Putting the Pieces Together

Industrial Design and Concurrent Engineering

Canadian Manufacturers' Association B.C.Division

Canada

Industry, Science and Technology Canada

Industrie, Sciences et Technologie Canada

PUTTING THE PIECES TOGETHER:

Industrial Design & Concurrent Engineering

for Western Canadian Manufacturers

Written by

Mandy Chan

Canadian Manufacturers' Association B.C. Division

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Foreword

For several years, the BC Division of the Canadian Manufacturers' Association has encouraged – in practical terms – the greater utilization of Industrial Design in manufacturing. We have sponsored – often jointly with Industry, Science and Technology Canada – studies, seminars, student projects and summer jobs for Industrial Design students. This publication *"Putting the Pieces Together: Industrial Design and Concurrent Engineering for Western Canadian Manufacturers"* represents one more step in the journey – for Western Canadian manufacturers – toward international competitiveness. It also represents, we hope, a blueprint that all of the affected parties can use as they strive to work together effectively. Western Canadian/Canadian business must make use of the most current and successful techniques if Canada is to continue to enjoy its current high standard of living. We believe that Industrial Design and Concurrent Engineering are two critical strategies that must be pursued.

Any project of the size and complexity of this publication requires the talents and efforts of many contributors. At this point then I would like to acknowledge the contributions of a number of people. Ms. Mandy Chan, both as a Co-op student from Simon Fraser University Faculty of Business Administration and as a Consultant, did most of the research, writing and troubleshooting on the publication. The quality of her work – as demonstrated by this publication – clearly shows that she will enjoy a successful career.

Thanks are also due to Art Sauder,P.Eng, Consultant, who did most of the work for the Concurrent Engineering section. Further, for reviewing the draft document and offering constructive suggestions, my thanks to: Michelle Guest (Design Vancouver); Edmund Ho and Bruce Bernard (V-Tech Engineering); Greg Howard (Columbia Plastics); Harold Copping (Teleflex Canada); and, Dr. Brian Anderson and Chris Bywater (ISTC - Vancouver).

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Special thanks are due to Karl Humphreys, BCID, for designing the cover of this publication and Industry, Science and Technology Canada -Vancouver for providing funding for this project.

Blair Wilson
Vice-President, B.C. Division
Canadian Manufacturers' Association
Vancouver, B.C.
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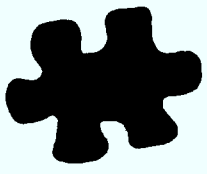

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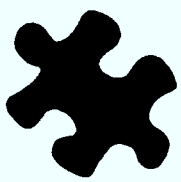
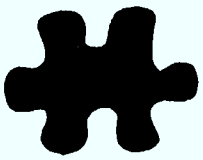




Introduction

The bottomline for any business is to make Profits. In today's marketplace that means being internationally competitive. There are two fundamental principles to a competitive business strategy: 1) Continual Innovation, and; 2) Productive Efficiency. Neglect of either one of these basic principles leads to premature obsolescence. Manufacturing, in particular, is one industry which is threatened by the new economic changes which have been taking place in the last two decades. Many industrializing countries are able to manufacture competing products at much lower costs. Innovative products of post-industrialized countries like, Japan, Germany, Switzerland and the United States are overwhelming the consumer and industrial goods markets. Canada, somehow, has lagged behind the *Innovators* and the *Labour Intensive Producers*. Realistically, there is little chance for Canada to maintain its high standard of living if the competitiveness of our products continue to dwindle, in price and in distinctiveness.

The objective of the Canadian Manufacturers' Association is to help promote the competitiveness of Canadian manufacturing by providing a means to the industry for becoming more strategically competitive in the international marketplace. The two proposed tools for gaining a competitive edge in this new marketplace are ***Industrial Design*** and ***Concurrent Engineering***. The effective integration of Industrial Design into the management framework of Concurrent Engineering will stimulate the innovation and efficiency necessary to achieve competitive superiority.

Innovation & Efficiency

Innovation refers to the generation of new ideas or concepts aimed to improve the utility of a current product or to satisfy an unmet market demand. Innovation can be the mastermind behind a "new to the world" product or it can simply be a strategic approach to extending the life of an existing product.

Innovation, product differentiation and meaningful product distinction are synonymous. They are a means to sustaining long-term competitiveness in an international marketplace. *Industrial Design* is one of the most powerful weapons available to companies for achieving this end. Yet, the full potential of Industrial Design is not fully understood by its Users (manufacturers and product developers) or Suppliers (Industrial Designers and affiliates).

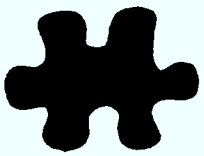
Effective industrial design contributes more to product development than mere aesthetic appeal, it is a process which involves the understanding of many other areas –from the initial idea generation to knowledge of modern materials to comprehension of engineering concepts. The creativity which upholds design enables it to restructure and synthesize new and existing ideas for innovative productive purposes.

Efficiency measures how quickly, and how cost and effective a product or service can be produced. Technological advancements have contributed to greater efficiency in production of higher quality products in less time, cost and manpower. In manufacturing, improved automation of assembly procedures and production processes have facilitated increased efficiency. However, little attention has been directed to inefficiencies which are often inherent in poor product designs. Regardless of how highly automated and efficient the production process, it can not eliminate unnecessary steps which have been designed into a product. Ultimately, costs cannot be fully minimized, nor profits be fully maximized.

Concurrent Engineering encourages multi-functional and multi-disciplinary teaming in the Product Development Process. The synergy which results from the co-operation between experts of various

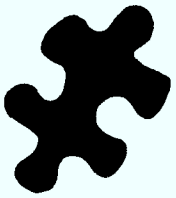
specialty areas enables more effective and efficient initial product design developments. Subsequently, the blueprints of the product are ready for the production stage and need not be "sent back" to be "fixed" again and again .

Industrial Design is a source of innovative creativity which should not be neglected, but rather exploited. ***Concurrent Engineering*** provides the infrastructure that advocates "cross-pollination" of fields, hence providing an opportunity for inventive and diverse ideas to come together into a "profitable" whole. The effective application of Industrial Design and Concurrent Engineering will provide a powerful competitive edge to Canada for achieving success in the global marketplace.



What is Industrial Design?

"Industrial Design is not about making things pretty. It is about making a product do what it's supposed to do and do it well, preferably better than its competitors. It's about making the product durable and easy to use and service. It takes into account the need for cost-efficient manufacturing, distribution, marketability and the end price customers are willing to pay. Only after those aspects have been dealt with does a skilled designer consider appearances."[1] According to Katherine McCoy – co-chairperson of the Industrial – Design Department at Cranbrook Academy of Arts in Bloomfield Hills, Michigan – industrial design is both art and engineering. Innovatively applied, design is the key to overall quality, as important to the manufacturing process as to aesthetic appeal. A designer with a background in engineering, architecture or technology will probably design 'inside out' – concern for product mechanics before product ergonomics and appeal. A designer with a background in art, sculpture, fashion, interior or furniture design would tend to work 'outside in' – concern for product form before product function. Effective industrial design should simultaneously consider all issues involved in designing 'inside out' and 'outside in' so that benefits from both approaches can be captured.



The objective of industrial design is "to add value to good technology so that the product would perform more successfully in the marketplace".[2] Effective industrial design aims to achieve integration of ergonomics, aesthetics, safety, and marketing factors with design for manufacturability so to optimize product utility and market acceptance.

The *Association of Chartered Industrial Designers of Ontario* (ACID-O) identifies Industrial Design as a process of "creating concepts for consumer and industrial products which render those products practical, attractive and economical to manufacture. The industrial designer is trained to follow a project from idea through production and to optimize its appearance, function and value to the mutual benefit of user and producer."

In effect, industrial design can be synonymously referred to as product design because it is the process by which "the synthesis of ideas and specifications that optimize the function, form and value of products for the mutual benefit of the consumer and manufacturer" can take place. Effectively applied to product development, industrial design helps achieve product and corporate differentiation.

To Norio Ohga, president of Sony in Japan, "...design may soon be the only element that differentiates one product from another." It is that intangible element which differentiates one manufacturers' product from its competitors that will drive the market of tomorrow through higher perceived value.[3] What managers need to realize is that in manufacturing, the product is the company's image. Consequently, the design of a product becomes an important economic function with profit and market success being the dependent variables. The better the design of the product is able to communicate its value to the consumer, the more successful it will perform in the marketplace.

Industrial design extends a concept which marketing managers have long recognized to be an important criterion to product and corporate success – consumer-orientation. The only variation is that this consumer-orientation has now taken on a global orientation – products are rapidly becoming more and more universal and increasingly more competitive. "There are two dimensions which a business can seek a competitive advantage. It can try to be a low cost producer within its target segments, or it can differentiate itself by its product offering or marketing program."[4] If price and quality were the arbitrators of success in the 80's, then design and innovation will be the judge in the 90's.[5]

WHAT IS INDUSTRIAL DESIGN?

High quality and competitive pricing no longer impart the competitive edge that once guaranteed success in the marketplace. While a pricing strategy may be the most frequently implemented choice of recapturing lost market share, it is not the solution to gaining a sustainable competitive edge. In the short run, it may retain the product's market position but it reduces profits which in turn affects the financial stability and the growth potential of the business. In the long run, it is suicidal as the lowered prices drain away increasingly small contribution margins. Meanwhile, the product declines further along its product life cycle.

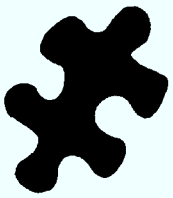
The alternative is to pursue a product differentiation strategy. In markets dominated by a myriad of competing products, creating meaningful distinction will be a difficult challenge. Investment in the design function of a product to better meet the demands of the consumers will enable greater product success in the marketplace. Adopting a design strategy for product differentiation reinforces the strength of the business by ensuring continued demand for its products. This translates to long run profitability and corporate security. The eventual benefits arising from the success of the product should more than offset the "relatively low" initial product design investment and threat of market share loss.

I. CO-ORDINATING MARKETING & DESIGN

As part of the industrial design process, a number of product development concerns need to be considered. Product quality, performance, appearance, durability and cost are strategic decision areas of the *Design mix.* These attributes of a product communicates what the product does (function), how well the product does it (performance), how it looks (aesthetics), how long it lasts (durability), what it costs (affordability), how it is made, how it is packaged, and how well it integrates with other products or services. In aggregate, these attributes communicate a product's consumer appeal.

Understanding the interrelationship of the *Design Mix* elements is critical when designing for product success. Once these elements are well-established, consideration of the *Marketing Mix* elements – product, price, promotion, and place – will be necessary in planning for the product's introduction into the market.

A. THE DESIGN MIX



Customers, whether consumer or industrial, make purchases based on evaluating the costs versus benefits of a product's attributes. Obviously, all buyers want to obtain the best value for their money. Effective design requires the creative balancing of the *Design Mix* elements – Performance, Quality, Durability, Appearance, and Cost – in order to provide a quality product to the target market at a price which the consumers within the segment can afford. With markets becoming increasingly more competitive, the effectiveness in which these design elements can be co-ordinated with the components of the *Marketing Mix* – Product, Price, Place and Promotion – will determine the unique advantage which the final product will have over its competitors.

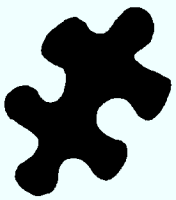
1. The ***Performance*** of a product must fulfill certain customer needs, wants or objectives. Therefore, the designer must have a clear sense of the functions which the target market is interested in. It is at this stage which designers will require the assistance of Market Researchers and Sales Experts to identify the Users' product demands and expectations.

2. The ***Quality*** measure of a product is subjectively determined by the Users' of a specific target market based on their individual evaluations of product cost to product benefits. The choices made by the designer concern the selection of the most cost effective materials and workmanship

standards based on the goal of providing *affordable quality* – highest quality attainable at a given price level aimed at specified target market

3. The perception of ***Durability*** in a product reflects the Users' expectations of the product's performance and quality characteristics. Visual durability communicates to the consumer the physical endurance of the product. Based on the form of the product, potential buyers can immediately assess whether the product promises the quality its physical appearance suggests.

4. The ***Appearance*** of a product is the visual distinctiveness or the "look" of the product. Achieving a distinctive style or form is the means by which products can stand out among its competitors. The Appearance of the product should be both functional and visually attractive.



5. The ***Cost*** element of the Design Mix is the main constraint which Designers must acknowledge. The final product must carry a price within a certain range respective of its intended market position. The budget limits the amount of time and resources that can be devoted to the product so that bottom-line profitability can still be met.

B. THE MARKETING MIX

The 4-P's – Product, Price, Promotion and Place, are fundamental to any marketing function. These four elements establish the framework which enables strategic decision-making regarding product and corporate marketing to take place. The customer is not a part of these four elements. But rather, the customer is the central point which links the product, its price, promotion and distribution objectives to the market.

1. The ***Product*** concern focuses on developing the "right" product or products to meet the needs of a specified market. Whether the needs are rational or emotional, they must be clearly identified so that the desired elements can be designed into the product.

2. The ***Price*** concern aims at introducing the "right" product to the target market at a price the consumers can afford. The appropriate pricing strategy will be dependent on the nature of the product, the level of consumer involvement, and the degree of product price sensitivity. The better the product is able to meet consumer demands in the competitive market, the higher the price it will be able to command for its added-value.

3. The ***Promotion*** concern is about communication. It is about letting the target market know about the product. The most important promotional tool is the product itself. Ideally, if the product can effectively communicate its value to its consumers, there is no need for any other promotional forms. However in a competitive environment, this is not always possible. Investing in effective product design is a commitment to securing the company's corporate identity and ongoing success in the marketplace.

4. The ***Place*** concern concentrates on physically delivering the product to the target market. Despite the 'wonder' of the product, if it can not reach its customers effectively, it will not perform very successfully in the market. In determining the market exposure of the product and how that can be achieved, this concern must account for the nature of the product. Luxury or specialized consumer goods, for example, would require a more selective choice of distribution outlets. These decisions will depend on the product's objectives.

Exhibit 1: Strategic Decision Areas in Design and Marketing

DESIGN MIX

Durability
Reliability
Materials Selection
Assembly/Production
Expected product life

Performance
Function
Features
Technical Engineering
Ease of use
Maintenance
Ergonomics

Appearance
Styling
Aesthetics
Market Appeal
Form
Colour
Decorative Features

Quality
Customer Cost - Benefit Evaluation
Quality = Performance + Visual Appeal + Durability + Affordability
Affordable Quality = Value

Cost
Product Development – Return on Investment Analysis
1. Anticipated life cycle
2. Contribution Margins
3. Price Elasticity
4. Size of target market
5. Nature of target market
6. Tangible vs. Non-Tangible Value

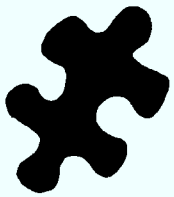
MARKETING MIX

Product
Physical good or service
Features, Accessories
Installation. Instruction
Product Line
Warranty
Packaging
Branding

Price
Product Market Position
Flexibility
Price Elasticity
Discounts/Allowances
Pricing Strategy over product life cycle

Promotion
Promotion Blend
Sales force – selection, training, motivation
Advertising
Publicity

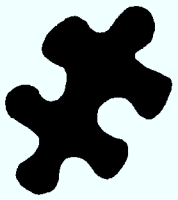
Place
Channel Type
Market Exposure
Middlemen Selection
Service Levels
Managing Channels



II. WHAT ABOUT PACKAGING?

The basic purpose of a package is to provide protection to a product. The benefits resulting from a well-designed package appeals also to the emotional dimensions of consumer needs. In today's markets, packaging functions to attract consumer attention, seduce their interest, and invite their trial of the product. Studies have shown that as many as 80% of purchase decisions are made in the store. Impulse buying accounts for 60% of purchases.[6] Other than the product itself in being able to communicate its value, no other form appears to be able to affect a purchase decision as much as packaging.[7] The package is the first physical encounter between the buyer and the product. The better the package is able to attract consumer involvement, the more effective it will be in influencing the buyer's purchase decision.

Packaging is a form of marketing communication aimed at selling products. It is the only advertising material to which consumers are constantly exposed. A package appeals to the rational senses by clearly identifying the product's features and functions. At a more subliminal level, the package appeals to the emotional senses. The package form may invite touch while its visual imagery may attract attention. An effective package design has a strong visual image that is distinctive and functional. It is ongoing advertising that stimulates the rational and emotional senses of the consumer by explicitly identifying purchase benefits and visually enticing trial.



Packaging is an arm of industrial design. An industrial designer must consider human characteristics and needs, safety, market appeal, efficiency in production, distribution, use and maintenance. Similarly, a package designer must account for these concerns. The difference is that the package, in itself, must be able to communicate all these elements to the consumer. The industrial designer must be familiar with marketing requirements and be proficient at anticipating buyer needs and design trends. The package designer must also have knowledge in these areas in order to effectively design a package using production processes and materials that are cost effective. The common objectives of the industrial designer and package designer are to distinguish the package from its competitors and attract consumer interest.

"For packaging, the environment will be to the 90's what convenience was to the 80's."[8] How to package products in an environmentally friendly way is a complex issue. In the United States, President Bush has acknowledged environmental safety a top priority by appointing a Secretary of the Environment to control the level of solid waste. Currently, one third of the solid waste is made up of packaging.[9]

In Germany, the problem of packaging waste is considered to be a serious environmental hazard. As a result, the federal government of Germany has passed a law to reduce the amount of waste going into landfills and incineration. As of December 1, 1991, "companies must take back and recycle packaging used during transport or arrange somebody else to do so. From April 1, 1992, that law will extend to 'secondary' packaging – intermediate layers such as gift wrapping or the cardboard box around a whiskey bottle. From January 1, 1993, it will cover all packaging from yogurt containers to butter wrappers. By July 1, 1995, 80 percent of packaging wasted must be collected. Of the collected materials, 90 percent of glass and metals must be recycled, and 80 percent of paper, board, plastics and laminates. Incineration, even if used to generate power, is ruled out."[10]

With growing concerns of environmental safety, the package designer will need to be more knowledgeable in areas of production processes and materials selection to design effective packaging that is environmentally safe. Already many countries have followed suit of Germany. "The Netherlands and France have both made tough deals with industry to encourage more recycling of packaging; Austria is even proposing a legal obligation on the consumer to return packaging to the retailer."[11] Doing business with these countries in the future will require companies to operate within new constraints, which in turn will require the packaging designer and the industrial designer to have a greater understanding of each other's skills and awareness of environmental issues.

According to Herb Murrie, president of Chicago design firm *Murrie, White, Drummond, Lienhard and Associates*, "...package design today involves skills well outside the range of the typical graphic designer. If a graphic designer say he understands fill rates and blow-molding, he's either a genius or he's going to fall on his face." Murrie further suggests that, "the wise packager will seek out a designer who's well-versed in industrial design."[12]

Industrial Design in Western Canada

To gain a better understanding of the industrial design function among British Columbia manufacturers, the Canadian Manufacturers' Association and Industry, Science, and Technology Canada (ISTC) conducted an Industrial Design Project in the Spring of 1991. The objective of the project was to advance both the awareness and use of industrial design among member companies and to encourage the effective integration of industrial designers with manufacturers in BC. The project comprised of four interrelated elements: a preliminary exploratory research study, a seminar, a student project and a student summer employment program. Experience suggests similar trends exist in other Western provinces.

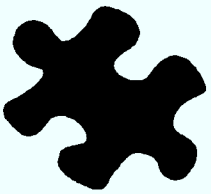
- Only 30 percent of the 56 respondents (17 companies) have used or are using industrial designers. Only one company had an in-house industrial design staff. The rest of them contracted industrial design on an "as needed" basis. Generally the larger firms, those with 45 or more employees, were more likely to use industrial designers.

- It should be noted that there is a group of non-users who perceive themselves as users. These companies use in-house engineers or technicians as substitutes for an industrial designer to contain costs.

- True non-user companies engaged in product development had a rudimentary understanding of what industrial designers do.

- Users showed they had a more sophisticated awareness. In general, industrial designers are perceived as making significant technical and aesthetic contributions to the creation of cost-effective products which "look good and work well" while meeting the needs of the end user.

- Even user companies failed to grasp fully the specific contributions industrial designers can make to both the products and the process. These contributions occur in the areas of product conception, safety, market appeal, efficiency in production, distribution and maintenance, and anticipation of buyer needs and design trends.



- Even with their limited knowledge of the range of industrial design's potential benefits, companies generally recognize its value, users more so than non-users. On the other hand, both are reluctant to pay for it. This contradiction suggests that manufacturers require more information for analyzing the cost-benefit of industrial design.

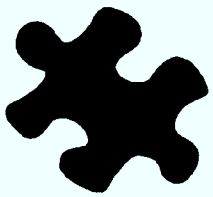
- When utilized, industrial designers are employed in a wide range of capacities. Sometimes they are involved only in concept generation, other times they are used in various specific stages of product development, such as rendering drawings, modelmaking and designing aesthetic appearance. ***Industrial designers are rarely involved in every stage of the process, from concept to completion.***

- The 17 companies that have used industrial designers have generally found the experience beneficial. The Users reported that for the most part the industrial design process enhanced product competitiveness in terms of performance, appearance and value. However, they found it very difficult to directly assess the value of industrial design, whether in decreased product development time or increased sales. The inability to isolate and extrapolate the value of industrial design is a major stumbling block for users.

Non-users also lack a means by which they could assess the potential value of utilizing industrial design in product development.

- Non-user companies balk at what they perceive to be the high costs, in both time and money of using industrial designers. Not only are they considered expensive, but bringing industrial designers up to speed on projects is seen to be too time consuming. Moreover, there is a perception among users that locally available industrial design talent is not up to the job. Despite the perception of inadequate local talent, only one company contracted a designer from outside the area.

- Each of the 56 respondent companies engaged in product development has designed, developed or approved products for production over the past 3 years – 25 % average 1 product per year; 40% average between 2 to 5 products a year; and 34% average 6 or more products per year. Some 65% of the 56 respondent companies engaged in product development said product development is critical to survival. One CEO indicated that, "Either we develop new products or we die."



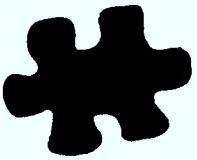
Continuous improvement and ongoing product development are vital to the life of a company. These two elements support the competitiveness of the product and the company in a marketplace that is becoming increasingly more demanding. Industrial design offers a means of developing products that better meet the demands of the global market. It is a strategy which establish product and corporate distinction.

Putting Principles to Work – Case Studies

Very few companies in Canada have made use of industrial design as a strategic tool for product differentiation to achieve competitiveness in the marketplace. Sony, Apple, and Braun represent only a few of a number of international corporations who have consistently used design, as a competitive strategy, to distinguish their products from competitors. The organizational structure, size, and available resources of these companies are very often beyond the realistic scope of small and medium-sized manufacturers. How can smaller companies be expected to identify with these large corporations in terms of financing entrepreneurial ventures in areas such as design, research and development? The constraints faced by smaller companies are far more immediate and the extent to which they can commit their resources are far more limited.

Taking into account the limitations faced by smaller companies, the following case studies were researched. The companies studied do not represent ideal models of how "perfectly" industrial design has been incorporated into product development. But rather, these companies represent those who are aware of the value of design. This basic understanding of industrial design's value and the active incorporation of design into their product development have enabled them to achieve product success in the competitive marketplace.

The following case studies are based on in-depth interviews with the "champion" of industrial design in each of the four companies. The background of the companies and the challenges faced by each of these companies are identified. Then, their perception of industrial design is defined. Following, the complexity of the company's decision making process with respect to its product development process and organizational environment is determined. There are three types of responses which the companies undertook: Innovative, Corrective or Innovative and Corrective. The innovative response questions: What appeals to the market? The corrective response questions: What consumers didn't like about the product? The innovative and correction response addresses both these concerns.



Weiser was faced with strong price competition from low cost imports and a threatened decline in market share. To alleviate these competitive pressures, it responded "innovatively" by using design in its packaging renovation and in its new product development. B.C. Sugar was facing a dwindling market share in a shrinking market. The company took corrective action by providing its customers with a package that facilitates greater ease of use. By re-designing the packaging for the syrup, BC Sugar as able to reverse the trend of declining demand. Teleflex and V-Tech responded both "innovatively" and "correctively". Teleflex's customers criticized the appearance of its product, hence industrial design was used to correct this problem. However, industrial design was also used "innovatively" in contributing to the product's ease of maintenance. V-Tech was not faced with a problem but rather an opportunity. The company recognized the potential in the cordless telephone market. V-tech took corrective action in resolving the many criticisms of cordless telephones as indicated by consumers and took innovative action in designing their cordless phone to appeal to market desires.

Previous to implementing industrial design, each company explored other alternatives to resolve its problems or to pursue its opportunities. The Case Analysis following the Studies will identify the obstacles faced by each company in implementing industrial design and address how each of them could have better incorporated industrial design to its advantage. While none of the companies, on its own, may have incorporated industrial design ideally, together they have created an environment in which industrial design can be integrated and effectively applied. Despite industry differences among the companies – Weiser, Teleflex, V-Tech and B.C. Sugar – they share a common business strategy to achieving market success – industrial design.

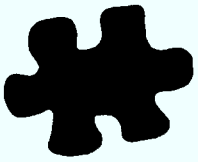
I. CASE STUDY: Weiser Canada Ltd.

CORPORATE INFORMATION

Name:	Masco Corporation
Headquarters:	Taylor, Michigan
Locations:	Multi-national, 150 subsidiaries worldwide
Total Sales Revenue:	Approx. $4 Billion Annually
Products:	Home Fixtures, Furniture, Decorative Hardware, etc.

PRODUCT DIVISION

Name:	Weiser Incorporated
Location:	6700 Beresford Street. Burnaby, British Columbia
Number of Employees:	Approx. 500
Sales for Division:	Approx. $50 – $100 million annually
Product(s):	Residential Locks
Target Market:	Canadian New Home and Home Renovation Market



THE CHALLENGE

Weiser Canada Limited is Canada's largest residential lock manufacturer, accounting for approximately 50% of the industry's market share. Since the early 1980's, however, Weiser faced increased competition from low cost imports and a gradual decline in it's market share. The challenge for Weiser was to design and package their products so that they could be easily differentiated from their competitors.

BACKGROUND

Weiser Canada was founded in 1952 as a subsidiary of a larger company based in Los Angeles. It is now one of over 150 subsidiaries owned under the multinational Masco Corporation based in Taylor, Michigan. Initially, Weiser served as a distributor in Canada of products produced in the United States. Since then, Weiser Canada has matured into a fully self-sufficient manufacturing and business enterprise with its own mechanical design and manufacturing facilities. It is located in Burnaby, British Columbia with 300,000 square feet of administrative and factory space. The products offered by Weiser are a line of residential locks which Larry R. Hughes, Vice President of Planning and Product Development, has termed "Decorative Door Hardware".

THE RESPONSE

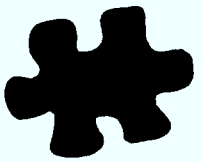
Like most companies, Weiser's initial response was not to use industrial design. But rather, they focused on implementing a more competitive pricing strategy by improving their production processes to reduce costs and to offer lower prices and greater value to their customers. Despite efforts to compete at lower price levels, further price competition was deemed unfeasible and definitely unprofitable.

Since Weiser recognized they could not offer price differentiation, they strove to offer product differentiation. Weiser increased the use of marketing research and formalized and intensified its product development process. Weiser's sales staff offered their insights to new product design and upper management provided support to enable the development of prototypes. Industrial design was used to enhance product appearance and to improve product function.

THE ROLE OF INDUSTRIAL DESIGN AT WEISER

At Weiser, industrial design serves the functions of detailing and styling. Industrial design provides the aesthetics of the product and serves to enhance the interface between the product and the consumer.

In the past, Weiser, like many other Canadian subsidiary companies, imported designs, components, and expertise from its parent company in the United States. It was not until the early 1980's that Weiser became aware of the potentials of industrial design. Initially, industrial design was used only sporadically to aesthetically complement their products' mechanical functions. However, Weiser has increased their confidence in industrial design over the past five years . Despite the fact that expenditure in industrial design is still relatively nominal at Weiser, as compared to investment in mechanical design, Mr. Hughes admitted that it has been *industrial* and *packaging design* which have contributed most distinctly to successful product differentiation.



INDUSTRIAL DESIGN & THE PRODUCT DEVELOPMENT PROCESS

The incorporation of industrial design into product development has been a gradual process. The ideas for new product development or product re-design generally come from Weiser's sales staff. They would establish the parameters of the type of products they have in mind. The ideas of Weiser's sales staff are spurred from personal experience and expertise in the industry. After the preliminary ideas are drafted, a cost analysis and feasibility study is performed, and a conceptual prototype is then created. It is at this stage that industrial designers are asked to contribute their skills in specifying the details of the designs. According to Mr. Hughes, "the basic structure of a product tends to be the same, the distinctiveness of a product comes from its details."

At Weiser, there is close collaboration between the product designers and manufacturing engineers within the company. One of their most pre-eminent responsibilities is to focus on reducing costs of production. The industrial designers tend to work more closely with Mr. Hughes himself. After preparation of sketches based on the criteria outlined by Mr. Hughes and the sales and product development staff, a formal presentation is made by the industrial designer to the group. The tasks of the industrial designers are completed once the proposed designs have been accepted. Thereafter, Weiser's manufacturing and sales department complete the product development process by producing and marketing the products to the consumers.

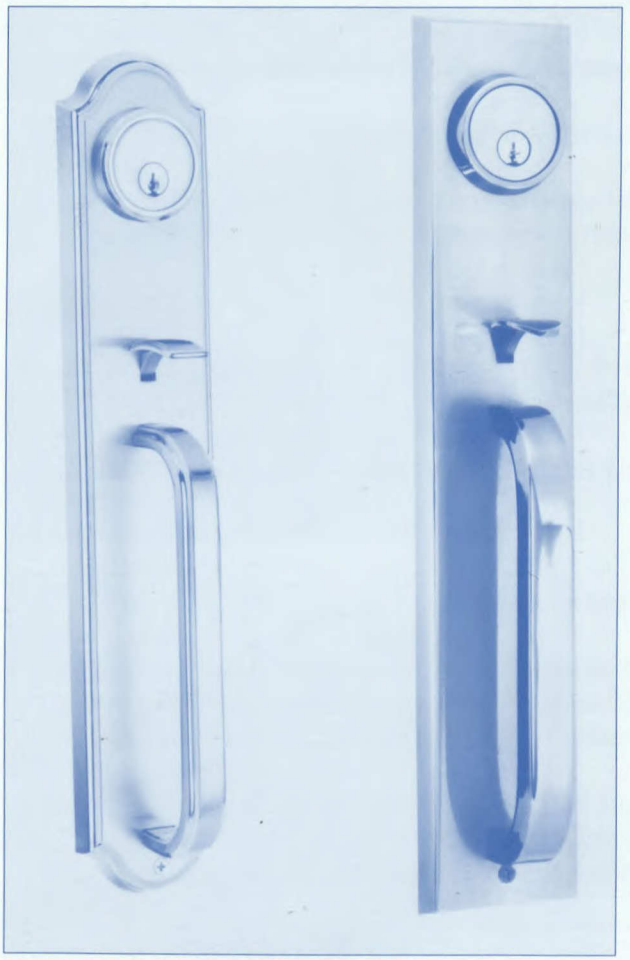
INCORPORATING INDUSTRIAL DESIGN – THE OBSTACLES

Other than the seemingly high initial outlay costs for industrial design and often the inability to directly measure its benefits, what other deterrents have prevented companies from realizing the value of industrial design?

Mr. Hughes, the *champion* of industrial design at Weiser, suggested that corporate culture is one of the biggest obstacles to overcome. In general, the mechanical engineers, the manufacturing staff, and others who are not aesthetically trained are not sure where and how an industrial designer would fit into the company, other than in the visual appearance and packaging of the products. Even though industrial design has become more acceptable in the past few years, creating the initial awareness and promoting the value of industrial design has been and still is a "tough struggle".

THE PRODUCTS

Two specific products which resulted from direct outside industrial design input have received positive feedback and are anticipated to perform very successfully in the market. The Victoria Grip Set was first produced and marketed in 1990. After the successful launch of the Victoria, the Marielle was introduced in the Spring of 1991. The Victoria Grip Set and the Marielle Grip Set are targeted toward two distinctly different market segments. The Victoria is clean and "hard" and is positioned to appeal to the modern or the *'avante-garde'*. While the Marielle is "softer", more curvi-linear and is positioned to appeal to a more *'traditional'* market segment. Both are positioned at the upper end of Weiser's product line and are designed to appeal to the upper scale consumer market.



Marielle Grip Set (left) and Victoria Grip Set (right).

Mr. Hughes does not merely see residential locks as a Security Products Industry but rather a "Decorative Hardware" Industry. Changes in mechanisms are slow to evolve; what's more important is the careful selection and application of the "right" finish, the "right" materials, and the "right" design. These elements contribute to product differentiation in a relatively generic market where, "locks are locks" unless one provides something more than just function.

The success of a product, according to Mr. Hughes, comes from careful planning in all aspects of product development and in keeping up with technology. The product must be high quality and cost effective. At Weiser,

they are trying to overcome the foreboding threat of low cost imports by,"being as productive as they can" and trying to become more, "distinctive through marketing".

Packaging and industrial design are interrelated and both are integral parts of an extended marketing strategy. Packaging design is used to capture initial consumer attention. Industrial design is used to enhance the product's overall visual appearance. A Toronto packaging design firm provided Weiser with a major renovation to its product packaging in 1989. Weiser used local industrial designers for its Victoria and Marielle design projects. Weiser has adopted both packaging and industrial design to distinguish their products from low cost imports. Weiser 's products stand out because of ***Design.***

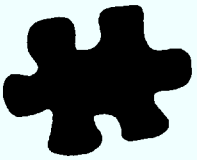
II. CASE STUDY: Teleflex (Canada) Limited

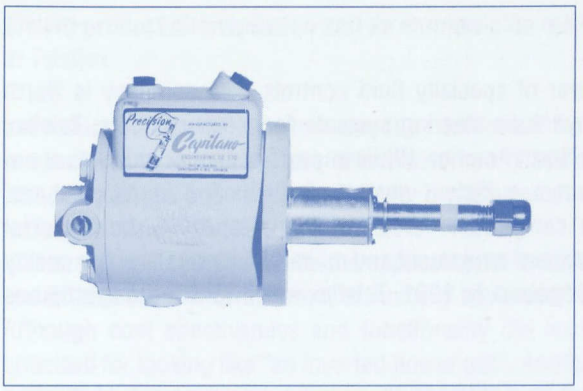
CORPORATE INFORMATION

Name:	Teleflex Incorporated
Headquarters:	Pennsylvannia, USA
Locations:	Multinational, 35 divisions and subsidiaries
Total Sales Revenue:	Approx. USD $450 million (1990)
Products:	Push-Pull Cables, Medical Disposable &Hardware products, Hydraulic Marine Cable Steering Products, Automatic Pilots, etc.

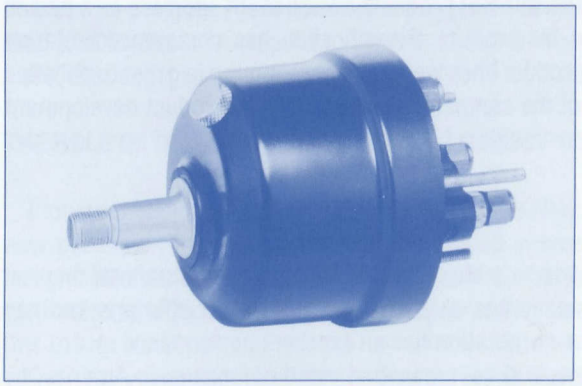
PRODUCT DIVISION

Name:	Teleflex (Canada) Limited
Location:	3831 No. 6 Road, Richmond, British Columbia
Number of Employees:	110
Sales for Division:	Approx. $12 million (1990)
Product(s):	Marine Hydraulic Steering Systems, Industrial Fluid Controls (Diesel Engine Heaters, Engine Governors, Fuel Control Valves, and Customized Hydraulics), Marine Automatic Pilots
Target Market:	1. Pleasure Boat, {Marine Hydraulic Systems & Automatic Pilots} 2. Heavy Equipment {Diesel engine preheaters & governors} 3. Industrial & Custom manufactured fluid controls

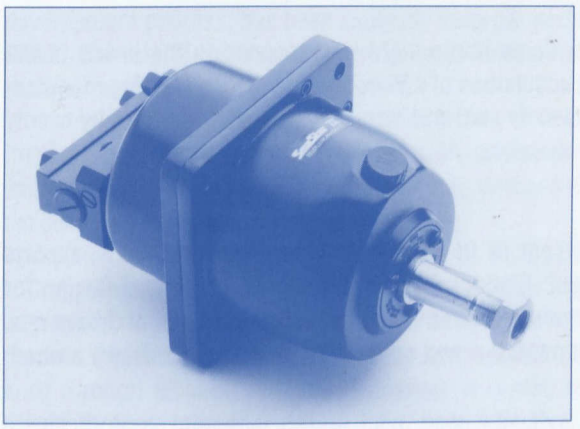




1972 Capilano Helm Pump



1976 System Helm Pump



1985 SeaStar Helm Pump

1990 SeaStar Helm Pump

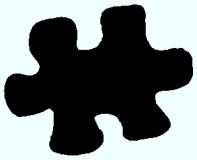
THE CHALLENGE

Teleflex (Canada) Limited is a manufacturer of specialty fluid controls. The company is North America's largest manufacturer of marine hydraulic steering systems for pleasure boats. Teleflex currently holds a 55% share of this market in North America. While imports of similar products are of concern, Teleflex has been able to maintain a sufficient degree of distinction in its products' appearance and engineering to offset this competitive force. Additional specialty fluid control products serve the heavy duty trucking, agricultural equipment and military markets. The high quality standards of Teleflex products have been recognized. In 1991, Teleflex was awarded the prestigious Ford Q-1 Quality Designation.

The challenge for Teleflex is a long term commitment to ongoing improvement of existing products to enable leadership in each new generation of products designed. In addition, as a part of Teleflex's strategy for future growth, a plan for product diversification has commenced. Marine automatic pilots and diesel engine preheater product lines were recently acquired in order to enhance Teleflex's strength and future growth in two of the company's major markets. Product development has already been undertaken in both these non-traditional product groups.

BACKGROUND

Teleflex Incorporated was founded in Ontario in 1940, as a manufacturer of aircraft mechanical control cable products. Since then, the company has diversified in its product offerings and has moved its headquarters to Pennsylvannia. The corporation has an excellent performance record and in the 1980's was regularly rated as one of the 200 best managed small companies in America, by Forbes magazine. (Teleflex has since outgrown the "small company" classification.)



Teleflex (Canada) Ltd. relocated to British Columbia in 1974, in response to the needs of the Marine Group of Teleflex Incorporated for the acquisition of a Vancouver hydraulic steering manufacturer. Since then, Teleflex Canada has quadruped its staff and increased their division sales by twenty fold. Teleflex Canada has a world product mandate; no products duplicate those of the parent corporation.

Currently, Teleflex Canada exports 90 percent of its sales to 28 countries, with U.S. exports accounting for over 70 percent of total output. Statistical Process Controls (SPC) and Design for Manufacturability (DFM) techniques were introduced into the company five years ago and have now become a routine. Real commitment to customer focus and ongoing improvement is deeply embedded in Teleflex Canada's corporate culture.

Continued expansion and product development will enable Teleflex to secure and increase market share. The company has benefitted from the association with its parent, which encourages adoption of numerous advanced quality and manufacturing systems, and provides some market access advantages. Teleflex Canada's most valuable resource, however, lies in its creative process of design. Currently, in-house designs account for over 80 percent of the company's sales; the balance being generated from production of customized or licensed designs. Through differentiation in product design, Teleflex achieves much of its competitiveness in the marketplace.

THE RESPONSE

Teleflex's reputation for high quality marine and industrial products have enabled them to gain considerable customer loyalty. In effect, it has alleviated some of the competitive pressures generated by low cost imports. An effective combination of a competitive pricing strategy, an orientation

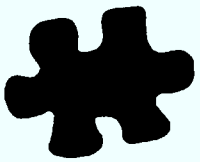
toward product differentiation and an emphasis on quality establish the criteria for product success at Teleflex.

Product differentiation – how can it be achieved? As compared to consumer products, industrial products tend to receive less attention when it comes to using industrial design. Why does a component need to be attractive? "Why bother, no one will see it" tends to be the rationale. Teleflex no longer shares this view.

International success led to the application of industrial design. In the 1970's, Teleflex designed and introduced one of the most technically advanced marine hydraulic steering helms in the world. Although cost effectiveness and functionality did lead to commercial success, the product was criticized for looking like "an inverted flower pot". Another ugly but functional product was described by an European customer as reminding him of "a Russian car", as he appealed to the company to improve its designs. These comments suggested something: there is more to product differentiation than just function. In response, Teleflex strove to improve the appearance of its products and, in 1983, first engaged an industrial designer.

THE ROLE OF INDUSTRIAL DESIGN AT TELEFLEX

Industrial design at Teleflex was initially used solely to improve the visual appearance of certain new products. The industrial designers would provide renderings and models of the engineers' designs and make suggestions to enhance their attractiveness. When an industrial designer was contracted to work on a project, the designer would not enter until the final stage of product design.



Over the years, industrial design has achieved increased acceptance into new product development, its role has become more clearly defined. In fact industrial design, as an element of the product development process, has been explicitly incorporated into Teleflex's 5-Stage Product Development Chart. The role of the industrial designer at Teleflex is advancing towards becoming a full fledged member of the product design team.

For Teleflex, the ideal industrial designer has knowledge of manufacturing process capabilities, as well as aesthetics and product performance. Without this knowledge, the industrial designer is not believed to be able to design cost effectively.

Compliments, as opposed to criticisms of Teleflex's product designs, are often heard from today's customers. In products where industrial design was emphasized, market share has increased by 10 percent. While these results are partially attributable to functional improvements of product performance through technology and engineering, it is also clear that ergonomic and aesthetic improvements through industrial design have been effective. Although the extent of industrial design's contribution cannot be directly measured, Harold Copping, President of Teleflex Canada, is sure that industrial design has been one of the most important distinguishing elements. He believes that given functionality, industrial buyers will pay a premium of 5 - 15 percent for "superior" industrial designs.

A "cleaner" design facilitates greater ease of use and maintenance. It provides enhanced market appeal. To the manufacturer, a more effective overall design provides more economical production and a product that is easier to sell.

THE PRODUCT

Marine hydraulic steering systems comprise Teleflex's largest product line. The company presently commands a 55 percent share of the U.S. pleasure boat hydraulic steering market. Teleflex's high performance hydraulic systems have consistently maintained market leadership. In particular,

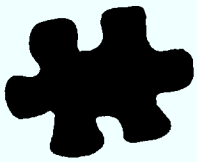
the Seastar helm pumps have been especially well received by the market. Improvements in the visual appeal of the products along with ongoing improvements in technology have enabled Teleflex to stand out in the crowd.

Since 1974, Teleflex's helms have undergone three generations of improvement, in terms of performance and appearance, with industrial design as a contributing component. The newest "Seastar" helm pump is a fourth generation product design. The function of the helm pump is to provide the hydraulic pressure output to sustain responsive steering. As compared to the cable steering systems, the low friction design of the hydraulic system provides a smoother and more positive steering response.

The new Seastar "compact" helm provides a new dimension of quality compared to the second generation "Syten" helm which was criticized for looking like an inverted flower pot. The "cleaner' styling of the new product, resulting from the contributions made by industrial design, presents the system to be less complex, more durable and easier to understand. The helm's appearance, however, does not reflect the complexity of the system's hydraulic design. Improved engineering has enhanced the steering component's performance and has enabled the mechanical design to be more compact. The refined design of the helm contributes to greater mounting flexibility, to longer product life, and to enhanced visual attractiveness.

Teleflex's high performance steering system represents the ultimate in efficiency, safety and reliability. Superior design, teamed with the finest of materials, precision manufacturing and rigid quality control all add up to an outstanding product.

INDUSTRIAL DESIGN & THE PRODUCT DEVELOPMENT PROCESS



The organization of Teleflex's product development departments and the talent of its product design groups are determinants of the company's success. Teleflex follows a well-formated 5-Stage product development cycle, within the Advanced Quality Planning manual. The commitment to industrial design is explicitly outlined.

To date, the industrial designer has been introduced into the design stage after preliminary engineering designs were completed. According to the updated manual, an industrial designer will in future be introduced "unofficially" after the initial "dream" stage. The purpose of bringing an industrial designer into the "idea development" second stage is to promote a team-oriented atmosphere so that future co-operation between the product design team and the industrial designer would be more effective. Actual industrial design work may not arise until several months down the road.

The third stage of the product development cycle is the "design" stage. Industrial design is officially incorporated into product development at this time. At Teleflex, industrial design contributes to product aesthetics, ease of use, and to techniques in rendering and modelling that facilitates design decisions. Mr. Copping admits that Teleflex's strong engineering departments have other aspects of product development well controlled – such as in the development of concepts, choice of materials, methods of production, and standards of product performance. However, he credits the industrial designers with having contributed to both the aesthetics and function of Teleflex's products.

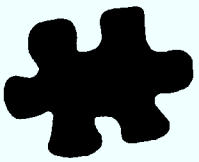
A good example of functional improvement was the successful Seastar "tilt wheel" steering helm introduced in 1988. In this product, the ergonomics were improved, as well as the attractiveness, by an industrial designer. For the latest generation Seastar helm, introduced in 1990, an industrial designer improved the housing for the helm so that it would have a "cleaner", more stylish look that "merged" the helm pump with the hub of the steering wheel.

INCORPORATING INDUSTRIAL DESIGN – THE OBSTACLES

Why do we need an industrial designer? How will we select one? These two questions raised the barrier against the effective implementation of industrial design at Teleflex. Design engineers sometimes tend to resist the employment of industrial designers. They may tend to regard industrial design services as being a "waste of money", or an inference that their own aesthetic talents are inadequate. Funds expended for an industrial designer may be thought to be applied to a larger engineering budget. Industrial designers can even be resented as an outsider sharing credit for suggestions which are intangible and often not uniquely theirs.

One of the main problems is that there are rarely any guarantees that the industrial designer can do an adequate job on a particular project. While many industrial designers may be very strong in their aesthetic rendering abilities, they may lack specialized knowledge of manufacturing processes. Without adequate experience in manufacturing processes such as injection molding, die casting, forging, and sandcasting, it is extremely difficult for the industrial designer to produce cost effective designs. Experience has led Teleflex to believe that offering too much freedom to the industrial designer can result in unacceptable tooling or component costs. Good teamwork is essential.

One of the advantages of industrial design is that it is a means of communication. Like advertising, effective product design can establish the image of a company. Teleflex has found that engaging different external industrial designers each time can lead to an inconsistent "corporate image". Several generations of a product, given variations in features and appearance, should still reflect a certain distinctive "look". The distinctive image of Braun appliances is an example. Awareness of this will encourage greater sensitivity to have future industrial designers maintain a certain consistency in the "Teleflex" styling.



Finding an appropriate industrial designer and effectively integrating industrial design are crucial in determining the effectiveness of the design project. Teleflex has provided the following suggestions to help those considering incorporating industrial design into their product development process:

1. The industrial designer should be introduced early into the engineering and manufacturing departments so that an atmosphere of team work can be established from the very beginning, even if the industrial designer may not be heavily involved until a few months later.

2. Consider obtaining proposals from various designers, in order to gain an initial insight to the relative cost of industrial design as well as the capabilities of designers. Obtain a profile of each designer, and his or her qualifications.

3. Use a "design brief" to clearly define the time frame available and the responsibilities of the industrial designer. This reduces the risk of being late or exceeding the budget.

4. Establish ownership rights of designs at the very beginning so that no future misunderstandings will occur.

5. Involve the marketing department. The marketing department can identify market demands and preferences that the industrial designer should investigate. This will enable the industrial designer to better reflect those demands in the product design. Marketing people tend to be more appreciative of the value of industrial design, hence they will help to promote the acceptance of industrial designers by the design team.

CMA – BC & TELEFLEX – A CO-OPERATIVE SUCCESS

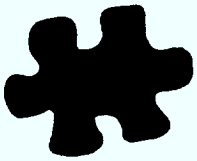
(The following was adapted from the "Effectiveness of Industrial Design Summer Student" report prepared by Andrew McFadyen, Chief Engineer Teleflex Canada Ltd.)

In association with CMA-BC's Industrial Design Program, launched in the Spring of 1991, Teleflex decided to hire an industrial design student from the Emily Carr College of Art and Design to work with its engineers in product development. Hiring a summer industrial design student was a major departure from Teleflex's regular program of hiring summer engineering students. The objective of the program for Teleflex was to enhance the interface between engineers and industrial designers.

The goal of the Canadian Manufacturers Association – BC Division is to help bridge the gap between industrial design, education, and industry. Successful implementation of the program would provide a better understanding of the role of industrial design within the traditional organizational structure of a company to both the student and industry members. Subsequently, the communication channel between academia and industry can be improved and the gap be reduced.

The industrial design student, Terry Striker, participated in projects involving illustrations of instructional drawings to preparing renderings of designs to creating mock-ups or prototypes to generating sketches of company momentos for Teleflex. The benefits cited by Terry in being able to work at Teleflex revealed that the experience provided him with an excellent perspective on the application of industrial design and a better understanding of the role of the industrial designer within an organization.

Other benefits include being able to learn CAD systems and software and being able to gain exposure to various practical constraints in design, such as cost and manufacturability. Essentially, Terry gained a better focus of what the role and the function of the industrial designer entails and what it will take to become a truly valuable industrial designer.



One of the biggest benefits of having an industrial design person on staff, for Teleflex product designers, is the ability to generate a variety of renderings and/or mock-ups quickly and cost-effectively. During the Product Design Cycle, deciding on "looks" usually involved a great deal of ambiguity, subjectiveness, and soul-searching between the engineering and the marketing people. Thus, the issue is sometimes delayed until just before the tooling orders are to be placed. At this stage, changes in product design tend to be too costly to make. Terry helped alleviate these problems by producing "point-and-comment" renderings and mock-ups which were used to explore various options that would not have been otherwise considered due to time constraints. The alternatives recommended and the avenues explored may one day expose competitive advantages for Teleflex.

Terry's training and orientation towards the appearance of things offered objective input which helped bring about a consensus on differing design directions. Terry was able to answer, to some extent, "Why" one look was superior to another. In effect, Terry's skills enabled him to synthesize ideas and assist in various levels of decision making involved in the product development process. Having Terry on staff for four months helped to crystallize the product development group's understanding of the abilities and the limitations of the industrial design field. Teleflex has been highly cost-driven in the past, however, the company has now acknowledged a need to re-focus on "best looking" in addition to "best performing" and "price competitive" product attributes. Input from industrial design provides the means for effective product differentiation.

The project offered the industrial design student a chance to gain hands on experience in the work force and to use this experience to complement his theoretical studies. The engineers at Teleflex were given an opportunity to work simultaneously with an industrial designer in product develop-

ment. This experience helped improve the engineers' appreciation of the value of industrial design. Consequently, the enterprise provided a mutually beneficial opportunity for the student and the product design engineers to gain a better understanding of the interrelatedness of each of their roles and functions within the overall product development process. The success of the program exceeded the expectations of Teleflex. Future plans to continue hiring summer industrial design students are expected.

III. CASE STUDY: V-Tech Engineering Canada Limited

CORPORATE INFORMATION

Name:	Video Technology Group Limited
Headquarters:	Hong Kong
Locations:	Multi-national, 29 divisions and subsidiaries worldwide
Total Sales Revenue:	Approx. US $440 million (1991 Fiscal Year)
Products:	Electronically advanced toys and learning aids, computer hardware and software, satellite television receivers, cellular phones, car audio and entertainment accessories, video accessories, cordless phones

PRODUCT DIVISION

Name:	V-Tech Engineering Canada Limited
Location:	#160 – 6651 Elmbridge Way, Richmond, British Columbia
Number of Employees:	36 Engineers, 8 supports staff
Sales for Division:	Not applicable, research and development facility with a budget of about CDN $2.6 million
Product(s):	Research and Product Development for Electronics, Computers, and Telecommunication products
Target Market:	Consumer – Oriented, some original equipment manufacturing

THE CHALLENGE

V-Tech is one of those companies which has been setting the pace and standard of product development and innovation in the global marketplace. While others are striving to achieve global standards in their products, V-Tech is helping establish them.

CASE STUDIES

Price competition with manufacturers in Taiwan and Korea was a major issue of concern for The Video Technology Corporation a few years back. The company has now alleviated this problem by establishing a manufacturing plant in China which has enabled lowered manufacturing and assembly costs. In the past, V-Tech operated frequently as an original equipment manufacturer for large, well-known brand name distributors. The challenge for V-Tech is to continue to develop increasingly sophisticated products to compete in a market where technological development is advancing more rapidly than ever. The real test for V-Tech will be to establish popularity and demand for its own brand name. The market's first extended range digital cordless telephone – Tropez 900DX – is yet another step toward establishing market leadership for V-Tech electronics.

BACKGROUND

The Video Technology Group was founded in Hong Kong in 1977. Since then, the company has grown over sixty-two fold. Based on the corporation's annual report, it employs approximately eight thousand employees worldwide and has generated over US$440 million in revenue in 1990. The growth of Video Technology in the 1991 financial year was estimated at fifty percent. This rate of growth is double that of the electronics and technology industry's rate, which averaged about twenty-five percent.

A large degree of the company's success has been achieved due to the creative application of technology. Video Technology entered into the "video game craze" at its initial market development stage. This enabled the company to establish a strong presence in the electronics market and to secure financial stability. Subsequently, the Video Technology Group has diversified its product development into computer, telecommunication and electronic markets. The Group's decentralized organizational structure has enabled each of the three divisions to operate autonomously, thus providing an infrastructure that is flexible enough to facilitate quick responses to market changes and consumer demands.

V-Tech Engineering in Richmond is the research and development facility for the corporation's product development division in North America. The development of V-Tech Engineering in the past three years has been a major strategic change in the corporation's operational structure. Up to this point, all of V-Tech's research and development was performed in Hong Kong. As 1997 approaches, and the fear of Communist China's recolonization of Hong Kong becomes more prevalent, a phenomenon termed "brain drain" has resulted in a major loss of highly trained and qualified professionals to countries such as Canada, United States, Australia and Britain. Consequently, it was necessary for the Video Technology Group to relocate its research facilities to an area where an adequate source of electronics and technical experts could be secured. By establishing its research facilities in Richmond, the Group has not only gained a stable supply of qualified engineers, but has also achieved closer links to its North American market.

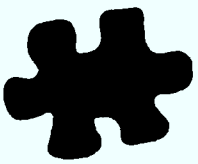
Up until the summer of 1990, V-Tech Engineering was only responsible for designing the electronic circuits of the various products developed. V-Tech Engineering had always hoped to enhance its contribution to the product development process but it was not until the fall of 1990 in which an opportunity arose. The corporation's staff shortage in Hong Kong enabled the Richmond division to demonstrate its true potential. The result was the Tropez 900DX, the first digital cordless telephone in the market. The Tropez 900DX is a new generation product both for the industry and for V-Tech. What a way to begin!!

THE RESPONSE

V-Tech has realized that a competitive price strategy is essential to operate in the consumer marketplace. But it has also acknowledged that there is a limit as to how low prices can be before profits are eliminated. Therefore, V-Tech feels that it is necessary to combine an effective pricing strategy with a distinct product differentiation objective. While, engineering design provides the means of offering differentiation in product features and performance, industrial design provides the means of offering aesthetic appeal and overall product quality. The ability of industrial design to integrate the visually attractive and the ergonomically functional elements of product design forms the basis for product success.

This strategy is an extension of the Video Technology Group's long term commitment, "to design and manufacture electronic products in a cost effective manner and to deliver them in a timely fashion to customers around the world", because it answers "HOW" that strategic vision will be achieved. Continued profitability and growth of the corporation will be attributable to its ability to successfully maintain a decentralized organizational structure which can efficiently and effectively meet market demands and economic changes while still being able to work collectively toward a common corporate goal.

THE ROLE OF INDUSTRIAL DESIGN AT V-TECH



For V-Tech, industrial design has always been an accepted part of the product design and development. Bruce V. Bernard, Assistant Engineering Manager at V-Tech Engineering, defined industrial design as, "a practice and a thought process, that helps a product achieve harmony in cosmetics, usefulness and engineering". Many companies hesitate to integrate industrial design into their product development because of the relative high start-up costs and the difficulty of measuring its contributions to the success of a product. While these may be strong deterrents against using industrial design, Mr. Bernard suggests that these concerns should not be accepted at face value.

Initially, industrial design may appear to be expensive and a dollar value may not be attributable to its contribution, but industrial design does make a difference in terms of customer satisfaction and product preference. There has never been a method of measuring the value of industrial design at V-Tech. Nonetheless, V-Tech has devotedly employed it into its product development. The measure of industrial design's success is observed through the complements received from V-Tech's customers and the success of V-Tech.

The Video Technology Group employs many industrial designers who work in its various divisional product development offices. The job of the industrial designer ranges from product conceptualization to functional design and styling. External and freelance industrial designers are also employed on a contractual basis. V-Tech Engineering in Richmond has yet to employ an industrial designer on staff. However, in its design of the Tropez 900DX, Roman Izdebski, industrial designer and instructor of the Industrial Design Program at Emily Carr College of Art and Design, was contracted to assist in the cosmetic styling of the phone.

THE PRODUCT

The original conceptualization of the Tropez 900DX was actually an offshoot of another product design. The product was called the Vidiview, a wireless audio/video transmission device designed to

transmit audio/video signals from a video cassette recorder, cable box, satellite receiver or camcorder without the use of a complicated cabling system to other receivers in the home. The product was developed to operate at the 900 MHz frequency band. Due to the Federal Communication Commission's (FCC) restrictions on the level of power utilization, the transmission capabilities of Vidiview was limited to a range of only about one hundred feet. Consequently, this product was deemed unfeasible for the market. At the same time, another team was designing an analog cordless telephone to operate in the 46/49 MHz range. The inspiration for an extended range digital cordless telephone was conceptualized.

Tropez 900 Digital DX

Current cordless telephones operate based on analog modulation. The preferred choice of design is digital. However, the frequency band allocated by the FCC and the DOC for cordless telephone specifically stated that analog modulated transmission must be used. Analog transmission is the cause of the major drawbacks of cordless telephones. Analog transmission is susceptible to a high degree of interference as the handset's distance from the telephone base increases. Furthermore, conversations can be easily monitored or overheard by those who tune into the frequency. These problems take away from the privacy of one's conversation and the mobile convenience of a cordless telephone.

The Tropez 900DX was designed with the goal of resolving the two predominant drawbacks of cordless telephones:

1) limitations in the range of transmission, and
2) security.

The Tropez 900DX transmits at a frequency of 900MHz. The available use of the 900MHz frequency band was announced only a few years ago. Its transmission frequency is very close to the one used by cellular phones. No restrictions were made as to whether it should use digital or analog modulation. No one in the industry has yet taken advantage of this new frequency. V-Tech had found its niche.

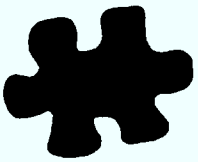
Here are some of the outstanding features offered by the Tropez 900DX cordless telephone: The Digital Transmission Format has an extremely high immunity to noise and interference signals. It has a communication radius of up to 400 meters. Due to its digital transmission, clarity of sound is ensured so that the same level of quality between 2 meters and 400 meters is maintained. With

analog transmission noise simply increases until the transmission can no longer be heard. Noticeable interference from the cordless analog phones can be experienced at a distance of 10 meters. Distance greater than the 400 meter limit will cause the out-of-range indicator on the handset to beep, even when the handset is in standby mode. This ensures that no incoming calls will be missed or current calls be lost. An automatic frequency changer is also featured so that the call can be redirected to another channel when faced with interference.

To secure privacy of calls, voice transmissions are scrambled. A privacy mode is also available on both the handset and the telephone base to disable the unused unit from tapping into the conversion taking place. One other feature unavailable from any other cordless telephone is the choice of ring types. There are four types of ringers which can be selected from, plus all the general features of a sophisticated cordless telephone.

The market position of the Tropez 900DX is upper end. The suggested retail price once it enters the market in the Fall of 1991 is US$299.00. The sophistication in technology and features offered, as well as the functionality and styling contribute to Tropez's distinctive market positioning. The next two models of the Tropez 900DX are already in the process of development. Be assured that the technology is even more sophisticated and that there are even more features. Styling is expected to change slightly so that it further improves on the ergonomic functions of the current design.

INDUSTRIAL DESIGN & THE PRODUCT DEVELOPMENT PROCESS



The resources allocated by the Video Technology Group for research and product development is approximately 4 percent of total revenues. This translates to about US$18 million dollars per year that is reinvested into upgrading current products and developing new ones.

The Tropez 900DX took about one year to move from its initial conceptualization stage to its current production stage. Once the idea for the telephone was generated, the parameters and features of the product were established by V-Tech's electronic engineers and marketing people. V-Tech still pursues a serial product development process. Essentially, that means designs move from one stage to another, only after the previous stage has been completed. After the specifications of the telephone are outlined, the electronics design team carried on with the interior designs of the phone. At the same time, the industrial designer was contacted to produce initial visual renderings of the phone.

Roman Izdebski designed most of the cosmetics of the phone, in terms of structure and styling. The structure and visual styling of the phone was to be made as thin, as small and as narrow as possible. Given the nature of the product, the size of the telephone was dictated by the electronics which made up the product from within. The electronics design team consisted of four members: a person to design the software; another to handle the high frequency design; another to design the digital signal processing circuits; another to design the audio circuitry. The project was supervised by Bruce Bernard. The "leap frog" technology engineered by V-Tech's design team has enabled V-Tech's first line of phones to be the market's most sophisticated.

The mechanical aspects, involving the manufacturing and the materials used in production, were handled by the mechanical engineers at V-Tech's Hong Kong office. Industrial designers in Hong Kong further contributed to the final styling of the Tropez 900DX.

According to Paul C. Brown, National Sales Manager of V-Tech Electronics in Canada, the Tropez 900DX will be entering a Canadian cordless telephone market estimated to be $500 million and an American market roughly estimated to be about $5 billion. Being a new generation product, V-Tech optimistically hopes it will be able to capture 6 to 7 percent of the cordless telephone market, which translates to over $330 million in revenue. Much popularity for the new phone has been shown at various trade shows. The design and technological sophistication of Tropez 900DX has resulted in numerous offers from large electronic companies requesting V-Tech to manufacture the product for their distribution.

INCORPORATING INDUSTRIAL DESIGN – *WHAT* OBSTACLES?

How difficult was it to integrate industrial design into V-Tech Engineering? Obviously, it hasn't been very difficult at all. According to Mr. Bernard, the electronic design engineers were more than willing to accept any additional input into the the Tropez 900DX telephone design. However, Mr. Bernard does recognize how it may be difficult for other companies to initially incorporate industrial design into their product development processes. In order to take advantage of the industrial design's benefits, it is necessary to admit that certain design elements are beyond the expertise of the current design group. V-Tech's Tropez 900DX's design team was confident in their engineering ability to produce a telephone which would be unsurpassed in technological sophistication but to design a phone which would be ergonomically functional and aesthetically appealing to the consumer market was something else. The assistance of an industrial designer was perceived as a valuable asset.

According to Mr. Bernard, the most important criteria in selecting an appropriate industrial designer is whether the individual can work effectively with the team. Effective communication between design team members is critical for successful collaboration. Roman Izdebski integrated easily into V-Tech's product development environment and the design team at V-Tech welcomed his assistance. The only drawback, according to Mr. Bernard, is that there appears to be a lack of engineers and designers in Canada who are experts in mechanical engineering and production processes. Lack of knowledge of plastics technology and injection moldings type of production processes limits the ability with which V-Tech is able to carry out all stages of its product design process in British Columbia. Currently, V-Tech's Hong Kong office handles all the manufacturing and material selection aspects of product design and development.

Other than the receptive attitude of the design team, one other reason may have contributed to the ease in which industrial design was accepted. Unlike many companies which already have functional departments with clearly outlined responsibilities, V-Tech did not. A staff which is secure in its role and function may be unable to understand the role of the industrial designer and where he or she might "fit in". Therefore, the process of integrating industrial design would have to be an educational process, requiring strong upper management support. Given that any change is difficult to implement, it will be up to management to outline the benefits of change and to provide the leadership required to facilitate development of a "design-minded" attitude. A change in attitude is a process requiring long term nurturing.

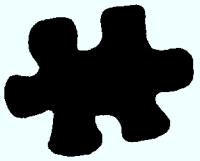
IV. CASE STUDY: BC Sugar Refinery Limited

CORPORATE INFORMATION

Name:	BC Sugar Refinery Limited
Headquarters:	Vancouver, British Columbia
Locations:	Alberta, Manitoba
Total Sales Revenue ('90):	Approx. $290 million
Products:	Sugar and Syrup

PRODUCT DIVISION

Name:	BC Sugar Refinery Limited
Location:	123 Rogers Street. Vancouver, British Columbia
Number of Employees:	Approx. 350
Sales for Division(1990):	Approx. 100,000 tons of sugar
Product(s):	Cane sugar processing for all different kinds of sugar
Target Market:	Canadian commercial and consumer markets



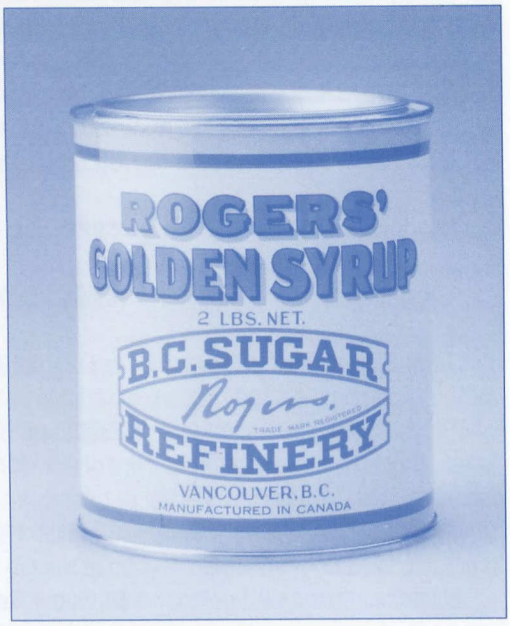
THE CHALLENGE

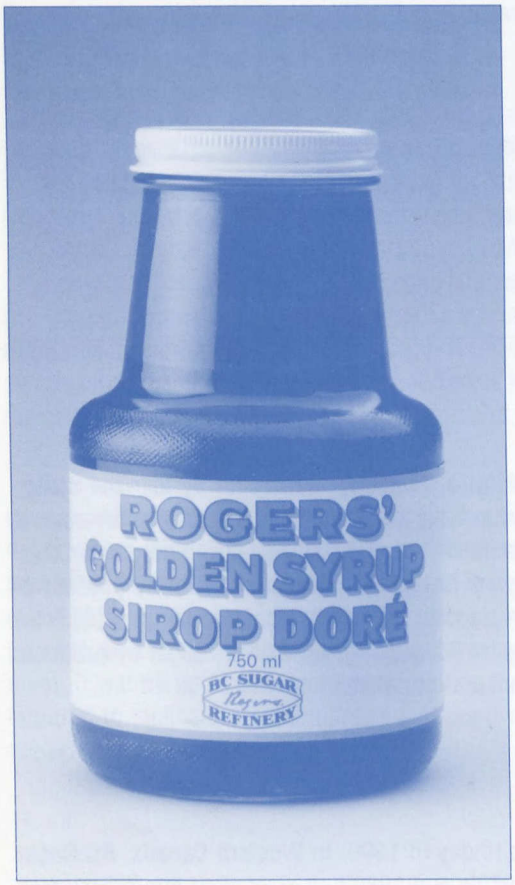
BC Sugar has been faced with declining demand in a shrinking market for syrup. The steady decline in sales of Roger's Golden and pancake syrup have been an issue of concern for several years. Somehow, BC Sugar had to stimulate the demand for syrup by revitalizing consumer consumption of the product. The ingredient for the syrup is derived from the natural by-product of refined sugar. Continued decline in demand for syrup would ultimately eliminate the product from the market. This would result in reduced profitability for BC Sugar given that the sugar by-products would no longer be worthwhile to process for the consumer market.

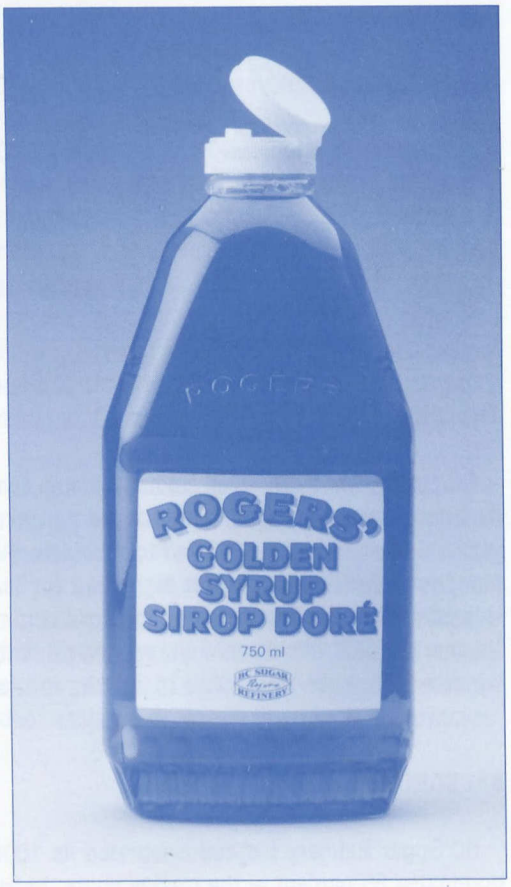
BACKGROUND

BC Sugar Refinery Limited celebrated its 100th birthday in 1990. In Western Canada, BC Sugar dominates 85 percent of the market share. In the 1970's and 1980's, it diversified into other areas such as packaging, oil and gas, and specialty chemicals. In the 1990's, BC Sugar refocused its attention to what they know and do best – sugar processing. BC Sugar produces a full range of sugar products from sugar cane and sugar beet. No sugar by-products are left unused.

The Evolution of Rogers' Syrup Packaging







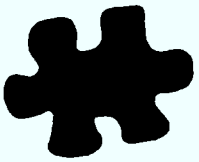
Roger's Syrup has been a household staple and market leader in Western Canada since 1913. In the early sixties, with the advent of convenience foods, the market demand for syrup started to decline. In response to consumer trends, Roger's introduced a Butter and Maple Flavoured Pancake Syrup into the market.

THE RESPONSE

How do you revitalize a shrinking market? How do you change consumer attitudes and consumption patterns? These questions were critical in developing a strategic plan of action to offset the negative change in attitude and demand for sugar and syrup consumption. Since the content of the product was not to be changed, another element of the product had to be in order to revitalize consumer interest.

Package re-design was the strategy employed by BC Sugar to stimulate product appeal and regain market share. According to Brian Rogers, General Sales Manager at BC Sugar, the only variable that was changed in the syrup's marketing mix was the packaging and line extension. In isolating this variable, BC Sugar was able to conclusively attribute the increase in sales of the syrup to the the re-design of the package. Had they not implemented the change, Brian Rogers, believes that the pancake syrup would be out of business and the golden syrup would have continued to decline.

THE PRODUCTS



Roger's Golden Syrup and pancake syrup did not undergo any formulation changes. It was in the packaging of the syrup which BC Sugar chose to establish product differentiation. Roger's Golden Syrup is now bottled in a clear, plastic container, which is significantly different from the glass bottle or the can previously used. For the first time, the clear, shiny, natural quality of the syrup is uninhibited by packaging materials and can be seen by the consumer.

While enhancing the visual appeal of the product was a point considered, a more important focus dealt directly with complaints arising from the consumers. People found the sticky mess of syrup to be so much of a problem that they tended to avoid using it. Although the initial change to a glass bottle alleviated some of the problems, it was insufficient to make a noticeable difference in terms of revitalizing sales. About a year and a half ago, the idea of the clear plastic bottle came about. "The whole syrup market has turned around", says Brian Rogers, after observing an increase in sales over the last year of 10.3 percent.

THE ROLE OF INDUSTRIAL DESIGN AT BC SUGAR

Industrial design is not a well-defined term at BC Sugar. Industrial design, as understood by Brian Rogers, is used mostly for styling and aesthetic purposes. Industrial design's main purpose would be to apply the "design concept to fit industrial use." While he may be able to site examples in which industrial design may have contributed to the packaging of certain bulk food products, industrial design is not identified to be something "spectacular", nor particularly important. This is not a negative attitude, just an uneducated one pertaining specifically to industrial design. *This attitude reflects the lack of understanding of industrial design – the concept, not the application.* Inadvertently, industrial design was used at BC Sugar. It was used as a part of an overall marketing strategy aimed to enhance product marketability and sales. The goal was "to give the consumers what they want".

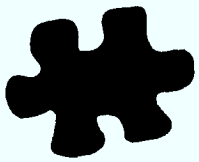
CASE STUDIES

Industrial design incorporates a variety of functions entailed in product design. Though not applied with ideal consciousness or devotion by most manufacturers, many industrial design elements have been pervasive in standard marketing strategies. Product design, as a marketing tool to enhance product image, corporate image and overall product sales, has served as the basis of market success.

Industrial design at BC Sugar may not have resulted from the input of a professional industrial designer, but the basic premise followed by industrial designers – improving product quality in terms of appearance and ease of use -was central to establishing the parameters of the Roger's Golden Syrup package re-design process. The specifications for the clear plastic bottle were identified and submitted to Richards Packaging, in Richmond, for technical development and design. BC Sugar wanted a package that would not only "suit the product" but also reflect, to some degree, the history of Roger's in Western Canada.

INDUSTRIAL DESIGN & THE PACKAGE RE-DESIGN PROCESS

Re-design of Roger's Golden Syrup and pancake syrup was the strategy undertaken to stimulate demand for the two products. A design brief, though not formally developed, was prepared by Brian Rogers outlining the various criteria which the new package was required to fulfil. One of the first criteria was that the new packaging process must be compatible with existing packaging equipment. Second, the bottle must be clear to reflect the colour of the product. Third, the bottle designer and packaging company must be local to facilitate ease of communication. Fourth, the package should reflect a sense of Roger's history in the Western Canadian market. Most importantly, the bottle must facilitate convenience or ease of use and product safety. The final design was a clear, squeezable plastic bottle with a "flip top lid" and a tamper proof seal.



The idea of a clear plastic bottle was conceptualized from observing new forms of product packaging entering the market. Taking environmental issues into concern, the preferred plastic material used for the bottle would be one that could be recycled. While many condiment producers and distributors packaged their sauces, syrups and liquids in plastic containers, the containers tended to be opaque. It was necessary for the Golden Syrup to be able to show its natural quality and shine, hence a clear plastic bottle was considered to be most appropriate. Of course, it was of primary importance that the bottle could be easily poured or squeezed from without causing a sticky mess. To reflect the history of Roger's, the traditional design of the Golden Syrup label was only slightly updated. The tamper proof seal prevented spillage and ensured that the syrup remained safe from the environment.

After the conceptualization of the new clear plastic bottle, tests were performed to ensure compatibility of the bottle with the syrup content in terms of odor, safety and recyclability. Many problems arose during the design process of the plastic container for the Roger's Golden Syrup bottle. One of them was that the recessed area on the bottle for the label was not deep enough so that the labels would rub together and become scuffed during shipping.

Another was that the warm syrup caused the bottle to expand when filled and contract when cooled. Larger bottles were re-designed to account for the retraction and expansion of the plastic to contain the 750ml content requirement. Other problems which occurred, resulting from weak molds, led to bottle leakages and breakages.

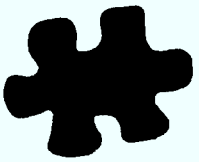
In order to facilitate more convenient pouring of the Golden Syrup, a wider mouth was designed. This also prevented the caps of the Golden syrup and the pancake syrup from being confused during packaging in the plant.

In BC Sugar's syrup packaging renovation, the company transformed its product package at minimized costs by limiting purchase of new equipment. Other than a microwave facility that was purchased to seal bottles, the new packaging process was entirely compatible with BC Sugar's existing packaging technologies and equipment. While the re-design of the bottle may not have reduced packaging costs, it has effectively enhanced overall package appeal and helped achieve increased bottomline profitability.

The design of Roger's Golden Syrup bottle has earned an award of excellence from the Vinyl Institute Packaging Council – Division of the Society of the Plastics Industry of Florida. This award recognizes how well the bottle has been able to enhance product quality, contribute to ease of use and transport, as well as focus attention to concerns of environmental safety.

INCORPORATING INDUSTRIAL DESIGN – THE OBSTACLES

The main obstacle of incorporating industrial design into the organization is that industrial design is simply not a clearly recognized element of the marketing strategy at BC Sugar, even though it may be inadvertently used. As demonstrated by the case, industrial design has been employed to improve overall product quality. Although the product itself has remained unchanged for over seventy-five years, the new package has enhanced its quality by enabling the natural appeal of the product to be visible and by providing greater ease of use. Product performance and market appeal are basic evaluative measures of quality, as defined by the consumer.



Despite the fact that the design process has only been termed packaging design, it is a function of industrial design. Had BC Sugar contracted a professional industrial designer to assist in the design of the bottle, one who has knowledge or familiarity with new production processes and modern materials, many of the trial and error design problems which emerged may have been avoided.

The main point is that industrial design was used in the redesign of Roger's Golden Syrup bottle. Whether or not it was employed with a full understanding of industrial design is an issue of concern but the bottomline is that it achieved what it aimed to achieve – increased profitability and market share. It is important to note that the strategy which contributed to BC Sugar's success was "design-based". With greater design awareness, perhaps industrial design could be more effectively and consciously employed to further enhance products and profits.

V. Comparative Case Analysis

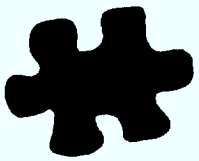
In the cases discussed, industrial design was applied within different environments for different purposes. In each case, industrial design was used strategically against the challenges faced by the company. Industrial design is a marketing initiative. It answers 'HOW' challenges can be faced and goals be achieved. In today's markets, how successfully a company and its product(s) perform is a function of the customers' "total quality" perception of not only the product, but the company.

In many cases, a pricing strategy can be implemented to offset the competitive pressures of low cost imports and/or new market entrants. This strategy can help extend a company's position in the marketplace for a short period of time, but it is a short term solution to a long term problem. By striving to lower expenses, material costs, and other inputs to minimize production costs and maintain margins, the product itself suffers. Eventually both product quality and profitability will both disappear.

An alternative is to implement a product differentiation strategy. Through industrial design, a product can be designed to better meet the needs of the consumer. At the same time, it is important to remember that "quality" can only be designed into a product. A well-designed product can reduce costs of production as well as offer greater added-value to the customer. A consumer-oriented approach to design for manufacturability(DFM) of products can provide the edge to achieve competitive market success.

Weiser, Teleflex, V-Tech and BC Sugar were able to integrate industrial design into its organization because there was upper management support. Larry Hughes, Vice-President of Planning and Product Development for Weiser; Harold Copping, President and General Manager of Teleflex; Bruce V. Bernard, Assistant Engineering Manager of V-Tech Engineering; and Brian Rogers, General Sales of BC Sugar were key promoters of industrial design within their companies. Without their design leadership, industrial design would not have been introduced or undertaken within these companies.

"The basic structure of a product tends to be the same, the distinctiveness of a product comes from its details."(Larry R. Hughes, Weiser) "Customers, I believe, are willing to pay 10 to 15 percent more for a superior product."(Harold Copping, Teleflex) "The whole syrup market has turned around" and "the only variable changed was the packaging."(Brian A. Rogers, BC Sugar) Industrial design "is a practice and a thought process, that helps a product achieve harmony in cosmetics, usefulness and engineering."(Bruce V. Bernard, V-Tech) These quotes accredit industrial design's ability to contribute to product differentiation, profitability, competitiveness and "total product quality."



At Weiser, industrial design was introduced into a traditional organizational environment where its role was not clearly understood nor defined. As a result, "corporate culture" was the main obstacle preventing effective integration of industrial design. In V-Tech's case, industrial design was introduced into a "design-oriented" organizational structure where it was readily accepted and appreciated. Industrial design's only obstacle at V-Tech exists as a result of a geographically dispersed product development team. With many of the company's mechanical engineers and in-house designers based in Hong Kong, design decisions and team efforts were more difficult to co-ordinate.

At BC Sugar, packaging design was not recognized as industrial design but as simply an extended marketing strategy. While industrial design may not have been employed with a clear understanding of its value, its contributions have been well acknowledged. The obstacles faced by BC Sugar, in its design of the syrup bottle, were primarily in its material sourcing. Had an industrial designer, who has knowledge of plastics and related production processes been contracted, many of the problems which came about during the design phase may have been prevented. Unlike BC Sugar, where the design function is less apparent, Teleflex has identified and incorporated industrial design as a specific function in its product development.

By design, Weiser's *Victoria* and *Marielle* grip sets have positioned themselves to successfully attract the upper scale consumer "decorative hardware" market. By design, Teleflex's new Seastar Helm is more compact, more attractive, simpler to install, easier to maintain and costs less to produce. By design, V-Tech's extended range digital cordless telephone will out perform all other cordless telephones in the market. By design, BC Sugar revived the demand for syrup and regained its position in a once "dying" market.

Understanding the industrial design function and the "total quality" concept, recognizing individual limitations and then providing an environment conducive to continual improvement will bring about the productive efficiency and continual innovation necessary for competitive survival in the international marketplace.

Why Is Industrial Design Neglected?

A discussion of the following concerns may be able to provide a better understanding as to why the utilization of Industrial Design has been so limited in Canada.

I. Industrial Designers: Product vs Consumer-Orientation.

The product is industrial design. While designers are well aware of the importance in designing products which meet consumer demands, they have neglected to adopt this orientation in designing their own services. Designers are asked to design products that are specifically catered to the users' demands and expectations. Yet industrial design, as a product, is very often not marketed in a way which caters to the sensibilities of its target customers.

Industrial design's target customers are not the consumers of the products they design but the business people who manufacture those products. Just as designers claim business people may be too narrowly focused to see the value of industrial design, business people may claim that designers are too narrowly focused to see who their customers really are. For industrial design to succeed, designers must focus their efforts in meeting the needs of businesses. Those who succeed are those who meet the demands and expectations of their target market.

In Canada, there are very few business managers who truly understand the value of effective industrial design. Those who do understand have exploited design's potentials and are managing companies that are prepared to move into the 90's competitively.

The industrial design industry in Canada is in its infancy. Although industrial design can be a valuable resource to businesses, this message is not well communicated to its target audience. Even the best ideas if not executed properly are meaningless. Appropriate promotion and marketing to the "right" target market is critical to generating awareness, understanding, and interest. Ineffective promotion leads to inadequate exploitation of the market's potentials. In believing that the product will sell itself, designers have been implementing an outdated "production-oriented" marketing strategy. Adopting a "consumer-oriented" approach will enable them to better "design" their product to serve the specified needs of their customers. How can industrial designers expect to increase demand for their services if the majority of their target market is unaware of what industrial design is, much less understand its potential?

II. Design Illiteracy vs Design Literacy.

A majority of North American managers and executives can be classified as being *Design Illiterate.* They are D*esign Illiterate* because, very bluntly stated, they are ignorant of what effective design can offer to long term strategic planning and product differentiation. The blinders worn by many management professionals tend to focus on short-term cost and risk minimization objectives. In effect, long-term strategic planning for future competitiveness and profitability is neglected.

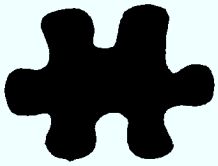
Being Design *Literate* is being "design-minded". It is a view which encourages strategic thinking. Managers must realize that design is a powerful means to generating new ideas, adding value to products and achieving product differentiation. It is becoming more and more difficult to distinguish a product in today's arena of products where functional quality and price differentials are often too minimal to be worthy of consideration. The design component will become the most visible element of product distinction in the marketplace.

III. Short Term Cost Constraints vs Long Term Strategic Planning

The competitiveness of Canadian products within today's global markets depend on the comparative distinctiveness in which they are able to project among the vast array of goods available to the consumer. The most common justification for not using industrial design is the high initial cost requirement. Many managers tend to believe that the initial cost of industrial design outweighs its eventual benefits. As a result, they refrain from incorporating it into product development. They hold the belief that it is sufficient to be mediocre. The priority is to concentrate on surviving now. Once the company develops a stronger financial base, it can then look into re-designing a better product.

This belief is shortsighted because it does not account for the fact that excellent production cannot usually compensate for poor design. A well-designed product with fewer components, easier assembly, and greater market appeal benefits both the manufacturer and the consumer. Effectively applied, design can provide valuable long term benefits. It is a vehicle for maintaining ongoing communication between the consumer and the company. It helps establish corporate distinction, define product personality, and promote product success.

IV. Tradition Bound vs Entrepreneurial Mindset



Why change if there is progress? This may be a comfortable position but there are no long-term goals associated with this general attitude. Satisfaction hinders improvement. While the rest of the world is aggressively pursuing a competitive international business strategy, this Tradition Bound attitude will only lead to one end – the rear.

Companies have to face the fact that markets are becoming increasingly competitive on a global basis. Those companies who lack an entrepreneurial vision and fail to secure its position in the new global market will eventually be eliminated. Only the strong survive. Therefore, the question should be: How can we improve our competitiveness, profitability and market superiority?

David Vice, Chairman of the Canadian Manufacturers' Association noted in an article published last year in the Globe and Mail:

> I've often heard this comment made by smaller manufacturers: "Look, I'm not a Northern Telecom. I'm never going to be an exporter into the Pacific Rim or to Europe, not even to the United States. I sell my products within a few miles of where I live, and I'm doing fine."
>
> I try to explain to this Canadian manufacturer that he has to think globally, even if his company doesn't move out of his own town.
>
> Why? Because there's probably somebody in Singapore, in Korea, in West Germany or the United States who has designs on his so-called "local" market, which they plan to invade.
>
> And he will get clobbered if he doesn't recognize that the whole world out there is looking at his market, even if it is only within a few miles of where he lives.

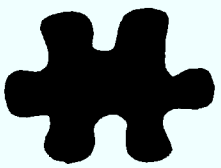
V. Corporate Politics vs Multi-disciplinary Co-operation

The culture of a company plays a significant role in the decision making process of the firm. A centralized, hierarchical organization tends to prevent co-operation between functional departments. It promotes an "Us and Them" type of bureaucratic culture. Each department feels it must compete against others in order to gain what it wants. Consequently, this infrastructure fragments people within the company into relatively autonomous groups. It limits effective communication between experts of various functional departments from taking place and discourages the understanding of each other's significant contribution to the overall success of the company.

In effect, this ignorance contributes to a relatively "close-minded" attitude toward accepting new ideas and change. Lack of vision within groups makes introducing new concepts extremely difficult as opposition is bound to arise. The cost of inflexibility in attitude towards learning is the loss of the cross-discipline synergies which could have otherwise been generated from effective teamwork.

VI. Theoretical Knowledge vs Applied Knowledge

One of the most common issues concerning the difficulty of integrating industrial design into a company's product development process is that the students who graduate from design programs tend to lack the proper blend of theoretical knowledge and technical know-how that is necessary to operate effectively in the workplace. The balance of theoretical knowledge and technical know-how will require increased association with industry. Industry must be willing to offer students opportunities to gain the experience and qualifications they look for when recruiting employees.

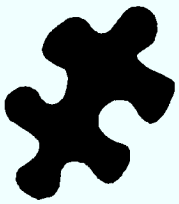


Engineering and business students are often not taught to appreciate the value of industrial design and design management. As product designers and business managers, they tend not to have an understanding of what industrial design entails. Depending on the organizational structure and the attitude of the company, the concept of industrial design may or may not be accepted if introduced. Currently, many industrial designers lack an adequate understanding of industry expectations. At the same time, many business managers lack a strong understanding of the industrial design function. The communication gap between industrial designers, engineers and business managers can only be reduced through education. A better understanding of each other's function within an organization will encourage more effective communication and greater respect for each other's role. Education can provide the means to closing this gap by familiarizing engineering, industrial design and business students with each other's language and culture.

The Role of Students

Industrial design has not been a well-defined term. A discrepancy between how business people and industrial designers view industrial design has been acknowledged as a "communication gap" or a language problem which is preventing effective application of industrial design from taking place. This gap results from the different educational processes business and industrial design students undergo. The Canadian Manufacturers' Association – BC Division conducted a survey of Emily Carr industrial design students to gain an insight into how well they understand the role and function of Industrial Design.

Of the 25 students in the industrial design program, 15 of them responded to the questionnaire – 8 of them are in their second year of the program and 7 of them are in their third year. Among the 15 students, only 5 have worked in a summer, part-time or full-time position where they have applied or gained skills as an industrial designer.



SUMMARY OF STUDY

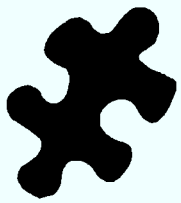
A majority of the students appear to share a common understanding of industrial design. However there were a few students who seem to remain unclear of the role and function of industrial design. A certain perception is prevalent among students, which is not unlike the bias held by many professional industrial designers. The rationale for the inadequate use of industrial design has been attributed to the low awareness and poor understanding of industrial design by manufacturers and business people. As much as this may be true, the bias occurs when they fail to consider the fact that there has been little promotion and information provided on the industrial design function up to this time. Therefore, the business sector should not be entirely to blame.

The students' perceptions may be the result of having an inadequate understanding of industrial design's partners – manufacturers and business people. The responsibility of the industrial design educator is to better identify and relate the business function with the industrial design function. This will discourage the students' current views and encourage improved working relationships to develop between industrial designers and business people in the future.

The role industrial designers play in the product development process is valuable. The industrial designer performs as problem solver in co-ordinating product design elements to meet market demands. However, it is important to recognize that the elements to be designed into a product are defined by marketing research, which is conducted by the marketing department as a business function. A successful product does well in the market not necessarily because it is designed "perfectly" but because it fits well into the consumption pattern, needs, and resources of the customer. These elements are determined by who the target market is, and how well the Marketing Mix and the *Design Mix* functions are co-ordinated.

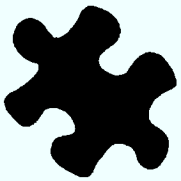
For industrial design to be introduced into the mainstream of business management, it will take time and education. To encourage greater understanding and use of industrial design by businesses, one student suggested that there may be a need to establish standards by which businesses can select and evaluate industrial designers' credentials. A benchmark for measuring industrial designers' skills and capabilities will reduce the risk of investing in an area most businesses currently lack an adequate understanding of. This proposal is constructive in that it clearly suggests how industrial design can be promoted and be incorporated into the business sector.

The scope of this survey is inadequate for making generalizations on the industrial design industry or its students. However, the findings do offer an insight into what more comprehensive studies have found to be significant inhibitions against the effective integration of industrial design into industries. Just as the business sector needs to better understand the value of industrial design, students and even professional industrial designers need to better understand that their skills are their product and businesses are their target market.



The Role of Educators

How the educator controls and disseminates information influences how that information is transformed into knowledge. This knowledge shapes the perceptions, attitudes and beliefs of the student and affects his or her approaches to decision-making. Therefore, the onus is on educators to provide the type of education students need in order to function productively in their respective disciplines. This challenge is becoming increasingly more difficult to meet as a result of the speed in which information is being transferred and applied. Electronics technology research and development is one area that is particularly susceptible to time limitations. As soon as a "new generation" concept is released, it is improved upon. Within months, this "new" development becomes passe.



In 1978, the cost to manufacture a standard photocopier was fifteen hundred dollars. In 1990, this cost fell to two hundred dollars. While US manufacturers have a lead time, on average, of 62 months to design a new vehicle, the Japanese manufacturers require only 43 months. These changes reflect the competitiveness of today's commercial markets.

Effective product design requires skills in marketing, engineering analysis, process technology, manufacturing, management, organizational behavior and industrial design. The principle message business, design and engineering educators must convey to their students is that successful product development requires doing everything right; from cost accounting to detailed mechanical design. Effective teamwork is critical to enhanced productivity, improved product quality, speedier product-concept-to-market entry, and lowered product costs. Integrating industrial design into a "design-oriented" environment (Concurrent Engineering) will provide the essential framework for facilitating collaborative effectiveness between experts from various product development functions.

Students must understand the significant contribution each specialized discipline contributes to the overall success of the product. The lack of understanding of one another's role and function within the corporate environment prevents effective co-operation between functional groups from taking place. Students must be taught to appreciate the value of one another's skills and to recognize individual limitations.

INDUSTRIAL DESIGN EDUCATIONAL PROCESS

One of the most common reoccurring complaints against industrial design by business managers is the difficulty they face in communicating with industrial designers, simply because "they don't speak the same language." It's a matter of perspectives and priorities. While the business people are talking about profit maximization and bottom line, industrial designers are preoccupied with making the product's form and function co-exist harmoniously. Business people will be the primary group of individuals the industrial design students will be working with when they enter the workplace. They are the industrial designer's clientele and yet they are largely alienated.

Educators must cultivate attitudes which are more conducive to inter-disciplinary co-operation. If industrial design educators fail to communicate the importance of industrial design's business orientation, then they are guilty of establishing the "Us" and "Them" adversarial relationship which now exists between the business sector and industrial designers. Similarly, if business management educators neglect to teach their students the value of industrial design as a strategic tool for competitiveness, they will also be contributing to this adversarial relationship. More importantly, the students will be inadequately equipped to face industry demands. This lack of understanding of one another's importance is what prevents effective incorporation of industrial design from taking place and competitive success from being achieved.

In the early 1980's, the United Kingdom began facing strong competitive pressures which reduced its exports and national productivity. Canada also faced similar competitive challenges from the many "newly" industrialized countries emerging into the international markets. The difference between Canada and the United Kingdom was that Canada had its resource-based exports to rely on to maintain economic stability so that the effects were less apparent. However, Canada must face that resource-based industries will not be able to continue sustaining the economy at its current level in the long run . Natural resources will eventually be depleted.

The United Kingdom chose Design as the weapon to counter the competitive threats it faced. Intense concentrated efforts by the UK government, the industrial designers and industrial design educators were required to generate awareness and understanding of industrial design's value. Based on the ***Industrial Design Requirements of Industry*** study, conducted by the Design Council in the United Kingdom, many of the problems which deterred effective integration of Industrial Design were traced to an insufficient educational process. The following elements which were found to be deficient in the United Kingdom's Industrial Design education may also apply to the Canadian situation.

WILLINGNESS TO COMPROMISE

- industrial designers need to view product aesthetics as but *only one means* to the achievement of corporate objectives;
- need to understand that what may be an ideal design solution for one company may not necessarily be so for another; and
- in reality, even an "ideal" solution may be modified for practical or 'political' reasons

ABILITY TO COLLABORATE EFFECTIVELY WITHIN A DESIGN TEAM

- industrial designers need to better understand the total design-production-sales process and his or her role in it;
- need greater emphasis of the importance of design teams; and
- need to inculcate attitudes essential to effective team work, such as realistic expectations, flexibility and sensitivity

SKILL AT ASSESSING THE FINANCIAL IMPLICATIONS OF DESIGN SOLUTIONS

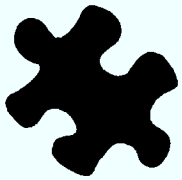
- industrial designers need to better understand the various ways in which design affects final product costs; and
- the importance of cost-effective versus aesthetic design

SENSITIVITY TO MARKET NEEDS

- education needs to provide the skills necessary to assess consumer needs objectively;
- to emphasize the importance of designing to objective rather than subjective criteria;

- to impress on designers that gradual improvements in products to which consumers are accustomed is preferable to radical new designs; and
- to prepare young designers for the fact that a "beautiful" product does not necessarily sell

In summary, respondents of the study indicated that the "business management" aspect of the industrial design education was particularly poor. Educators need to provide young industrial designers with:



- a better appreciation of the fact that business provides the environment in which most design is produced;
- a 'truer' perspective on business structure and methods;
- more understanding of 'what make a company tick', especially risk, investment and profits; and
- an improved grasp of the overall profit implication of industrial design

The value of industrial design is in its ability to effectively synthesize a range of ideas and to convert them into visible and attractive products. In effect, the education and training of industrial designers produces, to some extent, generalists. As a part of the educational process, industrial design students should work in teams to develop their communication skills. As a part of a product development team, each student should take the opportunity to play the role of the engineering and marketing manager, as well as design consultant. This will foster greater appreciation for the skills and knowledge of other product development team members.

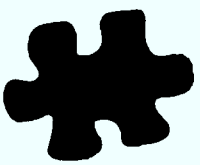
Industrial Design & the Industrial Designer

According to Kenji Ekuan, founder of GK, Japan's first and largest design consultancy, designers are "priests of the material world."[13] "Industrial design aims to reconcile consumer needs with manufacturing possibilities. It is concerned with the development of products from initial concept to manufacture and sale, exploring the wide variety of alternative paths for product development while trying to harmonize the requirements of marketing, production, engineering, finance and the contribution of others in the product development team."[14] In Japan, designers are expected to bear the social responsibility of what manufacturers make because they are the ones who decide what is necessary and what is important to people. To do this effectively, the designer must have training which provides him or her with the background and skills required to make these decisions. Awareness of commercial realities, technical knowledge, ability to adapt to the corporate environment and design skills are all fundamental requirements the designer must have.

An industrial designer concentrates on the relationship between products and the people who use them. He or she specializes in producing items that are attractive, desirable and saleable – products that look and feel good and are satisfying to own and use.[15] The degree to which an industrial designer is able to satisfy this responsibility depends on the individual's own abilities and skills. While making products that are attractive, desirable, feel good and satisfying is important, designers very often neglect one very basic premise. That is, their primary target market is the business people or managers. "Industrial designers must realize that managers constitute the largest market for their skills. They also make up the most powerful body of 'designers' in the world: for it is they who decide the design problems to be tackled, the concepts that go forward, the resources committed to their development, and how solutions are presented to the market."[16]

The industrial design industry, in Canada, is relatively small but it offers a lot of potential. The first step in promoting greater use of this industry is to communicate the value of industrial design to its users – the business people. Industrial designers must be more sensitive to the fact that business managers are bottomline profit and cost minimization oriented. As much as industrial designers may claim they can synthesize concerns from marketing, finance, engineering, customers and others into overall design, very often no direct value can be attributable to it. In addition to the lack of a standard by which the value of design can be measured, one of the most predominant criticisms coming from industry is that industrial designers are not concerned enough about the bottom-line.

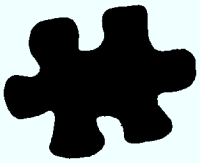
Industrial designers concentrate on designing products which satisfy the needs of the final users. Yet, they have neglected to apply this basic idea in designing their own product – industrial design service, so that it would better satisfy their customers – the business people. Industrial design is in its introduction stage in Canada, where awareness and understanding of its functions and benefits are poor. Creating awareness and understanding is an educative process. Changing attitudes is not an easy challenge but it can be made easier if the subject is introduced into a context which the target audience already understands. Then, it merely becomes a matter of adapting new ideas into an established construct. Like all products in its introductory stage, promotion costs to generate initial awareness are high. These costs may exceed the industry's available resources. Perhaps government assistance or "co-operative marketing" efforts can be arranged. Nonetheless, it is the industrial designers who best understand the benefits of their product. However, the ones who determine its value are the consumers – the business people.



ROLE OF THE INDUSTRIAL DESIGNER

I. INDUSTRIAL DESIGNERS' TASKS AND FUNCTIONS

The following findings resulted from a study commissioned by the Department of Education and Science in association with the Design Council of the United Kingdom, on the *Industrial Design Requirements of Industry.*



A. DESIGN COMPETENCIES

Skills in Selecting Materials
- Select materials to achieve the best balance of aesthetics, performance and cost
- Specific areas of weakness include,
  - a knowledge of materials that have very specific performance requirements, such as heat resistance;
  - an awareness of new materials and applications, especially polymers;
  - a preparedness to select the most cost-effective material, even if it may be 'less attractive'

Ability to sense potential safety hazards
- Ability to spot design features that might prove hazardous or unsafe

Creative or original thinking
- Most vital attribute of the industrial designer

Skill in selecting joining and assembly methods
- Choosing the correct methods of joining and assembling the various parts of a product

B. ADAPTING TO A CORPORATE ENVIRONMENT

Adopting a disciplined, professional approach, especially with respect to deadlines
- The need for a product be launched in the most cost-effective manner makes it imperative that the industrial designer completes certain aspects of his work by stated deadlines
- Study finds that many industrial designer lacks this vital component of professional discipline

Non-visual communication skills, especially oral communication
- Visual communication skills are not sufficient by themselves for designing within a corporate environment
- The industrial designer must be able to 'communicate', in the broadest sense of the word, with other members of the company whose background skills and preoccupations may differ
- Study finds the communication skills of industrial designers to be fairly poor

Willingness to Compromise
- Willingness of industrial designers to compromise their design standards to fit in with the wider needs of the company
- Recommendations to industrial designers:
  - view product aesthetics as only one means to the achievement of corporate objectives;
  - understand that what may be an ideal design solution for one company may not necessarily be so for another; and
  - accept that even an 'ideal' solution may have to be modified for practical or 'political' reasons

Ability to collaborate effectively within a design team

- An increasingly common way to achieving integration is through a multi-disciplinary design team
- Respondents of the study blamed education for being inadequate in:
  - helping the designer understand the total product design-production-sales process and the role of the industrial designer within it;
  - emphasizing the importance of design teams and the importance of work teams; and
  - inculcating attitudes essential to effective team work, such as realistic expectations, flexibility and sensitivity

C. TECHNICAL SKILLS OR KNOWLEDGE

Awareness of volume production constraints

- Ability to translate a design into a mass-producible product
- It is important to be as knowledgeable of volume production methods – and as skilled at determining production feasibility – as he or she is in basic design competence

Skill in recognizing maintainability and reliability constraints

- Recognize the importance of these two elements in influencing consumer choice

Knowledge of anthropometrics/ergonomics

- What was once a matter of human sensitivity and instinct has become a highly complex technical discipline.
- Attention to these principles are an essential part of an industrial designer's responsibility

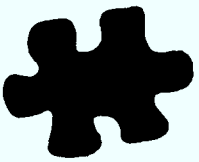
Sensitivity to engineering requirements

- Successful integration of engineering and industrial design requires that the engineer and the industrial designer understand and be sensitive to the concerns of the other
- Importance of design-related technical knowledge:
  - the development of highly specialized knowledge in areas traditionally seen as part of general design competence, such as colour and shape;
  - the explosion of knowledge in all fields of engineering, but especially in electronics engineering;
  - rapid advances in materials and manufacturing technologies; and
  - the greatly enhanced abilities of new-generation computer to store and process technical data

D. AWARENESS OF COMMERCIAL REALITIES

Skill at assessing the financial implications of design solutions

- Consider direct product costs, such as materials and components, which are strongly influenced by design
- Industrial designers must consider various ways in which design affects final product costs and the trade-off cost effectiveness and ideal design



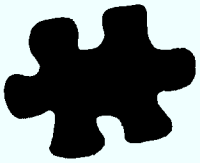
Sensitivity to market needs

- Vital for the industrial designer to understand the needs, preferences and expectations of the market for the product in question
- Study finds that industry designers tend to be often guided by their own sense of what consumers ought to want than what consumers actually want

ROLE OF THE INDUSTRIAL DESIGNER

Awareness of business management realities

- Specifically pertaining to young industrial designers, they should have:
  - a better appreciation of the fact that business provides the environment in which most design is produced;
  - a 'truer' perspective on business structure and methods;
  - more understanding of 'what makes a company tick', especially risk, investment and profits; and
  - an improved grasp of the overall profit implications of industrial design



Overall Awareness

- Industrial designers need to be more aware of commercial realities than what is present, such as:
  - designing products that would meet the objective requirements of increasingly specific market segments;
  - developing designs that satisfy these market segments in the most cost-effective way; and
  - understanding the way in which legislation, for example in consumer or environmental law, influence design alternatives

II. INCORPORATING INDUSTRIAL DESIGN INTO CURRENT OPERATIONS

This following section was prepared by Peter Busby, on behalf of the British Columbia Industry Designers' Association (BCID).

A.Where and How to find Industrial Designers?

There are approximately 50 practicing Industrial Designers in British Columbia. They are either under the direct employ of certain companies, or they are independent consultants. As independent consultants, they devote their time to preparing industrial designs for clients on a project basis.

Please see Appendix B: British Columbia Industrial Designers' Association (BCID) members and *Appendix C:* Alberta Industrial Designers.

If you are interested in employing a full time Industrial Designer to work in-house for you, there are several sources of new employees: Emily Carr College of Art & Design in British Columbia, University of Alberta in Edmonton, Carleton University in Ottawa, and the Royal College of Art in Toronto, are four of the best known post-secondary institutions producing graduates of Industrial Design. (Pl*ease see Appendix A:* Industrial Design Education in Western Canada for institutions and program information) An advertisement for a Product Designer and/or Industrial Designer in any one of the daily papers in these cities will produce responses of people looking for positions.

B. Industrial Designers: "In-House" or Consultancy?

Whether you wish to hire an in-house Industrial Designer, or hire a Consultancy, first consider how much you wish to spend on the process of product design.

In-house Industrial Designers can provide a continuous design service to a range of projects or problems for a larger firm. Standard salary ranges from $3,500.00 per month to $5,000.00 per month plus, for experienced designers. Employing a full-time Industrial Designer comes the obligations of being an employer, i.e., vacation, benefits, sustaining the work load, medical plan, etc.

The positive aspects, if you can afford to do so, of retaining a full-time Industrial Designer on staff, is that he/she will in time completely understand your product requirements and/or processes. He/she will also get to know your engineering, and manufacturing staff as well as understand your marketing niche, goals/aims or strategy.

The negative aspects of hiring a full-time person on staff is that he/she will not be able to bring outside ideas, marketing expertise or other experience to your project. You will not be able to "pay for service" and limit your expenditure on design, and after a period of time the designers will probably get "stale." Even the very largest firms vary as to whether Industrial Designers should be in-house or out-of-house. Sony works exclusively with outside consultants, but Yamaha works exclusively with an in-house team.

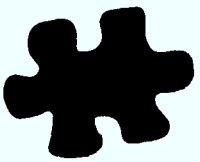
In the context of Western Canada, it is more likely that there are very few firms that can afford to maintain in-house expertise full-time, and that the kind of budgets available for industrial design are in the order of $5,000.00 to $20,000.00 per product, for one or two projects per year, requiring the use of Consultant services. For these reasons, the remainder of this section deals only with evaluating relative Consultancies.

C. Evaluating an Industrial Designer

Currently, British Columbia is the only western province with an industrial design association. The British Columbia Industrial Designers Association was first registered in 1985. It's Constitution and Bylaws have been accepted by the Provincial Government. BCID is a non-profit organization which represents and qualifies Industrial Designers working in British Columbia. Members of BCID are recognized by the Province as professionals who have attained a standard, to carry out the practice of Industrial Design in the Province of British Columbia. Membership in the Association is denoted by the use of the letters BCID after the designers' name. If there are some doubts about whether the Industrial Designer you are speaking to is a registered member, verification can be made by contacting the BCID. BCID members all are all required to have had four years of University training and have had experience and knowledge in all levels of industrial design, from materials sourcing, manufacturing techniques, to engineering, and design.

Industrial design firms in Western Canada have a range of capabilities. The majority of industrial designers are one man operations because there has been a sustained need for them in B.C.. However, there are now several firms , that employ two or more registered professional Industrial Designers, qualifying them to carry out the larger projects. In evaluating and selecting the choice of an Industrial Designer, you should look for:

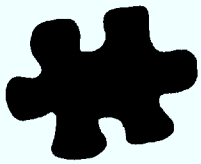
- similar relevant design experience;
- range of design experience;
- capability of the firm in terms of capacity to carry out your project;
- demonstrated design expertise (ask to see illustrations of previously completed projects);
- reference names and phone numbers of previous clients.



All Industrial Designers are prepared to spend an hour or more of their time convincing you that they are the best designer for your project, so help yourself to that free service. They will also develop a proposal for your project at no charge.

It is important to see products that you like in the portfolio of the Designer you are evaluating. It is not important, however, to see products that are the same, or look the same as the one you want designed. Design is a problem solving process; one can design large or small items successfully for

a wide range of products, using the same methodology, and the same design and graphic skills. However, it is also often true that if an Industrial Designer has designed something very similar to what you want, he or she may be restricted by an agreement with that client from designing a competing product.



Perhaps one of the most important criteria in selecting an Industrial Designer is to feel comfortable with the person. The most difficult part of designing a product is getting to know you, the client, and understand your needs. to do this effectively, very good communication has to be established between the client (and his development team) and the designer. Effective communication is only possible if you feel comfortable with the designers' design style, presentation and communication skills. Get to know your Industrial Designer.

D1. Confidentiality

Most clients are concerned about confidentiality of the project they commission. Standard Confidentiality Agreements exist, and most Industrial designers have a copy of a blank agreement. If they are not able to provide you with one, BCID has a document available. These agreements are quite standard, to protect you the owner from having you Designer communicate your drawings, ideas, and design to others. This will ensure that the information you disclose to the deisgner remains carefully controlled. You, the client, should not feel any inhibitions about pulling out a Confidentiality Agreement at the beginning of your first meeting, and having your Designer sign it there.

D2. Copyright Ownership

Ownership of design is an area of law that is well developed. Whilst you, the owner, might think that you own everything immediately, this is not necessarily the case. If one commissions a painting from an artist, you buy and own the painting, you do no own the right of the painter to produce another painting similar or slightly different. Similarly, the law of Copyright in Canada regards ownership of original designs and documents, and specifically states that unless agreed otherwise, ownership remains with the designer. This applies to all engineering, architecture, and industrial design, as well as many other areas of practice. That said, however, it is possible to reach an agreement with your Industrial Designer to own the Copyright for the design he produces for you. That agreement is often developed in the fee structure at the beginning of the design process. Most Industrial Designers are willing to sell Copyright to the client, in exchange for either a lump sum payment, or a royalty. Your contract and fee structure agreement should explicitly state that you, the client, receive design copyright in exchange for some specific consideration, if you wish to own it.

There are many industrial designs produced where the Client does not own the Copyright without any significant difficulty to either party.

D3. Patents

Copyright should never be confused with the ability to reproduce design for you, the paying client. You are, after having paid for a design service, at all times free to receive copies of the design, or any details of the design in drawing or written form from your designer, as often as you wish, provided you pay for reproduction. You have a permanent right of access to the design you paid for.

The Client of a project may wish to protect reproduction of a design from others in the manufacturing world. Protection in Canada falls into two main areas; Industrial Design Registration, and/or Letter of Patent. Industrial Design Registration is a fairly simple process that protects the product for

a period of two years. It is available in Canada only. It is an economical process to protect your ideas from others, while you are applying for patents, or "proving out" a project.

Patents are a unique area of law and design protection that can be local or worldwide in scope. They are expensive to implement, require specialized drawings, and the hiring of lawyers.

Canadian patents are accessible in Ottawa. If you are considering patenting an idea or product, search the patents files in Ottawa initially for similar designs. For a fee they will provide to you copies of all the patents that have been produced in a similar subject area. This will often yield surprising results. there are an extraordinary number of patents in Canada alone.

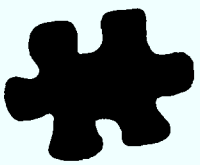
If you are satisfied that your patent application would be substantially different from other existing patents, then you can go about hiring a patent lawyer (contact the legal profession). The process of retaining a patent lawyer, and filing for patent will cost a minimum of $5,000.00 in Canada alone. This will offer protection only in the Canadian marketplace; US patent applications are even more costly and consume more time, and are more demanding in terms of technical support. Allow at least two years to obtain a patent. there is now a central patent authority in Europe, covering protection in all EEC countries. It is more difficult to get patents in Japan and other parts of Asia, where protection is most necessary. There are also countries, such as China, Hong Kong, Taiwan, and Thailand, where, although these countries are signatory to patent agreements, they are not enforcing these agreements amongst their manufacturers.

Consideration of whether to file for a patent or not, is one of timing, cost effectiveness, the uniqueness of the product, and your own marketing plan. Apple has done very well out of their patents, the man who invented the computer chip did not. It is a very competitive world, and it is easy to evade a patent by making minor changes to the design of a product that you have seen in another country. The most effective strategy for exploiting new products is usually to design a product, manufacture, and market as hard as you can, as quickly as you can, for as long as you can, to obtain a dominant market position, which will give you the protection that patents cannot often afford you. 3M's scotch tape is not protected by patents.

It will be necessary for the owner of the Copyright, the Designer, to give up his ownership of that right to you, the client, for either Industrial Registration or Patent Protection for the product. If you are thinking of either of these areas of Copyright protection, you must have an agreement with your Designer to obtain Copyright yourself.

E. CONTRACTS AND FEE STRUCTURES

You should sign a contract with your Industrial Designers covering the Scope of Work and the fees you will pay for the work.

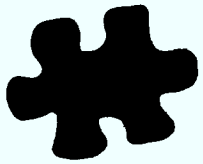


All members of BCID and other Industrial Designers have copies of standard contracts, which they will be happy to provide to you for the development of an agreement. Alternatively, BCID can be contacted, and they will provide a copy of this material to you directly. Typically, owners like to break fees into three or more phases. The phases are:

- Schematic Design
- Design Development and Prototype; and
- Contract Documents for Manufacture

ROLE OF THE INDUSTRIAL DESIGNER

Depending on the product you have, or the design refinements you have, the phases can be broken down into many further sub-phases or tasks. A comprehensive listing of these phases might be as follows:



- collection of samples;
- description of the state of the art;
- development of a marketing plan;
- development of a merchandising plan, including packaging and presentation;
- general consulting;
- preliminary sketch studies;
- presentation drawings and material;
- prototype and/or model;
- research of materials or processes;
- supervision of prototype and/or model construction;
- prototype review and analysis;
- design development drawings;
- comprehensive working drawings;
- tool and mold drawings;
- specifications;
- materials and/or parts;
- schedules;
- colour schedules;
- supervision of tests;
- supervision of installation;
- checking of production samples;
- calling for quotations;
- purchases;
- patentability study and assistance;
- physical packaging recommendations;
- corporate image consultation;
- product image consultation;
- product publicity consultation;
- CSA approval; and
- UL approval.

Fees can be structured on a time basis (either hourly or per diem), on a lump sum basis (fixed quotation for a defined amount of work), on a percentage basis, on a royalty basis, or on a "payroll plus management fee" basis. Typically, contracts include components of several of the above methods. Industrial Designers are registered professionals with a minimum of four years University, and therefore regularly charge professional fees in the order of at least $65.00/hour, and depending on experience, can be considerably more.

F. RESPONSIBILITIES AND LIABILITIES

The responsibilities of the client and Designer are spelled out in the fee agreement outlined above. The subject of liability is more involved. As a manufacturer, you are ultimately the first target of any liability suit from the public. The manufacturer has to ensure that his product, as put into the marketplace, is one that will not incur him liability.

That said, your professional designer may also carry liability. If there is clearly a design error in

something he has designed for you, and it can be clearly traced to a fault in the drawings or specifications, you would have a case to sue your Designer for negligence or liability. This will usually be to seek redress for funds paid out by you in a public suit already. Your ability to collect funds from your Designer is quite limited, due to the lack of assets or financial resources that designers typically have, compared to manufacturers. It is usually much easier for a public or private plaintiff to obtain a settlement from the manufacturer, or the manufacturer's insuring company, than it will be for you, the manufacturer, to obtain funds or financial compensation in turn from your Designer.

Professional liability insurance is rare in the product design work, simply because unlike engineers or lawyers, Industrial Designers are not often requested to provide it. Typically, manufacturers assume the liability themselves. Larger professional Industrial Design firms, however, are able to provide liability insurance. If you think your product is one that requires product design insurance, you should ensure that your designer is capable of providing it. Areas of liability suits are typically ones where consumer products can cause harm to people, such as the design of car seats or appliances. If you are concerned about your liability in any way, you should ensure that your Design Agreement includes the development of CSA or UL design approval as part of the project.

G. DESIGN BRIEF

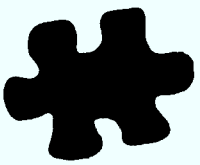
The design brief you give your Designer is a critical element in the relationship between the two of you. A design brief should be appended to your fee or contract agreement. It can also be developed by the Designer in consultation with you.

A Design brief should include a description of the purpose of the project, the product to be produced at the end of the design exercise, the schedule to be adhered to, and the technical requirements that the Designer must work to. It may (or may not) include a price range for the completed product. It can, and should, include any specific areas of concern that you wish investigated, or elements that you wish included in the design (i.e., if you have related products and you want the design to be similar, spell it out in the design brief). The client should initiate most of the requirements for the brief, but if you are unfamiliar with this process, it can be developed by the Designer, for your approval.

The design brief should conclude with a general statement on the philosophy of the company, stating the overall goals and the objectives of the project. This will be the measure, at a higher level, of the product you and your Designer are aiming to create.

CONCLUSION

This "How To" section has been prepared by Peter Busby of Designlines Canada Ltd., a product design firm in Vancouver. For more detailed assistance with legal issues, please consult your lawyer.



Role of Management

Design is a strategic resource that communicates ideas, differentiates strengths, simplifies work and enables people to operate more effectively. The competitive edge in the 80's was price and quality. In the 90's, design and innovation will provide the added value to products which will command the higher profits. Yet, this message has not been clearly communicated. While many companies may not reject "the need" to invest $500,000 for a 6-month advertising campaign, they reject "the need" to pay a fraction of that cost for corporation identity and product design. This is particularly curious given that a company's reputation and its product are considered to be the basic pillars of its existence.

Management with the ability to recognize changes in the environment and the flexibility to adapt to those changes provides the type of leadership that will ensure a company's future growth and prosperity. "Getting closer to the consumer while maintaining a real or perceived 'distance' from competitors is an essential ingredient for profitable survival. Corporate reputation, especially when it transcends national frontiers, is increasingly important in securing sales and retaining customers. Building such reputations demands leadership over competitors not just through superior financial resources, manufacturing capabilities and marketing flair, but increasingly through superior design performance."[17]

To achieve "world class" distinction, designers must: 1) consider manufacturing issues early in the design process; 2) collect opinions and views from team members representing various disciplines; 3) evaluate competition through benchmarking; and 4) pursue continuous improvement through product process and change.

Competitive success will be dependent on design leadership. It will be a key ingredient, especially when creating alternative concepts or refining configurations for products and services already on the market. "It is one of the most powerful means of generating new ideas, making tangible the market expectations revealed through research, demonstrating added value, and differentiating in a cost-effective way".[18] A poor understanding of industrial design results in a lack of urgency among business people to take advantage of its benefits. Germany and Japan are international leaders in design application and management. The effectiveness of their designs is what distinguishes their products from their competitors worldwide. In order to increase awareness of design's importance, it is vital that top management commits to initiating and encouraging that change. Achieving a cultural change in attitude will require continuous commitment and patience.

Management must first recognize the different roles a "traditional" manager plays as compared to a "design-oriented" manager. *(See: Exhibit 2 – Differences in Managerial Roles)* It is understandable that a "traditional" manager would show reluctance in making the transition to becoming a "design" manager. The approach and skills necessary in the different management roles are contradictory. Therefore, it is critical that upper management show strong commitment to the necessity for change.

Leadership is the primary role of management. Problem solving, adapting to external and internal changes, and corporate development are some of the responsibilities involved. The key elements of design leadership in business will provide the infrastructure in which design will be able to flourish. The successful collaboration of product development team members will provide the synergy required for effective and efficient product development. *(See: Exhibit 3 – Key Elements of Design Leadership in Business)*

Exhibit 2: Differences in Managerial Roles

DIFFERENCES IN MANAGERIAL ROLES	
The Traditional Manager	**The Design Manager**
Experience-based know-how. Education as one time activity.	Managerial knowledge based on recurrent up-dating.
Technical and analytical skills emphasized.	Skills needed to deal with ambiguity, complexity, conflict.
Standard operating procedures guide decision-making process.	Decisions augmented by environmental and other inputs.
Inward perception emphasizes internal, issues, competition.	Inward/outward perception includes societal problems.
Importance attached to stable relationships.	Temporary relationships tolerated.
Assumes rational organizational behaviour.	Rationality seen as being subjective.
Task-oriented.	Goal-oriented.
Action oriented to keep physically busy.	Combines periods of reflection with action.
Individualistic approach to specialized problem solving.	Interdisciplinary team approach to complex problem-solving.

Source: Oakly, Mark. *Managing Product Design.* Weidenfeld and Nicolson. London, UK, 1984. Page 56.

Exhibit 3: Key Elements of Design Leadership in Business

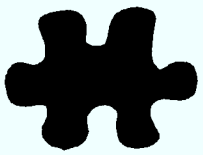
Key Elements of Design Leadership in Business

Open eyes to a broader vision of what is possible through design

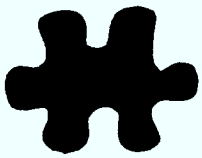
- Convey vision of what is possible through a professional approach to design
- Describe the principle categories of design normally encountered in business, and how they can be co-ordinated to generate maximum impact
- Clarify links between design and other functions, as well as the implications of decisions across disciplines.
- Highlight relevant trends in design, and illustrate achievements from a variety of sources
- Set this promise within a context, the vision should convey the reality of the design discipline within areas of particular interest

Offer a 'map' or scope of design management discipline

- Point at goals that need to be set and hint at tasks ahead
- Indicate what information is needed and why
- Indicate how the data might be evaluated



ROLE OF MANAGEMENT



Create a focus and direction for design initiatives
- Offer a detailed 'mirror' of what goes on in design terms within organization, i.e. Formal audits of corporate design and design management practices identifying what is done well, what could be improved, what is not being done at all?

Provide support to help shoulder design responsibilities
- Offer role models in design leadership
- Provide support groups as executives develop commitment to design
- Create opportunities to share burdens, vent frustrations, express fears or personal shortcomings, test out new ideas, rehearse key messages to be communicated

Introduce a fresh and 'refreshing' approach to design problem solving
- Provide objective independent advice on design issues, interpretation needs, balancing different viewpoints, and arbitrating when there are conflicts of interest
- 'Freshness' approach encompasses opening up novel areas for investigation
- Promote an integrated 'holistic' approach to business problem-solving

Harness available talent to better effect
- Involve wider spectrum of people in discussions
- Organize multi-disciplinary project teams to generate better results

Increase the effectiveness and efficiency of investments in design
- Pin-point areas where design development is necessary and explain ways which best deals with them
- Draw up long term program of investment in design, with clear direction and priorities

Balance attention devoted to the 'hardware' and 'software' of managing design
- Ensure the balance between 'hardware' of design (manuals, procedures and so on) and the 'software' of relating to people

Balance long-term and short-term considerations
- Natural tendency to require new disciplines to prove themselves quickly, therefore it is the responsibility of the design leader to offer enough immediate support to maintain credibility

Balance 'visible' and 'invisible' leadership
- Imbue colleagues with the appropriate philosophy and standards, then delegate as much of the work as possible consistent with the degree of responsibility
- Not all leadership must be high profile

Integrate design fully with other disciplines
- To be integrated fully into the fabric of an organization, design needs to enter its bloodstream, implying that designers should work with staff from other disciplines on a wide range of projects – not just those concerned with design

Build continuity into design management practices
- Introduce a measure of consistency and continuity in management approach
- Seek to ensure that standards and levels of investment in design are maintained over time

Expend corporate language to encompass design
- Clarify common terms and provide guidance on correct usage
- Help to develop ways of expressing the organization's design philosophy

Make quality design 'visible' through training
- Staff are unlikely to be convinced that design discipline is important if it is not featured in development programs
- Make philosophy of design 'visible' by instituting training for staff and managers alike

Adapted from: Topalian, Alan. "Design Leadership in Business: The Role of Non-Executive Directors and Corporate Design Consultants". *Journal of General Management.* Winter, 1990. Page 48.

Concurrent Engineering

The difficulties and uncertainties of new product development have increased with each new decade. In the 1980's, firms learned that their products had to be different from those of the competition – made with a high degree of quality and priced competitively. We are now learning in the 1990's that this will not be sufficient. Success also requires speed and flexibility in product development. Firms will prevail in the 1990's only if they have speedy development cycles, low cost, high quality, and flexibility to meet market requirements. Many firms are now turning to Concurrent Engineering to help achieve these goals.

I. WHY IS CONCURRENT ENGINEERING NEEDED?

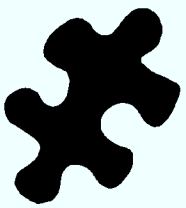
In past years, improved production methods and technology have enabled firms to achieve dramatic gains in manufacturing performance. Today manufacturing success cannot be assured on the production floor alone. It must start up front with the product design process. Companies relying on traditional ways of designing new products and bringing them to market are finding it increasingly difficult to compete. In the electronics sector, the first two manufacturers that bring a new-generation product to market lock up as much as 80% of the business. High-tech products introduced to the market on budget, but 6 months late, earn 33% less profit over 5 years than if they had been on time. In contrast, coming out on time but 50% over budget, cuts profits by only 4%.17 Leading edge companies are redesigning their product development processes and are using concurrent engineering to achieve lower product development costs, shorter cycle times, higher total product quality, and enhanced customer satisfaction. The flexibility in production capabilities enables quicker response to the changing market. This translates to greater profits.

II. WHAT IS CONCURRENT ENGINEERING?

To many companies that practice concurrent engineering, it is simply the smart way to do business. They believe in "working smarter, not harder." Simultaneous engineering, parallel or integrated product development, and team design are common terms used to refer to the Concurrent Engineering process.

The term Concurrent Engineering was coined in 1986 in a repot (R-338) issued to the U.S. Pentagon by the Institute for Defense Analysis (IDA) of Arlington, Virginia.18 This Definition is now generally accepted.

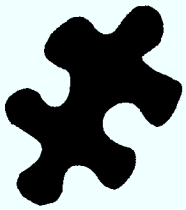
> "Concurrent Engineering is a systematic approach to the integrated concurrent design of products and their related processes, including manufacture and support. This approach is intended to cause the developers, from the outset, to consider all elements of the product life cycle from concept through disposal, including quality, cost, schedule, and user requirements."



In many ways, what firms implementing concurrence on large complex projects are attempting to do is to recreate the same situation that exists in many small organizations. Here, people involved in a project work in close proximity to one another, interact, share data and ideas, and collaborate from beginning to end.

III. ELEMENTS OF CONCURRENT ENGINEERING

" It is important to remember that concurrent engineering is not a product, it is a process. It is a personnel, discipline, procedure, methodology, and management issue. It depends more on the culture of communications and participation within a manufacturing organization than it does on the organization's degree of automation."19



A. Organization

The traditional approach to product development and manufacturing has its roots in the "assembly line" method, introduced in the early 1900's by Henry Ford. Assembly line production promoted specialization as the means of achieving productive efficiency. Over the years, most corporations organized resources along functional lines and operated with an authoritarian management style.

In large firms, the bureaucratic structure has been characterized by excessive layers of management and complex networks of functional departments. If product conceptualization and product engineering were the responsibility of separate departments, each would operate independent from the other as well as from other function areas such as, manufacturing and assembly, marketing, finance, and others.

The drawback of this organizational structure is that individual departments begin to lose sight of the whole picture. The hierarchical structure promotes a "Us and Them" mentality which discourages collaboration between departments and encourages competition. Problems which occur in product development tend to be "passed over the fence" to the department downstream in the process. Blame for mistakes or failures is cast upon the "other group(s)." Such unconstructive behavior among departments does not resolve problems but rather prolongs cycle time and increases costs. This attitude is unhealthy in an environment where everyone is supposed to be striving to achieve a common goal, the corporate goal. This is not to say that all organizations are at this extreme, however, many companies do possess, to some extent, these attitudes which limit team-oriented productivity. The synergy, which otherwise could be generated from effective teamwork, is lost.

Focus must be directed away from the traditional top-down approach to management towards one which is more participative and team oriented. The culture and organization of a company must be established in a manner which fosters concurrent engineering in order for it to be successful in achieving its potential.

At Advanter, Raychem Corp's advanced computer integrated manufacturing facility in Richmond, BC, "Everyone is charged with the responsibility of problem solving and is given the freedom to implement solutions," says David Chen, Plant Manager. On the shop floor, work methods are designed to foster teamwork. There are no forms of personnel stratification. Everyone is a Team Technician and shares the same prerogatives. Technicians are cross trained and learn every function. They rotate on a regular basis from job to job. The entire factory is organized in a fashion which facilitates Raychem's team of dedicated and talented administrators and technicians to respond quickly to market demands and customer needs with a total quality product objective. The compensation system is designed to encourage personal achievement. Performance is defined in a context of how well an individual contributes to the team.

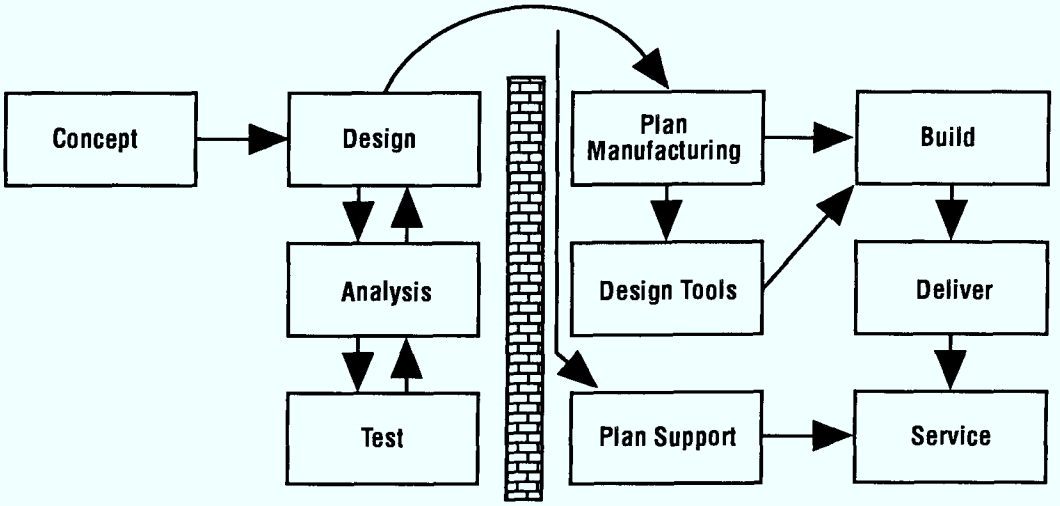
A1. Teams

For concurrent engineering to flourish, there must be an effective multi-functional team approach to product development where teams are empowered with the authority and responsibility to make

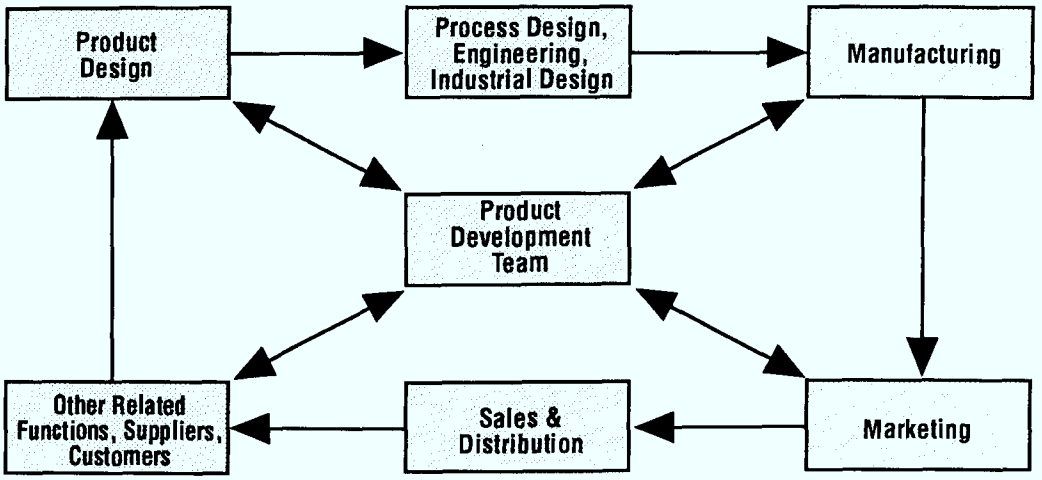
decisions. Exhibit 4 compares the organization of the traditional serial approach to product development to the cross functional approach.

Exhibit 4

TRADITIONAL APPROACH TO PRODUCT DEVELOPMENT



CROSS FUNCTIONAL APPROACH TO PRODUCT DEVELOPMENT



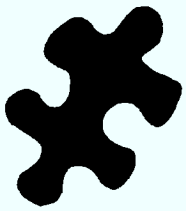
Source: Musselwhite, W. Christopher. "Time-Based Innovation: The New Competiive Advantage." *Training & Development Journal.* January, 1990. Page 56.

Depending on the scope of tasks involved, teams will represent all the disciplines involved in the total development process. This will include participants from downstream functions such as manufacturing, third party suppliers, quality control and customer support. It is important that they become appropriately involved very early in the process before concepts and product specifications become finalized. Any changes made thereafter become far more costly to implement as shown in Exhibit 5 – Cost of Making Changes.

Exhibit 5: Cost of Making Changes

When Changes Are Made	Estimated Cost
During Design	$1,000
During Design Testing	$10,000
During Process Planning	$100,000
During Test Production	$1,000,000
During Final Production	$10,000,000

Source: Port, Otis. "Smarter Way to Manufacture." *Business Week.* April 30, 1991. Page 111.



A formal or informal approach to concurrent engineering can be undertaken depending on the complexity of the product and its development process. A simple product might be designed using a small team that meets infrequently. A more complex product such as a commercial airliner would require many teams to ensure various development processes can proceed concurrently. In this situation, separate management teams are needed to coordinate resources, to manage the issues that flow from the various teams, and to integrate the overall process.

At the Boeing Commercial Airplane Group in Renton, Washington, a team approach is being used to design the 777, a 747 sized twin engined airliner. Boeing is banking on the design to make the jetliner the most preferred in its class. When it becomes operational in 1995, the plane will be the largest commercial twin jet in service. Between now and the year 2005 it will be competing in a market estimated to be more than $200 billion. Competition in this market will be primarily from Airbus Industry, the government-backed European passenger-jet consortium. To establish market leadership, Boeing has developed a "preferred" product development process based on concurrent engineering. Garnet W. Hizzey, 777 Production-Engineering Manager, says,"When you are dealing with strong competition, you have to do things in an extremely efficient manner. We developed our preferred process to give a more integrated approach to the project so we don't get into the old sequential problems." The expected benefits include, reduced rework or second efforts, reduced change orders, more producible designs, fewer mock-ups, and increased competitiveness.

Historically, Boeing has found that most of its costs have been the result of second efforts, of "not getting it right the first time." Hizzey suggests that this cost inefficiency is "the fault of the *process, not the people.*" A recent study by Boeing of the factors contributing to cost problems in their factories, attributed most problems to product definition arrived at without taking into account the downstream process. Boeing has used design/build teams in parts of other product development programs over the years and has found team oriented product development tended to have a better track record in achieving higher cost efficiency and quality. This positive experience was an important factor in making the decision to use design/build teams for the entire 777 project.

Boeing has more than 230 design/build teams working on the 777 project, some of which include representatives from suppliers and 777 airline customers. Each team is responsible for a section of airframe or major system. The teams have expertise from all functional groups including quality, tooling, engineering, manufacturing, finance, customer support, marketing and procurement. Members are co-located to enhance communications. A sophisticated information system facilitates easy access to data and information for team level decision making. A shared knowledge base enables effective and efficient evaluation and implementation of alternatives. Each member understands the role of others within the group, as outlined by "the charter." Concurrently, they work to ensure they

are creating a superior product designed for market success.

In implementing a simultaneous team-oriented approach to product development, the manpower curve for Boeing has shifted to the left. There is more development time and cost up front, but Hizzey says, "The upstream investment will be leveraged substantially in downstream benefits, such as lower cost, higher quality and higher customer satisfaction."

In order to achieve the benefits of concurrent engineering, everyone needs to clearly understand each other's role and work toward achieving a common corporate goal.

The multidiciplinary team members represent every function impacted by team output and decisions. This approach ensures that the requirements of each function is considered. Team members:

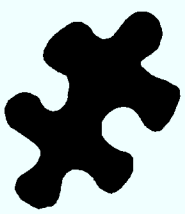
- Strive to understand one another's point of view and take into account the skills, background and knowledge of other's as they interact to develop optimized designs and solve problems.
- Contribute ideas freely recognizing the potential for the synergy to give rise to superior ideas and solutions.
- Share information and ideas....collaborate.
- Openly deal with different points of view and resolve differences to achieve consensus.
- Accept responsibility for their decisions and ensure they meet company and customer requirements.

Companies that practice concurrent engineering successfully indicate that there is no specific model organization of managers and teams to imitate that will ensure success. In setting up the organization, they focus on developing a structure that will work best in each particular case based on their knowledge of the company, the people, the product, and the challenges of the situation.

A2. Managers

Managers play a key role in establishing culture. They:

- Create and empower product development teams.
- Show commitment by sharing their vision of the value of a team approach with the whole organization.
- Continuously assess team needs to ensure an optimal balance of professional, technical, and leadership skills and knowledge.
- Develop an appropriate communications infrastructure including systems for continuously measuring quality of designs with regards to cost, schedule, and conformance to customer requirements.
- Coordinate resources and integrate the process.
- Manage issues flowing from teams and ensure team output is in line with corporate requirements.
- Become more like coaches and less like bosses.

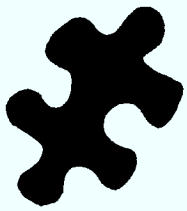


B. Communications

A second key element to successful concurrent engineering is effective communication. An effective communication infrastructure provides the basis for a common knowledge source which is crucial for sharing information and ideas. It is critical to establishing collaboration because effective communication helps create a shared understanding of the product and its production processes.

Again, complexity has a lot to do with what is required. A relatively simple product involving only a small team and few disciplines might only require co-location to enable collaboration. The required

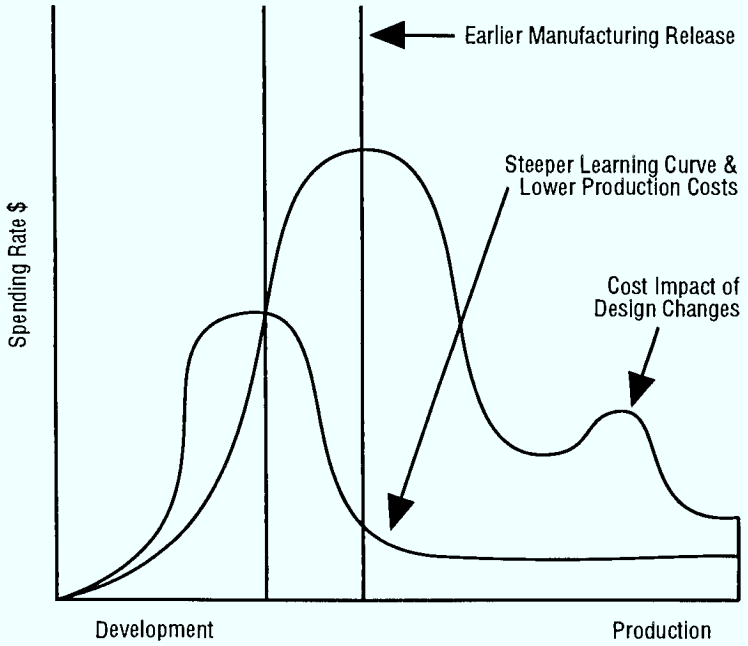
information could be in someone's file or personal computer and all that would be necessary would be to ask for it. A more complex product development process involving many teams, individuals, and disciplines, would require a more complex infrastructure involving equipment and software which provides access to single and multiple databases.



C. Customer Requirements

This is the third key element of concurrent engineering. The success of a product is determined by how well internal requirements are met and the extent to which the product's attributes provides customer satisfaction. In concurrent engineering this is accomplished by carefully defining requirements and creating a clear understanding of what the goals are early in the design process – the product conception stage. Requirements are kept in clear focus as the design progresses from stage to stage to ensure that targeted goals are achieved. As shown in Exhibit 6, firms using this approach spend more time and money at the front end. They do this to achieve downstream benefits because they know the bulk of the later spending is determined by the work done up front.

Exhibit 6: Cost Impact of Concurrent Engineering



Mustang Engineered Technical Apparel Corporation in Richmond B.C. designs and manufactures marine and aviation survival equipment as well as a wide range of buoyant clothing. President Dwight Davies states that, "(concurrent engineering) is a process of developing newer and better solutions to the problem of survival. And, it's a guarantee of uncompromising quality in every product that carries the name Mustang." Through extensive R&D and close working relationships with the product users, a Mustang product development team will design a survival product customized to the users operational environment. To accomplish this, a team of engineers works to determine the user's exact requirements and to establish design parameters. Designs are tested comprehensively in both the laboratory and the field. Strict standards and rigid controls are carried through the manufacturing stage where product integrity is tested and retested. The result is safety

and survival equipment which provides the functionality and dependability requirements crucial to its demanding environment.

The cost, performance, and production schedule of a product is impacted by parts supplied by outside suppliers. It is important that these "customers" be included in the process.

The Ebco Aerospace precision machining facility, located in Delta, BC, is equipped with systems and machinery to meet the most demanding specifications of the aerospace and defense industries. As a supplier of parts and components to these industries, David Belanger, Vice-President of Ebco Aerospace, feels it is important to be involved and have input at the design phase of a project. "Suggestions can be made which will reduce a suppliers cost to manufacture," says Belanger. He points out two obstacles that impact his ability to be more concurrent and hence more competitive. Firstly, the lack of supporting industries in the Vancouver area makes it necessary to send parts long distances to the U.S.A. for intermediate processing. This adds to time and cost. Secondly, the incompatibility of computer systems makes it impossible for him to link up with the company's various customers to achieve a higher level of concurrence.

D. The Product Development Process

A fourth key element is the integration of the various processes involved in product development into the total product development process. The use of multifunctional teams ensures that all downstream concerns are considered – product testability, manufacturability, reliability, and maintainability. Design changes made early in the development process results in significant positive benefits.

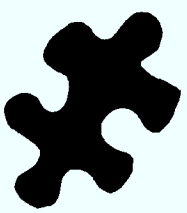
E. Methods For Design Optimization

Powerful methods for design optimization have become an important part of concurrent engineering. Some of these methods are:

Design For Manufacture and Assembly[20]

DFMA is both a philosophy of design and a software package that alerts design engineers to the manufacturing implications of their work. Software rams, based on years of research, supply quantitative data on manufacturing parameters such as, machining rates, assembly times and material properties. This information is used in determining the feasibility of manufacturing a particular design before it is too late to consider alternatives.

In applying DFMA to the design process, engineers strive to design a product that can be produced at minimum cost while still be able to retaining salient product attributes – utility, function, quality, and long term reliability. Models and prototypes are used to check DFMA before specs are locked in and designs are released. This saves tool debug time and results in faster ramp up to full production.



The objectives of DFMA are outlined in Exhibit 7 – Design Guidelines for Simplifying Product Manufacturing and Assembly.

DESIGN GUIDELINES FOR SIMPLIFYING PRODUCT MANUFACTURING & ASSEMBLY

Make Assembly Foolproof
- Japanese "Poke-a-yoke" design principle
- Assemble product only in the "right way"
- simpler assembly process:
  - eliminates need to document and store elaborate assembly procedures
  - requires less employee training
  - allows workers to be more flexible and build a wider variety of products on the same production lines
  - eliminates costly assembly inspection and rework

Simplify Assembly Process
- To be automated, assembly process must consist of only simple movements which can only be guaranteed by the product's design
- Designs simplified for automated production also make manual assembly more productive

Make Product Easy to Test
- If design features make failures easy to diagnose, troubleshooting will be quick and inexpensive
- Designing a product to be testable assures its quality and reduces its cost

Use Common Components Across Product Families
- Better quality can be achieved by using common components and processes because attention and resources can be focused on monitoring and improving them
- Equipment used to produce a wide variety of products will probably have a higher utilization rate

Avoid Excessively Tight Tolerances
- Quality is reduced because no inspection is 100 percent reliable
- Design in quality with realistic manufacturing capability tolerances

Use Modular Product Options
- Flexibility from modular add-on options yields obvious improvements:
  - an almost infinite variety of products can be configured at the end of the production line
  - makes final assembly and inspection easier, as well as repairs and maintenance
  - manufacturing can satisfy the mix of new product orders; and
  - marketing can easily supply customers with customized products

Source: Walleigh, Richard. "Product Design for Low-Cost Manufacturing". *The Journal of Business Strategy.* July/August, 1989. Pages 37-39.

Quality Function Deployment (QFD)[21]

Known as the "house of quality," QFD is a method for listening to the voice of the customer. It involves constructing and evaluating a chart that relates the characteristics a customer wants to required engineering elements needed in the design. The value of this tool is that it allows engineers at the conceptual stage to evaluate alternative ways of providing customer wants. In this way, quality from the customers point of view is designed into the product.

Statistical Process Control[22]

SPC seeks to monitor and correct drifts in quality in the manufacturing processes, starting with a thorough knowledge of the link between them and defects. SPC can lead to product specifications and manufacturing tolerances that yield the lowest production costs and highest quality.

Design For Testability[23]

To ensure proper operation after assembly most products must be tested. As product complexity increases, especially in electronics, the need for product designs that incorporate testing provisions becomes very critical. This assures its quality and cost. A product designed to be verified easily can be tested by a production worker where otherwise a technician or engineer would be required. If the design makes failures easy to diagnose, troubleshooting will be quick and inexpensive.

Design For Maintainability and Reliability[24]

Maintenance is close to the end of a product life cycle. However, it is by no means the least important stage in design. A harmonious combination of reliability and maintainability results in a viable, maintainable life cycle. These two aspects can be considered and evaluated early in the product and process design stages. Otherwise they will have to be considered later at a much higher cost.

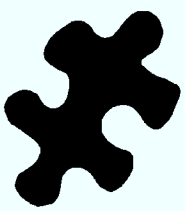
Total Quality Management

TQM applies a set of principles to focus continuous attention on quality at every step of design, development, and manufacturing by everyone in a company for the purpose of increasing value to customers.

Continuous Process improvement

CPI is systematic continuous study of a process, year after year, to find ways of improving it. Firms start by using the information that flows through the concurrent engineering environment to develop ways of improving the product and its development process the next time the design process starts. Some firms evaluate customer requirements continuously. This allows them to keep on redefining their products and processes.

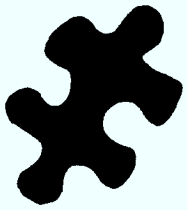
F. 3-D Solids Modeling



With the 777, Boeing wants to weed out costs associated with rework. The company will be able to do this partly by using a software system called CATIA (computer-aided, three dimensional interactive application).

This technology enables designers to create the 777's parts and systems as three dimensional solid images in real time, instead of the traditional two-dimensional drawings. For conceptual modeling, designers can accurately create parts and then simulate the assembly of those parts on the computer. The ability to pre-assemble parts on computer screen allows designers to find, and

easily correct, misalignments and other interference problems, which reduces costly rework during production. Such parts fit better, rarely have to be retooled, and reduce design and build time.



Modules enabling Finite Element Analysis (FEA) may be incorporated that use the solid as a basis for analysis. Analysis may be of performance, part clearance, and ease of manufacture.

This geometric definition of an object is a rich set of information about volumes, centers of gravity, parts and part relationships, and features such as bolts, holds, indentations, and fillets. When linked from CAD to CAM, modeling can streamline (numerical control) part programming and other manufacturing applications thus reducing scrap and rework.

The computer application also is an interactive communication tool, which makes engineering a concurrent task by allowing individual teams to augment designs and to do so with full knowledge of what other teams have done. "Expensive mock-ups will be greatly reduced", says Hizzey.

Suppliers that have CATIA workstations can receive design details electronically, which eliminates blueprints and reduces errors. Also, engineers can annotate manufacturing instructions.

The computer design system will continue to benefit 777 customers long after the initial design is complete. As airlines order 777s, the designs can be easily revised to accommodate customer-requested options. Overall, the accuracy and quality of the designs will be enhanced, the need for engineering changes will be reduced and there will be fewer production problems in the factory.

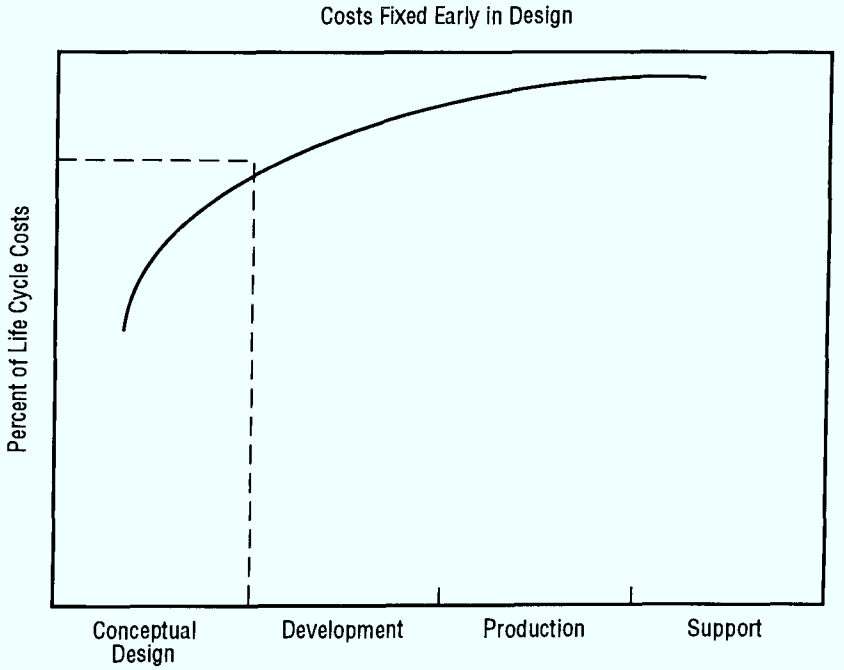
IV. The Pay Offs

In a recent speech given at the International Workshop on Concurrent Engineering Design, Patrich J. Kelly, Vice President of McDonnell Douglas Corporation said:[26]

> Any large new commercial airliner requires a tremendous investment, When viewed in terms of the two dimensions of ROI and magnitude of investment, the promise of concurrent engineering is moving such a project from the high investment and moderate ROI region to the moderate investment and high ROI region. We believe that concurrent engineering can have a great impact on the return of the investment and some impact on the total investment, particularly in the tooling area...We are in the process of looking at a lot of our operations from the design of the product, the processes we use to build it, and the systems that we use to support and control those operations,...We are seeing very significant gains that we can make with concurrent engineering. We are seeing the gains that we get out of team designs, we are seeing the gains that we get out of the better processes and systems. We're seeing gains associated with tooling for the new aircraft, and we are working very hard on the ROI side from the top down to be sure that the product we are offering is developed in a concurrent manner with our customers. This is because their requirements and quality are top priorities...Two of the major drivers in a business plan of the nature of the one that I'm working on happen to be the time to market and the recurring cost. Both of these are driven down by concurrence.

Kelly also states that the total investment required by a new aircraft is heavily influenced by the conceptual design. Notice in Exhibit 8, the conceptual design phase can account for up to 80% of product development costs.

Exhibit 8: Allocation of Product Development Costs



Source: Report on Findings of the International Workshop on Concurrent Engineering Design held at IC2 Institute of the University of Texas. October 10-12, 1990.

This is true of most products. Regardless of whether concurrent engineering is used or not, about 40-60% of the cost is built in, locked in when you complete the conceptual design. Exhibit 9 illustrates the Cost Commitment to Varying Stages of Product Development. It is this reality that is forcing companies to consider concurrent engineering.

Exhibit 9: Cost Commitment to Varying Stages of Product Development

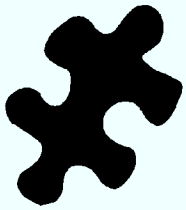
	Percentage of Total Costs*	
	Incurred	Committed
Conception	3% - 5%	40% -60%
Design Engineering	5 - 8	60 - 80
Testing	8 - 10	80 - 90
Process Panning	10 - 15	90 - 95
Production	15 - 100	95 - 100

* Cumulative

Source: Port, Otis. "A Smarter Way to Manufacture." *Business Week.* April 30, 1991. Page 110.

In one industry after another, success is coming to those who integrate the various functions involved with the product development process.27 Bombardier Inc., Industrial Equipment Division recognized the importance of integration when it did a major redesign of its Ski Slope Maintenance Vehicle. In 1990, Bombardier and designer Jean Labbe were awarded winner status in the Canada

Awards for Business Excellence, Industrial Design category. The award was granted for superior integration of engineering and design details in the BR400+ vehicle. According to Engineering Manager Pierre Blain:



> The challenge was to design a financially viable industrial ski hill maintenance and conditioning vehicle that is reliable, performs excellently, and has visual appeal. Extensive research, team effort, and much cooperation were required in every stage of development. The most innovative aspect of the BR400+ is its very user friendly cabin design and attractive high tech look. The cabin is functionally superior to competitors models. Also, unlike other machines of its kind the BR400+ has modular assembly and a simplified design which uses fewer parts, dramatically reducing production time and costs."

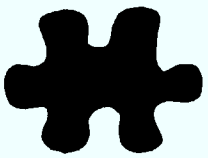
"Profit by Design"

The Industrial Design Society of America estimates that every dollar spent on design results in an average of $2,500 in sales for companies with billing under $1 billion and $4,000 for those with sales over $1 billion. Some estimates have suggested that good design can account for 50% of the trade advantage in manufactured goods.[28] That's because design affects not only how something looks but how it works. According to Aris Melissartos, General Manager of Engineering and Manufacturing operations for Westinghouse Electric Corporation – Electronic Systems Group, "No amount of factory automation can compensate for poor design. This is because 90% of production costs are preordained by design decisions made long before the blueprint reaches the shop floor."

Design provides a powerful means of generating new ideas and making those ideas tangible. It can create a "product personality" distinctive from that of competitors. It can help reinvigorate mature products and extend their life cycle. Effective design seeks to optimize consumer satisfaction and company profitability through the creative application of the major design elements (performance, quality, durability, appearance, and cost) in connection with products, environments, information and corporate identities.29

An effective design reduces confusion, complexity, and variability in the production process, thus enabling more cost effective production. At the same time, effective design can help enhance the interface between the product and its user by improving product ergonomics, function, aesthetic appeal and perceived quality. "Design is a huge deal not because it makes things beautiful or garners awards, but because in our rapidly changing, customization-oriented, service-added, software-added, intangibles-oriented business environment, design is a critical focus for knowing what a product is, what a customer is, and what an organization is."30 Effective industrial design synthesizes all these elements into a package. Ideally, the final product becomes a "visual manifestation of product quality", a reflection of consumer identity and a representation of corporate character.31

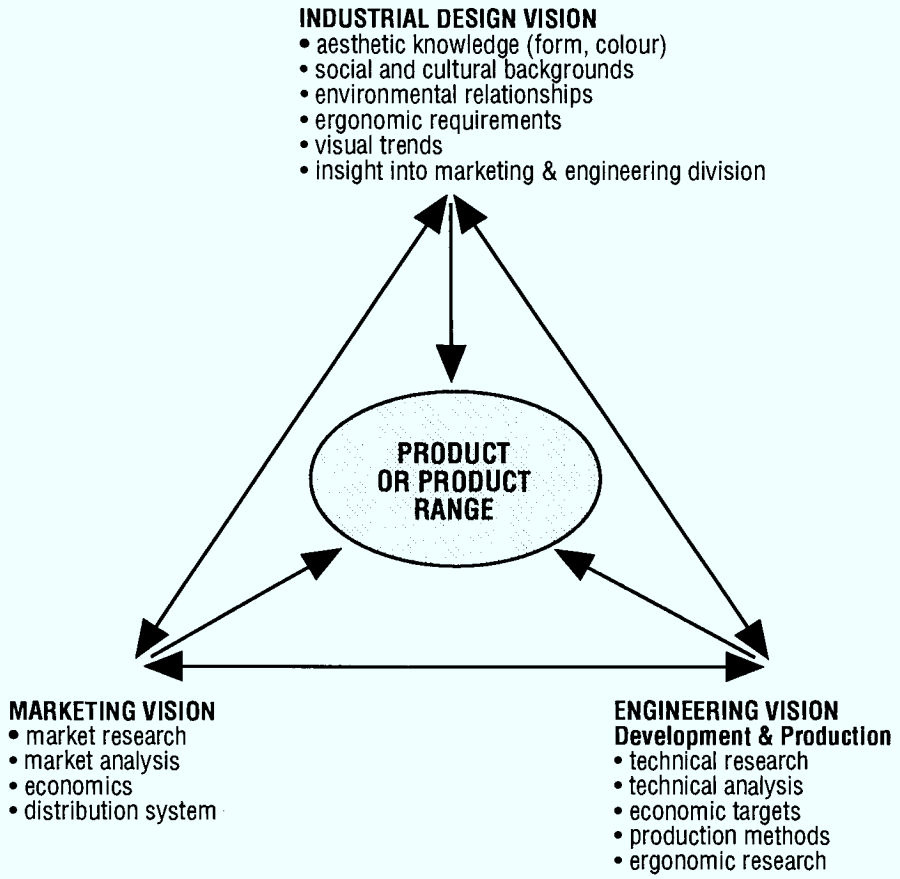
"Businesses compete globally in what has become a continuous improvement game. It is no wonder that bureaucracies can't cope. They celebrate getting to the end rather than encourage a constant outlook for new beginnings. They reward bigness rather than than creativity. And they measure cost, sales, productivity, and margins and pay only lip service to the issues that are elusive but so critical to competing in the 90's – quality, customer, perception, and innovation."32 Effective design management is a strategic approach that sheds traditional barriers – suboptimization, overspecialization and bureaucratic power struggles – and pursues an interdisciplinary organizational structure which emphasizes collaborative team efforts. As a strategic product design culture, individuals from engineering, marketing, manufacturing, finance, and industrial design are encouraged to interact closely with one another to improve communication and co-operation. In effect, this promotes greater understanding and appreciation of each team member's role and function within the organization. A common commitment to a product goal develops into a common commitment to the corporate goal.



There is no way to measure the synergy that develops as the barriers between people comes down. Efficiency in production, speed to market , product quality and product success in the marketplace resulting from the effective collaboration of various functional experts however can be measured in terms of profitability. This design-led strategy is inherent in the Concurrent Engineering approach to management. Concurrent engineering, often referred to as simultaneous or parallel engineering, is a holistic approach to management which strives to dismantle formal organizational structures and establishes an infrastructure conducive to effective team work. The successful incorporation of industrial design into a product development process, founded on a multi-disciplinary, team-oriented, work methodology, provides the ideal framework in which creative design can prosper and

efficient product development can take place.

Exhibit 10: The Ideal Organization of Product Development Teams



The above diagram illustrates the ideal pooling of cross-functional "visions". Note that the Industrial Designer can also supply marketing and engineering ideas. (Adapted from Concern Industrial Design Center, Philips, Eindhoven)

The lack of awareness and understanding, on the part of top management executives, prevents this management approach from flourishing. This is not a fault on their part necessarily, but rather design management is a relatively neglected part of management education in North America. Industrial Design and Concurrent Engineering comprise the two central components of a design-led business strategy aimed at achieving design innovativeness and productive efficiency.

Industrial Design Education in Western Canada

EMILY CARR COLLEGE OF ART & DESIGN

Associate Dean of Design: Ken Hughes
Address: 1399 Johnston Street, Granville Island, Vancouver, B.C. V6H 3R9
Telephone; (604) 687-2345 Fax: (604) 844-3801
Program Credentials: Diploma or Bachelors Degree in Design
Program Enrolment: 25 students

Industrial Design – Program Philosophy

The Goals of the Design division are to:
1) strive for excellence;
2) to provide rigorous, creative and reflective learning environments; and
3) to ensure that the curriculum remains responsive to the 'global community'.

The Design division at Emily Carr aspire to produce designers prepared to shape the future of Electronic Communication Design, Graphic Design, and Industrial Design in Canada. Each program emphasizes teamwork and individual initiative with the objective of training designers knowledgeable in the entire process of design activity, conversant with changing technology.

Program Format & Objective

The program emphasizes diversity and challenges in the Design field. Students develop conceptual, analytical and technical skills focusing on Industrial Design aesthetics, product and performance, innovation and ergonomics. As graduates, students will be able to function responsibly as independent designers or as members of a design team, designing products and environments that respond to the needs of the marketplace.

UNIVERSITY OF CALGARY – FACULTY OF ENVIRONMENTAL DESIGN

Program Director: Ron Wardell
Address: 2500 University Drive N.W., Calgary, Alberta T2N 1N4
Telephone: (403) 220-7434 Fax: (403) 284-4399
Program Credentials: Graduate Program, Master of Environmental Design
Program Enrolment: 26 students

Industrial Design – Program Philosophy

Industrial Design can and should seek the improvement of life through its influences on social, psychological and environmental conditions. These influences arise both from functional utility and from emotional, cultural, and aesthetic value. Industrial design should be seen as an opportunity for positive economic development and satisfaction of human needs.

APPENDIX A

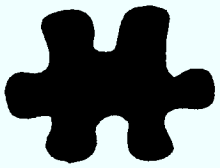
Program Format & Objective

The Industrial Design Program is a graduate program that aims to prepare students for professional roles in product design or related practice. The program stresses the conceptual issues and the intellectual and operational skills pertinent to the manufacture of artifacts or components of the built environment. Students develop basic knowledge and skills in industrial design and advanced skills and knowledge in concentrated area of study.

Those without prior design education follow a more generalized program. However, students with a prior degree in industrial design pursue a more specialized program of course work, directed studies and research. Concentrated study is available in design practice, design management, ergonomics/human factors, history and theory, and industrial design technologies.

UNIVERSITY OF ALBERTA – DEPARTMENT OF ART & DESIGN

Program Director: Bruce Bentz
Address: 3-98 Fine Arts Building, Edmonton, Alberta T6G 2C9
Telephone: (403) 492-3261 Fax: (403) 431-0332
Program Credentials: Bachelor and Masters in Industrial Design
Program Enrolment: 90 undergraduates registered, 4 graduates



Industrial Design – Program Philosophy

The creative activity which incorporates innovations into a product so that it better meets the need of the user. It is concerned with products in which function, form, aesthetics, ergonomics and other human factors play a significant role.

Program Format & Objective

There is a strong pragmatic approach, so that the program addresses itself to the *practice* of industrial design. Within the total context of the industrial design program, there are three main areas of concern – creativity, methodology, and technical skills. Creativity embraces imagination, innovation and problem solving ability. Methodology includes procedure, process and attitude – social concerns, responsibility, motivation and initiative. Technical skills are those concerned with the practical applications of design, such as sketching engineering drawing, model-making, prototype fabrication, research and presentation.

Industrial Designer Associations in Canada

ACID	Association of Canadian Industrial Designers, member of the International Council of Societies of Industrial Design (ICSID)
ACID-O	Association of Chartered Industrial Designers of Ontario
ADIQ	L'Association des designers industriels du Quebec
BCID	British Columbia Industrial Designers Association

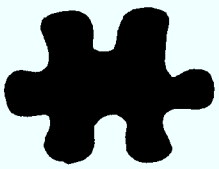
British Columbia Industrial Designers List of Members

The following information was provide by the British Columbia Insustrial Designers' Association (BCID).

BCID EXECUTIVE BOARD OF DIRECTORS

Name	Position	Phone	Fax
Neville **GREEN**	Chairman	525-9229	525-9229
Lionel **HOLT**	Membership	980-2361	980-2361
Freddie **TSANG**	Treasurer	299-3001	591-2211
Brain **KEANE**	Public Relations	844-3842	844-3801
Karl **HUMPHREYS**	Secretary	736-9899	736-7005
Peter **BUSBY**	Program	736-9899	736-7005

Professional Membership: Require minimum of an undergraduate degree with a major in industrial design . Practicing industrial designers without formal industrial design education will also be considered based on amount and type of professional experience. Primary professional responsibility as a practitioner or educator is with the industrial design of products, instruments, equipment, packages, transportation, environments, information systems or other industrially produced artifacts.



Associate Membership: Recent graduates with a degree majoring in industrial design or related discipline, who are working towards professional status. Primary responsibility as a practitioner or educator in a design related field such as display design, interior design, engineering design and architecture

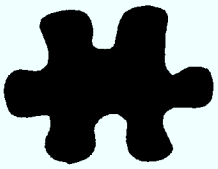
Please Note: The requirements for membership are currently under review.

PROFESSIONAL MEMBERS

Name	Address	Contact Numbers
Chris **AU**	1573 East Pender Street Vancouver, B.C. V5L-1V9	Office: 253-1125 Home: 738-9005
Michael **BARBER**	2650 Carnation St. West Vancouver, B.C. V5L-1H5	Office: 929-8666
Herb **BENTZ**	4521 John Street Vancouver, B.C. V5V-3X3	Office: 525-3685 Home: 876-2964
Gordon **BRADFORD**	6-2269 West 6th Avenue Vancouver, B.C. V6K-1V7	Office: 732-4662 Home: 732-4662

APPENDIX B

Peter **BUSBY**	1650 West 2nd Avenue Vancouver, B.C. V6J-4R3	Office: 736-9899
Greg **CORRIGAN**	308 - 611 Alexander Street Vancouver, B.C. V6A-1E1	Office: 255-6100 Home: 734-8486 Fax: 255-3800
David **CUNNINGHAM**	6393 N.W. Marine Drive Vancouver, B.C. V6T-1W5	Office: 822-5976 Home: 228-1126
Henry **ENG**	718 - 1330 Burrard Street Vancouver, B.C. V6Z-2B7	Office: 421-1311 Home: 669-6983
Alex **FELDMAN**	3254 W. 3rd. Ave Vancouver, B.C. V6K-1N4	Office: 736-9899 Home: 733-1429
Miles **FENTON**	2106 Panorama Drive North Vancouver, B.C. V7S-2C9	Office: 436-9899
Neville **GREEN**	7410 - 16th Street Burnaby, B.C. V3N-1P1	Office: 525-9229 Home: 525-9229
Bob **HAMILTON**	11411 No. 5 Road Richmond, B.C. V7A-4Z3	Office: 277-1511
Bruce **HEWSON**	2251 Bellevue Street West Vancouver, B.C. V7V-1C5	Cellular: 351-4503
Lionel **HOLT**	831 West 1st Street North Vancouver, B.C. V7P-1A4	Office: 980-2361 Home: 980-5759 Fax: 980-2361
Karl **HUMPHREYS**	2942 West 12th Avenue Vancouver, B.C. V6K-2R3	Office: 736-9899 Home: 736-9673
Roman **IZDEBSKI**	1399 Johnston Street Vancouver, B.C. V6H-3R9	Office: 687-2345
Brian **KEANE**	205 - 2170 West 44th Avenue Vancouver, B.C. V6M-2G3	Office: 844-3842 Home: 264-0479

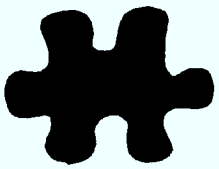


Roger **KIMBERLY**	7601 Robin Crescent Mission, B.C.	Office: 820-3444 Home: 826-3729
Addison **LANIER**	603 - 150 East Keith Road North Vancouver, B.C. V7L-1T8	Office: 986-7591
Nick **LIEM**	1584 Fell Avenue North Vancouver, B.C. V7P-3E7	Office: 986-6884 Home: 986-0648 Fax: 984-9758
Barry **MARSHALL**	308 - 611 Alexander Street Vancouver, B.C. V6A-1E1	Office:255-6100 Fax: 255-3800
George **RADKE**	4974 Dogwood Drive Delta, B.C. V4M-1M6	Home: 943-1670
Roman **RAK**	5154 - 44th Avenue Delta, B.C. V4K-1C8	Office:277-1511 Home: 946-7201
Blythe **ROGERS**	6668 East Boulevard Vancouver, B.C. V6P-5R1	Home: 261-8826
Gordon **ROSE**	311 - 2211 West 5th Ave Vancouver, B.C. V6K-1S4	Office: 687-4557
Louise **ST. PIERRE**	410 - 118 Alexander Street Vancouver, B.C. V6A-3Y9	Office:687-8657 Home: 683-8278
Freddie **TSANG**	2 - 7955 122nd Street Surrey, B.C. V3W-3T4	Office: 299-3001 Home: 591-2211
Tommy **TSE**	5057 Elgin Street Vancouver, B.C. V5W-3J7	Home: 321-8769
Mike **WALL**	3034 East 2nd Avenue Vancouver, B.C. V5M-1E8	Office:251-4565

APPENDIX B

ASSOCIATE MEMBERS

Maatje **CAMPBELL**	2950 Capilano Road North Vancouver, B.C. V7R-4H6	Office: 984-1877
William **CHUE**	7631 Manitoba Street Vancouver, B.C. V5X-4S9	Office: 322-5080 Home: 322-5080
Wilfried **HAEST**	1799 Peter Road North Vancouver, B.C. V7J-1Y7	Office: 687-0246 Home: 987-0992 Fax: 684-2818
Shinya **IWATA**	357 East Keith Road North Vancouver, B.C. V7L-1V8	Office: 980-7525
David **JENSEN**	25 - 451 West Cordova Street Vancouver, B.C. V6B-1E5	Office: 687-8657
Rod **KARDAM**	113 - 11031 Bridgeport Road Richmond, B.C. V6X-3A2	Office: 270-8071
Giovanni **LENCI**	7860 Afton Drive Richmond, B.C. V7A-1A4	Home: 277-1614
Bob **MERRIAM**	5230 Shelby Court Burnaby, B.C. V5G-1V2	Home: 294-0505
Ed **PERSON**	632 Tyndall Street Coquitlam, B.C. V3J-3S8	Office: 255-6100 Home: 936-0784
Nicholas B. **SMITH**	831 West 1st Street North Vancouver, B.C. V7P-1A4	Office: 988-5751 Home: 988-8559
Brad **STRUBLE**	1573 East Pender Street Vancouver, B.C. V5L-1V9	Office: 253-1125
Kent **STURTON**	311 - 8460 Ackroyd Road Richmond, B.C. V6X-3E9	Office: 279-1982 Home: 279-1987
Phong **TRAN**	12770 - 102 Avenue Surrey, B.C. V3V-3E5	Office: 299-3001



Alberta Industrial Designers

Currently, there is no organized association of industrial designers in Alberta, as in British Columbia. The following list of Alberta industrial designers was provided by Industry, Science and Technology Canada (ISTC). This list of industrial designers was assembled by ISTC for reference purposes only and does not represent ISTC endorsement. As well, the following list of industrial designers may not necessarily be complete. For those designers who have not been included on this list and would like to be included in ISTC's future reference material, please contact your local ISTC office.

Industrial Designers	Specialization
Mr. David **Smith** ***Adaptive Engineering*** 2004 – 10th Avenue S.W. Upstairs, Suite 2004 Calgary, Alberta T3C-0J8 Tel: (403) 245-3551 Fax: (403) 245-3597	•Product Prototyping •Machine Design, etc.
Mr. Mark **Lumbard** ***Axis Design Associates*** 110 – 3030 3rd Avenue N.E. Calgary, Alberta T2A-6T7 Tel: (403) 248-6987 Fax: (403) 273-3708	•New product development ranging from telephone booths to electronic product enclosures
Mr. Mike **Murakami** ***By Design*** 3rd Floor, 9945 – 85 Avenue Edmonton, Alberta T6E-2J7 Tel: (403) 439-5015 Fax: (403) 439-2586	•Product development: -Research -Planning -Design •Packaging design •Exhibitions •Visual communications
Mr. Greg **Kasa** ***Designworks*** 9749 – 54 Avenue Edmonton, Alberta T6E-5J4 Tel: (403) 438-8089 Fax: (403) 436-5199	•Product design ranging from computer cabinetry to vehicle based systems
Mr. Avrum **Wright** ***Innovate Design Inc.*** 10717 University Avenue Edmonton, Alberta T6E-4P8 Tel: (403) 439-5018 Fax: (403) 439-4461	•Product development specializing in mechanical devices and lab equipment

APPENDIX C

Mr. Joseph **Tang**
J. Tang & Associates Design Ltd.
202 – 10357 109 Street
Edmonton, Alberta T5J-1N3
Tel: (403) 423-0434
Fax: (403) 425-9821

- Research, design and development of consumer products, and capital equipment
- Package design
- Visual communications

Mr. Jim **Budd**
J. Budd & Associates
135 – 18th Avenue N.E.
Calgary, Alberta T2E-1N1
Tel: (403) 230-0770
Fax: (403) 230-0433

- Product design
- Model making
- Graphic & package design
- Display & exhibition planning and design
- Marketing communications

Mr. Keith **Hanna**
Kigo Design
100 – 3553 31st Street N.W.
Calgary, Alberta T2L-2K7
Tel: (403) 282-2764
Fax: (403) 284-4094

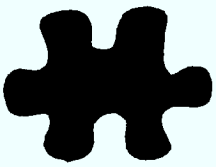
- New product research, design and development support to new and expanding ventures

Mr. James **O'Grady**
O'Grady Design
303 – 908 17th Avenue S.W.
Calgary, Alberta T2T-0A3
Tel: (403) 228-0222

- Design & design management

Mr. Bruce **Bentz**
R.E. SOURCE
10632 – 84 Avenue
Edmonton, Alberta T6E-2H6
Tel: (403) 431-0024

- Furniture design and making



Mr. Jim **Dickinson**
Two Design Associates
9938 – 77 Avenue
Edmonton, Alberta T6E-1N5
Tel: (403) 439-6812
Fax: (403) 439-6812

- Research, design and development of consumer products, furniture, capital equipment
- Package design
- Visual communications

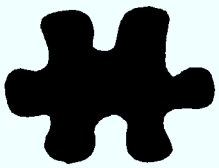
Mr. James **Patrick**
Spatial Concepts, Inc.
Box 1112
Red Deer, Alberta T4N-6S5
Tel: (403) 843-4606
Fax: (403) 843-3013

- Specializing in providing computer modelling services to industrial designers

Mr. Mick **Saruwatari**
Osine Corporation Limited
4838 – 32 Street S.E.
Calgary, Alberta T2B-2S6
Tel: (403) 248-9066
Fax: (403) 273-8133

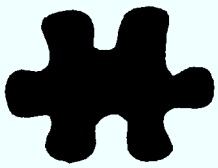
•Machine, hydraulic and electronic system design

Mr. John **Craig**
John Craig Industrial Design Ltd.
2615 – 83 Street
Edmonton, Alberta T6K-2Y5
Tel: (403) 461-5614



Notes

1 Hoppenrath, Metchild. "Made in Canada". *Report on Business Magazine.* April, 1988. Pg. 99
2 Garfitt, John R., "Honing the Competitive Edge for the 90's". *Trek.* November - December, 1991 Pg. 12
3 Ibid
4 Porter, Michael E., *Competitive Advantage.* New York. Free Press. 1985 Pg. 12
5 Garfitt. John R. pg. 12
6 Seguin, Real. "Good Package Design is Essential for Success." *Marketing,* March 23, 1992. Page 27
7 Erickson, Greg. "The Right Package." *Packaging.* February, 1990. Page.31
8 Blyth, John. "Overstimulated consumers challenge designers, retailers". *Marketing News.* August 6, 1990. Page 8
9 Ibid
10 "Recycling in Germany - A Wall of Waste". *The Economist.* November 30, 1991. Page 73
11 Ibid
12 Erickson, Greg. Page 31
13 Johnstone, Bob. "High Priests of Design". *Far Esatern Economic Review.* February 22, 1990. Page 34.
14 Austen, Ben. *Student Designs for Industry.* The Design Council. London, UK. 1987. Page 2.
15 Ibid. Page 1.
16 Topalian, Alan. "Deisgn Leadership in Business: The Role of Non-Executive Directors and Corporate Design Consultants". *Journal of General Management.* Winter 1990. Page 43.
17 Port, Otis. "A Smarter Way to Manufacture." *Business Week.* April 30, 1991 Page 111
18 Winner, Robert I, James P Pennel, Harold E Bertrond, and Marko M. Slusarczuk, "The Role of Concurrent Engineering in Weapons Systems Acquisition." *Institute for Defense Analyses,* Dec. 1988.
19 Coughlon, Paul D. and Albert R. Wood. "Developing Manufacturable New Products," *Business Quarterly,* Summer 1991 Page 49
20 Rosenblatt, Alfred and George Watson. "Concurrent Engineering," *IEEE Spectrum,* July,1991 Page 24.
21 Ibid Page 24
22 Ibid Page 24
23 Walleigh, Richard. "Product Design For Low-Cost Manufacturing." *The Journal of Business Strategy.* July/August 1989 Page 38
24 Adopted from "Engineering Software." Supplement to Automotive Engineering. July 1991 Page 8
25 Ibid Page 4
26 Report on findings of the International Workshop on Concurrent Engineering Design held at IC2 Institute of the University of Texas on October 10-12. Page 3-13.
27 Coughlon, Paul D. and Albert R. Wood. "Developing Manufacturable New Products," *Business Quarterly,* Summer 1991. Page 49
28 Hoppenrath, Metchild. "Made in Canada". *Report on Business Magazine.* April, 1988. Page 99
29 Kotler, Philip and G. Alexander Rath. "Design: A Powerful but Neglected Strategic Tool". *Journal of Business Strategy.* Autumn, 1984. Page 16
30 Peters, Tom. "The Design Challenge." The Tom Peters Group. Page 9
31 Johnstone, Bob. "Sold on Looks". *Far Eastern Economic Review.* February 22, 1990. Page 35
32 Peters, Tom. Page 12



Bibliography

Atkins, Cliff. "Design: The fuel for marketing fire". *Marketing.* September 26, 1988, Pg. C6

Austen, Ben. *Student Designers For Industry.* The Design Council. London, UK. 1987

Bak, David J. "Paying attention to product design". *Design News.* November 7, 1991 Page 47

Brazier, David and Mike Leonard. "Concurrent Engineering: Participating in Better Designs". *Mechanical Engineering.* January 1990, Pages. 52 - 53

Caplan, Ralph. "Designers and Engineers: Strange but Essential Bedfellows", *Technology Review.* February - March 1983 Pgs. 70-77

Carter, Donald E. and Barbara Stilwell Baker. "Concurrent Engineering: The Product Development Environment for the 1990's." Addison-Wesley Publishing Company., July 1991

Chris Hayes Associates and Keller Dorsey Associates. *The Industrial Design Requirements of Industry.* The Department of Education and Science in association with The Design Council. London, UK. 1983

Cohen, Stephen S. and John Zyman. *Manufacturing Matters.* Basic Books, Inc., Publishers. New York, 1987

Colburn, Kate. "Concurrent Design Unites Design, Test and Manufacturing", *EDN*, May 4, 1989. Pgs 73-76

Coughlan, Paul D. and Albert R. Wood. "Developing Manufacturable New Products", *Business Quarterly,* Summer 1991, Pgs. 49 - 52

Donnelly, James H. (Jr). " Six Ss for New Product Success". *Bank Marketing.* May, 1991. Pgs. 36 - 37

Duffy, James and John Kelly. "United front is faster; speed in developing a product or service will reduce your costs and give you a hefty market share" .*Management Today.* November, 1989. Pg. 131 - 139

Eppinger , Steven D., Charles H. Fine, and Karl T. Ulrich. "Interdisciplinary Product `Design Education". *IEEE Transactions on Engineering Management.* November, 1990. Pg. 301 - 305

Erickson, Greg. "The Right Package". *Packaging.* February 1990. Pages. 30 -32

Farmanfarmalan, Roxane. "Does Good Design Pay Off?", *Working Woman.* July, 1989. Pgs 47-50

Fleck, James D. and Joseph R. D'Cruz. "The Globalization of Manufacturing". *Business Quarterly.* Winter, 1987. Pages. 42 - 51

Funk, Jeffrey L. "How Does Japan Do it?" *Production.* August, 1988. Pages 57-62

Gardner, Donna. "DFM Adds Sparkle to Toy Line". *Design News.* August 7, 1991. Pages 62 - 65

BIBLIOGRAPHY

Gautschi, T. E. " Product Design as a Strategy Activity". *Design News.* December 19, 1988, Pg. 140

Gautschi, T.F., "The Rules of Product Design Change". *Design News.* July 23, 1990 Page 166

Gorb, Peter. "Design - Pervades the Whole of the Manager's World". *Accountancy.* February, 1986. Pg. 70 - 74

Heap, John. *The Management of Innovation and Design.* Cassell Educational Ltd. London, UK, 1989

Hoppenrath, Mechtild. "Made in Canada". *Report on Business Magazine.* April 1988, Pg. 99

Johnstone, Bob. "Sold on Looks". *Far Eastern Economic Review.* February 22, 1990. Pg 34 - 36

Knorr, Robert O. and Edward F. Thiede, Jr. "Making New Technologies Work", *The Journal of Business Strategy.* January/February 1991, Pages. 46 - 49

Kochan, Anna. "Simultaneous Engineering Puts Team to Work", *Multinational Business.* Spring, 1991 Pages. 41-48

Kotler, Philip and G. Alexander Rath. "Design: A Powerful but Neglected Strategic Tool", *Journal of Business Strategy.* Autumn, 1984. Pgs 16-20

Kuo, Way and J.P. Hsu. "Update Simultaneous Engineering Design in Japan". *Industrial Engineering.* October 1990, Pages. 23 - 26

Lawrence, Peter. "The Design Asset". *The Corporate Board.* July/August 1988, Pgs. 17 - 20

Lorenz. Christopher. *The Design Dimension - The New Competitive Weapon for Product Strategy and Global Marketing.* Basil Blackwell, United Kingdom, 1990

MacKay, Barbara. "From Sleek Designs to Bottomlines". *Business Journal.* November 1989, Pgs 31 - 33

Markowitz, Michael C., "Concurrent Engineering Journey Starts with the First Step". *EDN.* July 18, 1991. Pages 110-114

Mayer, Laura. "One-on-One: Peter Lawrence". *Contract.* October, 1989. Pages 47 - 48

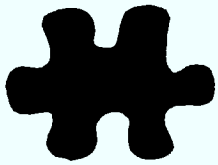
McClearly, Elliot H. "The (New) Shape of Things to Come". *Consumers Digest.* July/August 1989, Pgs 25 - 28

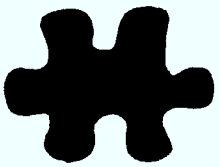
McKenna, Joseph F. "What's Your Sign?" *Industry Week.* February 4, 1991, Pgs. 27 - 28

Musselwhite, W. Christopher. "Time-Based Innovation: the New Competitive Advantage". *Training and Development Journal.* January 1990, Pages. 53 - 56

Nussbaum, Bruce. "Smart Design - Quality is the New Style". *Business Week.* April 11, 1988. Pgs. 102 - 117

Oakly, Mark. *Managing Product Design.* Weidenfeld and Nicolson. London, UK 1984





Olins, Wally. "Management by Design". *Management Today.* February 1985, Pgs. 62 - 69

Papadopoulos, Nicolas and Louise A. Heslop. "As Others See Us: The Image of Canadian Products Abroad", *Canadian Business Review.* Winter, 1989. Pgs. 27-31

Pigeon, Thomas. "Package Designer a Strategic Partner". *Playback Strategy.* July 15, 1991. Pg. 19

Port, Otis. "A Smarter Way to Manufacturer." *Business Week.* April 30, 1991, Pages 110-117

Report on Findings of the International Workshop on Concurrent Engineering Design held at IC2 Institute of The University of Texas. October 10 - 12, 1990

Robertson Nickerson Limited. *The Development of the Industrial Design Function in Canada.* Consulting Services Division - Industry, Sciences and Technology Canada. Ottawa, Ontario. March, 1990.

Rosenblatt, Alfred and George Watson. "Concurrent Engineering". *IEEE Spectrum.* July, 1991. Pages 22 -26

Smyka, Mark. "Design Strategy for Global Competition". *Playback Strategy.* July 15, 1991. Pg. 19

The Design Management Institute. *Designing for Product Success - Essays and Case Studies from the TRIAD Design Project.* Prentice - Hall, USA, 1989

Thomas, Hester. "Design Packs a Punch". *Marketing.* November 20, 1986, Pgs. 47 - 49

Topalian, Alan. "Design Leadership in Business: The Role of Non-Executive Directors and Corporate Design Consultants". *Journal ofGeneral Management.* Winter, 1990. Pgs. 39-61

Vasilash, Gary S. and Robin P. Bergstrom. "Concurrent Engineering". *Production.* May, 1991. Pages. 64-67

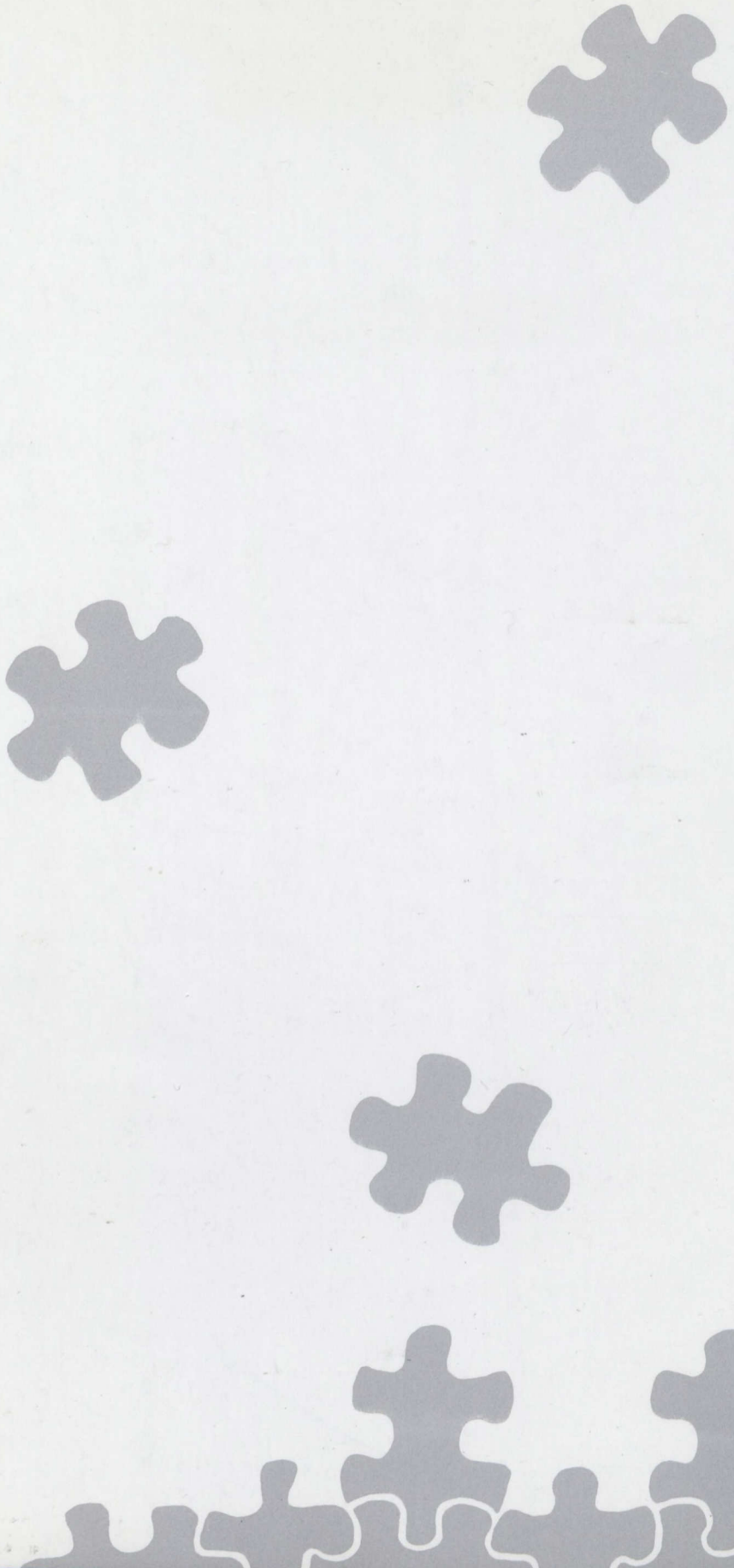
Vogt, Carlton F., "Concurrent Engineering: Industry's Best Hope". *Design News.* March 25, 1991. Pg. 23

Walleigh, Richard. "Product Design for Low-Cost Manufacturing". *The Journal of Business Strategy.* July - August, 1989. Pages. 37 - 41

Welter, Therese R. "The Genesis of Product Design". *Industry Week.* October 16, 1989. Pages 16 - 22

Winner, Robert I., James P. Pennel, Harold E. Bertrand and Marko M. Slusarczuk. "The Role of Concurrent Engineering in Weapons System Acquisition." Institute for Defense Analysis. December, 1988

Yong, Dori Jones. "Boeing Knocks Down the Wall Between the Dreamers and the Doers." *Business Week.* October 28, 1991. Pages 120 - 121



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