18: Average sales of FSC/SFD product



Sample: 74 (face-to-face and postal)

On average, sales of the FCS/SFD product accounted for a third of average turnover. These projects were therefore very important to the product development strategy of most of the companies surveyed.

To make an evaluation of the commercial success of a product or project requires sales income to be related to the cost of generating those sales. Table 5 summarises the information from our survey, incorporating the qualitative as well as quantitative indicators of commercial success. This involves adding to the profitable projects those which were considered by the people interviewed to be commercially successful and adding to those with a specified loss those viewed as ‘loss making’ or to have made a loss simply because they were not implemented.

At a very basic level, our data shows that 60% of the 179 projects for which we had quantitative or qualitative financial data were commercially successful and 40% made a loss. For the 120 *implemented* projects on which we had quantitative or qualitative financial data 89% were successful and only 11% loss-making. It should be noted that most of the loss making projects were not implemented, involving little more than the loss of the FCS/SFD subsidy.

Table 5: Commercial performance of different types of design project (all projects)

	Inputs of design expertise - whole project			
Payback Period	Product Design (n=86)	Engineering design/ engineering & industrial design (n=49)	Graphic/ packaging (n=46)	All design projects (n=181)

Profitable projects	57%	43%	83%	60%
Loss-making projects	43%	57%	18%	40%
	100%	100%	100%	100%

Sample: 181 implemented and non-implemented projects with quantitative or qualitative financial data.

We also analysed the subsample for which we had full financial data. This was used to calculate the time it would take from the market launch of the new or updated product or packaging[5] for profits from sales to pay back the total investment (the payback time). This is the measure we found to be most widely used and understood by the type of firms we were dealing with.

For new products, we assumed that the total gross profits from sales would be devoted to paying back design and implementation costs. For redesigned products, it was assumed that sales of the existing design could have continued. Using information supplied by the firm we estimated the additional sales and gross profits resulting from the redesign and it was these additional profits that were related to project costs to provide a payback figure..

This subsample had a higher proportion of commercially successful projects than the combined qualitative/quantitative sample. 70% of these projects paid back their total investment compared with 60% being commercially successful in the sample that added wider qualitative data to the quantitative figures. This difference is thought to be mainly due to differences in responses between the face-to-face and postal survey. As noted earlier in section 3, non-implemented projects were frequently transferred from the face-to-face to the postal survey. It was found that for non-implemented projects, with more limited data to gather, the postal survey was adequate. Compared to the face-to-face interviews, fewer of the postal questionnaires yielded detailed financial data. Overall, it is likely that the commercial success rate of 60% in the combined qualitative/quantitative sample is a more accurate figure, with the 70% in the face-to-face survey being an overestimate. However, the degree of bias is not very large, although it needs to be noted.

For the implemented projects with quantitative data, 94% were profitable and just 6% loss-making. Again, this was a little higher than the 89% ‘commercially successful’ projects using the combined quantitative/qualitative criteria.

The average payback period for all projects in the survey was 14.5 months with 88% of implemented projects paying back within the maximum of 3 years often required by small and medium-sized firms (see Table 6 and Figure 19). There is little difference in the payback period or success rate between projects involving product design expertise and

[5]Note that the payback calculations are from the market launch of the product, not from when the expenditure was incurred. This was because we had exact market launch dates for all projects whereas information on when expenditure was incurred was less precise.

'technical' projects involving pure engineering or engineering plus industrial design. But graphic/packaging design projects are significantly more likely to be profitable (chisquare $p<0.03$) and on average pay back faster. The overall payback figures are similar to the *estimated* payback periods of projects funded under the `Design Initiative' which succeeded SFD (DTI 1989).

Table 6: Payback and Loss for different types of design (all projects)

Inputs of design expertise - whole project

Payback Period	Product Design (n=43)	Engineering design/ engineering & industrial design (n=31)	Graphic/ packaging (n=17)	All Implemented (n=91)
Profitable projects	65%	61%	94%	69%
Mean pay-back period	15.9 months	15 months	11.5 months	14.5 months
Loss-making projects	35%	39%	6%	31%
Mean loss	£18,900	£17,000	£4,000	£17,500
	100%	100%	100%	100%

Sample: 91 implemented and non-implemented projects with quantified financial data.

Figure 19: Payback period for implemented projects

However as shown in Figure 20, once the projects are put into production, the likelihood of product or engineering projects being profitable is almost as great as that for graphics projects. Indeed, the difference in risk is not statistically significant (Fisher p=0.33). The difference between product, engineering and graphics projects is in the implementation rate of design work. Once projects are implemented there is no statistically significant difference in the proportion that make a profit or loss.

Figure 20 Profitable and loss making projects for different kinds of design - left: all projects; right: implemented projects

Sample: 67 implemented projects with financial data

Table 7 provides more detail of the financial performance of the implemented projects according to the type of design input.

Table 7: Cost, Payback and Loss for different types of design (Implemented projects only)

	Inputs of design expertise - whole project			
Payback Period	Product Design (n=29)	Engineering design/ engineering & industrial design (n=22)	Graphic/ packaging (n=16)	All Implemented n=67
Mean cost	£54,100	£64,000	£37,900	£53,600

0 - 6 months	17%	23%	50%	27%
7 -12 months	24%	14%	25%	21%
13-24 months	35%	36%	12%	30%
25-36 months	17%	9%	0%	10%
> 36 months	4%	4%	12%	6%
All profitable projects	97%	86%	100%	94%
Mean pay-back period	15.9 months	15.0 months	11.5 months	14.5 months
Made a loss*	3%	14%	0%	6%
	100%	100%	100%	100%

* Too few projects to give reliable mean loss.
Sample: 67 implemented projects with financial data.

The greater proportion of commercially successful graphics projects compared to projects involving product or engineering design is not surprising. Most of the loss-making product and engineering design projects involved exploring options that in the end were not adopted. This happens all the time in engineering design and product development. At the other extreme, with graphics projects, such technical exploratory work hardly exists. Graphics projects simply do not face the technical uncertainties or market shifts of engineering and product development. They operate under shorter time-scales and with more certainty of the final outcome.

However, once implemented, there is little difference in the proportion of graphics and product/engineering projects that are profitable. Where a difference remains is in the time it takes to break even. Three-quarters of graphics projects paying back within one year, whereas it took two years for a similar proportion of product design and engineering/industrial design projects to become profitable. The similar risk is perhaps surprising given the complexity of most product/engineering compared with graphics projects, but the longer payback periods are to be expected given the higher costs of product/engineering projects.

4.5 Cost Savings and Profit Margins

Table 8 gives some examples of the direct and indirect commercial impacts of the design projects. Several firms mentioned other direct commercial benefits: 10% of projects led to reduced manufacturing costs (and/or increased production rates) and 3% to stock savings.

Table 8: Examples of the direct and indirect commercial impacts of design

Project	Commercial performance: Before redesign	Commercial performance: After redesign	Project cost	Payback period	Indirect Impacts
Redesign desk and cladding of sound mix-ing console to update appearance & reduce cost	Av. sales £1.4m GPM 46%	Av. sales £3.4m GPM 48%	£44,500	<2 mths	Improved company image Reduced stock holding costs
Packaging redesign for canned foods.	Av. sales c £12m	Av. sales c £13-14m	£43,000	6 months	Changed management attitudes towards design.
Repackaging of traditional 'pocket money' toys.	Av. sales £43,300 GPM 45%	Av. sales £76,700 GPM 51%	£5,000	8 months	No indirect effects
Redesign of control equipment for industrial vibration testing machine	Av. sales £90,000 GPM 50%	Av sales £95,000 GPM 68%	£66,000	2 years	New styling used for other products but no change in management attitudes.
Redesign motorcycle crash helmet & pack-aging to compete with imports & create new brand image	Av. sales £130,000 GPM 15%	Av. sales £360,000 GPM 15%	£29,500	20mths	Changed management attitudes towards design
Redesign railway points lever box to reduce costs and improve performance	Av. sales £127,800 GPM 41%	Av. sales £141,500 GPM 43%	£5,240	22mths	Reduced stock-holding costs. Recruited inhouse designer.
	New design				
Coordinated range of flame retarding fabrics/wallpaper to exploit market opportunity	Av. sales £355,000 GPM 20%		£77,000	12mths	Helped create new enterprise
Low-cost amplifier to compete with budget hi-fi imports	Av. sales £392,000 GPM 35%		£58,500	7mths	Entered new market sector

Vegetable dishes to diversify into ready-meal market	Av. sales £330,000 GPM 10.5%	£29,600	12mths	Six new jobs created

In eleven cases we managed to obtain 'before and after' figures in gross profit margins. Of these, three were qualitative. In all cases profit margins either increased following the design project or held at the same level. The latter was usually a result of a fixed GPM policy on the part of the company. On average, where we had quantified data, GPM rose from an average of 37% before the design project to 46% after it.

There were two basic reasons behind the increase in GPM. Firstly, in those projects where cost reduction was a major element, a higher GPM simply followed. However, some companies did use design to add value to their products and command a higher price. Cost reduction generally only produced a marginal improvement to GPM, whereas added value was associated with a greater increase in GPM. For example, a cosmetics manufacturer used a major repackaging exercise to relaunch their product and raised GPM from 40% to 50% as a result of the higher price they were able to command. Another example is the toy manufacturer mentioned in Table 8. They used a packaging design in order to enter new markets where they were able to obtain a 6% higher GPM.

Overall, however, companies did not seem to be taking advantage of design to add value to their products and increase GPM. This could be viewed as an aspect of design that is more difficult for the smaller firm to realise than in a larger company. Large firms can afford the advertising and marketing expenditure that is often necessary to achieve design's potential for added-value.

4.6 Marketing and International Trade Effects

Although companies expected to recover their total investment, in many cases this was just part of what they viewed as the commercial impact of their design project. Entering new markets, increasing market share, exploiting a market opportunity and other more strategic benefits were often more important aims than obtaining a rapid payback on the project itself. As noted earlier (Section 3.5), 40% of projects were started with the aim of entering a new market and 43% aimed to improve market share. In practice, 28% of all projects started obtained new markets and 30% improved market share. That this is below the proportion that sought these objectives is largely due to the effect of non-implementation.

In addition to the direct benefit of entering new markets, 14% of the FCS/SFD projects resulted in indirect sales and marketing benefits. In 5% the FCS/SFD work provided publicity or improved the sales of other products made by the company and in 8% the effect was upon the company's general external image and credibility. For example, one clothing company that used the SFD to design a novel "bush vest" (Figure 21) mentioned that the project 'helped the company's image very much as it was a unique garment unlike any other'....it 'got a glowing write-up in the *Sunday Telegraph* which helped the company generally as well as helping the product'.

Figure 21: The clothing company's 'Bush Vest'

Underlying much Government support for design is the desire to improve Britain's trade performance. The impact of these design projects on international competitiveness is therefore of particular interest. The results from our survey are relatively encouraging.

Of the firms for which export information was obtained, 70% reported exporting their FCS/SFD product or design. Where we had precise figures, the average amount exported amounted to £151,000/year representing nearly a fifth (19%) of its total sales. This proportion of exporting firms seems high, given the predominance of small firms in the survey, which tend to concentrate on supplying home markets. However, it can be partly explained by the fact that, from 1986, the selection criteria for a subsidy under the SFD scheme included the potential for improved international competitiveness, which is likely to have raised the proportion of exporting firms in our sample. Assuming this rate of exporting to be representative of the FCS/SFD programme as a whole, (and also assuming that 65% of all projects started were implemented), then the 5 000 projects under these two schemes would have generated nearly £500m in exports

More detailed analysis provides some interesting results (Table 9). Implemented engineering and engineering/industrial design projects produced much higher export ratios (69% of annual sales) than product design (10% of annual sales) and graphics/packaging projects (7% of annual sales).

This pattern of export performance is not suprising, particularly as graphics and packaging projects included a number of food and drink products targetted to the home market. It could be argued that improved packaging design could actually stimulate the sale of imported goods. However, we found no direct example in our survey of a graphics project that involved improving the packaging of an imported manufactured product, although imported foodstuffs were involved in the ingredients several of the food and drink projects.

Table 9: Proportion of sales of FCS/SFD product exported according to design input

Design Input	Average annual sales	Average annual exports	Percent exported	Sample
Engineering Design & Engineering Design & Industrial Design	£638,700	£441,400	69[6]	13
Product Design	£394,800	£40,800	10	23
Graphics/Packaging Design	£520,600	£38,200	7	11

Sample: 47 (both face-to-face and postal questionnaires)

Additionally, product redesigns/updates produced much higher export ratios (48% of annual sales) than new products (20% of annual sales). The reason for these findings is not certain. However, a likely explanation for is that more British engineering products are aimed at export markets than are consumer goods, and that small and medium sized firms probably aim new designs first at the home market while improved designs are particularly relevant for exporting.

As noted above, one of the main benefits of the projects studied was that they enabled firms to enter a new market. Specific questions were asked about whether the new market entered was a British or export market and about the firm's competitors in that market. 28% of all the projects surveyed resulted in firms entering a new market with their new or improved designs. Of these, in 16% of projects it was a home market only, in 3% it was a new export market only and in 9% both new home and export markets were entered. For implemented projects, a more relevant sample to consider is the proportion of projects that resulted in export markets being entered, which was 15% (see Figure 22). Added to this, another 1% of projects produced increased exports of products that before being redesigned were already selling overseas.

[6] This sample was strongly influenced by one firm that exported nearly all its output. However, even when this firm is excluded, 41% of the output of the remaining firms in the sample was exported. This is still much higher than for the other design input categories.

Figure 22: Impacts of design projects on international trade

Sample: All projects, 91; Implemented projects, 72.

Import substitution

Directly entering an export market is only one of several international trade impacts. There are other effects that indirectly affect the balance of trade. Of these, import substitution, where domestic sales were captured from foreign competitors, was a major factor in 21% of the implemented projects (Figure 22). One example of import substitution was the development of a combination bicycle lock by a West Midlands company. The manufacturers were convinced that a high-quality combination lock would find a market even though its price would be considerably higher than Far-East imports. In the first year of production they sold nearly 50,000 locks in a British market that previously had been supplied entirely by imported products.

Strengthening areas under import threat

A fourth area of international trade impact is where a firm is operating in a market where imports are already high and increasing. In such cases the new or improved product resulting from the design work enabled the firm to hold its own against foreign competition in the British market. This was the largest single category of trade implications, involving 25% of implemented projects. An example of this was a project to improve the design of a shoe repairing machine. The company did export a third of its output, but in Britain the company's Managing Director noted that: ‘the project maintained the company's position in a market where there is intense international competition’. He estimated imports to be 40% of British sales. Another project involved new designs for pre-school toys. About 75% of this market is met by imports. Although the company concerned did export its toys, a major benefit of the project was simply maintaining domestic sales against this strong import threat.

Finally, of course, there were projects that had no discernable international trade impacts. This applied to 38% of implemented projects in the study.

Overall, 62% of implemented projects (and 49% of <u>all</u> projects) had some international trade impacts. Most were indirect, involving import substitution or reinforcing a market sector against an import threat.

4.7 Influence of design and other factors on commercial outcomes

Of course the objection could be raised that the various commercial, financial and trade effects outlined above are not necessarily due to the use of professional design expertise since many other factors might have been involved. In order to address this crucial point, we made an assessment of the overall contribution of design to the commercial outcome based upon a number of questions in the interview. Firstly, in the case of redesigns, the sales figures were adjusted based upon an assessment with the person interviewed as to what was likely to have happened had there not been a redesign. For new designs we asked, where possible, for comparative figures for a similar product made by the company that had not received the same design attention as the FCS/SFD subsidised project.

Finally we asked the interviewees questions about their views on what gave their product ‘a competitive edge over rival products’ and then to make an assessment of how much of the commercial outcome of the project was due to more or better design and development work and how much to other factors (such as changes in price, the state of the economy as a whole, marketing effort, etc).

For the competitive edge question, we also asked the respondents to rank the factors according to importance. As shown in Table 10, design or design-related factors (such as specification and performance, styling and visual appearance) were the top two categories cited for both the respondents’ Rank 1 factors and All Ranks. This again suggests that design played the largest role in the products subsequent commercial performance.

Table 10: Factors that give the surveyed product a competitive edge over rival products
(percentages of all factors mentioned according to first, second or third ranking in order of importance)

Competitive edge factor	RANK 1 (n=85)	RANK 2 (n=80)	RANK 3 (n=73)	ALL RANKS (n=238)
Price	14	12.5	14	35
Value for money	10	16	11	32
Specification and performance	30	15	8	47
Quality and reliability	8	21.5	26	47
Ergonomics and safety	7	2.5	4	12
Styling and visual appearance	22	12.5	8	39
Produced to individual customer's requirements	6	10	4	18
Speed of response/delivery time	0	4	7	9
Marketing and sales promotion	1	5	10	13
After sales support	1	1	7	8
Other	1	0	1	2

Sample: 91 face-to-face interviews

The question about factors other than design contributing to the success or failure of the project suggested that in most cases a negative effect occurred. i.e. the other factors *reduced* the commercial impacts of the design work. For example, in one case, where a company launched a new range of frozen seafoods, there was a near-disastrous loss, not due to the quality of the design work, but to very poor costing of the whole project. The company had not worked out that they could never make a profit unless they sold a volume ten times more than planned. In many other cases the positive 'other factors' were actually linked to the design work, such as improved marketing and publicity that only became possible when there was a new design to publicise.

In 32% of the projects, the firms said that factors other than design affected the commercial outcome. Of these, about a third said that half or more of the commercial outcome was attributable to non-design factors. So, of the total firms in the sample, in only 12% of cases was design *not* considered to be the major influence on the commercial outcome. It *was* considered the major influence in 88% of projects. So while one cannot attribute all the benefits to better design and development work alone, it is probable that design played the major part in most of the projects studied.

5 INDIRECT BENEFITS AND IMPACTS

For many firms the indirect impacts of undertaking a project involving a professional design consultant were as important (and in many cases more so) as the direct financial ones. An analysis of the outcomes of the projects revealed a variety of learning effects, spinoff benefits, and changes in attitudes towards design.

5.1 Development of other products

In just under a quarter of firms (23%), the design work on the FCS/SFD project assisted the development of other products or designs. In 11% of firms it provided the technical basis for other projects, in 10% of firms it provided design ideas and in 2% of firms the work on the FCS/SFD project stimulated improvements of existing products. For example, in one company, the barrel-vaulted roof design developed for a bus shelter in the SFD project has been applied to covered walkways that are also manufactured by this firm (Figure 23).

Figure 23: (left) The SDF barrel-vaulted bus shelter design and (right) the barrel-vaulted walkway.

Another example involved the industrial design of electronics equipment that was then applied to a family of the company's products (Figure 24) The graphics from this project were also used as a house style. The use of FCS/SFD subsidised designs for wider corporate identity purposes occurred in a number of cases.

Figure 24: The industrial design work for the large modular sound mixing desks was adapted for the companies whole range of products, including this small mixer.

5.2 Changed attitudes to design

As noted earlier in section 3.2, over half (55%) of the firms employed in-house RD&D staff at the time of the FCS/SFD project. However, two-thirds (68%) had no previous experience of using design consultants and a higher proportion had not previously employed a designer qualified in specialist areas such as industrial design. As a result of the projects, 74 companies (exactly a third of the firms in the survey) said that their attitudes to design had improved, including cases where the project had not been implemented. (Table 11).

Table 11: Improved attitudes to design following FCS/SFD project

	percent	(number)
Made company aware of commercial importance of good design carried out by professionals	20	(44)
Made company aware of commercial role of appearance, ergonomics, packaging etc. in product or engineering design	6	(13)
Made company consider alternative design possibilities and external design ideas	8	(17)
All Changed attitudes:	100	(74)

Sample size: 74 out of 221 firms which mentioned changed attitudes to design

Of these 74 companies, 20% became generally aware of the commercial importance of professional design. For example, the Managing Director of a wire manufacturer which used an engineering consultant to help develop a wire joining device said ‘We used to look at design as a cost rather than an investment. We now have a better idea of what designers can do.’ Another company mentioned that they have used their SFD consultants again for another project and that ‘we are more likely to use such consultants, having taken the plunge’.

These results confirm those of the DTI, which regarded industry's increased willingness to use design consultants as one of the main benefits of the FCS/SFD programme (Shirley and Henn 1988). However a few (5%) firms came to the conclusion that professional design was better undertaken in-house than by consultants. In some cases this may very well have been true, particularly regarding very specialist markets and technologies where certain types of design work requires a close knowledge of the industry and its production methods.

In 6% of cases manufacturers of engineering or other products became aware of the contribution that industrial design could make to their commercial success. In one case, the chairman of a firm that used an industrial design consultancy to help redesign its crash helmets (see section 3.5 and figure 11) previously felt that design was ‘a waste of money’. Now he admits ‘the whole management team is aware of the contribution of visual design and packaging to sales’. A printing equipment firm observed that the project ‘enabled it to convince "unbelievers" that appearance is important even in selling industrial products’.

A further 8% of projects made the firm aware of new design possibilities and helped it recognise the importance of external design ideas. An example of this involved a pump manufacturer which realised that alternatives to the designs the company had always used were possible. Even a firm whose main business was product design, which used the FCS to design a pocket knife, commented ‘we remain confident of our ability to evolve new designs, but are now aware of how powerful an effect objective scrutiny from a professional design consultant can have.’

5.3 Use of professional designers

Perhaps more important than changed attitudes are changes in the resources devoted to design. Following the FCS/SFD project 47% of firms increased their use of professional design while 22% reduced their use. These changes are detailed in Table 12. Interestingly, however, only 8% of companies used their FCS/SFD consultant again. The reasons for this latter finding are unclear and merit further investigation.

Table 12: Changes in the use of professional design following FCS/SFD project.

	per cent	Sample
<u>*Change in in-house staff*</u>		
Introduced or increased in house design staff	20	45
No change in in-house design staff	54	120
Decreased in-house design staff	6	12
Don't know	20	44

Change in use of design consultants		
Introduced or increased use of design consultants	19	43
No change in use of design consultants	52	116
Decrease in use of design consultants	9	19
Don't know	19	41
Sample: 221		
(Note: many companies changed their use of both in-house and design consultants)		

The outcome was that by the time of the interview nearly two-thirds of firms had in-house RD&D staff compared to about half before the FCS/SFD project (see Table 13).

5.4 Management of design and product development

9% of companies mentioned that the project had stimulated a change in the way they manage the product development process. In 2% of companies a more formal approach to product development was adopted, and in 4% the company established ways to improve coordination of staff. Other changes were mentioned in another 3% of firms.

The information that was gathered on who undertook design work before and after the FCS/SFD project, indicated an increased use of teamwork. As can be seen from Table 13, the use of in-house designers alone and consultants alone declined. There was also a decrease in the use of in-house non-RD&D staff acting alone. The areas which grew were in the use of in-house RD&D staff combined with consultants and others and also in-house non-RD&D staff combined with consultants and others.

This shift towards teamwork in design and product development is something that has been advocated for a number of years in both government reports (e.g. NEDO 1979, Pilditch 1986), and academic studies (e.g. Francis and Winstanley, 1987). At the company level, previous work by the Design Innovation Group has identified a link between good design, good financial performance and the use of teamwork in design (Walsh et. al 1991; Potter, 1990). The growth in teamworking for design in this study suggests that such lessons are beginning to be understood, even in relatively small companies.

Table 13: Who undertook design work before and after FCS/SFD project

Design/development work done by:	**Nature of FCS/SFD Project by input of design expertise** Product Design		Engineering/ Engineering & Industrial Design		Graphics/ Packaging Design		ALL DESIGN	
	before	**after**	before	**after**	before	**after**	before	**after**
Full time in-house RDD staff with inputs from other in-house staff &/or external consultants, suppliers, customers etc.	42%	**46%**	60%	**66%**	13%	**25%**	41%	**48%**
Full time qualified in-house RDD staff alone	13%	**9%**	27%	**22%**	0%	**4%**	14%	**12%**
Other in-house staff (main job not RDD) with inputs from consultants &/or suppliers, customers etc.	13%	**23%**	0%	**9%**	39%	**37%**	15%	**22%**
Other in-house staff (whose main job is not RDD alone)	26%	**20%**	10%	**0%**	13%	**12%**	17%	**11%**
External consultants &/or suppliers/customers alone	0%	**0%**	0%	**3%**	31%	**21%**	8%	**7%**
No-one (no previous design/ development experience)	6%	**0%**	3%	**0%**	4%	**0%**	5%	**0%**

Sample: before 84; after 91

Another important indirect benefit was that the projects enabled firms to learn how to use professional design consultants (Table 14). Three-quarters of firms reported learning one or more design management lessons. Of these 15% learned the importance of choosing an appropriate consultant. A third (33%) mentioned learning about the importance of a clear and detailed brief. An example of this is provided by the supplier of automotive components mentioned earlier (section 3.5), who used the FCS to help upgrade a manual car seat adjuster to be electrically-powered. The consultant's design was not implemented because the manual design could not withstand adjustment under load. This key factor was overlooked in the consultant's briefing and the company had to spend considerable in-house time developing an entirely new mechanism. The respondent concluded that their main problem was that "this was a specialist field and we needed to be careful .... The main problem was that the brief was not correctly specified".

There were many other comments concerning the importance of the brief, including the following:

‘We had reservations about the complexity and production costs of the design ... we were as much to blame [as the consultant] for not getting the 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).

Of all the factors in this study associated with project failure, the lack of a clear brief to the consultant was the most common. This finding reinforces previous studies undertaken by the Design Innovation Group and others which have shown 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 (Roy 1987; Roy and Walker, 1988).

An important benefit of the FCS/SFD programme therefore has been that through it many small and medium-sized companies have learned the importance of preparing a thorough brief for design consultants. This is despite the fact that a written brief was a requirement of the FCS/SFD ‘terms of reference’. It appears that in some cases the preparation of a written brief was seen as a formality to obtain the subsidy and not treated seriously or was not done expertly enough.

Table 14: Lessons learnt concerning how to use designers and consultants

Lesson learnt	per cent
Importance of choosing an appropriate consultant	15
Importance of a clear brief/specification	33
Importance of regular monitoring of and contact with consultant	10
More confidence in using design consultants	3
Other lessons	13
All lessons	75
No lessons learnt	25

Sample: 91

A tenth of firms mentioned learning about the importance of regular contact with the consultant during the project. The importance of good communications is discussed further in section 6.3.

Some 13% of firms mentioned other lessons they had learned, such as ensuring that consultants are aware of manufacturing constraints. The 25% that said they learnt no lessons from their FCS/SFD consultancy did include many firms that were experienced in using consultants.

It has already been noted that in 9% of firms, the project led to changes in the management of product development and an increased use of teamwork, but other specific changes were mentioned by a number of firms. One example included establishing an organisation to improve coordination of staff in the product development process. Another involved a branch of a multinational company that concluded that centralised RD & D was becoming too remote from users and subsequently decentralised RD & D to be closer to user markets.

Table 15 summarises the other major indirect impacts of the FCS/SFD project. One company learned how to use Computer Aided Design through their SFD project and subsequently invested heavily in this technology. In another case the consultant gave the manager of a very small company a ‘real boost of confidence’. He had feared that his idea for a product ‘might be silly’ and was unsure whether it would work. ‘The consultant really encouraged me and took what was little more than an idea in my mind and showed me that it really would work. It was the real shot in the arm that got me going’.

Some firms benefitted in several ways. For example the Managing Director of a swimming aids manufacturer said, ‘The funding started a whole chain of developments in the company. Four products and their packaging have been designed since FCS plus a new logo. The project gave us impetus and confidence to move ahead’.

Figure 25: The ‘Floatsuit’ design project.

Table 15: Other indirect impacts of design projects
(percentages)

Improved image and confidence within company	4
Taught in-house staff useful design skills	6
Company invested in new design and development facilities	2
Project stimulated in-house staff to improve unsatisfactory design	3
Project helped avoid development of unsuitable design idea	3
Product helped to protect or generate employment	4
Project provided useful contact with suppliers	1

Sample: 221

6 LESSONS OF SUCCESS AND FAILURE

We have analysed various factors which might have influenced the financial outcomes reported in section 5, including firm size and the company's previous experience in using design consultants. Surprisingly neither of these factors seem to have significantly affected the whether a project was profitable or made a loss. What was more important was the overall management of the project and in particular avoiding the problems, such as those outlined below, which afflicted less successful projects.

6.1 Classifying 'success' and 'failure

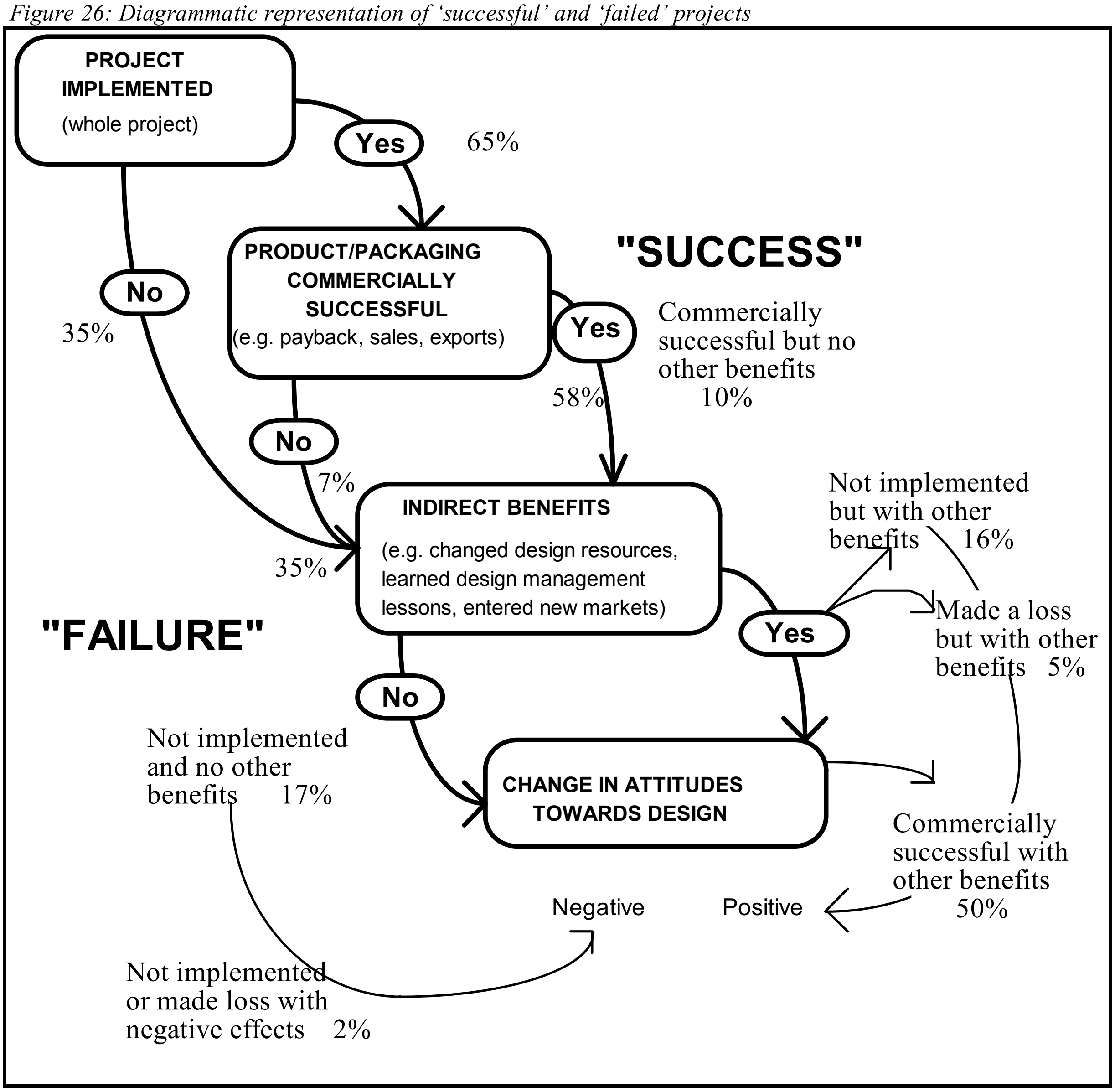
In this section we return to the typology to classify 'successful' and 'failed' projects, discussed in section 4.1 (Figures 14 and 15) in order to examine the question as to what represents ‘success’ and ‘failure’. The projects in the sample were allocated to categories according to the criteria of implementation, financial success, indirect benefits and effects on attitudes to design. A more detailed classification, based on the same criteria, is shown in Table 16. Projects with a known payback and loss are from the subsample in which quantitative financial information was available, while those classified as qualitatively successful or with an unknown loss are from the qualitative sample.

Table 16: Classification of 'successful' and 'failed' projects
(percentages)

		Project produced other direct or indirect benefits	Project produced no other direct or indirect benefits	Project had negative effect on attitudes to or use of design
Project implemented & commercially successful	Known payback	33%]	3%]	0%]
		] 50%	] 10%	] 0%
	Qualitatively successful	17%]	7%]	0%]
Project implemented but made a loss	Known loss	2%]	0%]	0%]
		] 5%	] 0%	] 1%
	Unknown loss	3%]	0%]	1%]
Project not implemented (i.e. made a loss)	Known loss	10%]	3%]	$\frac{1}{2}$%]
		] 16%	] 17%	] 1%
	Unknown loss	6%]	14%]	$\frac{1}{2}$%]
Number:		128	47	3
Sample: 178				

Using this classification, half the projects could be viewed as 'complete successes', in that they were commercially successful as well as producing other direct or indirect benefits. A further 10% were commercially successful without producing other benefits. Of the remaining 40% of projects that made a financial loss, only 19% can be classified with certainty as 'failures', in that they yielded no other benefits or led to negative effects on attitudes to design. 21% made a commercial loss but also produced other direct and indirect benefits and so could be viewed as at least partial successes. In some of these cases the firms concerned felt these other benefits made the project a 'success', despite losing money on the project itself.

Figure 26: Diagrammatic representation of 'successful' and 'failed' projects



6.2 Why projects failed to be implemented

We further analysed non-implementation against several other variables including firm size, prior experience of using consultants and reasons for applying to FCS/SFD. This analysis produced some unexpected results, of which two will be noted here.

First, there was no statistically significant difference in the rate of implementation and the firm's prior experience of using design consultants. Indeed, as will be shown later, only 10% of firms experienced major design consultant problems despite the fact that nearly 70% had no prior experience of using them.

Second, when the basic business and marketing reasons for undertaking the project (discussed in section 3.5) were analysed against implementation, this showed that reactive strategies were more likely to lead to an implemented project than a proactive approach (Table 17). Further analysis of the commercial outcomes of proactive and reactive projects is needed in order to relate this finding to other work (e.g. by Service, Hart and Baker, 1989) which suggests that firms which adopt proactive design strategies tend to be more commercially successful.

Table 17: Project implementation and reasons for undertaking design project.

	Reasons for undertaking design project			
	Proactive (n=116)	Reactive (n=52)	Both (n=49)	No reason given n=4)
Implemented	59	71	69	50
Not implemented	37	23	29	50
Still under development	4	6	2	0
Sample: 221				

Firm size was, however, one factor which appeared to be associated with implementation rate (Table 18). Very few larger firms (over 500 employees) failed to implement their projects, whereas for firms under 500 employees, implementation was in the range 60 - 70%. The reasons for this could be associated with better access to finance and better project management in large firms compared to smaller firms.

Table 18: Project implementation and firm size (per cent)

Number of Employees	Project implemented	Project not implemented	Project still under development	Total
Under 20	61	32	3	100
20 - 99	71	23	6	100
100 - 499	59	41	0	100
Over 500	86	14	0	100
Sample: 208				

Certain motivations in applying for the FCS/SFD subsidy were also associated with higher levels of project implementation (Table 19). These included the desire to speed up product development, (where there were no unlaunched projects), a lack of in-house expertise and (interestingly) the admission that the firm applied simply because the money was available. The latter, however, did include a number of small firms that were suffering from the common problem of lack of finance for their design and development work. On the other hand, the desire to reduce risk was also associated with a high proportion of non-implemented projects, which may be because the firms viewed the project as being marginal as they were not willing to risk their own money on it.

Table 19: Project implementation according to reasons for applying for an FCS/SFD subsidy. (percentages)

Reasons for applying to FCS/SFD	Project Implemented	Project not implemented	Project still under development	Total
To speed up development	90	0	10	100
Money available	86	14	0	100
No in-house expertise	85	12	3	100
Shortage of resources	77	20	3	100
Needed independent view	73	20	7	100
Subsidy reduced risk	55	45	0	100
Other	64	36	0	100

Sample: 91
Note: many projects involved more than one reason.

Where projects were not implemented, specific questions were asked as to the reasons why. Quite often there were several reasons, but commercial and/or technical reasons were the ones most often cited (Table 20)

Table 20: Reason for non-implementation of project according to design input
Percentage of projects. Note: many projects involved more than one reason.

	DESIGN INPUT			
REASON FOR NON-IMPLEMENTATION	Product Design (n=36)	Graphic Design (n=11)	Engineering Design/Eng Des & Ind Design (n=26)	Total (n=73)
Project not judged commercially viable	14	10	54	27
Technical problems	28	10	34	27
Design proposals unsatisfactory	30	18	23	26

Market changed since start of project	17	18	15	16
Company could not afford to implement	25	10	0	14
Other reasons	42	10	46	38

Sample of 73 non-implemented projects from face-to-face and postal survey

In over a quarter (27%) of non-implemented cases the project was simply not considered commercially viable.This reason was particularly common among engineering/engineering and industrial design projects. For example, a window opening device for pivoted windows was not implemented because the 'costings for production indicated that the price would be too high for the market place'. In another case a redesign of an automotive component was to reduce manufacturing costs, but the cost savings were insufficient to warrant the costs of implementation. This reason also affected some product design projects. For example, a range of ceramic bathware was not implemented because the company 'could not get the designs made by UK ceramic manufacturers to a price that was acceptable to the buyers of the five main DIY chains'.

In another 27% there were technical difficulties in development. There were many examples of technical difficulties, especially in engineering, industrial and product design projects. For example an air filter design was not implemented because the consultancy 'could not produce a material of the required efficiency'; a lighting design was not implemented because the designer was unable to meet the specifications; a project for a screen mat for mining and quarrying use was not produced because the material being investigated proved to be unsuitable; the reclining mechanism for a commode was not sensitive enough to people's weight.

In a number of cases time was the crucial element. A company recognised that the technical aspects had to be sorted out in order to make a market launch for a certain target (e.g. a trade fair or simply because of rapid technical progress in the field as a whole). If the technical problems had not been solved by a certain deadline there was no point in continuing and the project was scrapped. In one case, that of the design of a cricket pad in a new material, the design was not implemented simply because of technical progress. An even newer material came along which did not require high tooling costs.

As noted above, technical problems and questions of commercial viability affected engineering and product design projects more than graphics. To a large extent this is not surprising. Some projects were just exploring technical possibilities. For example a marine electronics company's project examined the possibility of using fibre optics for its equipment but came to the conclusion that the technology would be insufficiently robust for boating compared to conventional wiring. Such cases can hardly be considered design 'failures', but are just part of the process of identifying the best design option. As one company put it 'we needed to do something quickly so two avenues were explored'.

Market change, however, was a reason that affected all types of design projects, contributing to an average of 16% of all non-implemented projects. For example, a project to redesign the casing of a computer modem was not implemented because sales dropped and the company had sufficient stocks of the old casings to meet the lower level of orders. A tent manufacturer scrapped a project for a totally new design of ridge tent in favour of the cheaper option of upgrading existing designs due to a decline in orders for this type of tent. Another example was an aluminium conservatory design which was not put into production because the company's 'competitors launched in aluminium one of less complex construction combined with lower pricing than achievable by our unit'. In a number of cases, shifts in market demand had resulted in design projects not being implemented simply because the company had decided to move out of that business sector altogether.
More worrying was the fact that 14% of firms simply could not afford to implement the design, even though it was judged to be commercially viable. This factor particularly affected product design projects. For example, a luggage manufacturer could not afford to implement designs for a new range even though they were 'desperately needed' to compete with French rivals who 'receive massive investment from their government'.

There were various other reasons for non-implementation e.g one interviewee specifically complained about 'the lack of foresight and long-term strategic product planning' by senior management which resulted in 'this, like other exciting projects, being abandoned'. In another case it was a failure of marketing skills. The project was launched but was discontinued because 'the shops we normally dealt with were not the ideal outlet for the new product'.

6.3 Problems with design consultants

Despite the fact that two thirds (68%) of firms had no previous experience of using design consultants, only 28% of the companies experienced any type of 'problem' with their consultant and of these only 10% experienced 'major' problems (see Table 21 and Appendix 2). 'Major' problems were defined as those that significantly affected the outcome of the project (in most cases the consultant's recommendations were not used and the whole project may have been abandoned). 'Minor' problems largely referred to difficulties that were mentioned by firms, but which did not have much effect (if any) on the eventual outcome of the project.

Table 21: Proportion of firms (percentage) experiencing problems with consultants.

	Major problems	Minor problems	No problems
% of firms	10%	18%	72%
Sample:219 (excluding 2 na)			

A detailed study of this issue has been made using the preliminary results from this survey (Roy and Potter 1990). Table 22 provides an analysis of the type of problems experienced for the full sample.

Table 22: Problems experienced with design consultants.

	number of responses	% of firms giving this response	
Problems with quality of design consultant's work			
Design work poor/failed to satisfy brief	19	39%]	
Consultant's design impractical to manufacture	4	8%]	61%
Poor value for money/results 'thin'	4	8%]	
Consultant ignored brief/wanted to do 'own thing'	3	6%]	
Problems with firm's design management			
Poor brief for consultant	8	16%]	
Poor management of consultant or project	6	12%]	
Internal divisions over consultant or project	2	4%]	38%
Inappropriate choice of consultant	2	4%]	
Difficulty in dealing with 'design culture'	1	2%]	
Communication problems between firm and consultant			
Poor/infrequent contacts between firm & consultant	9	10%]	
Consultant located a long way from firm	2	4%]	24%
Consultant/firm relationship did not work out	1	2%]	
Problems with service provided by consultancy			
Consultancy passed work to inexperienced junior	4	8%]	
Commitment poor/ran over time	2	4%]	14%
Consultancy management poor	1	2%]	

Sample size: 49 firms with consultant problems from both face-to-face and postal sample.
Note: several firms mentioned more than one problem.

The reason for these problems were categorised into four major groups. The first, and largest category, is where the firm felt that the consultant's work was of poor quality or otherwise unsatisfactory. The level and reasons for dissatisfaction with the consultant's work varied considerably and there were a few examples of extreme dissatisfaction. One person interviewed said *'I get the designer's sketchbook out when I want a laugh'*. Another commented that the *'design was awful, very unprofessional: sample fell to pieces'*.

In a few cases where unsatisfactory designs resulted, there was a serious clash between the firm and consultants on the purpose of the project. For example: '*They* (the consultant) *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.*" (This project involved the industrial design of an electronic programmable controller). 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 product was 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 designer's job to educate the customer in the use of design, but it is not part of a designer's job to please themselves or other designers in preference to what is wanted by the client. Interestingly, most of the companies that experienced this problem were able to go on and produce a commercially successful product. It was not a problem that significantly contributed to project failure rates.

Sometimes the unsatisfactory work was due to inadequate technical skills on the part of the consultant, but often it was linked to the second main category of problems - namely deficiencies in the way in which the consultant was selected, briefed or managed. The importance of adequate briefing of consultants was mentioned in section 5.4 as one of the lessons learnt by companies through their design project. Although there were a number of examples of unsatisfactory consultant's work, briefing and management of consultants was the most common underlying problem.

A good example of this is provided by a company making industrial remote control units, for use in factories involving dangerous or awkward operations. The project did not involve the electronics of the radio control unit, but its industrial design and ergonomics. 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 felt they had to redesign the casing and controls quickly and so an industrial designer was employed through the FCS. The consultant produced drawings of alternative designs and then made up a replica 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 box. 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 vastly underestimated the tooling cost of his design.

Despite this obviously poor design work, the company did not view the outcome as entirely the consultant's fault. The firm's management felt that they had put too much emphasis on cost savings, and in retrospect they felt they should have committed the resources to *'do the job properly from the start'*. 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". We should have got more money to do a good job from the start.'* In the end, the poor work produced by the consultant stimulated the company's in-house designers to redesign the control unit casing themselves with entirely satisfactory results.

Another example involved 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. It is difficult in such a situation to judge whether the main problem was poor design work or an expectation on the part of the firm that the work could be undertaken with inadequate resources. In either case, for engineering projects, the ever-diminishing subsidised time under the FCS and SFD could only make a very small contribution to the overall project.

Underlying many of the examples of 'poor design work' there was often a deeper problem of poor communications between company and consultant, which accounted for the third category of consultant problems.

In some cases poor communication was viewed as the consultant or consultancy firm's fault - some were criticised as being over-committed, 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 an electronics firm who regularly used consultants and 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.'*

The smallest number of problems related to the service provided by the consultancy, although this was also linked to poor work. In one case, the job was passed on to an inexperienced junior designer who was not present at the briefing with the firm. Not surprisingly he produced a design that was inappropriate. In another example, involving the design of food packaging '*the job was passed on to a young chap straight out of college ... (he) went in (the) wrong direction, took a long time time and produced only one design in a "take it or leave it" attitude'*. In a third case a firm, which wanted to launch its shatterproof, laminated glass mirrors on to the retail market, engaged a famous firm of design consultants through the FCS to help define design and market options. The project failed because the job was passed on to an inexperienced staff member, 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.

Firm size and consultant problems

Smaller firms were particularly prone to problems with or difficulties in managing design consultants. The average size of firms that experienced 'major' problems with consultants was 81 employees, compared with an average of 111 for firms that experienced 'minor' (i.e. lesser) problems and 126 for firms that had no problems at all.

Table 23 details the distribution of consultant problems according to severity. ‘Major’ problems are the most important ones to consider because, as was noted at the beginning of this section, these were problems that significantly affected the outcome of the project. The proportion of ‘major’ problems was roughly twice as high in firms with under 100 employees than in those with over 100 employees. The smallest firms (up to 10 employees) had the highest proportion of ‘major’ problems, with ‘minor’ problems peaking in the 51-100 employee category.

Table 23: Distribution of firms according to size and problems in using/managing design consultants (percentages).

Firm size (employees)	1-10	11-25	26-50	51-100	101-150	151-250	251-500	500+	Total
Sample n	(29)	(24)	(36)	(37)	(24)	(26)	(22)	(6)	(204)
No problems	73	96	75	65	83	81	77	100	78
'Minor' problems	10	0	11	21	13	11	14	0	11
'Major' problems	17	4	14	14	4	8	9	0	11
	100	100	100	100	100	100	100	100	100

These results have policy implications for the current *Design Initiative*, which subsidises design consultants in firms with under 500 employees. Help and advice on managing design projects and consultants needs to be targetted mainly towards small firms. This would apply not only helping small firms seeking a subsidy under the Design Initiative, but to the general advisory work of the Design Council and DTI.

Consultant problems and project outcomes

Consultant problems clearly influenced the eventual outcome of many projects. However, there were certain types of consultant problems with which particularly adverse results were associated.

Although the subsample of firms with data on consultant problems and commercial success/failure indicators was relatively small (26 in all), three types of problems were clearly associated with project failure.In nearly 80 per cent of cases of genuinely poor design work by the consultant, the project was a failure. This was often due to the work being passed on to an inexperienced junior designer. However, problems *within* the commissioning company were associated with a similarly high level of project failure. Inadequate briefing of the design consultant and internal disagreements by management about the aims or value of the project almost inevitably led to project failure (Table 24).

A lack good contacts between the consultant and in-house staff produced mixed results, with about a two thirds/one third split between commercial success and failure. However, the average payback period of the successful projects was longer (17 months), which suggests that communications problems can reduce the financial effectiveness of design work, but not to the point of making it entirely unprofitable.

Table 24: Effect of consultant problems on commercial outcomes

(a) percentage of projects implemented and commercially successful

Average of all firms without consultant problems	76
Average of all firms with consultant problems	46

(Sample 94)

(b) Sub-group of firms with problems:

	Commercially Successful		Loss Making		Total	
	n	%	n	%	n	%
Projects where consultant's design work was 'poor'	2	22	7	78	9	100
Projects where brief was poor	1	20	4	80	5	100
Firms that had internal problems managing consultants	1	20	3	80	5	100
Design work passed on to junior in consultancy	0	0	2	100	2	100
Firms that had infrequent contact with consultants	5	71	2	29	7	100
Designer wanted to ‘do own thing’	2	100	0	0	2	100
Choice of consultant poor	2	100	0	0	2	100
Consultant geographically remote	2	100	0	0	2	100
Consultant’s work ‘thin’/poor value	1	100	0	0	1	100
Unspecific reasons/other	0	100	4	100	4	100

Sample: 26 firms with consultant problems and financial data from both face-to-face and postal surveys
Note: some firms gave more than one response.

A final group of consultant problems were both infrequent and appeared to have virtually no impact on the commercial success of their projects. These included the consultant’s desire to ‘do their own thing’, the consultant being geographically remote, producing work that was viewed as ‘thin’ or of poor value and where the choice of consultant was viewed as poor.

7. GOVERNMENT SUPPORT FOR DESIGN

Although this study did not aim to assess the FCS/SFD programme, information was inevitably gathered that relates to government policies to support design investment in industry.There was a specific question on the FCS/SFD programme itself, together with more general questions on the respondent's views as to the importance of design in their company. In many cases it was difficult to get the respondent to comment on the principles and working of the schemes rather than their particular experience of their consultant or more general views on the value of design.

The comments on the FCS/SFD programme could be grouped into three main categories. Firstly there was the most common reaction, covering a third of responses, which was a generalised broad approval. Given that the firm had received a government subsidy this reaction is not surprising and is in line with the DTI evaluation of the programme (Shirley and Henn 1988). The reaction of these firms was non-specific. They were pleased to have received the subsidy and, even if their design project had not worked out as well as it might have, they still felt that government support for design work was a good idea.

Only half a dozen firms out of more than two hundred surveyed viewed the schemes entirely negatively. One respondent said that the whole thing was a *'waste of money'*" that '*can't be justified ..... companies should stand on their own two feet and pay for it [design] themselves'*. However, earlier in the interview the same person had said that they were disappointed not to be able to use the scheme again!

The second broad category of firms were those that had specific comments on the working of the FCS/SFD schemes. Some 11% of comments noted the smooth and unbureauracratic approach of the Design Council's Design Advisory Service which administered the programme. One General Manager said that *'The administration was virtually zero' .... 'didn't take more than one hour in total. More smooth than anything else I've done with a government agency'*. One or two other government schemes came in for criticism by comparison. The same Manager also commented *'For example a couple of years ago we tried to get some export information out of the DTI. It was a total waste of time, had a couple of meetings with people who were not capable of doing anything'*.

In another company, the Managing Director commented that the SFD had *'no horrendous reams of paper, unlike the SFI' (Support for Innovation)*. The paperwork for Support for Innovation was again contrasted with the SFD's lack of burdensome administration in another company, where the respondent felt his firm spent more on administering the SFI than they received in the grant! Nevertheless, a few (3%) felt the FCS/SFD administration to be burdensome, although there was some indication that these viewed any administration as a cause for complaint. One company actually wanted *more* administration. They felt there should be more control over the design process, involving progress reports and plans.

Just over half (52%) of firms had used a consultant recommended by the Design Advisory Service. In general, comments on the advice and working of the Design Advisory Service (DAS) were positive. Three firms specifically mentioned the good choice of consultant, for example, the Executive Director of a clothing firm commented that the DAS: *'Gave straightforward advice and made sure the consultant was a sound one. Followed up well and showed interest and...... gave encouragement and positive support and were not at all cynical as others had been'*

Four people commented that further advice from the DAS would be helpful. Design management and design for production were two areas mentioned where further advice would be appreciated. On the negative side, there were, a few firms (3%) which felt that consultants needed better vetting and a similar number questioned the capability and thoroughness of the Senior Industrialists used to evaluate projects prior to the approval of the subsidy. The time taken to approve a project was a cause for complaint in only three (3%) cases.

Besides the better vetting of consultants, the only other comments related to the choice of consultants being at 'the expensive end' of the market and one idea, from a company whose project had been very unsuccessful, that there should be a clause in the subsidy agreement for compensation if the consultant's work turns out to be poor. This reflected a view held by several firms that professional design consultants were expensive and that the FCS programme represented 'easy money' for the consultancies. One firm said that '*we always felt the design consultancy did as little as possible to justify their fee and were looking to keep some work up their sleeve thereby to justify an extra fee'*.

A number of firms would have liked to apply for more than one grant or to have a larger subsidy in order to employ their consultant for a longer period of time. 13 responses (15%) mentioned these aspects. This, of course, is not so much a criticism of the FCS/SFD programme as a comment on its value. The Managing Director of a small engineering company commented that the FCS grant was '*the most beneficial grant that one can get. There should be a lot more money for that sort of grant (design, redesign and innovation), especially for small companies. The FCS is the smallest grant we've had, but probably the best'.* The Managing Director of another engineering company felt that '*There is too little money to go beyond embryonic ideas. For the same money the Design Council could have fewer large schemes and get more successes.'* This comment leads on to the third category of responses. Some companies, rather than concentrating on the strengths and weaknesses of the existing scheme, provided some strategic comments on how the objectives of the FCS/SFD might better be achieved.

As well as the Managing Director mentioned above, a number of other people interviewed raised the idea that fewer but larger grants could be more effective. As noted in Appendix 1, the pattern of successive design support schemes has been to reduce the amount of individual subsidy available while opening up eligibility to a wider range of small and medium-sized firms. Yet in practice, the amount of subsidised consultancy time is generally insufficient to make a major contribution to the project as a whole. The main exception to this is graphics and packaging, where 15 days work can produce useful results.

In their evaluation of the SFD programme, Shirley and Henn (1989) noted similar comments from the firms they had visited:

> *'In the case of graphics, the consultancy assistance generally took the project well towards a satisfactory conclusion. With product/engineering design, although a particular problem may have been resolved, there was usually a great deal more work to do. Three-quarters of the firms with product/engineering*

> *projects felt that the time available was too short. Moreover, our fieldwork indicated that some smaller companies failed to implement design proposals because they did not have the expertise .... or sufficient cash to fund further consultancy work.'*

A number of interviewees in our survey questioned why the subsidy was only available to employ consultants and not to support in-house designers or the implementation of existing design work. One Managing Director felt that *'there are easier and cheaper ways to employ people than consultancy'.* The FCS...*'does not go far enough'* we..*'need cash for implementation of the project.'* One idea, associated with the concept of fewer and larger grants, was for a design grant to be awarded for an agreed amount of work in a design project, be it undertaken by consultants, in-house designers, or for implementation work.

The frustration expressed by a number of respondents suggests that successive government design support schemes have spread resources among too many small grants. The impact of the FCS, SFD and Design Initiative has been positive and the subsidies are justified in terms of their commercial impact, but there is a valid criticism that the amount of subsidised time needs to be tailored better to the type of design project involved. Engineering and product design projects tend to require more consultancy time than industrial design, which in turn require more time than graphics and packaging. One respondent felt that a more selective and carefully vetted scheme would not only be a more cost-effective use of resources, but would have marketing and quality effects, in that to be selected for support would amount to a sort of design award.

Shirley and Henn (1988, p26) suggested that:

> *'In future a greater flexibility is built into the days allowance after the initial two free days. The number of part-subsidised days should be varied according to recommendations made by the SI/DAO*[7] *following their initial review of each company's needs. In principle, we suggest that up to 25 days should be available in total for product/engineering projects but only 8 days for graphics work'.*

In actual fact, from 1989 graphics were removed from the Design Initiative scheme, with no increase in the level of support for product/engineering projects. However, other schemes have been added to the DTI portfolio. In 1991, under the Research and Technology Initiative, the DTI announced the competitive Small Firms Merit Award for Research and Technology (SMART). This is limited to 180 awards of up to £45,000 for businesses with under 50 employees. Second-stage awards of up to £60,000 are also available to help companies produce marketable products. In February 1991 another scheme was announced, the Support for Products Under Research (SPUR) which provides support for projects involving a 'significant technological advance' in firms of under 500 employees.

It has become clear in this survey that small firms face major resource problems in financing design and innovation work. Although the situation has become better since these projects were undertaken in the mid-1980s, the predominant view amongst the firms interviewed was of a reluctance by conventional sources of funds to finance design focussed or innovative projects. Small firms ended up seeking a design subsidy, not because a consultant was appropriate for the work, but simply because that was the only way they could get the work funded.

The idea of a grant to help implement a design projects is a somewhat separate issue from whether the support should be for in-house or other non-consultant design work. In a number of the firms visited, a strengthening of in-house design capability would have been more appropriate and cost-effective than employing a consultant. In practice, it is interesting to note that slightly more companies reported increasing in-house design staff following their FCS/SFD project than increased their use of design consultants (Table 12, Section 5.3). So, when design resources were increased, firms themselves put slightly more emphasis on in-house design capability than employing consultants. Modifying the Design Initiative, which like the FCS/SFD is totally consultant-oriented, to include an initial assessment of what type of design input would be most appropriate could be investigated.

On the question of funds for implementation, one respondent raised a fundamental criticism of the whole approach of specific, small, short-term grants or subsidies:

> *'The MD feels a lot of money is wasted through such grant schemes. We need to take a lesson from the Germans, where banks are far more supportive of*

[7] Senior Industrialist/Design Advisory Office.

investment projects. It would be far more useful the Government getting the banks to be supportive than getting schemes like this which don't have much impact.

In other words, it is more important to develop a financial system that supports longer-term design and innovation work in British industry rather than provide a series of small subsidies that take an inadequate financial system for granted in order to plug a few gaps where the system failure is at its worst.

The new DTI schemes, such as SMART and SPUR have been announced since our survey work was undertaken. Equally, of course, we were surveying projects that began in the mid-1980s and since then there have been some improvements in the availability of venture capital. However concerns over investment in British manufacturing industry and the level of Government support for research and design work have not decreased. Indeed, the subject has become one of major concern. In 1991, the House of Lords Select Committee on Science and Technology, concluded that Britain could end up with no significant home-owned manufacturing industry if government continued to fail to develop a strategic manufacturing policy and combat short-term attitudes in the City. They felt that *'DTI schemes such as SMART and the Enterprise Initiative are worthwhile but are too small-scale to have appreciable impact'.* (House of Lords, 1991, p 39). This report points out that average state aid per employee to manufacturing (1986-88) was 806 ECU in Britain compared with 1,135 in Germany, 1,456 in France and 3,316 in Italy. The report suggested targetting help to small and medium-sized companies, the use of 'product launch' aid, regional development agencies in England and more stable, accessible and consistent DTI schemes.

Overall, views by companies on the FCS and SFD depend very much on the breadth of the perspective adopted. For the respondents that considered the scheme in its own terms, the general impression was positive. Administration was generally viewed as minimal and informal and the Design Advisory Service was considered helpful and competent. Suggested changes really focussed on the notion that the amount of consultancy time was frequently too short for the design projects involved. The DTI's own evaluation came to the same conclusion, although the suggested reforms were not all implemented.

Broader criticisms questioned why support should be restricted to design consultants alone while really strategic criticism felt that, useful though the subsidies are, they simply patch up a system in which the British financial system for industry is fundamentally flawed and government industrial policy is under-financed and lacks direction. The recent House of Lords Select Committee report has focussed on this question. It seems that without a strategic framework and proper resourcing of a government policy for manufacturing industry, schemes such as the *Design Initiative* will never fulfil their full potential.

8. CONCLUSIONS

This study of the Commercial Impacts of Design shows that the Government's programmes of subsidized design consultants have encouraged a proportion of small and medium-sized UK manufacturers to make use of professional design, many of whom would not have done so without help. Although at the time of the subsidized design project, over half of the firms employed full-time, qualified in-house RD&D staff, in nearly a third design/development was undertaken mainly by individuals with main jobs other than RD&D, and in most cases this was the first time the firms had used a design consultant or drawn on specialist expertise in areas such as industrial design.

The study shows that, even in typical small and medium-sized firms such as these, the development of new and improved products, components, packaging, etc. using professional design expertise can be an excellent commercial investment. Two-thirds of the projects were implemented and 60% were financially successful. Over 90% of a subsample of implemented projects for which we had detailed financial data were profitable with payback periods averaging under fifteen months and almost all recovered the total project investment (including the subsidy) in under 3 years. Another subsample analysis showed that projects which involved redesigns or updates of existing products on average generated an increase in sales of over 40%.

The risk of financial loss at the start of the product/engineering/industrial design projects was significantly higher than for projects involving graphic design. But once the product or design had been put into production the risk of loss was low for all types of design project.
This evidence on risks and returns should help UK firms and financial institutions to overcome their traditional reluctance to invest in design and product development.

Another important commercial benefit was that the projects enabled about 28% of all firms to enter a new market. In terms of international trade the main benefit was import substitution. Nevertheless, 16% of implemented projects led to new or increased exports and a fifth of all FCS/SFD product sales were exported. Grossed up for the whole FCS/SFD programme this represents some £500m worth of exports over six years. The indications are that investment in product, industrial and graphic design is helping to reduce imports, while professional design is helping some small and medium-sized British manufacturers of all types of product to enter export markets. In the case of graphic design there is the possibility that improved packaging etc. could actually stimulate extra sales of imported goods, but no clear cases of this occurred in our survey.

So, investment in design expertise has a major commercial impact. It can make a major contribution to commercial success, although good design alone cannot guarantee this. Design influences commercial success by adding value to the product and can in effect make the difference between a workable idea and a marketable product. Investment in design improves financial performance, retains and regains market share, enhances exports and affects the competitiveness of British industry.

For many firms the indirect benefits of undertaking a project involving a professional design consultant were as important as the direct commercial ones. The experience not only improved understanding of and attitudes towards design in many firms, it encouraged nearly half to employ consultant designers for subsequent projects at their own expense and/or to increase their in-house design staff, so that by the time of the interview nearly two-thirds of firms had full-time RD&D staff compared to just over half before the FCS/SFD project. Moreover, following the subsidised projects, design/development was more likely than before to be a team effort involving groups of in-house staff and consultants. Other important indirect benefits included helping firms to learn key design management skills, especially how to select, brief and manage professional designers. In many cases the indirect impacts are of greater long-term importance than the short-term financial returns. As a manufacturer of loudspeakers observed *'the project helped open the door to using design. Our experience was going through the learning curve rather than direct benefit'.*

Nearly a fifth of the design projects studied were failures, neither being implemented nor producing indirect benefits. Problems in using and managing the design consultants, in particular inadequate briefing and internal disagreements within the firm about the project, were important factors associated with such 'failed' projects. Although they suffered more from difficulties in managing consultants, small firms were no less likely to produce profitable projects than medium sized and larger ones. Given the small amount of subsidy involved, successful projects (especially in product and engineering design) depended as much on the willingness of the firm to persevere and invest its own resources as on the skills of the design consultants.

There were inevitably some projects which failed despite highly satisfactory design work. A few projects foundered for lack of finance, but other projects failed mainly due to factors such as the strength of the competition, market resistance and changes of ownership. While this reinforces previous research (Walsh, Roy, Bruce and Potter 1988) which showed that 'good design' alone is not enough for commercial success, the main contribution of this study has been to demonstrate how important investment in professional design can be.

However, as the 1991 report from the House of Lords Select Committee on Science and Technology noted, the wider economic and trade benefits can only be realised if a significant proportion of UK firms increase their investment in design and product development in the long term. Lack of awareness of the potential commercial returns among small and medium sized British firms seem to be a major barrier to this investment. Another is the fact that most firms surveyed viewed the design projects as a one-off investment rather than as a way of incorporating design into their long term strategy. One of the objectives of the FCS/SFD programme was that 'design should become an integral part of corporate strategy and incorporated into all stages of product development'. Both ourselves and the DTI evaluation report (Shirley and Henn 1988 Annex J p. 35) conclude that the FCS/SFD programme failed to do this. The latter notes:

> *'Our evidence suggests that the scheme falls short of this objective and is probably structurally inadequate for the task. Although there have been many successful projects, very few have featured design in a central role: for the most part, design input has been limited to post-development product styling or graphics'.*

Programmes such as the FCS, SFD and Design Initiative are valuable, but only reach a small proportion of UK manufacturers which could benefit and the subsidies are low compared to those offered through similar schemes in some other countries (for example in Spain). There are still large numbers of firms that need to be made aware that investment in design can be as essential to their business as investment in marketing and manufacturing and much more needs to be done in using Britain's undoubted design expertise to relieve the growing trade deficit in manufactured products.

The problem of design management is one which remains to be tackled. Seminars, advice centres and short courses for managers would be some of the ways forward in this respect and some progress has been made in the provision of regional technology centres. The area of client - consultancy relationships and basic skills in preparing a design brief, allocating responsibility to liase regularly with the consultant, interpretation of design drawings and proposals, budgeting design work, etc. all need to be addressed. Awareness of different approaches to design management in other companies and other countries would help develop this area of managerial expertise.

REFERENCES AND FURTHER PUBLICATIONS ON THE COMMERCIAL IMPACTS OF DESIGN STUDY

Arbonies, Angel L (1991): *New product design and the role of external design consultants: preliminary results.* SPRU, University of Sussex, July.

Bruce, M and Capon, C.H. (1990) The role of design in strategic marketing, in *Proceedings: Marketing Education Group Conference,* Oxford, July.

Bruce, M and Roy, R (1990): Design: its role in innovation and competition, in McCalan, J et al (eds) *Proceedings of the British Academy of Management Conference,* Glasgow, 10-11 September.

Bruce, M and Roy, R. (1991): Integrating marketing and design for commercial benefit, *Marketing Intelligence and Planning.*

Bruce, M and Capon, C.H. (1991): Design - marketing's poor relation? *Journal of Marketing Management.* (submitted).

Department of Trade & Industry (1989) *Evaluation of the Consultancy Initiatives: Report by Segal Quince Wicksteed*, London: HMSO.

Department of Trade and Industry (1991): *Profits by Design.* DTI.

Design Council (1986): *Design Advisory Service - Funded Consultancy Scheme. Long-term project assessment,* Confidential Report (mimeo). London, The Design Council.

Francis, A and Winstanley, D (1987): Organising professional work: the case of designers in the engineering industry in Britain. *EGOS Colloquium,* Antwerp, 23 July.

House of Lords Select Committee on Science and Technology (1991): *Innovation in Manufacturing Industry, Session 1990-91, First Report,* Vol 1. HMSO.

NEDO (1979): *Product Design: a report by K.G. Corfield to the National Economic Development Council,* London NEDO.

Neal, Michael & Associates (1988) *Attitudes of industrial managers to product design,* London: The Design Council.

Pilditch, J (1986): *Design: paper by J. Pilditch CBE, Chairman of the Design Working Party.* London, NEDO.

Potter S, Lewis, J, and Roy, R. (1987): *The commercial impacts of design: background, aims and pilot study.* Working Paper WP-10, Design Innovation Group, The Open University, November.

Potter S., Lewis, J. and Roy, R. (1988) The commercial impacts of design: the effects of subsidised design input on the competitiveness of small and medium sized firms, in *Proceedings 2nd. International Congress of Industrial Engineering 'Competivity of the Business Enterprise'*, Nancy, France, Dec. 12-14., Pt II pp 837-846.

Potter, S (1990): Successfully Managing Research, Design and Development. pp 281-291 of Khalil, M and Bayraktar, B (Eds): *Management of Technology II: Proceedings of the Second International Conference on Management of Technology*. Industrial Engineering and Management Press, Norcross, Georgia, USA.

Potter, S. and Roy, R. (1990): Managing design inputs in small high-tech firms, in Millman, A and Saker, J (eds): *Growth and development of small high-tech businesses*. Cranfield School of Management, April.

Potter, S and Roy, R (1991): The international trade impacts of investment in design and product development. Paper for the *Fifth British Academy of Management Conference,* University of Bath, September.

Roy, R. (1987) Design for business success, *Engineering*, January, pp 16-17.

Roy, R and Walker, D (1988): Case studies: A&R Cambridge; Hewlett Packard. Unit 2 of Open University Course *P791 Managing Design.* The Open University Press.

Roy, R., Potter, S and Capon, C.H. (1990) *The Benefits and Costs of Investment in Design: a summary of results,* Working Paper WP-12, Design Innovation Group, The Open University.

Roy, R., Potter, S, Capon, C.H, Bruce, M and Walsh, V. (1990) *The Benefits and Costs of Investment in Design: End of award report to the Economic and Social Research Council.* Working Paper WP-13, Design Innovation Group, The Open University.

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

Roy, R. and Potter, S. (1990) Managing design projects in small and medium sized firms, *Technology Analysis and Strategic Management*, Vol.2 No. 3, pp 321-336.

Roy, R and Potter, S (1991): The benefits and costs of small firms' investment in design. *Piccola Impresa/Small Business,* Milano (in English).

Service, L.M, Hunt, S.J and Baker, M. J (1989): *Profit by design,* London: The Design Council.

Shirley, R. and Henn, D. (1988) *Support for Design : Final evaluation report,* Assessment Unit, Research and Technology Policy Division, Department of Trade and Industry, June.

Walsh, V.M. and Roy, R. (1985) The designer as `gatekeeper' in manufacturing industry, *Design Studies*, Vol. 6 No. 3, July, pp 127-33.

Walsh, V.M, Roy, R. and Bruce, M. (1988) Competitive by design, *Journal of Marketing Management,* Vol.4 No.2 Winter pp201-216.

Walsh, V.M, (1991): Det betaler sig at investere i design (The benefits of investment in design). *Civil Økonomie (Business Economics)*, No 2 pp 15-16 Copenhagen. (in Danish)

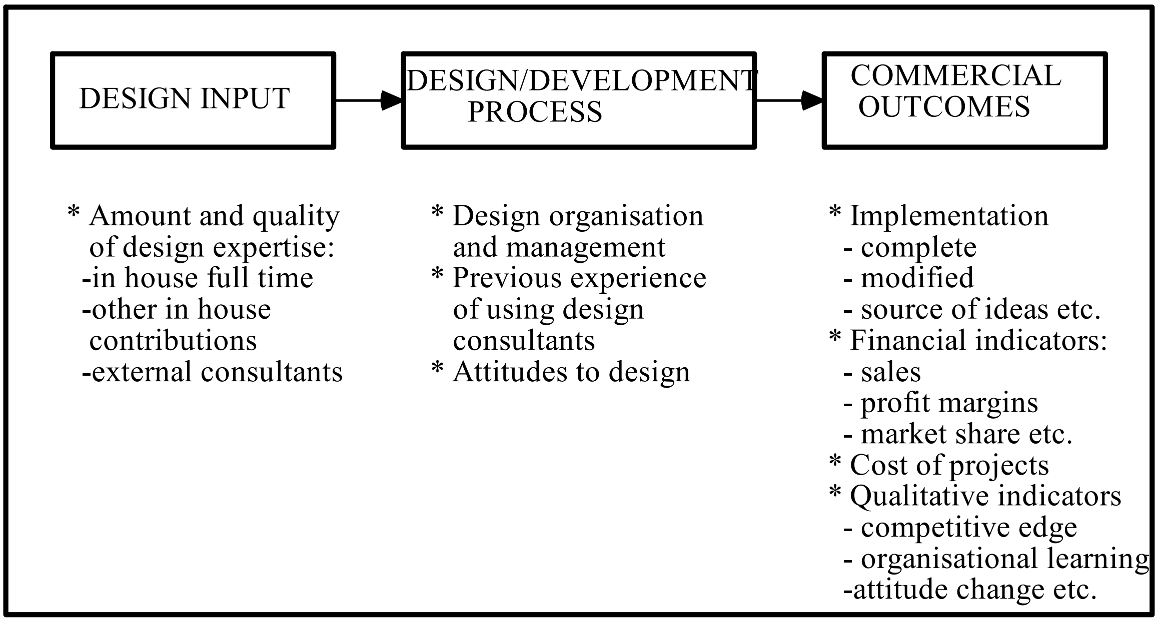
Walsh, V M., Roy, R, Bruce, M and Potter, S.(1992 forthcoming): *Winning by Design: Technology, product design and international competitiveness* Oxford: Blackwell.

APPENDIX 1: METHODOLOGY OF THE STUDY

A 1.1 The Research Model

In previous studies the Design Innovation Group has examined the relationships between a firm's reputation for 'good design' and its business performance (Walsh and Roy, 1983; Walsh and Roy, 1985; Roy 1987; Walsh, Roy and Bruce, 1988). For this study, to avoid the difficulty of defining the quality of a firm's products in terms of 'good design', the focus was on the commercial outcomes of specific inputs of money and research, design and development expertise in particular design projects. This may be viewed as a simple three stage model as shown in Figure A1.

Figure A1: The Commercial Impacts of Design research model



Frequently design is treated as a separate and distinct stage in product development or it can go to the other extreme and be seen as synonymous with product development itself. In examining the commercial impacts of design work it must be recognised that there is a difficulty in categorising what is a design investment and what is not. We overcame this problem by focussing our study on how companies used professional design skills, their motivations for doing so and the outcome on the whole of a product development or other project of their investment in design expertise. We did not seek to define design as a process.

Design 'inputs' were defined as professional design work undertaken by somebody formally qualified in a relevant design subject or whose job description is that of 'product designer', 'design engineer', etc. The cost of the professional design input was noted, together with any consequent costs (for example if putting a new design into production required the construction of prototypes, new tooling, use of different materials, additional marketing costs, etc.).

The commercial impacts of investment in design at a product or project level were assessed in terms of a number of financial indicators, including sales, market share, profit margin, exports and manufacturing costs. The costs and risks involved and managers' attitudes towards design were also examined.

A 1.2 The Sample

The research team were fortunate to have access via the Design Council to a large number of firms which had recently injected professional design expertise into specific projects. Our survey sample was drawn mainly from the approximately 3000 companies that took part in the Department of Trade and Industry/Design Council 'Funded Consultancy Scheme' and 'Support for Design' (SFD) programme. Because these schemes formed the bulk of the sample it is worthwhile examining them in a little more detail (for more information, see Shirley and Henn, 1988).

The Funded Consultancy Scheme/Support for Design Programme

The Funded Consultancy Scheme (FCS) operated from 1st July 1982 - 31st March 1985. It provided funds to enable manufacturing firms of 30 to 1,000 workers to employ a design consultant for 15 days at zero cost and a further 15 days at half cost. There was a quota of 20% of all projects for the smallest firms (30-59 employees), which from July 1983 was raised to 30%. The consultant could help in the development of new or improved products, components, packaging, product graphics or technical literature.

In April 1984 the option for a second 15 day project at half cost was withdrawn, and in April 1985 the FCS was succeeded by the Support for Design (SFD) scheme. Under the SFD, the subsidy was cut further. Only two days were provided free to the company with the DTI paying 75% of the costs for the remaining 13 days (an effective overall subsidy rate of 78%). However, new areas of design work (corporate image and promotional literature) were now included and eligibility for the scheme was widened to all sections of British industry (services as well as manufacturing).

There was also a significant shift regarding the type of firm the SFD sought to help. Rather than restricting the eligibility of very small firms for assistance, the focus shifted towards them. Under the SFD there was no minimum size and the maximum firm size was reduced from 1,000 to 500 employees. Additionally, up to 1986 subsidiaries of large groups were eligible, so long as the subsidiary had under 500 employees. From 1986 the group *as a whole* had to have under 500 employees. Basically, the SFD opened out the type of design work to be supported, shifted the focus towards smaller firms, but significantly reduced level of individual subsidy.

The widening of design work eligible and the opening of the scheme to all small firms resulted in the demand for support exceeding the funds available. In June 1986 this problem was addressed by reducing the level of subsidy still further by requiring the firms to pay a third rather than a quarter for their 13 days consultancy and by introducing new selection criteria such as the project was expected to lead to an improvement in the firm's international competitiveness. Allowing for the two free days, the subsidy rate was 71%. Another effect of the changing nature of the programme was that the proportion of graphics/packaging projects rose from an average of 12% under the FCS to over 40% under SFD (Figure A2).

Figure A2: Proportion of graphic and other design applications in the Support for Design programme, 1983-87.

Source: Shirley and Henn, 1988., Annex C

SFD was replaced by the Design Initiative in January 1988. The Design Initiative is one of several subsidised consultancy schemes within the DTI's *Enterprise Initiative*. Others include Business Planning, Marketing, Quality, Manufacturing and Research and Technology. The individual rate of subsidy was again reduced, from 71% under the SFD to 50% of up to 15 days consultancy (but with a two-thirds subsidy in Assisted Areas and Urban Programme Areas). In 1989 there was an important change in the type of design projects eligible for a Design Initiative grant. Graphics projects (including packaging, corporate identity, technical and promotional literature) were deleted from the scheme as it was argued that British firms no longer required support in this area.

So, broadly, the various succeeding schemes since 1982 had reduced the level of individual subsidy and length of subsidised time for a project, while concentrating more on small and medium sized enterprises. Until 1989 there had been a broadening of the type of design work that was supported, but since then the focus has very much been on product, industrial and engineering design.

The Consultancy Initiatives are due to end on March 31st 1994 and the DTI is undertaking assessments of the current schemes to evaluate if there should be any successors and, if so, what form they should take.

Administratively, the schemes have been run by the Design Council with Department of Trade and Industry (DTI) funding. The aim has been to operate with a minimum of administrative rules. Throughout the various schemes the procedure has involved the following stages: following a request for assistance, each company is visited by a Senior Industrialist and a Design Advisory Officer who discuss the company's specific needs and see whether the project fits in with the company's business plans. If a suitable project is agreed, a design consultant is selected either by the Design Council's Design Initiative Unit[8], or directly by the firm. The firm is invited to prepare terms of reference for the project, and once these are accepted by all concerned, the consultant goes ahead with the work.

The Design Advisory Office of the Design Council liases with both the company and the consultant and four or five months after the end of the project, the Senior Industrialist revisits the firm and provides a short report on the outcome of the project.

The FCS/SFD was particularly suited to this research because 3-5 years after the projects took place data on the commercial outcomes were becoming available. Should the project have failed, the reasons for failure should also be known. There was documentation on these projects in the Design Council files, which permitted a careful selection of firms and there was every chance of a good response rate given the existing contacts of the Design Council upon which we could build.

Although the FCS/SFD provided an excellent way of sampling firms that had undertaken a project involving inputs of professional design, the aim was not to evaluate the programme - this was being done by the DTI (Shirley and Henn, 1988). Thus we studied the whole project, not just the design consultant's (sometimes relatively minor) contribution, and the sample was designed to be representative of small and medium-sized firms across all sectors of UK manufacturing rather than of firms within the FCS/SFD.

A 1.3 Sampling method

Firms were sampled according to the distribution used by the Department of Trade and Industry in their assessment of the impact of the Manufacturing Advisory Service, which was based on Business Monitor statistics on the number of firms manufacturing with 60 - 1,000 employees, which was the closest match available to the FCS.

Within each of these 13 manufacturing Standard Industrial Classifications (SICs), firms were selected randomly from the FCS/SFD database. Additional filters were applied to ensure a balance of different types of project (new products, redesigned products, graphics, technical literature and packaging projects) and to exclude those unlikely to yield meaningful financial data (See Figure A3). The main focus was on the use of design in products, but we did look at graphics, packaging and technical literature as well. Our sample therefore adopted the 75% / 25% split between products and graphics projects found in the FCS/SFD as a whole.

Projects excluded because they were unlikely to produce usable results included, for example, minor components and products intended to sell other products (e.g. a display stand for carpets).

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[8]Formerly administered by the Design Advisory Office/Service.

Corporate identity projects were also excluded, unless they were a subsidiary part of a larger project. We did examine projects that were not implemented, although because there was less information to gather, many of these were surveyed by post or telephone rather than a face-to-face interview

Geographical location was not a criteria; we visited the firms according to the sampling procedure above which resulted in visits ranging from Teignmouth in Devon to Forfar in Tayside. Broadly the DIG members based in Manchester undertook visits to Northern Britain and the Open University members of the group undertook the visits to the South and West. However, due to travel budget constraints, Northern Ireland firms were only surveyed postally.

Figure A3: Commercial Impacts of Design sample structure

Initially it was intended that a comparison sample of firms that had not participated in FCS/SFD would be surveyed by approaching competitor firms named in the main sample and a pilot study of these was conducted with help from the Confederation of British Industry. But it became apparent that the FCS/SFD firms were typical of small and medium-sized UK manufacturers in their use of design (see 3.1) and the comparison was not considered necessary, especially given the difficulty of gaining access to a sufficiently large sample of non-FCS firms and projects.

Nevertheless, a small number of firms which had not participated in the FCS/SFD were visited as part of the process of deciding whether or not to undertake the comparative study.

A 1.4 Face-to-face Interviews and Postal Surveys

Both in-depth face-to-face interviews and postal questionnaires were used in this research. Concerns were expressed about whether sufficiently detailed information on the benefits, costs and risks of investment in professional design expertise could be obtained using postal questionnaires. The pilot stage of this project therefore included a thorough evaluation of the quality of data obtainable from in-depth interviews and postal questionnaires.

From this we concluded that, although the depth and detail of a personal company visit is necessary to address all the goals of this project, a postal questionnaire would be needed to cover a large sample of firms, even though the data was limited by this survey method. Even with a sample of 100 interviews, there could be problems of statistical significance in sub-sets of the main in-depth interviews. A larger sample of postally surveyed firms provided an indicator of reliability for the questions and subject areas common to both surveys.

A 1.5 Data Collection, Storage and Analysis

The project began in April 1987, the first six months of which involved the development and piloting of the questionnaires together with a number of discussions with other researchers and interested parties in this field. The main FCS/SFD interviews progressed in 1988 and 1989, together with the postal survey.

A computerised database, using DBase III+ was developed during 1988-89. As the data was collected it was entered into this database which meant that it was possible to produce preliminary results as the project progressed. Some early reports (see *References*) were based upon preliminary results. A large amount of data was analysed using DBase III+, with additional manual data analysis also being undertaken.

In the face to face survey, a total of 309 companies were approached among the FCS/SFD sample plus a further six for the comparative sample. 87 FCS/SFD interviews and four comparative interviews were obtained, making a total of 91 completed face-to-face questionnaires. Selected firms were initially approached by letter from the Design Council. It quickly became clear that a preliminary telephone interview could establish whether a visit was worthwhile or whether a postal questionnaire was more appropriate (for example, in the case of non-implemented projects or when detailed financial data was not available). As a result of these preliminary contacts, 105 firms were transferred to the postal survey.

However, one consequence of this procedure is that while equal numbers of implemented projects were surveyed using both face-to-face and postal methods, over 70% of the non-implemented, loss-making projects were surveyed postally and so there is less detail and financial data on these. This has resulted in a bias towards implemented projects developing in the results when an analysis is undertaken of questions that only featured in the face-to-face questionnaire. This bias is strongest at a detailed sub-sample level and it has been taken into account when presenting and interpreting the results.

Four percent of the firms sampled were confirmed as having ceased trading, with a further 8 per cent being untracable. Of all firms contacted, 14 per cent proved unsuitable, the main reason being that (usually due to staff changes) there was no information available on the FCS/SFD project. Only 9 firms (2 per cent) directly refused to assist us.

250 postal questionnaires were mailed. 13 % were returned marked ‘gone away’, about the same proportion of the combined bankrupt and untracable firms in the face to face survey. Of the 217 questionnaires presumed to arrive, 78 questionnaires were eventually returned (postal and telephone follow ups were made to non-respondents). This response rate of 36 % is a very reasonable one for a postal survey. Allowing for the companies transferred from the face-to-face survey, a total of 133 postal questionnaires were received of which 130 were entered into the database. Figure A4 traces the details of the sampling process.

The records from the Design Advisory Service allowed us to identify the person in each firm who was responsible for the design project. In most cases this was either the Managing Director or the Technical Director.

Figure A4: Outcome of approaches to firms for the Commercial Impacts of Design survey

Although the interviews with senior staff responsible for the projects usually lasted about two hours, several person days were required to arrange, conduct, write up and analyse each one. The data (consisting of completed questionnaires, summaries of the face-to-face ones and the dBaseIII+ database containing over 250 fields) is stored at the Open University and UMIST.

Descriptive statistics presented in this report were produced using both the computerised database and by manual analysis. The financial data for sales, exports, profits, payback, etc. were analysed manually and then coded into categories for entry into dBase III+. Crosstabulations between variables, including the coded financial data, were produced using the database in order to identify statistical correlations and to produce the tables shown in this report. Further results, including detailed examples and case studies, may be found in other existing and planned publications (see references).

This methodology has also been used in a Spanish study (Arbonies, 1991) and in a further DIG project examining the commercial returns and international impacts of the developing market for 'environmentally friendly' products.

A 1.6 Questionnaire Structure

Broadly, the questionnaire was structured as follows:

THE COMPANY	Ownership and size Main product line(s) Customers Design practices
THE FCS/SFD PROJECT	Business aims of the project Work undertaken Success of consultant's contribution
BENEFITS OF INVESTMENT IN DESIGN	Data on sales, market share, profit margin, exports and manufacturing costs for FCS/SFD project and (if possible) comparison product. Factors other than design affecting outcome Factors giving product a competitive edge Competitor's reactions to product launch New markets entered, effect on competitors. Indirect benefits
COSTS OF INVESTMENT IN DESIGN	External and in-house design costs, tooling, new plant and marketing costs. Opportunity costs Indirect costs
CONSEQUENCES	What company learnt about using design. Changes in attitudes to design

Changes in design resources used by firm.
Views of FCS/SFD programme

APPENDIX 2: ESTIMATING THE REAL LEVEL OF PROBLEMS WITH CONSULTANTS

The face-to-face questionnaire contained specific questions on the firm's relationship to the consultant, whereas the postal questionnaire did not, although this would have been reported in cases of major problems, for example as a reason why the consultant's recommendations were not implemented or if the project as a whole was not implemented. Hence the structure of postal questionnaire would be expected to under-report minor consultant problems. This was in fact the case as Table A shows. The ratio of minor problems to major ones is much lower in the postal than the face-to-face sample.

Table A 2.1: Major and minor problems with consultants

	Major problems	Minor problems
Face-to-face sample	7	12
Postal sample	16	13
TOTAL	23	25
As % of firms	11%	11%

Sample 219 firms of which 48 had problems with consultants. For a further 2 firms there was inadequate data.

To correct these figures for the under-reporting of minor problems in the postal sample, the ratio of major to minor problems was adjusted to be the same as for that in the face-to-face sample (i.e. 1.7 minor problems to 1 major). This produced the following results:

Table A2.2: Estimated true level of major and minor problems with consultants

	Major problems	Minor problems
Face-to-face sample	7	12
Postal sample	16	27
TOTAL	23	39
As % of firms	10%	18%