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SCHOOL OF BUILDING & ENVIRONMENT

DEPARTMENT OF ARCHITECTURE

UNIT – I – Product Design – SDE 3502

INTRODUCTION

Brief introduction to Product Designing - Various elements - History of Product Design - Definition of Product Design, understanding of Product Design - Purpose of Product Design - Role of Product Designers. Design approaches in product and lifestyle accessories design with a focus on functionality, ergonomics, aesthetics, multiple usages etc.

Product- An article or substance that is manufactured or refined for sale

What is Product Design?

Product design is the process designers use to blend user needs with business goals to help brands make consistently successful products. Product designers work to optimize the user experience in the solutions they make for their users—and help their brands by making products sustainable for longer-term business needs. The definition of product design describes the process of imagining, creating, and iterating products that solve users' problems or address specific needs in a given market.

The key to successful product design is understanding the end-user customer, the person for whom the product is being created. Product designers attempt to solve real problems for real people by using empathy and knowledge of their prospective customers' habits, behaviors, frustrations, needs, and wants.

Ideally, product design's execution is so flawless that no one notices; users can intuitively use the product as needed because product design understood their needs and anticipated their usage.

Good product design practices thread themselves throughout the entire product lifecycle. Product design is essential in creating the initial user experience and product offering, from pre-ideation user research to concept development to prototyping and usability testing.

But it doesn't end there, as product design plays an ongoing role in refining the customer experience and ensuring supplemental functionality and capabilities get added in a seamless, discoverable, and non-disruptive manner. Brand consistency and evolution remain an essential product design responsibility until the end of a product's lifespan.

Product design is sometimes confused with (and certainly overlaps with) industrial design, and has recently become a broad term inclusive of service, software, and physical product design. Industrial design is concerned with bringing artistic form and usability, usually associated with craft design and ergonomics, together in order to mass-produce goods.

PRODUCT DESIGN – THE BENEFITS

"..a good design starts from the principle that living is more than just a matter of existing and that everyday things which are both effective and attractive can raise the quality of life"- Terence Conran creator of the Habitat chain.

Product design is all around us and it has now become such a necessity that we would struggle to survive without it. However, the way in which we design products has changed over the years. The impact of new technologies and manufacturing systems has altered the way we approach design. Thanks to new computer technology and miniaturisation the aesthetics of a product is no longer dictated by the way it works. Aesthetics, appearance and

style have become such important parts of our lives that consumers often sacrifice quality, ease of use and value for money in their quest to remain 'in vogue'. The products we choose to surround ourselves with say something about us and indicate our values, customs and culture. In this century, the potential offered by product design promises a lot for the consumer. However, designers must take more responsibility for the products they create and the impact these will have on our lives. Designers need to have a social conscience and consider the way their products integrate and interact with everything that they come into contact with. Products have the ability to enhance our existence or to hinder it. Ultimately, they should be easy and enjoyable to use. They should provide benefits to the users and because they play such an important part in our lives, it is critical that they are well designed.

Some of the benefits product design can offer include:

- improve the quality of life of the user;
- give an improved performance over previous models;
- provide the user with status; • minimise manufacturing costs;
- create new markets or expand existing markets;
- increase the manufacturer's profitability;
- make economic use of resources;
- create a new or better aesthetic.

What is the History of Product Design?

Product design is an outgrowth of a very similar discipline called industrial design.

According to the Industrial Designers Society of America:

"Industrial design is the professional practice of designing products used by millions of people worldwide every day. Industrial designers not only focus on the appearance of a product but also on how it functions, is manufactured and ultimately the value and experience it provides for users."

Before the mass-production era of manufacturing, craftspeople built products primarily by hand. This meant there were fewer products available for sale and that they cost more. Then, the industrialization of manufacturing allowed businesses to mass-produce products inexpensively. To help sell their products to the millions of people who could now afford them, manufacturers enlisted the help of industrial designers to create products that were not only functional but also aesthetically pleasing. Over time, a subset of industrial design has evolved into its own category: product design. This is because industrial design today connotes physical products such as furniture and household appliances. In contrast, product design can refer to any product—even digital, virtual products such as software apps.

HISTORY OF PRODUCT DESIGN

- In the 15th Century, as the Middle Ages were transitioning into the Renaissance, people in European population centers wanted to have the same items in their homes and workplaces.
- News of these useful or desirable items soon spread along trade routes to the far corners of the civilized world.

Emerging Design Centers:

- Large workshops began to emerge in places such as Florence, Venice, Nuremberg, and Bruges where groups of collocated artisans replicated designs in larger volumes.
- Apprentices took 7 to 14 years to learn and become a Master. Demand growth quickly outpaced this approach as a solution.

Pattern Books:

- The use of drawings to act as instructions on how to construct something was first developed by architects and shipwrights during the Italian Renaissance.
- By the early 16th Century competitive pressures led to the emergence of "pattern books" in Italy and Germany, which were collections of engravings illustrating decorative forms and motifs for application to a wide range of products.
- And, importantly, the design took place well in advance of manufacturing.

Emerging Industrial Centers:

- In the 17th Century, growth in monarchies led to large government-operated centers epitomized by the Gobelins Manufactory, opened by Louis XIV in Paris in 1667.
- Hundreds of craftsmen, artists, decorators, and engravers turned out everything from tapestries and furniture to metalwork and coaches.
- This model was replicated in many cities, including the famous Meissen porcelain factory near Dresden in 1709.
- As long as reproduction remained craft-based, however, quality declined as scale increased.

The Industrial Age:

- The emergence of industrial design as a discipline mirrored the growth of industrialization and mechanization in Great Britain in the mid-18th Century.
- The term "industrial design" was first used in 1839 to describe how the school of St. Peter instructed draftsmen how to prepare patterns for silk manufacture.

Industrial Design:

- The first attributed use of the term "industrial design" in 1919 is credited to Joseph Claude Sinel, a self-proclaimed "industrial designer."
- However, many argue that the discipline began at least a decade before. Christopher Dresser is generally considered the first independent industrial designer.
- Then there is the Practical Draughtsman's Book of Industrial Design, printed in 1853.
- Together, these data points anchor the beginning of design as a profession between 1850 and 1900

Common Design Skill Sets:

- The Rhode Island School of Design was founded in 1877. But, it was not until the Carnegie Institute of Technology opened its design program in 1934 that historians began to recognize design as a profession.
- For the next 50 years, until the appearance of consumer electronics devices, the profession remained in the hands of individuals whose talents were sought as employees or consultants.

The Design Industry:

- By the 1980s, business demand for design skills had grown to the point where profitable design consultancies could be formed.
- Driven by broadening consumer electronics markets, the advent of global competition, shortening product life cycles, and the rapid evolution of CAD into 3D design and surface modeling, design grew from a profession into an industry.

Design Specialization:

- During the past 30 years, User Interface Design has already separated from generalized Industrial Design as a specialty.
- Sustainable Design is close behind and Additive Design is on the doorstep as 3D printing matures into Additive Manufacturing.
- Meanwhile, Design for the IIoT and IoT and Design for Big Data Analytics will both soon distinguish themselves as well.
- Trade schools and academic institutions now offer specialty degrees, and history tells us that is a meaningful development.

HISTORY OF PRODUCT DESIGN IN INDIA

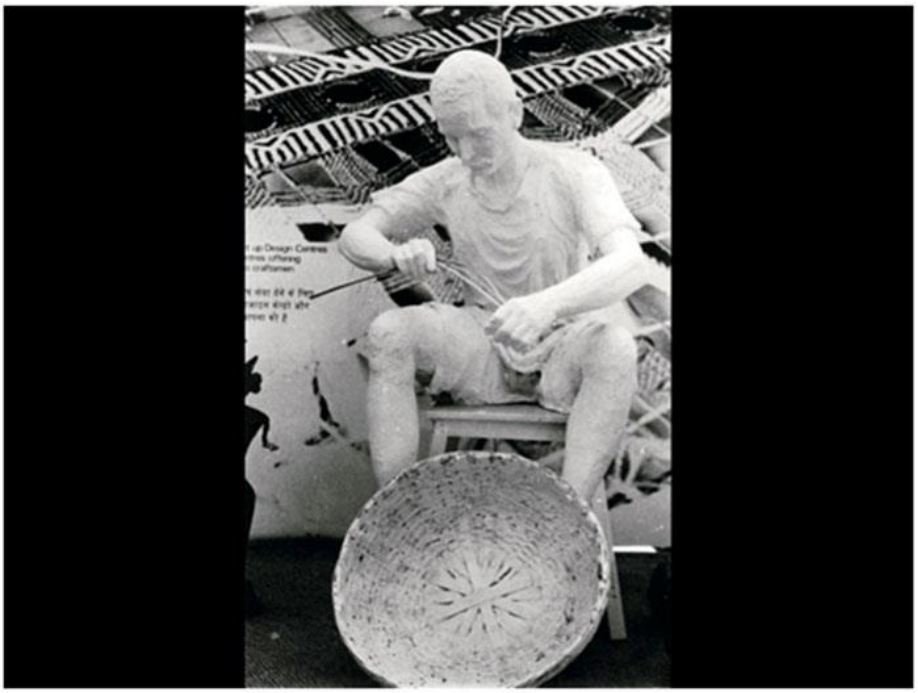
India's design history can be looked through many different lenses depending on the purpose of understanding it. Here the intent of documenting Product Design history is to:

1. Get a glimpse of the vast expanse that is India's inherent art, craft, design and architectural past that might often be overlooked when Design History is understood from a global context.

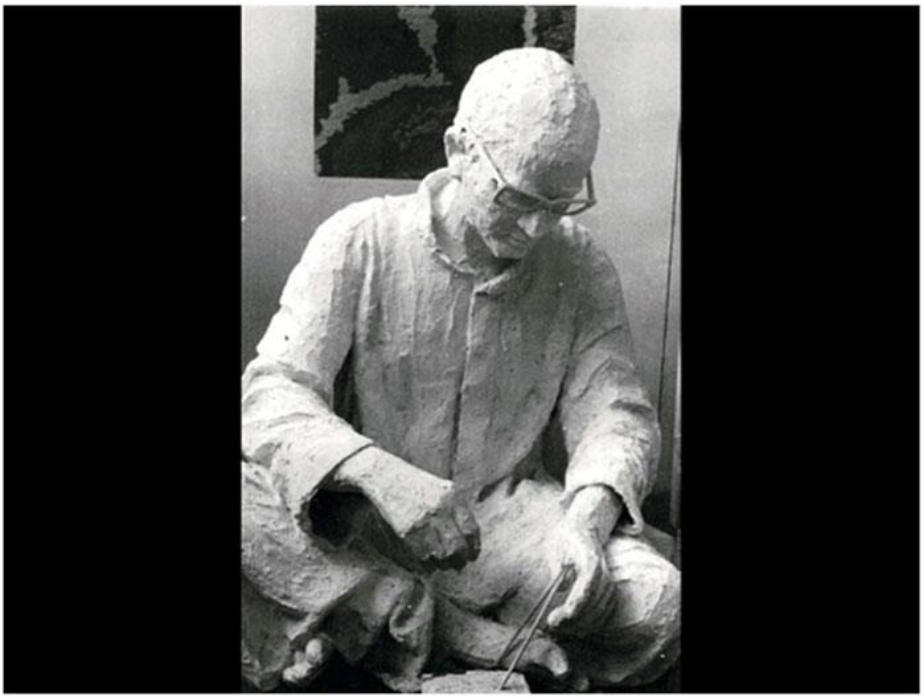
2. Understand the socio-political and economic influences that have either accelerated or impeded the manufacture and use of products that have its roots in principles of traditional as well as western design, through the eyes of academicians and industrial professionals.

3. To put together India's history in making products, which have had an impact on the lives of her citizens and possibly a global reach as well.

Indian Product Design in the global sense of the word is a fairly recent phenomenon, which is generally agreed to have come into being since the early 70's with the initial first set of designers trained from the National Institute of Design (then known as the National Design Institute) Ahmadabad and later with the Industrial Design Centre in the Indian Institute of Technology in Mumbai.



Made in India exhibition



Made in India exhibition 1979

Before launching into the narrative of postcolonial and post-industrial revolution and its impact on Indian Product design and manufacture, it is necessary to understand India's past in product design, briefly.

Pre-Industrial Revolution:
India has strong moorings in a unified format of what is now separately called in the western world as: art, craft, architecture and design, manuscripts refer to it as Kala. The kind of products that have originated in India before the Industrial Revolution for 2000 years has largely been out of local innovations and products that have been born from iteration and

evolution rather than short bursts of innovation or design revolution.

Nataraja sculpture

Tipu's Tiger with organ keyboard.

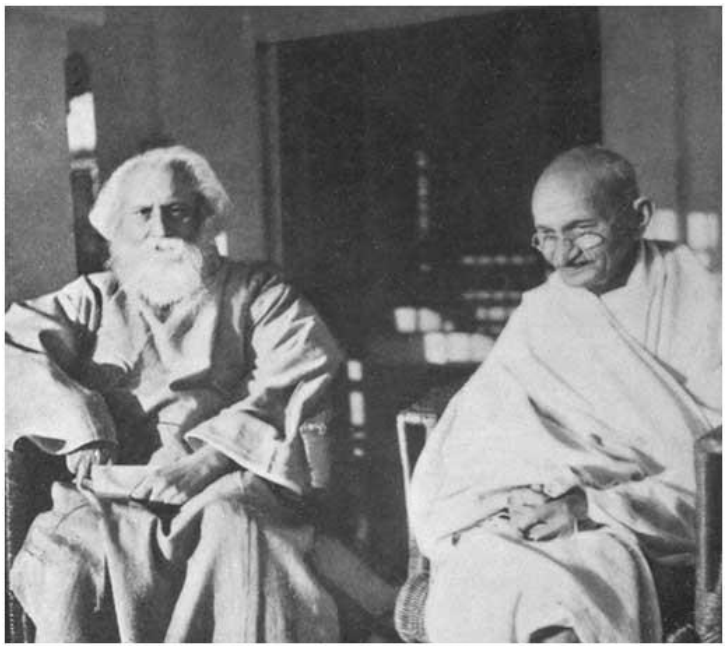
Masons, painters, illustrators, stone and clay workers, woodworkers and metal-smiths, often made the early products. The craft of making these were largely passed down from generation to generation via various guilds.

The Industrial Revolution brought about the first paradigm shift in manufacturing processes by transitioning from hand made products by a few skilled experts to semi-automated to automated industries that began making a set of products for a larger number of people in a shorter span of time, for lower costs. The revolution occurred largely in Western Europe and North America, as a result they have been the beneficiaries of it and its aftermath, as compared to countries that have been farther, geographically.

The result of mechanization led to the Arts and Crafts movement, the proponents of which felt that the ugliness in machine produced goods is a direct result of the removal of people who could work well with their hands, though its impact was short, it paved way for newer and alternative ideologies for products that could be produced by machines.

Pre-independence:
The debates and effects of the revolution was felt in India who had by then been colonized by the East India Company, through teachings at various arts and crafts schools in Madras (Chennai), Bombay (Mumbai) and Calcutta (Kolkata) which began during the 1850's. These were the schools for industrial art or applied art, though they were empty of inherent Indian skill-sets and literature regarding it. Thus began the disintegration of the guild systems (albeit leaving behind the systems of cast) and the practice of unified concepts of Kala in India due Macaulay's educational system, which was based upon the British model. Many Indian postcolonial historians and designers believe that this is how we have nurtured our differences and distinctions between design, craft and art.

Rabindranath Tagore at his Visva Bharati University in Shantiniketan experimented in trying to revive education in terms of literature, poetry, performing arts, crafts, apparel and even spaces where traditional design methodology could prosper. The concept of working by doing in was received more universally through Mahatma Gandhi's 'Nai Talim', which embraced self-sufficiency in all walks of life and led to small localized production systems based on man-power and small machines-the charkha, the Indian spinning wheel, being one of the most iconic examples of this country's resolve. Some of the major industries began during this time.


Tagore and Gandhi.

Gandhi spinning Charkha.

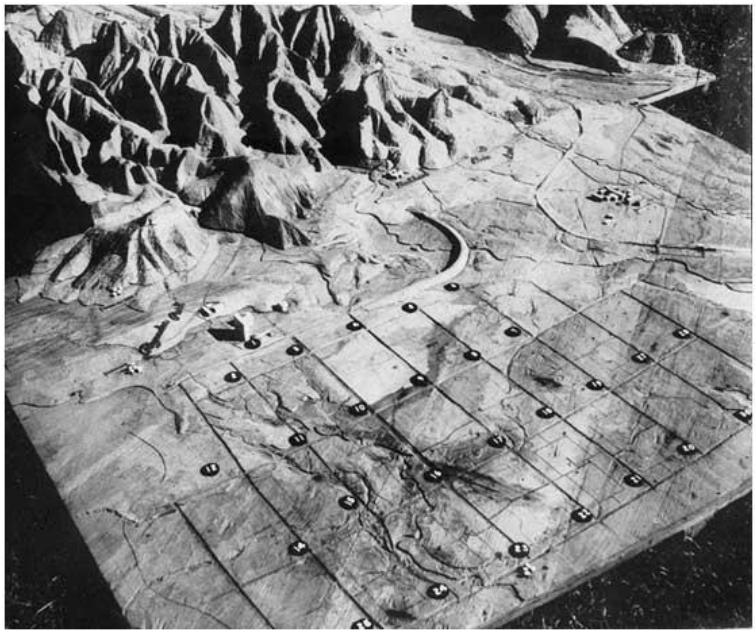
Rabindranath Tagore Teaching

Post-independence:
1947-1990's

With a move to improve India's economic standing a lot of emphasis was given for the promotion of Indian crafts-people via various agencies. However from a global understanding of the word "product design" some of the initial products, that made what the Indian market what it is today, came from a few private companies and industries that had begun prospering during the late 1800's. In the form of Tata Iron and Steel Company (TISCO) at Sakchi Bihar in 1907, some of the early bolstering of Indian industrial products had begun. After many hurdles in 1942 the Birla group formed Hindustan Motors Limited in Calcutta and WalchandHirachand formed Premier Automobiles with products such as pistons, electric bulbs etc. India's post-war industries and hence their products are a direct result of traditional merchant communities taking interest and investing into her expansion on a global scale.
One of the major government policies that have had its impact on India's industrial design history is the division of industries in terms of public and private sector, through a series of Industry Policy Resolutions in 1948 and 1956. Coupled with the elaborate matrix of licenses and regulations that were required to set up and run businesses in India between 1947 and

1990, the infrastructure for a planned economy eventually led to the culling down of Indian made products.

Product or industrial design education and the profession itself was an indirect outcome to create an industrial infrastructure for the development of resources on a national scale. During the 60's the profession became familiar, albeit to the ears of a few. The design movement thus began through the then Prime minister inviting Le Corbusier to plan and design Chandigarh and Charles and Ray Eames to research about India's inherent potential and nature to initiate design.



A model of Chandigarh by Le Corbusier

Charles and Ray Eames with scholar of Asian art and aesthetics

This is well captured in the "The India Report". In the seventies the corporate world as well as many NGOs began to receive its first set of design graduates.They faced many challenges,asthenascent economy had no place or understanding as to how to make use of designers and design methodologies. During this era in particular the term economic development was critically re-thought due to its latent relationship with social justice. Thus many Western models of design methodologies came to be questioned, as the eco-systems were incredibly different. This is the time period, which began the movement for Design to participate in "Real World " issues, using appropriate technologies and the birth of the "Barefoot Designer".

Post 1990:

As only Government sponsored industries were doing well before the 1990's. This coupled with the fact that private industries were still working within the domain of the "license raj", made for an extremely inflexible framework for the profession of design, even though the opportunities were many.

An open market:

The new government with P.V NarasimhaRao and Manmohan Singh spearheading the liberalization brought forth ample socio-economic reforms and the initiation of many smaller Indian industries and ultimately an open market in a global sense. For the first time an effort was made to catch up with the technologically advanced countries, efforts gave rise to a boost in homegrown technologies, with international standards and competitors in mind. The moment corporate sectors began recognizing the capabilities of a designer; a shift began, where in design was intervening in hi-tech areas and not just the grassroots level.

Ground realities:

In an open market, a number of Indian companies went head-on with equally equipped competitors. Success stories are few and far between. Even more obscure are products that are essentially Indian by design and that which succeeded in the market and sufficiently so to have an impact in day-to-day life.

With the advent of the PCs and the Internet, small design firms began emerging handling projects focusing on product concept, production and marketing. The networking that was done was both national and international. Recent advances through digitization allowed for really low manpower and yet high output, albeit India still has a lot to catch up in terms of a gap in prototyping technologies.

A Global sense:

With the beginning of integrated devices, definition of product design has evolved as tangible products are becoming more and more like information processors. Thus the emergence of smart devices have led to more ancillary branches like interaction and user experience design, which in essence still has origins in product design. Due to the prevalence of two different extremes, the global village versus the real village, the practice of design is also becoming slowly dual in nature. Where one impacts aggressively with a non-culture specific agenda and the other deals with issues, such as limited access to new technologies, lack of infrastructure and wherewithal for a smooth transition from- local to a glocal village.

The future of the industrial design profession, and the education of industrial designers-in India and in other countries in a similar situation-largely depends on how these challenges are met. As the trend indicates, industry and the government have begun to show unmistakable awareness of the designers' roles in all three levels of production."

GOOD PRODUCT DESIGN

1. ADAPTABLE- ADAPTS to the needs of users.
2. EQUITABLE- ADDRESSES environmental and societal issues.
3. USABLE- PERFORMS well and brings delight.
4. IMPACTFUL- DEMONSTRATES impact through adoption, scale, or growth.
5. TRANSFORMATIONAL- CHANGES the known.

COMMONALITIES

1. **Brands** retain their status as public-facing purveyors of "good" design.
2. Design remains intertwined with **industrialized economies**.
3. Although challenged, the bias toward **physical artifacts** remains.
4. Design leadership, regretfully, remains mostly **white**, **male-dominated** and **Euro-centric**.
5. The **"form factor"** remains an essential ingredient.

PRODUCT DESIGN EXAMPLES

CUPS ARE PLACED ECCENTIRC TO THE SAUCER TO GIVE ROOM FOR COOKIES

RAILING FRIEDLY PLANTERS !

USER FRIENDLY BATH LIQUID CONTAINERS

CANDLE HOLDERS THAT RECYCLE

PLASTIC HANDLE CUM POUR TO FIT DISPOSABLE BOTTLES

HANDLE CARVED OUT FROM THE MUG'S OVERALL FORM TO SIMPLIFY STACKING & PACKING

A MUG WITH SLOT FOR COOKIES BELOW IN ORDER TO SAVE SPACE IN THT TRAY

MUG WITH A GRIP FOR THE STIRRING SPOON

BOTTOM OF THE MUG PROVIDED WITH A DRAIN TO PREVENT ACCUMULATION OF WATER IN THE DISH WASHER

TEA MUG WITH PLACE TO HOLD A STRAINER

TRAY FOR FIRM HANDLING

INTEGRATED AND COORDINATED DESIGN WITH BASE TRAY, METAL STAND WITH TILTING FACILITY & KETTLE

OIL CANS DESIGNED FOR EASY PACKING AND TRANSPORT

COFFEE TABLES WITH INTERCHANGABLE TOPS "A & B"

INTERESTING BOOK SHELF !

ROCKING CHAIR WITH BUILT IN READING LIGHT

A PILLOW THAT UNDERSTANDS !

THOUGHTFUL KITCHEN TABLE ORGANIZER

DESK ORGANIZER WITH SPACE FOR CARDS & CELL PHONE

A PAIR OF SCISSORS THAT SQUATS

TOOTH PASTE THAT CAN BE HUNG

AN UMBRELLA WHICH PROVIDES VISION WITHOUT COMPROMISING ON PROTECTION

CARRY BAG THAT REVEALS !

STACKABLE FURNITURES WHICH REQUIRES LESSER SPACE WHILE BEING UNUSED

PRODUCT DESIGNERS

They have affected the lives of millions with their inventions and designs, especially the ones working with large corporations. Product designers are responsible for creating many items that we use on a daily basis, affecting the lives of millions with their work.

10 most influential of all time:

Below are 10 of the best product designers who you probably know through their work, even if you didn't know their names:

JONATHAN IVE, 1967, UK

Apple Mac Pro 2019

If you're an **Apple** fan, you've probably heard of Jonathan Ive.

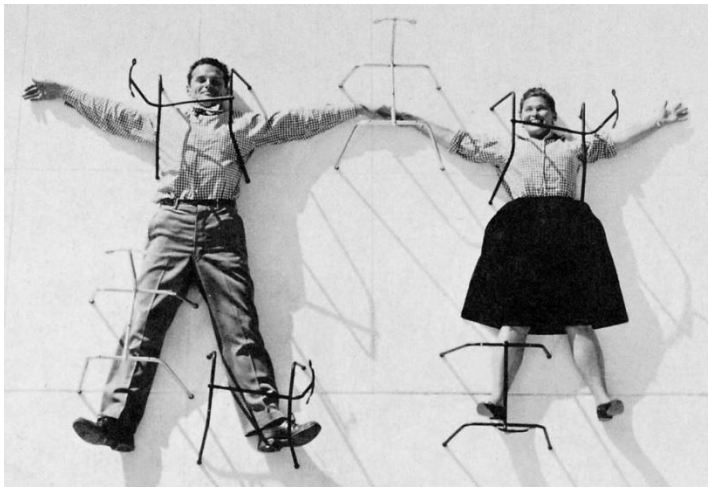
Being the Chief Design Officer at Apple, Jonathan was responsible for the creation of some of the world's favorite electronics. Jonathan was with Apple when they launched some of their most iconic products like the iPhone and the iPad. In addition to having worked at Apple, Jonathan is the Chancellor of the Royal College of Art in London.

JAMES DYSON, 1947, UK

Dyson AM07 Cool Tower Fan

Dyson is well-known for its innovations that helped vacuum cleaners and air blowing industry to a whole new level. Responsible for inventions like the No-Blade Air Multiplier Fan and the world-famous AirBlade hand dryer, James Dyson didn't only shape an entire industry but also created useful products for millions of people.

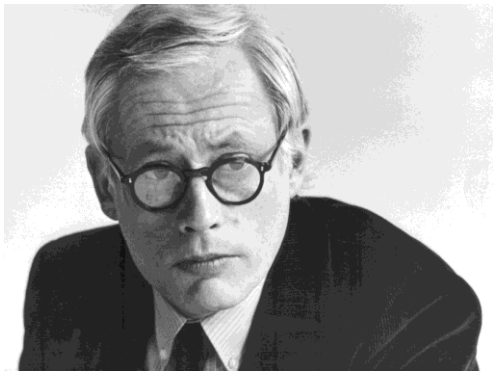
CHARLES AND RAY EAMES, 1907 AND 1912, USA



Eames Plastic Chair by Vitra

With a grand sense of adventure, **Charles and Ray Eames** turned their curiosity and boundless enthusiasm into creations that established them as a truly great husband-and-wife design team. Their unique synergy led to a whole new look in **furniture**. Lean and modern. Playful and functional. Sleek, sophisticated, and beautifully simple. That was and is the "Eames look."

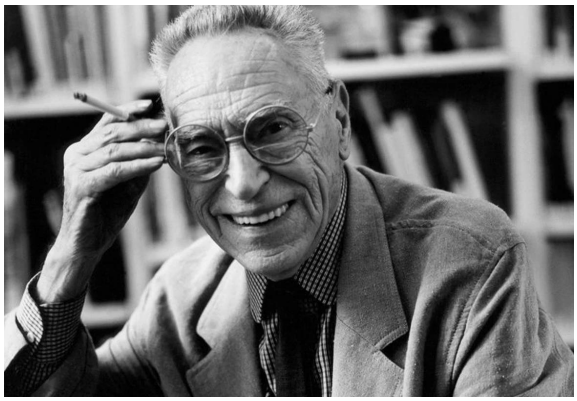
DIETER RAMS, 1932, GERMANY



Braun TG 60 Sound System

Dieter Rams has been leading the world-renowned consumer product company, **Braun**, while creating some of their most popular items. Asides from serving as the head of Braun, Rams has always been an advocate of good functional design, having written the 10 principles for good design: a great rule set for any product designer.

ACHILLE CASTIGLIONI, 1918, ITALY



Arco Lamp by Flos

Achille Castiglioni was a pioneer of Italian design and one of its most influential protagonists. Designing a wide variety of products, Castiglioni's work remains a huge influence on contemporary design. Famous for his elegant and playful lighting design, Achille Castiglioni pieces are considered design relics.

MARC NEWSON, 1963, AUSTRALIA

Lockheed Lounge

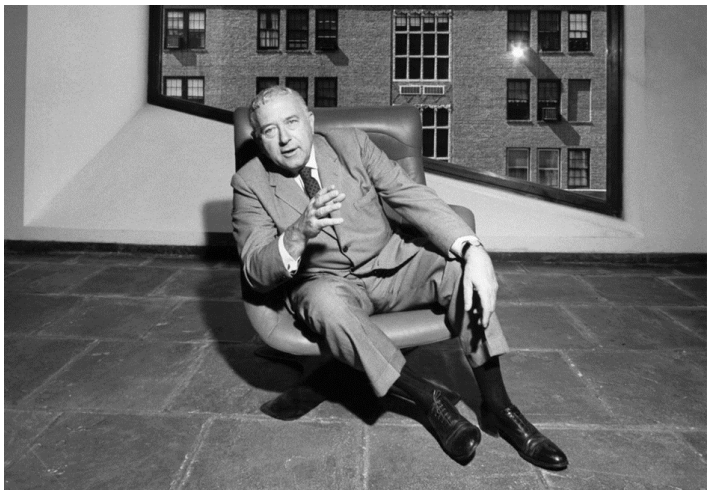
Marc Newson is an award-winning designer with works that range from **furniture** to aircraft and luxurious yachts. In addition to being one of the most influential product designers of his generation, Newson's works are featured in many contemporary design museums all over the globe.

ARNE JACOBSEN, 1902, DENMARK

Egg Chair

Danish-born Arne Jacobsen is considered to be amongst the most influential architects and product designers of the 20th century. Two of the standouts of Jacobsen's prolific career are his Egg Chair and Swan Chair. Even today, Jacobsen's work manages to be historical, futuristic, and contemporary at the same time. He's one of the reasons **Scandinavian design** is so popular these days.

MARCEL BREUER,

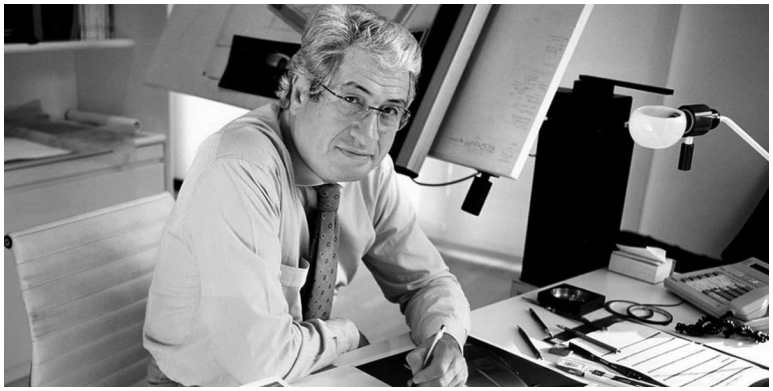


Wassily Chair

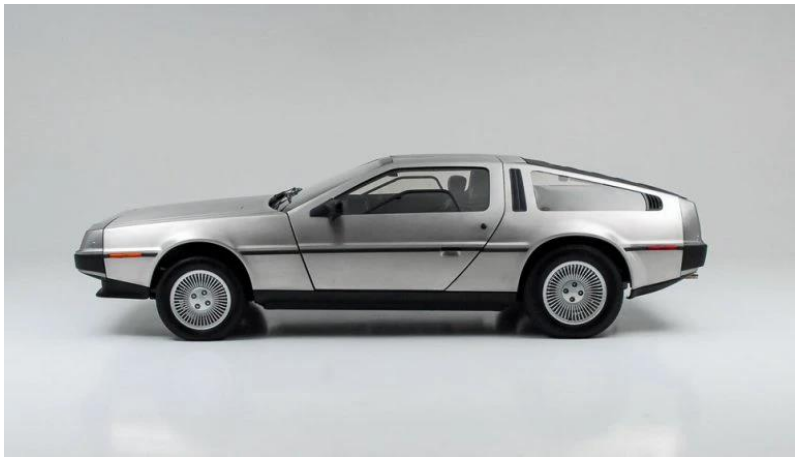
Marcel Breuer is a champion of the modern design movement and protégé of Bauhaus founder Walter Gropius, Marcel Breuer is equally celebrated for his achievements in architecture and furniture. Breuer was a student and subsequently a master carpenter at the

Bauhaus in the early 1920s. His work as a product designer embodies the driving Bauhaus objective to reconcile art and industry.

GIORGETTO GIUGIARO, 1938, ITALY



DeLorean DMC-12



Few other designers have been as influential as Giorgetto Giugiaro in shaping modern automobiles. In his career, Giorgetto has designed some of the most successful and influential cars in history, ranging from one-of-a-kind exotics to mass-market utility vehicles. He's designed over 200 cars for manufacturers around the world which collectively put over 60 million cars on the road. Furthermore, Giorgetto Giugiaro's career as a product designer goes far outside the **transportation** industry, ranging from photography cameras to guns, chairs and even his own pasta design.

PHILIPPE STARCK, 1949, FRANCE

Juicy Salif by Alessi

Philippe Starck is an advocate of democratic design and an iconic product designer whose works spans different disciplines. Asides from creating beautiful, useful and democratic designs, Philippe Starck's work is known for its political messages, which makes his work even more outstanding.

UNIT – II– Product Design – SDE 3502

HUMAN FACTORS

Application of human factors data. Human activities, their nature and effects. Human response to climate. Visual, Auditory, Tactual, Olfactory human mechanisms, Physical space and arrangement. Evolving the strategy of design with integration of technical complexities and lifestyle influences. Development of the design of products and accessories to specific interiors and prevailing trends.

SENSORY CONSIDERATIONS

Consider the **sensory considerations** of how the principles and elements of design work together with **acoustics**, lighting, visual stimuli, color theory, scent, and tactile qualities to create a design solution. **Special populations** including children and the elderly may experience these qualities differently.

SENSES

- Architecture & Interior Design, an important part of our environment, disturbs our experiences, feelings, memories, and ultimately the decisions we make.
- We understand buildings through our senses. There is an interplay between the five basic individual sense systems covering visual, auditory, taste–smell, orientation and the haptic sensations.

PERCEPTION THROUGH SENSES

- Sight gives us knowledge of three dimensions and colour.
- Light Quality – direct, indirect, natural, artificial, diffuse, dappled, focused –can be subtly manipulated in the design of a space to achieve the desired effects.
- Listening helps us to feel the building from a safe and relaxing point of view, so that we can sleep in comfort.
- Touch is very important, as an architectonic feeling of each and every object is perceived by this sense, for example, a faucet in a bath that is smooth to the touch, a towel that is soft to the touch, or soap that is leathery to the touch. The sense of touch is the most intimate when products are considered.
- Thermal Qualities – warm, cool, humid, airy, radiant, cosy - are an important part of our experience of a space, they not only influence what we choose to do there but also show how we feel about the space.
- Smell gives us a sense of cleanliness or dirtiness, of a turbid or rotten or fresh feel, and the ambience is felt first-hand with this sense.
- Taste is not directly effective in products except ones with food & beverage.

SENSORY DESIGN

Designs rely more heavily on the Visual Sense. By arranging spatial sensorial features, an architect can lead occupants through the functional and aesthetic rhythms of a created place. Architectural building for all the senses can serve to move occupants - elevating their experience. By engaging all of the senses, form and function may be more fully expressed so occupants can have deeper, more meaningful moments

The boundary line between the world and ourselves is identified by our senses. All the senses, including vision, are extensions of the tactile sense; the senses are specializations of skin tissue, and all sensory experiences are modes of touching, and thus related with tactility.

Our skin is the oldest and the most sensitive of our organs, our first medium of communication, and our most efficient protector. Touch is the parent of our eyes, ears, nose, and mouth. It is the sense, which became differentiated into the others, a fact that seems to be recognized in the age-old evaluation of touch as 'the mother of the senses.

The tactile experience: The skin is capable of reading the texture, weight, density and temperature of an object. The tactile sense is the one that actually establishes a connection between our body and the world. It is not just about physically touching an object but about accepting the volume and temperature of space. Great Interior Designers have created designs that appealed to the eye and also invited one to touch and explore.

The role of eyes: Architecture is regarded primarily as a visual phenomenon. Thus, we have many buildings that are designed to please the eye but fail to delight the body as a whole. Eyes absorb the visual qualities of a space. Vision is capable of stimulating other senses in our body.

The auditory experience: Vision is directional while sound is omnidirectional. Thus, sight isolates while sound integrates. The loss of senses in contemporary interior design can be attributed to the ignorance of acoustic intimacy. Sound can lend characters to a space: intimacy or monumentality, invitation or rejection, hospitality or hostility.

The form and the volumes of a building and the materials, with which it has been built, contribute to the sound generated in its interior and exterior spaces.

Induction of oral sensation: There is a delicate transference between tactile and taste experiences. Also, taste is generated by the combined action of nose and tongue. Eyes collaborate with tongue as well. It has been found that certain colours and delicate details generate oral sensations.

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How to design for the senses?

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- **Consider the shape of a space, the colour of a wall, the light from a window, the comfort of a textile, the sound of a floor.**
- **Each of these moments are key opportunities to think about the sensory signals of a space and what experience you want people to have.**

Design Theory- Don't confuse ***design theory*** with a *design style*. Style is an aesthetic, such as French provincial. **Design theory** is a designer's unique approach to a creative problem solving process based on one or more of the following:

- Historic precedent
- Human behavior and perception
- A particular process
- Environmental design research and evidence-based design

- A designer's personal worldview
- Functional needs

Both the *elements* and *principles* of design theory are visual building blocks common to all design practices.

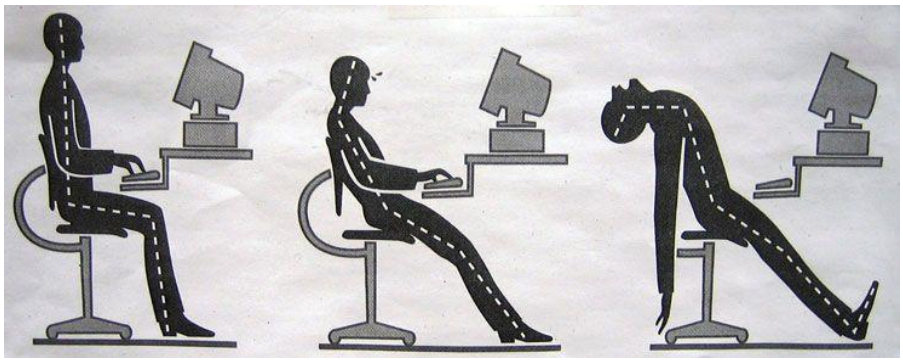
Influences

The design of the built environment relies not only on theory, but also the temperament of what's happening outside of the immediate confines of the project. While more subjective and ever-changing, some not so obvious influences include:

- Cultural and societal beliefs
- Political conditions
- Cultural symbolism
- Regionalism
- Psychological factors
- Economic Factors

Economic conditions frequently resonate in interior and architectural design. In times of financial hardship, designs are often more streamlined and subdued. A more stable, prosperous economy will often substantiate more luxurious designs.

ERGONOMICS



Human factors focus on the fit between objects, spaces and users. With an emphasis on physical dimensions, psychological, social and physical needs are also considered.

Ergonomics studies the *relationships* between the human body and the physical environment. It uses anthropometric data as a base, but focuses more on the interaction with specific objects and tasks, such as a stove top for cooking or office workstations.

Ergonomics is a relatively new area of study and can be described as:

"The science of looking at how people relate to the products that they come in to contact with"

Ergonomics is about creating products that suit the user rather than the user adjusting to suit the product. For example, computer chairs adjust so the operator is comfortable and less likely to develop painful and crippling problems such as repetitive strain injury (RSI).

Ergonomics consists of three areas of study:

- PHYSIOLOGY: the study of bodily strength, fatigue, reaction times etc
- PSYCHOLOGY: the study of behaviour: the way we react to heat, light, texture, colour, noise.
- ANTHROPOMETRICS: the study of human measurements such as height, arm length, reach.

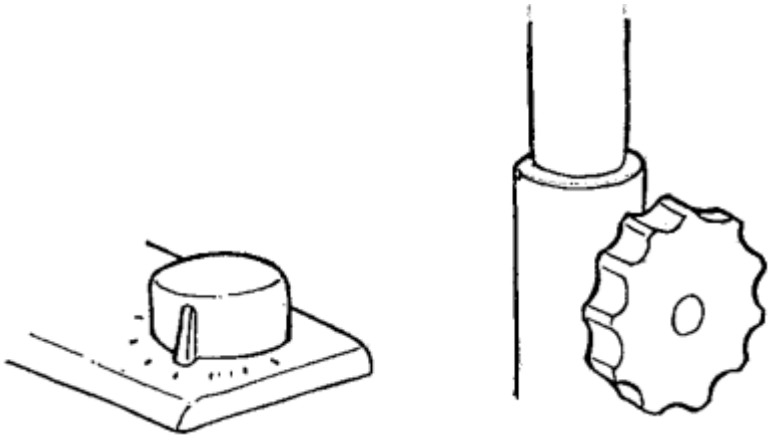
PHYSIOLOGY

Physiology is the science of how living things work. This subject is of interest to designers because they need to create products that are within the physical limitations of the human body.

For example, a car braking system must be designed so that the even the weakest driver can use the brake pedal and stop the vehicle. So the designer would need to refer to the data on the pushing force from adults right leg and then create a brake system to suit the smallest value.

The designer should also consider which part of the body is most suited to performing a specific task. Legs are stronger than arms and are more suited to simple repetitive tasks involving large forces. Hands and fingers are more nimble and are better suited to finer controls such as adjusting the volume on a radio.

The shape and size of handgrips vary greatly. For example, the diagram opposite shows two grips, one for a gas cooker ring and the other for adjusting the height of an office chair. The cooker control has a smooth texture with no grip because it is easy to turn and allows fine adjustments to be made. The chair adjuster however has to be grasped firmly so it requires a serrated surface to provide plenty of grip.



An effective way of developing designs for handgrips or controls is to make simple models out of plasticine or clay. These can then be easily tested on potential users and quickly modified as necessary.

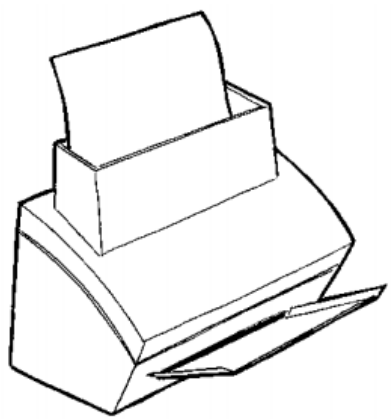
PSYCHOLOGY

Psychology is the study of the human mind and the way it affects our behaviour. Our five senses (sight, sound, taste, touch, smell) input information from the outside world to the brain. The brain interprets this data and provokes a reaction in us. For example, a sudden loud noise may prompt you to place your hands over your ears.

All aspects of the environment affect the way we behave; on a sunny day you may feel happy and if it is cloudy you may feel sad. In the same way a bright room will heighten our senses whereas a dull room can be subduing. There are a variety of aspects in the design of a product that might affect our behaviour and so having an understanding of how the mind works is important when considering the human/product interface.

Designers can improve the way we interact with a product by making it clear and simple to use. The user must be able to easily sense important information, be it through touch, sight or sound and then react accordingly. For example the on/off button might be raised clear of the surface and give a reassuring 'click' when pressed.

The shape of a product can also suggest its function and dictate the way in which it is used - this is called product semantics. In the inkjet printer shown opposite the position of the input and output trays, combined with the rounded form, suggest the path of the paper through the printer.



One of the challenges facing designers is how to present a lot of detailed information in a clear and ease to understand way. For example, an aircraft pilot has to monitor a whole range of dials and gauges. Displays showing rapid rates of change, such as altitude, can be either digital or analogue. A digital display is better for accurate measurements when the rate of change is slow whereas an analogue display lets the pilot see at a glance the overall picture. In practice a mixture of both types of instrument are often used.

Analogue display – easy to read at a glance, often uses colour to communicate information but not as accurate as the digital equivalent.

Digital display – very accurate, but can be difficult to read at a glance especially when figures change quickly.

On complex instrument panels important information such as a warning can easily be missed if only one sense is used. For instance the pilot may not notice when the air speed drops to a dangerous level and so a flashing light and audio "stall…stall" are also given. One recent technological development has been the use of the membrane switch panel. This is found in many products ranging from mobile phones and cash dispensers. The problem with this type of switch is that the contacts do not move and the user is often unsure whether the button has been pressed or not. The solution is to use sound to provide a 'bleep' and confirm that the

button has been pressed. Using one sense to reinforce another has the psychological effect of making us feel more confident and in control of the system.

ANTHROPOMETRICS

Anthropometrics focuses on the size, proportion and range of *motions* of the body. Findings are statistically grouped by sex, age and percentile ratios.

Before selecting anthropometric data you must consider how the product will be used. For example, if you were carrying a briefcase then the distance from your hand to the floor would be important. However, if you were pulling something behind you then your stride would have to be taken in to account so that the device does not catch your heels.

A sketch such as the one shown opposite would be a helpful starting point. This shows an ergonome and indicates crucial sizes to be found.

Before looking at the anthropometric tables, study your sketches and ask yourself the following questions:

- Are you looking for a clearance, reach or postural measurement?
- Which percentile range will you be looking for? (5th, 50th or 95th%le)
- Will you be looking for male or female measurements?
- What region of the world is the product to be sold (North American, Europe, Asia etc)?

TASK ANALYSIS

When considering the ergonomic aspects that will affect the design of a product it is helpful to carry out a task analysis exercise. Here you imagine that you are a typical user of the product and try to see all of the important ergonomic aspects (see page 6 on Design Stories). During this process a number of key questions need to be considered:

- What are the critical functions of the product?
- How will the product be stored, transported and maintained? How will this affect the design?
- Will the user wear gloves/outdoor clothes? Does the design allow for this?
- What are the age range, gender and race (North American, Asian, European etc) of the user?
- What sizes need to be tailored to the human form? (see the anthropometric data tables).
- Will the appearance of the design be important to the user? Can the aesthetic of a design have a positive psychological influence?
- Under what conditions will the product be used e.g. dark, wet, cold etc? How will this affect the design?

Proxemics

Describes how people use a space based on circumstance and cultural aspects. Four different distances are identified in the theory of proxemics:

- Intimate distance
- Personal distance
- Social distance
- Public distance

"Social distance" ranges from 4 to 12 feet and is the distance at which most impersonal business, work and interaction takes place between strangers or in formal situations.

A behavior setting links the effects of the physical environment with behavior patterns of the people using the space. By knowing the activity taking place in the space and how the users will react, the designer can then develop programmatic concepts for the project. Some behavioral components include *proxemics* and *territoriality*.

Territoriality

A non-verbal communication in claiming ownership to a space. You've likely seen a person sitting at a six-person sized table at coffee shop with their belongings strewn about, letting others know this is "their space" and their unwillingness to share.

AESTHETICS

Aesthetics is the study of how something looks. When consumers see a product for the first time they may look at the price or its features, but their initial reaction is most probably based on how good it looks. First impressions count; so designers must consider aesthetics when developing a product in order to maximise sales.

Certain shapes, particularly those based on the human body, can affect us in certain ways. This is because these shapes often relate to our most primitive feelings. Likewise, colours can affect us; experiments have shown that a red room will raise our blood pressure while a green room will lower it.

The effect of all these aesthetic factors will combine to shape our opinion on the beauty of a product. This judgment is in no way final and aesthetics, like beauty, can often be in the eye of the beholder

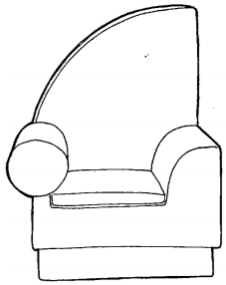
AESTHETICS: CASE STUDIES

The following case studies look at some of the roles that aesthetics can play in design:

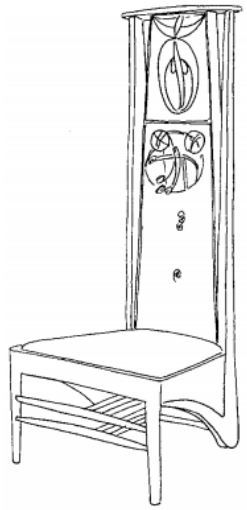
FORM FOLLOWS FUNCTION- The expression "form follows function" originated at the Bauhaus School of Design in Germany during the1920s. The Bauhaus School worked on the principle that decoration and ornament are superfluous to real design and that the form (or final appearance) should be derived from the function. The picture below shows the Cesca Chair designed by Marcell Breuer in 1928. The chair consists of a tubular steel frame on to which a woven cane seat and back have been added. Although the design is very simple and functional, it is still after 70 over years very popular, the main feature of the chair is the cantilever design that gives it its inherent springiness and is also responsible for the design's simplicity (one piece of tubing and no joints). The cantilever design also gives the chair a balanced look as the tubing at the base curves round under the back implying support.

LESS IS MORE- This style became very popular in the 1970s and was characterised by electrical goods manufacturers such as Braun and Bang & Olufsen. Details were kept to a minimum and neutral colours such as black, white and silver were used. Switches, buttons and displays were either hidden or designed in such a way that they blended in to the overall form. Contrast may have been used to separate different areas for example black and silver or a smooth and rough texture. This approach allowed the designer to concentrate on the overall form of a product seeing it as a whole rather than a sum of parts

LESS IS A BORE- This style is typified by the Memphis Group of designers who deliberately set out to shock people with their outrageous designs. The Memphis style originated in Milan in the 1980s where a number of designers decided to spice up the world of design with the philosophy 'Anything Goes'. The picture to the left shows the Bel Air armchair designed in 1982 by Peter Shire. The designer has used cylindrical or semi cylindrical forms to create an asymmetric design. The unusual overall form combined with the bright pink, yellow and blue colour scheme creates a striking design.



BIOMORPHIC DESIGN: CHARLES RENNIE MACKINTOSH- Like many of his contemporaries at the turn of the 20th century, Mackintosh based his designs on natural forms. Because we grow up with nature we find it easy to relate to the forms that are based on it. The chair shown was designed by Mackintosh in 1902 and is typical of the Art Noveau style. The headrest and back feature motifs based on flowers such as roses and these have either been screen printed or carved. Elsewhere, most of the lines on the chair are slender curves, which flow into one another. This gives a very soft, organic feel to the design, which suggests a connection with nature.



UNIT – III– Product Design – SDE 3502

DESIGN APPROACH

Design approach with limited constraints inherent in accessory products. Broad based approach towards innovative design and application to multi products and multi materials in manufacturing interior products and lifestyle accessories. Study of materials and processes adopted in accessories design. Stylistic development of interior products from the past to present with insight into technological advances and the influences of social, economic and political factors on their design. Form, Colour, Texture, Symbols, User specific criteria, Material, Technology and recyclability, Packaging. Multiple Utility oriented approach to Product Design.

PRODUCT DESIGN PROCESS OVERVIEW:

EXPLORE (PROJECT FOUNDATIONS)

Every project is different - it can originate as an idea or invention of yours or your boss' it could come from a client or brand; or it may be born from the requirements of a manufacturer who can only produce certain things in certain ways. A project's beginning depends on the source and the amount of innovation expected and the first thing designers need to do is scope out the project, to define what you're going to do and outline your approach to the project. Learn to ask the right questions to understand the user, market, production options; to establish user needs, goals and criteria; and to anticipate risks and roadblocks.

SKETCH (BEGINNING THE DESIGN)

The next phase of product design is expansive. The team takes the research and raw ideas and generates a wide spectrum of ideas to create a broad field of options from which to choose. Designs at this stage show variations on form and function, in materials and processes, and perhaps even of target users and customers. Rough sketches and models allow a design to be tested and expanded, as well as presented to users and the client for feedback. This phase of the process concludes with the selection of one product design to move forward into development.

DEVELOP (FOCUS AND TEST THE DESIGN)

Having selected a concept and chosen a path, the next step is to refine and perfect the design - define its form and dimensions, explore colors and graphics, choose materials, solve basic engineering issues and resolve production obstacles. With this work done, take the complete working sketch, generate a digital 3D model, and create a functional prototype of your product design to be used for testing with users, the client, manufacturers, and for health and safety requirements. Now is also the time to look ahead to a product's life out in the market and in users' hands, and think about packaging, instructions, graphics, advertising narrative and other elements.

DELIVERY (FINALIZE PRODUCT AND MANUFACTUING)

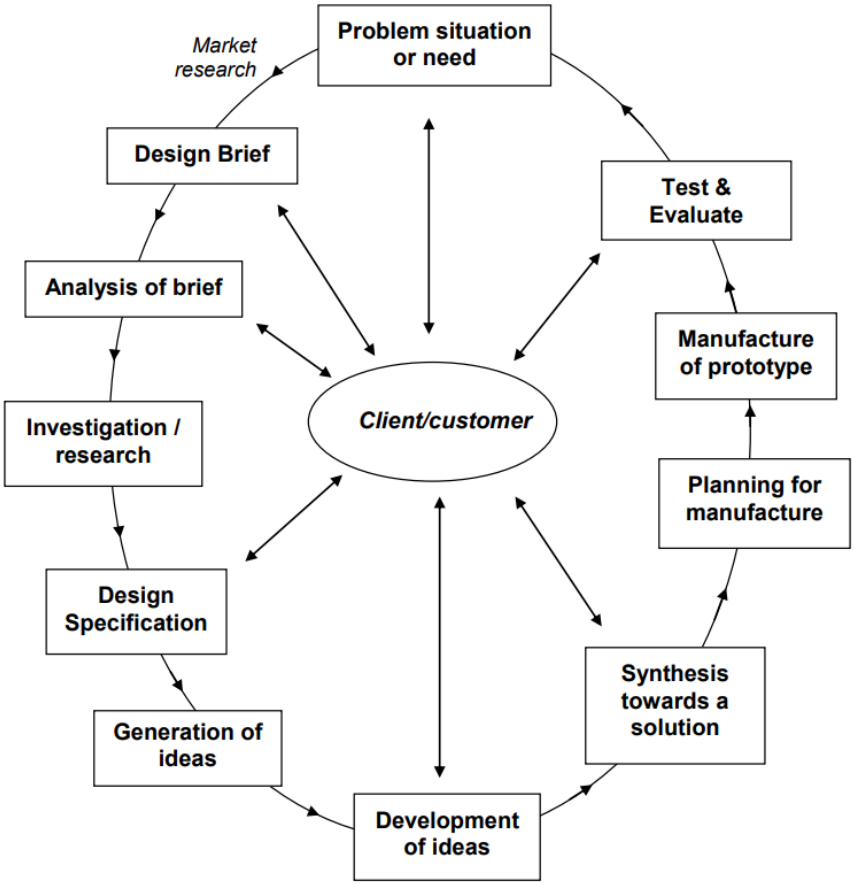
With a tested and refined prototype, the design will be ready for production. In order to hand over the design to a manufacturer, all the product specifications will need to be finalized and put into precise documentation which will communicate the specifications during fabrication. A designer must clearly communicate how every individual piece of the product looks and works. Finalizing the engineering details plays a crucial role in product development, but marketing, sales, and costing are also pivotal - a successful product is the result of insights from all sectors.

POST PRODUCTION (RESULTS AND REVIEW)

After the design is in production, you need to look back to move forward. Look back at the entire process: What went right? What went wrong? What should we do differently next time? Did we get the results we wanted? What worked well? The wealth of insights available to analyze post-project should help you in the next project: revising documentation, refining metrics, and revamp marketing and promotion. This review process prepares you for a simple question for everything: what's next? Next for the client, next for you, next for the profession, what's the next project? Every project, every design moves you forward as a designer and a crucial part of this reflection concerns your own professionalization.

THE DESIGN PROCESS

The design process is an activity that seeks to recreate invention in an orderly and controlled manner. Designers cannot afford to wait for inspiration; instead they must be able to produce ideas on demand and in a systematic way: "Ideas never come in a flash; they come as a result of months, even years of hard work." Barnes Wallis inventor of the 'bouncing bomb'. There are many approaches to design but it is important to realise that any design team will work through a series of planned stages towards a final proposal. Throughout this process the team will consult the client / consumer and evaluate then updated their work as required. The Design Chain is shown below; this is just one example of the approach to the design process:



The design process begins with a design brief (based on a problem, need or market opportunity) and ends with an evaluation of the solution.

PRODUCT DESIGN TEAMS: All new commercial products are developed not by one individual but by a design team made up of a number of specialised professionals. The exact makeup of a design team is not fixed and will vary from product to product and company to company, however some of the key personnel include:

DESIGNER- They normally carry the lead role in the team and will have overall responsibility for the development of the new product. This will involve producing sketches/drawings/models and developing the final proposal in order to satisfy the specification. In a small project a single designer will normally both coordinate and carryout most of the design work.

MARKETING- The marketing specialists will initially liase with the sales staff to identify potential niche markets for the product. This will usually involve market research (questionnaires, focus groups, user trials etc) in order to see what the market actually wants and needs. As the design nears completion they will use advertising to inform the public about the product. After the launch the emphasis of the advertising will shift to promote the product's features etc.

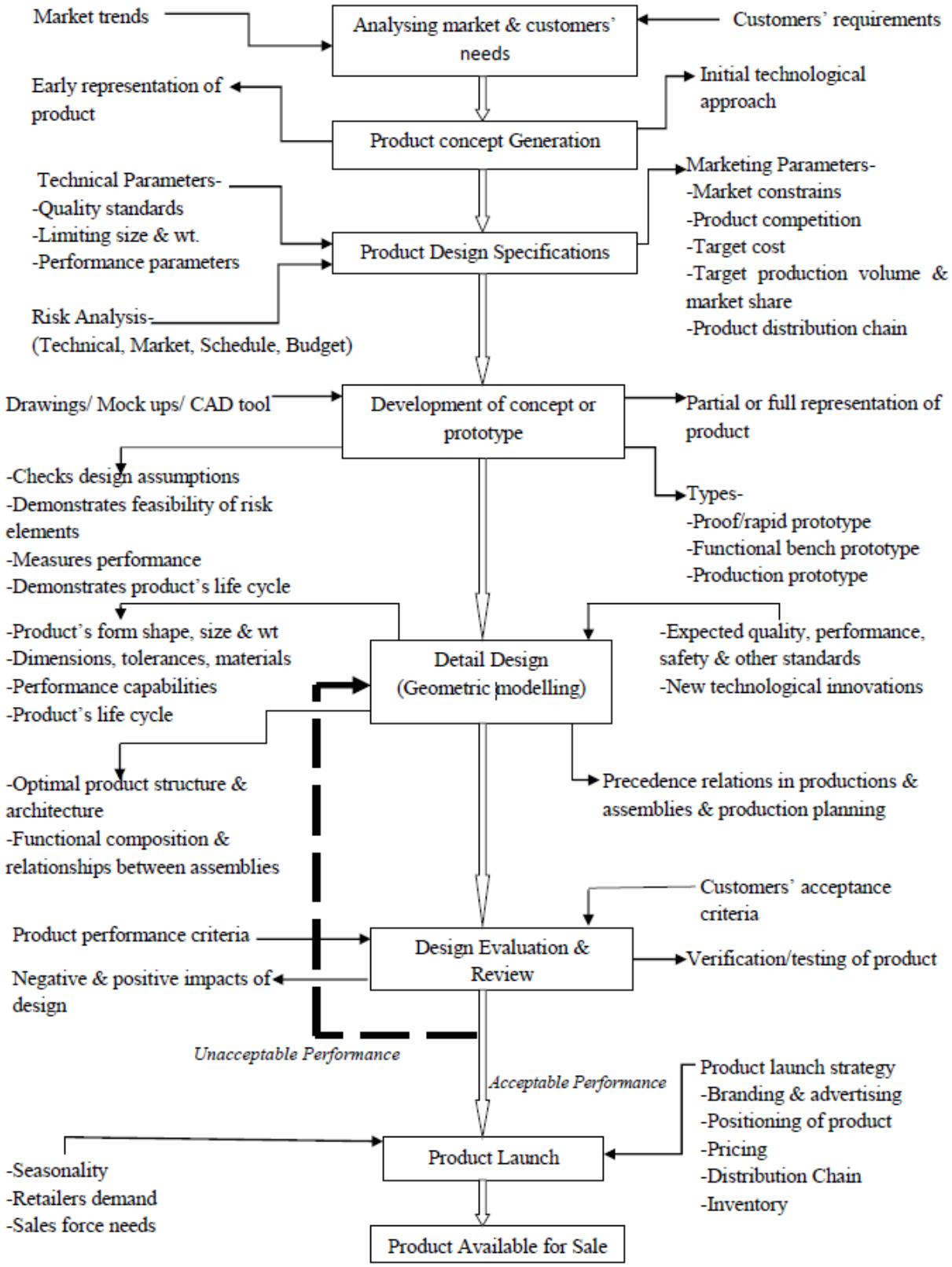
SALES- The sales specialist has detailed knowledge of the company's customers and will be involved in providing information on the market place, competitors' products and future trends. They know the company's existing consumers well, but many also commission market research to survey consumers on their thoughts about existing products and their future requirements. Their knowledge is critical when establishing the brief and specification and will normally be able to suggest the price bracket into which the product will have to fit.

ACCOUNTANT- Company accountants will supply ongoing advice on the research and development (R&D) budget and other project costs, as well as providing detail of the financial constraints for the production and marketing of the product with regard to predicted sales and the company's financial position.

ENGINEER- Various engineering specialists will be required to bring technical expertise (electrical, mechanical, computing, material, production etc) to the team. The company may have a product engineer who will accept overall responsibility for the manufacturer of the product. Once the project is completed the product may be manufactured wholly in-house, parts sub-contracted to specialised companies, or standard components sourced and brought in for assembly. The choice of manufacturing/assembly technique to be used will depend on the equipment available, staff skills, and volume of production.

MANUFACTURER- The manufacturer, like the engineer, brings detailed technical information to the team; they will provide detail on the expertise and equipment that the company currently has. They will advise on the workforce's training needs, investment in new equipment and the production method (batch, line, mass, flow etc). This is especially important if the designer is not in-house but a freelance design consultant (not permanently employed by the company and brought in just for the project).

Product Design & Development Process



THE DESIGN BRIEF

The design brief is usually the starting point for any creative project. It normally contains enough information to put the problem or need in context, define the market segment and indicate the main requirements of the solution. The design brief will state WHAT the problem is, WHY there is a need and WHO are the target market.

When writing a design brief the following points should be addressed:

- What is the nature of the problem/need?
- Why has the problem/need arisen?
- What is the target market?

An example of a design brief is shown below:

Garden tools such as spades, rakes, forks, etc come in a variety of shapes and sizes. The storage of these items in a garage or shed can cause a variety of problems. The tools get tangled up or stuck behind each other. You may require only one tool which is behind the others. Or you could stand on a tool and injury yourself. The main reason that the tools are difficult to store is that they vary in length and that the ends and handles are all different shapes and sizes. A device is required which will store the above items in a space saving manner whilst allowing easy access to each item at any time. Such a device would prevent accidents with such tools whilst making the task of gardening more efficient and enjoyable. The product will retail in the UK's leading DIY store B&Q and will be priced at around £20

A client or end user usually supplies the design brief. However, the way in which the brief is written can have a major influence on the design of the product:

OPEN BRIEF An open brief is one which sets out what has to be designed in fairly general terms. This type of brief leaves a lot open to interpretation by the designer and hence allows a wide range of possible solutions. One advantage of this type of brief is that truly original solutions can be explored, however it has the potential disadvantage in that much time and money can be wasted on proposals that may be unacceptable to the client.

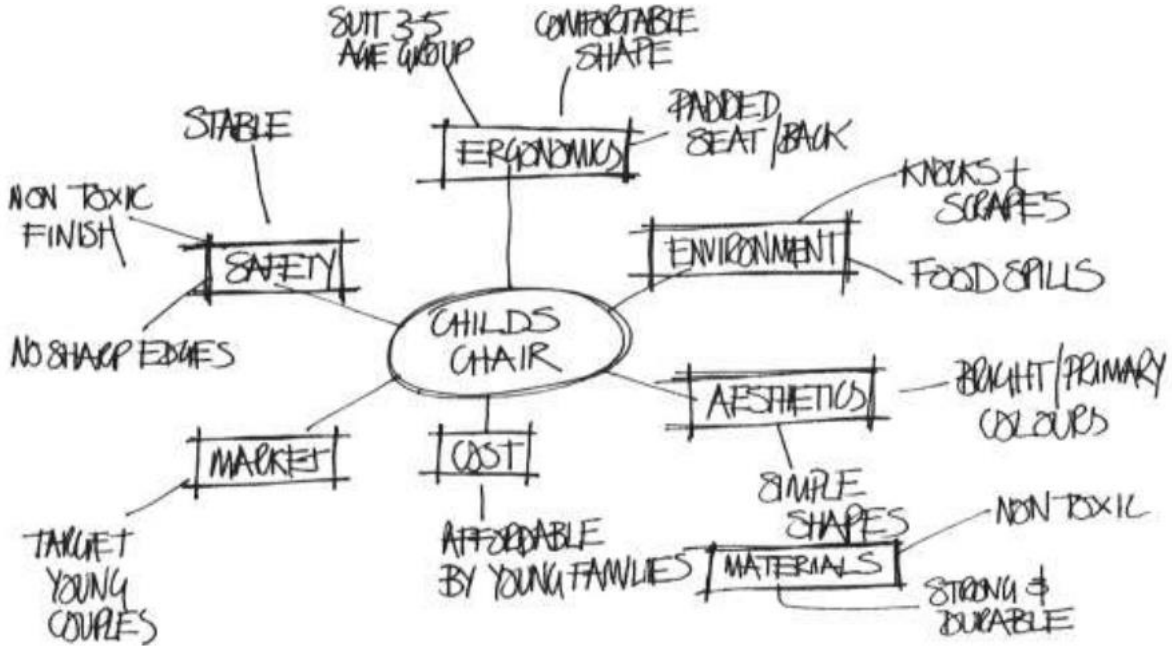
CLOSED BRIEF A closed brief sets out the requirements in fairly specific terms. This type of brief will highlight major restrictions, areas for research and direct the designer towards what the client and users want. This gives the client greater control over the process but it does tend to limit the design team's freedom and can reduce the chance of developing a groundbreaking design.

ANALYSIS (analysis, an-al'is-is, breaking up of a thing in to its parts) If we analyse something then we gain a better understanding of what is going on. So, when faced with a problem, the designer will break it up into its element and look at these in greater detail. Initially a brainstorming session may be used to suggest all the possible aspects that will influence the design. This is started by writing the name of the problem area in the centre of the page and then noting down all of the possible design aspects around it (mind map). The following aspects may provide a useful starting point:

- function;
- performance;
- aesthetic;
- ergonomics;
- market;

- economics.

The mind map below shows the initial analysis of the aspects influencing the design of a child's chair:



MIND MAP

Historically it was assumed that the mind worked in a linear manner. Note taking, for example, is usually in the form of vertical list. However, the complex process of selecting, sorting and categorising information quickly and effectively is an important skill which can be improved by mind mapping. The advantage of mind mapping is that the information is 'slotted in' easily, eliminating the need to alter or rewrite. Network of ideas and words are interlinked and added to as they are analysed, coded and criticised naturally during the process. Starting at the centre, jot down ideas branching out from the main theme. This creates a pattern which is easy to remember. It also helps to link concepts, enabling new connections to be made more readily. Then select, sort and categorise. The production of a mind map involves critical analysis, integration of information, easier recall and a better overall understanding.

LIFESTYLE BOARD

Producing a lifestyle board can be a very easy way of providing an aesthetic direction for the product. It should be full of visual images which give a snapshot of the lifestyle of the target market. There are no rules for producing a lifestyle board but it is useful if certain guidelines are followed so that the information gained from the board can be used effectively.

The first step is to identify the intended market group and then find out as much as possible about them (age range, gender, socio-economic group, culture hobbies etc). The next step can be more difficult and may involve people watching. The purpose of this is to get a general picture of the target market, where they go, what they wear, what food they eat and other relevant observations. Finally once an overall impression of the target markets' lifestyle has been captured the lifestyle board can be produced which may include:

- the food they eat;
- the clothes they wear;

- where they go on holiday;
- the houses they live in;
- the cars they drive;
- the music they listen to;
- the leisure activities they undertake;
- the style of furniture in their home;
- the products they own and aspire to own.

These visual images can be photographs or taken from magazines, newspapers, brochures or movies and may include textiles and swatches of material. The result can be viewed as a visual snapshot of the intended market group's life. The designer can use the colour, shapes, patterns and styles found in the lifestyle board when creating ideas. One of the evaluation tests that can be carried out is to place a picture of the finished product in the lifestyle board to see if it looks out of place with the rest of the images.

MOOD BOARD

A mood board is similar to a lifestyle board in that it brings together visual images from a range of sources and it is used as a stimulus for new ideas. The difference is that a mood board should create an atmosphere which reflects a chosen mood and it can be used to help give a product a particular image. Many adjectives can be used to describe a mood. It may be useful to apply these to a product and then explore and experiment with colour, shape, form and the other aesthetic features:

Happy Sad Aggressive Sexy Cool Fun Efficient Immature Relaxed Confident Outgoing Lonely Stressed Frantic

A mood board can also be a way of visual brainstorming where the images created by a mood are recorded and then pictures are found to illustrate them. In contrast, a lifestyle board is the result of a much more analytical process where the product's market segment is studied and visual images are then collected.

DESIGN SPECIFICATION

There are many different types of specification; product design, performance, marketing, technical and maintenance. For example, technicians would refer to a maintenance specification for a wind turbine to tell them when and how to lubricate parts, tighten bolts, apply paint, and replace rubber fittings. Although specifications can be boring to read, they account for every detail affecting the product. A product design specification (PDS) is a statement of the features that the finished product must possess in order to satisfy the design brief. It is written by the designer and is based on all the key research information gathered. The PDS should be unambiguously and list all the requirements of the product including any numeric detail including tolerances. The client, who set the design brief, should be fully consulted as their needs are of paramount importance. A product design specification is normally structured using the relevant design aspects:

- Function
- Ergonomics
- Performance
- Materials

- Aesthetics
- Manufacturing
- Marketing

Several points could be made under each heading. For example, the specification for a child's chair is given below:

Design Specification EXAMPLE: Child Chair Project

Performance:

1. The design must support the weight of a child up to the age of four years old.

2. The design must incorporate some form of table of tray for eating, playing etc.

Ergonomics:

3. The design must suit the anthropometric data of one to four year olds.

4. The design must be easy to lift by an adult.

Safety:

5. The design must have no sharp edges.

6. The finish on the design must be non-toxic.

7. The design must have no loose small parts that could be swallowed.

Materials:

8. The materials used must withstand scrapes, bashes, food spills etc.

9. The materials used should not splinter or chip easily.

Manufacture:

10. The design should be easy to manufacture in an average workshop with basic wood, metal and plastic tools/machinery.

Aesthetics:

11. The aesthetics of the design must appeal to the age group it is aimed at (primary colours, simple shapes etc).

Marketing:

12. The design must be affordable by a typical young family.

13. The design will be sold in toy departments in large department stores.

14. Whilst the design must be aimed at children between the ages of one and four, their parents who will buy it must also be made aware of its benefits.

PRIMARY & SECONDARY FUNCTIONS

In any specification there are always some aspects that are more important than others. These needs can be divided into either Primary or Secondary function. The primary functions are those that are vital for the product to do its job, whilst the secondary functions are those which although important could be compromised for the benefit of the primary functions. Dividing your specification up in this way helps you to prioritise, especially in the early stages of a design, and allows you to focus on the important aspects of the product. For example, the primary functions of a kettle could be listed as; boil 1.5 L of water and pour

safely. These functions will allow the designer to produce a range of sketch ideas without getting bogged down with such things as a water level indicator, cordless feature, etc.

GENERATING IDEAS

When faced with a blank sheet of paper many people find it difficult to come up with new and innovative ideas so a number of techniques have been developed to help provide a starting point. The main aim of each of these techniques is to guide the designer away from conventional thinking or existing solutions and help suggest new, original and creative ideas.

BRAINSTORMING

Brainstorming is a group activity in which people focus their attention on a specific issue or problem and generate a large number of ideas in a short space of time. One advantage of working in a group is that others may see the problem from a different perspective and suggest a fresh approach. This in turn stops the others from becoming too focused on a single train of thought. The rules of brainstorming are:

- the problem must be defined in fairly simple terms to encourage a variety of solutions;
- no criticism of any suggestion is allowed - judgment should be kept until later;
- all ideas should be welcomed, however bizarre they may appear;
- the emphasis should be on producing a large number of ideas;
- building on others ideas should be welcomed. Insisting on these rules leads to a relaxed environment where people feel uninhibited and open to free thought.

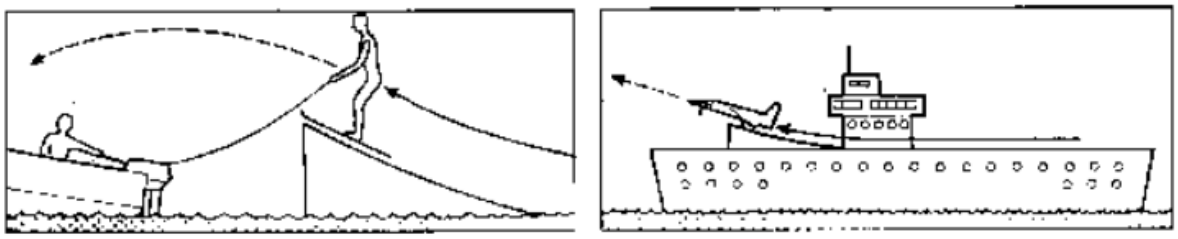
The suggestions are recorded in note or sketch form or a combination of both. Once the session is over however, it will then be necessary to sift through all the ideas and select those which show potential for further development.

ANALOGY

Analogies are very good for discovering things you had not realised about the problem or product and thus enable you to develop new solutions. Often an analogy will include the words "... is like ..." The first step is to make up an analogy:

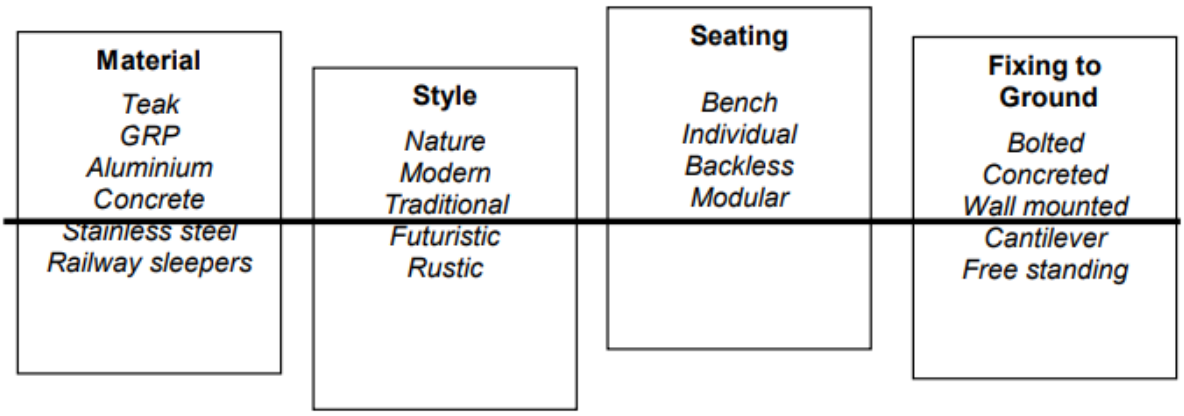
- What does the problem or product remind you of?
- What other areas of life/work experience similar situations?

Analogy's success depends upon your ability to identify useful lines of thought. For example, engineers faced a problem when designing a new aircraft carrier for the Sea Harrier jets. The decks were too short for the planes to take off with a full load, unless the carrier steamed at full speed into the wind. It was the analogy which likened this problem to water-ski jumping that provided the breakthrough and led to the ramp take off being successfully developed.



MORPHOLOGICAL ANALYSIS

One way to come up with a really good design is to have lots of ideas and then throw away all the bad ones. Morphological analysis is a simple technique which can suggest thousands of possible ideas. It is carried out by breaking the problem down into its main features. Each of these features is written on the top of a separate card and then a variety of options are noted below. These lists are laid sideby-side and moved up and down at random. Any interesting combinations are noted for sketching later. For example, when creating seating for a country park



This combination shown above suggests a traditional styled concrete modular wall mounted seat. If this does not sound promising then do not worry as these lists have 600 (6 x 5 x 4 x 5) possible combinations.

ATTRIBUTE ANALYSIS

Attribute analysis is very similar to morphological analysis but its starting point is an existing product. The main features of the product are noted on a table and then lists of alternatives are written in the columns below. The alternatives from each column are combined at random and any promising suggestions are noted for sketching later. For example, when updating the design of the traditional first aid plaster attribute analysis could be used to break the product down:

Fixing	*colour*	*material*	*shape*	*pad type*
Stick on	**Flesh colour**	**plastic**	**rectangular**	**gauze**
tie on	*red*	*cloth*	*round*	*medicated*
magnetic	*flower*	*paper*	*triangle*	*cellulose*
glue	*see through*	*ceramic*	*octagon*	*sawdust*
paint	*black*	*metal*	*square*	*nylon*
velcro	*text (ouch)*	*rubber*	*animals*	*plastic*
clamp on	*stripes*	*composite*	*irregular*	*cotton*

This attribute analysis table has 7776 (6 x 6 x 6 x 6 x 6) possible combinations for the re-design of a traditional first aid plaster!

TECHNOLOGY TRANSFER

New products, ideas and inventions are often the result of a process called associative thinking. This means that a designer will make a link with the technology in one field of design and use it to provide a new idea or solution in another. There are many examples, such as:

- Laser technology developed for space and defence programmes is now used in DVD systems.
- Dyson adapted the technology found in a sawmill dust extraction system for use in his vacuum cleaners.
- The principle of ski bindings is now used in bicycle SPD pedals and shoes.

These examples show how a technology which already exists can be transferred without further development and used in the design of a completely new product.

LATERAL THINKING

We all have habits in the way we think. These habits can often block our ability to correctly perceive a problem and create a solution. Lateral thinking is about looking at the problem in a different way and avoiding our everyday vertical type approach to thinking. In lateral thinking, it is not necessary to be right at every step since it is sometimes desirable to be wrong in order to organise and alter information or ideas. Challenging accepted concepts and information is what makes lateral thinking so important. Like a young child, lateral thinking constantly asks `why?'

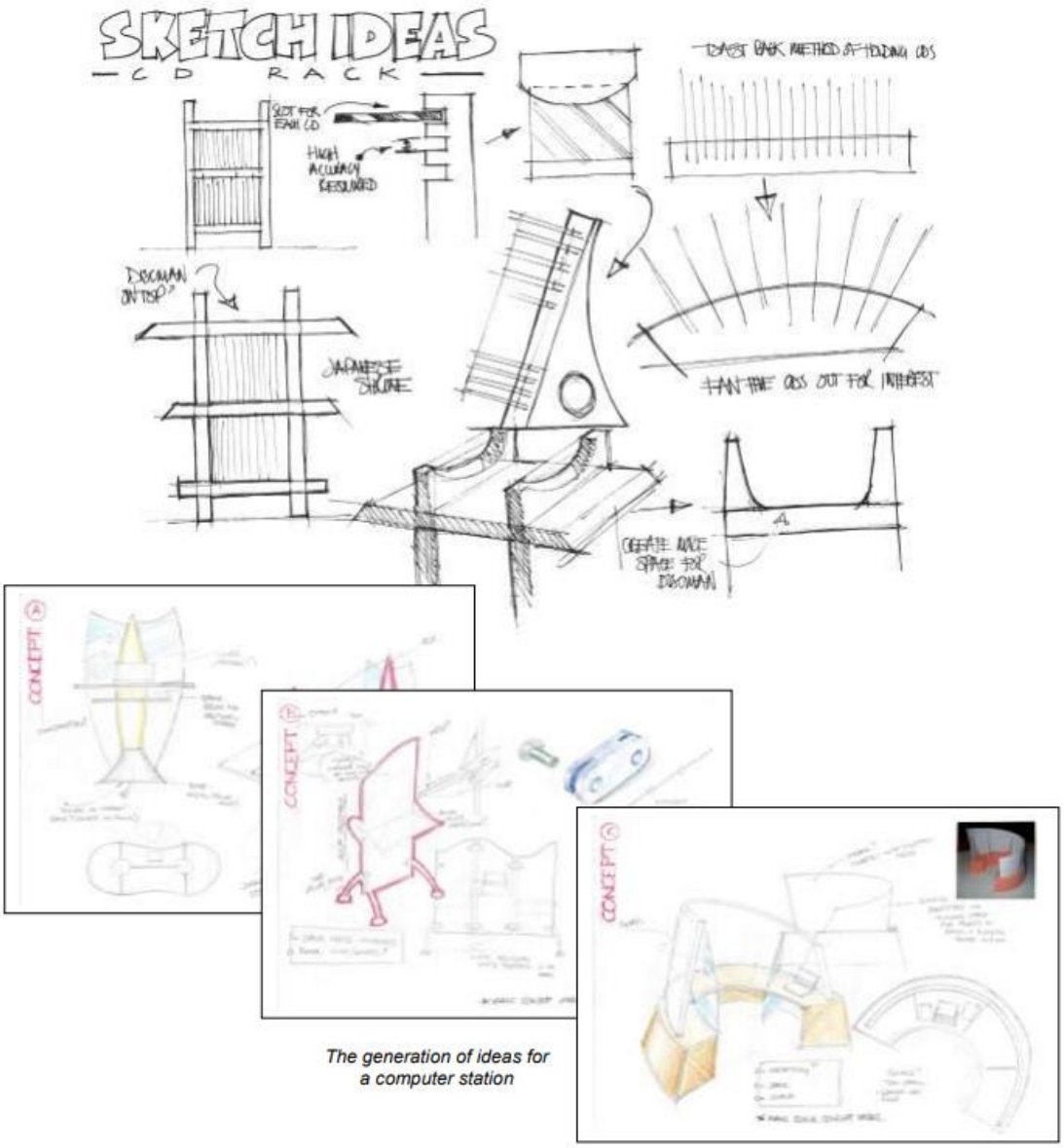
For example, lateral thinking could be used to generate ideas for supporting a table top (note that the word leg is not used):

- hang it from the ceiling;
- the top is the support;
- use magnets to support the top;
- attach the top to a wall;
- support the top with water.

As before these are starting points which need to be analysed and developed further using sketches.

INITIAL IDEAS

At the start of the initial ideas a designer would use an idea generation technique to suggest possible designs. These are sketched or modelled in 3D and annotated to highlight how they address the key points in the specification. In order to make this stage easier the designer should concentrate on generating ideas which meet the primary functions of the specification. These are sometimes called Sketch Ideas because that is what they are - simple sketches or models. During this process the aim is to create a large number of good ideas rather than a few well presented designs. It should therefore be a quick and spontaneous process with just a few minutes spent on each sketch. For example, a page of sketch ideas for a CD holder is shown below:



The generation of ideas for a computer station

DEVELOPING IDEAS

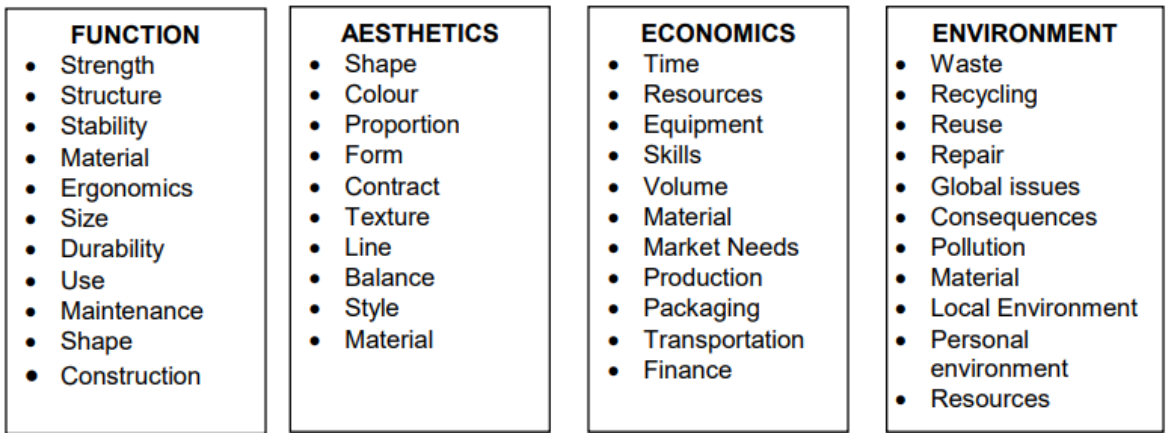
Having produced a wide range of initial ideas the most promising are selected (using the design specification) for development. Aspects such as ergonomics, aesthetics and function, along with at least three other design aspects must be considered. It is at this stage that the secondary functions may be incorporated into the designs.

During the development the design may alter slightly or even completely changed. Modelling can be a very effective method of developing the ideas, particularly when ergonomic aspects are being considered. Clay, card and polystyrene are suitable materials as they allow 'sketch' models to be quickly made. Models can also be used to test out mechanisms such as pivots or linkages where clearances have to be worked out.

It is useful to be aware of the main aspects which influence a designer's thinking and how concentrating on developing one area too much will affect the other aspects. For example, in the development of a certain product the following four aspects are considered:

• Functional requirements • Aesthetic requirements • Economic constraints • Environmental concerns

These are each divided into specific topics that can be considered in depth during the development of the ideas:



SYNTHESIS

The development involves expanding (divergent thinking) an idea as all the different options are fully explored. Synthesis on the other hand is the opposite and involves selecting and bringing together (convergent thinking) all the best features to create the final version of a proposal. During the synthesis a designer will normally use the design specification to help select the best options to combine. When selecting or rejecting these options the design should give good reasons for their choice. Saying that you have chosen an idea because it is 'good' is not sufficient. For example, your justification may be based on the following aspects:

Performance- How well will it do its job?

Ergonomics- How easy/comfortable is it to use?

Aesthetics- How pleasing is its appearance and finish?

Manufacture- How will the product be easily made?

Maintenance- Will the product be easy to look after? e.g. Changing batteries. Safety Will the product be safe to use? Sharp edges etc.

Once all the options have been combined tit may be necessary to carry out further development and detailing. Your answers to the questions above should highlight any areas for further development and this may take the form of models, scale drawings, cut away views etc. Once complete the best proposal is chosen with reference to the specification and a fully rendered presentation sketch is made to help 'sell' the design to the client.

PLAN FOR MANUFACTURE

During this stage of the design process the designer is adding enough information to allow the product to be manufactured. A plan for manufacture should therefore include detail on: • choice of materials;

• dimensions; • methods of manufacture (i.e. vacuum forming); • joints and other methods of construction including any jigs or formers to be used; • finishes; • stages of manufacture and assembly; • parts list.

Normally the plan for manufacture begins with a dimensioned sketch of the design, for example as in the CD rack below. As you can see from this sketch the designer has worked in

2D producing a front and end elevation with notes highlighting detail as required. Here the external dimensions are worked out using the storage space required for 20 CDs and allowing for the thickness of the timber (15mm) and the method of construction.

Sketching the product in this way allows all the fine detail to be quickly planned and adapted before the time-consuming formal technical drawings are made. The working drawing and cutting list are therefore the final tasks undertake before manufacture.

RAPID PROTOTYPING (RP)

Rapid Prototyping (RP) is a quickly method of producing an extremely accurate 3D model directly from a Computer Aided Drawing (CAD) file of the component. The rapid prototyping machine converts this CAD image into a control program which builds up the 3D model of the component layer upon layer in just a few hours.

3D Printing is the most common RP process due to its relative low cost (around £20 000). A layer of powder is spread over a table and a printer-type inkjet then passes over the powder spraying a waterbased adhesive. This bonds the powder together in the desired shape. The table drops slightly and another layer of powder is deposited. The process repeats itself until the desired model is built.

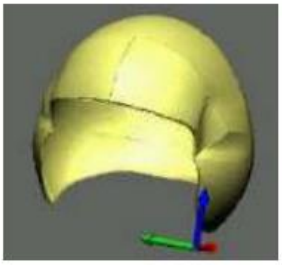
ADVANTAGES OF RP

• People prefer to evaluate and test a real-life model rather than just a sketch or computer image.

• Complex forms can be manufactured in one piece which may be impossible otherwise.

• RP enables exceptionally accurate models to be made from CAD files very quickly.

• Models made by some RP techniques can be used as masters for injection moulding dies. This reduces the lead time, that is the time between design and manufacture.



The Computer Aided Drawing (CAD) image of the product is created (fighter pilot helmet)

The 3D Printer converts the CAD image into a control program for the movement of the printer head across the powder.

Layer-by-layer the finished model is built-up. It can include holes, texture and hollow sections

EVALUATION

An evaluation is a necessary and vital part of the design process. The evaluation should not be regarded as something that is only carried out once the product is made. It should be seen as something that occurs naturally throughout the design process and should make continual reference to the specification. As part of the evaluation process you must decide upon an appropriate stratergy(ies). This will vary from product to product but may involve; user trials, tests, surveys, objective comments from others, and/or focus groups. The evaluation is usually presented in the form of a written statement or report with sketches and annotations as required. The following points should be considered:

• How well does the product meet the main design aspects considered?

- How does the solution compare with other similar products available?
- What do other people think about the design of the product?
- What are the good things about the design of the product?
- What are the bad things about the design of the product?
- What parts could be improved/modified?

As well as ensuring that new products conform to the appropriate safety regulations, designers are faced with the challenge of developing new ideas into products that consumers want to buy. They also have to respond to consumer demands for new, updated versions of existing products. Testing these products is a vital part of the product development, especially if the designer is to ensure that consumer needs and expectations are met, users' safety is not compromised and it is economically viable to manufacture the product for the potential number of sales.

These tests can be carried out in a number of ways but basically there are four methods of gathering useful information:

- End-user trials;
- User research;
- Concept testing;
- Expert appraisal.

END-USER TRIAL

These require end-users (or people pretending to be end-users) to actually use the product. Such experiments should include the sorts of activities that might be undertaken immediately before and after the products have been used. End-users trails can generate a number of improvements and changes that designers and manufacturers may not otherwise consider.

USER RESEARCH

This may involve watching experienced and inexperienced users. They should be observed closely so that improvements and further developments to the product may be identified. Such observation can be followed up with questionnaires and discussion on how users feel about the product.

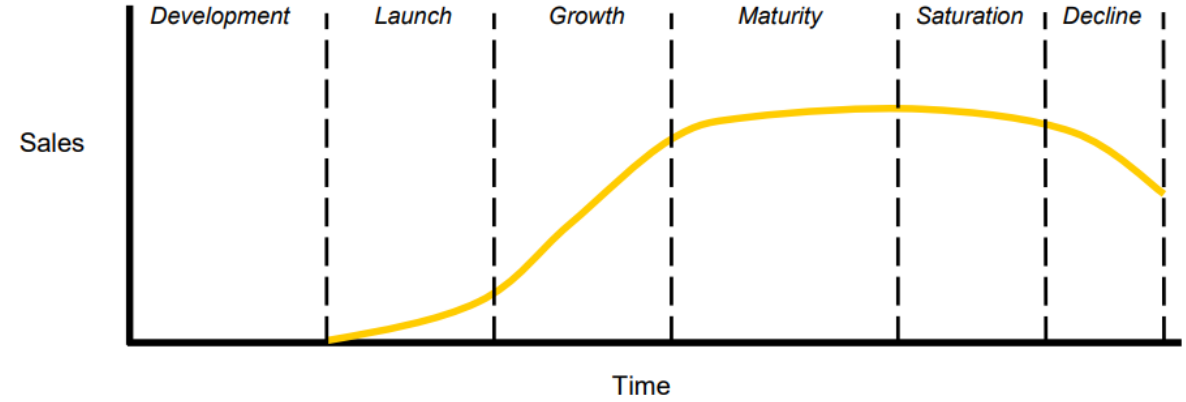
CONCEPT TESTING

This requires a new product to be tested on small groups of consumers who are part of that product's target market. This may not always require a prototype of the product. Models, pictures or even just description of the proposed product may be enough to establish if the idea has market potential. If a representative cross-section of the target market group is used for these tests, then an estimate of the total sales can be predicted. Suppose that 15% said that they would definitely buy the product. The company could use this figure and the market size to estimate potential sales. Predicting the sales volume will allow the company to select the most appropriate manufacturing processes and deciding upon whether or not the product could be sold profitable.

EXPERT APPRAISAL

This relies on the knowledge of recognised experts in the areas being tested. For example, an ergonomist would be able to report on a range of aspects relating to the design of a new mobile phone.

INTRODUCING NEW PRODUCTS: PRODUCT LIFE CYCLE



Development period: design, market research, technical innovation, and research & development (R&D). The company will decide whether it is worthwhile continuing with the new product.

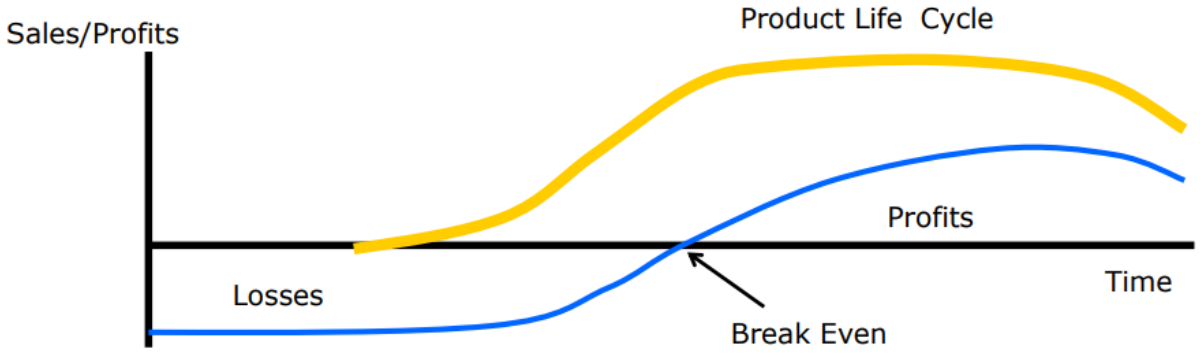
Launch period: the most expensive phase with the cost of R&D, production and marketing not yet recovered with the initial low sales volume. Informative advertising used and the firm will assess the commercial viability of the product.

Growth period: the product establishes its position in the market and retail outlets become easier to obtain as sales increase. There is a shift from informative to persuasive advertising. Competitors begin to enter the field and the prices fall.

Maturity period: product reaches its peak. More competitors enter and the market reaches saturation point. Increased advertising is required to maintain the market share. Efforts made to maintain the product‘s position by adopting extension strategies.

Saturation period: new competitors enter and saturate the market. New strategies are required to maintain the sales level – linking to fashion trends, seeking new or exploiting market segments, linking to joint ventures – media/music, etc.

Decline period: sales fall dramatically. Efforts are made to slow down this process but the firm would look to launch the replacement before the old product starts to damage the company’s image and prejudice the introduction of the replacement.



The timescale for the growth-maturity-decline will depend upon the type of product. For instance high-tech goods like computers have a life span measured in months whereas larger more complicated products, like cars, usually remain in production for many years with only small cosmetic changes (colour or upholstery or extra features) to reflect changes in fashion. The lifespan of a product is affected by three main aspects:

• **Technological push:** this could cause the product to be replaced almost overnight by a new, more advanced version. Alternatively advances in materials or manufacturing techniques could lead to an updated version of the product.

• **Consumer demand:** what the customers want and need from a product can change if it becomes unfashionable or if it seen as a fad. They may also become less popular if market competition increases.

• **Company policy:** the manufacturer may decide to kill off the product to make way for the replacement.

The effective use of marketing may have the affect of boosting sales and even extending the product's lifespan but in the end all products will inevitable decline and require replacing. The graph below shows the typical relationship between the volume of sales of a product throughout its life cycle against the company's profit:

BOSTON MATRIX

The Boston Matrix, developed by the Boston Consulting Group – a business strategy and marketing consultancy in 1968, is a means of analysing the company's products in terms of growth rate, market share, cash flow and possible marketing strategies. The Boston Matrix groups a product into one of four categories based on the market and its share:

Stars: products with a high share of an expanding market (the growth stage in the product's life cycle). There is potential for high revenue growth.

Cash Cows: products with a high market share in a low growth market (the maturity stage in the product's life cycle). They will be cheap to promote and will generate large amounts of cash which can be used for further R&D.

Dogs: products in a low growth market with a small or declining market share (decline stage of the product's life cycle). The will be a negative cash flow – the product will require large sums of money to market and support declining sales

Problem children: products having a low market share in a high growth market. Need money spent to develop them and will produce negative cash flow. Is it worth spending money on them?

PRODUCT EVOLUTION

Product development is usually the result of small changes or modifications made to a product over a period of time. This step-by-step evolution is known as incremental (gradual step-by-step) change. The result of any change can be an improved product or in some cases a different product. Many examples will spring to mind when you consider the products you encounter in everyday life.

The domestic iron has undergone many changes from when it was just a flat metal shape warmed over an open fire and used with a cloth wrapped around the handle to prevent burning the user. Over the years it has evolved with the introduction of electrical heating element, thermostat temperature control, steam iron, water level indicators, plastics, light weight metal alloys and nonstick surfaces.

These changes did not happen overnight and are the result of over one hundred years of evolution. Many changes were the result of technological developments in other products but were applied to the iron after a user need or weakness in the product was identified. By going back to the early stages of the problem and thinking it through afresh, it is possible to redefine what the need is for the product. In the case of the iron it would be reasonable to assume that its purpose is to remove wrinkles and creases in clothes. However, in some cases maybe the iron is not the best solution. For example, a trouser press offers a completely different solution that uses similar technology. This type of product developed can be referred to a radical change.

1890 Victorian irons

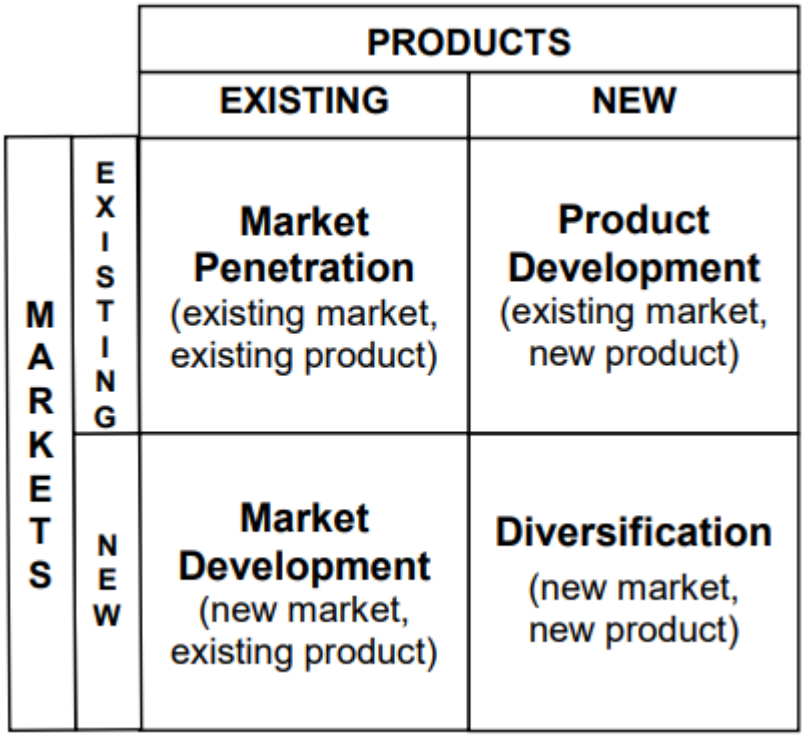
1937 Morphy Richards Electric Iron

1953 Morphy Richards Steam Iron

Other aspects that can influence radical change in product development include discoveries in new materials and technologies. Although plastic did not make a radical difference to the design of the iron, it did make a huge difference to the way it was manufactured and the way it was used. It made the product easier to mass-produce, more affordable and much lighter than its Victorian predecessor.

PRODUCT PLANNING

Deciding on which product is right for a particular market is a very important decision for any company. Clearly this will be guided by market research, technological developments and market demands. However, there are four options open to the manufacturer when considering the relationship between the new and existing products and markets:



MARKET PENETRATION

An attempt to increase the sales of a product through activities such as advertising, promotions and special offers. This would involve existing products in current markets. It could be regarded as 'injecting new life into an old product'

PRODUCT DEVELOPMENT

Deciding to develop new or improved products for an existing or established market.

MARKETING DEVELOPMENT

A strategy for company growth by identifying and developing new markets and new market segments for current company products. This can be done by finding new users, new customers or foreign markets.

DIVERSIFICATION

This can be done by designing, developing and selling entirely new products for the manufacturer in new markets.

THE PRINCIPLES OF UNIVERSAL DESIGN

UNIVERSAL DESIGN: The design of products and environments to be usable by all people, to the greatest extent possible, without adaptation or specialized design.

These seven principles may be applied to evaluate existing designs, guide the design process, and educate both designers and consumers about the characteristics of more usable products and environments.

1) EQUITABLE USE

The design is useful and marketable to people with diverse abilities.

2) FLEXIBILITY IN USE

The design accommodates a wide range of individual preferences and abilities.

3) SIMPLE AND INTUITIVE USE

Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.

4) PERCEPTIBLE INFORMATION

The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.

5) TOLERANCE FOR ERROR

The design minimizes hazards and the adverse consequences of accidental or unintended actions.

6) LOW PHYSICAL EFFORT

The design can be used efficiently and comfortably and with a minimum of fatigue.

7) SIZE AND SPACE FOR APPROACH AND USE

Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility.

1) EQUITABLE USE

The design is useful and marketable to people with diverse abilities.

GUIDELINES:

1a. Provide the same means of use for all users: identical whenever possible; equivalent when not.

1b. Avoid segregating or stigmatizing any users.

1c. Make provisions for privacy, security, and safety equally available to all users.

1d. Make the design appealing to all users.

EXAMPLES:

■ Power doors with sensors at entrances that are convenient for all users

■ Integrated, dispersed, and adaptable seating in assembly areas such as sports arenas and theatres

2) FLEXIBILITY IN USE

The design accommodates a wide range of individual preferences and abilities.

GUIDELINES:

2a. Provide choice in methods of use.

2b. Accommodate right- or left-handed access and use.

2c. Facilitate the user's accuracy and precision.

2d. Provide adaptability to the user's pace.

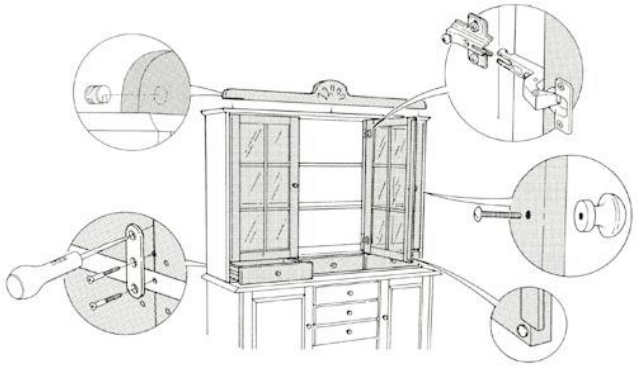
EXAMPLES:

■ Scissors designed for right- or left-handed users

■ An automated teller machine (ATM) that has visual, tactile, and audible feedback, a tapered card opening, and a palm rest

3) SIMPLE AND INTUITIVE USE

Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.



GUIDELINES:

3a. Eliminate unnecessary complexity.

3b. Be consistent with user expectations and intuition.

3c. Accommodate a wide range of literacy and language skills.

3d. Arrange information consistent with its importance.

3e. Provide effective prompting and feedback during and after task completion.

EXAMPLES:

■ A moving sidewalk or escalator in a public space

■ An instruction manual with drawings and no text

4) PERCEPTIBLE INFORMATION

The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.

GUIDELINES:

4a. Use different modes (pictorial, verbal, tactile) for redundant presentation of essential information.

4b. Maximize "legibility" of essential information.

4c. Differentiate elements in ways that can be described (i.e., make it easy to give instructions or directions).

4d. Provide compatibility with a variety of techniques or devices used by people with sensory limitations.

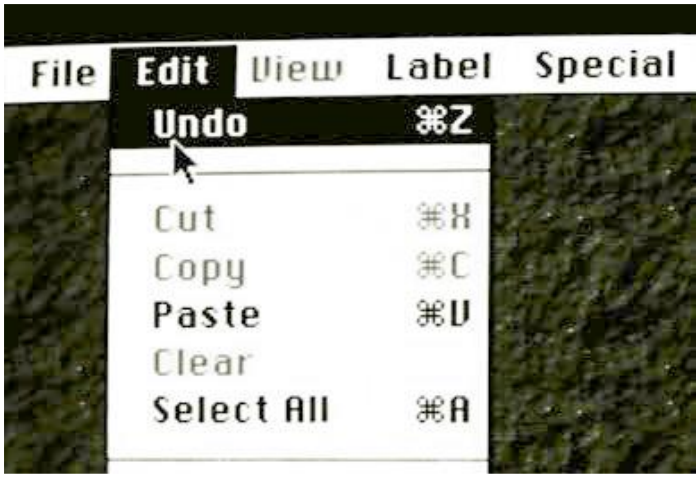
EXAMPLES:

■ Tactile, visual, and audible cues and instructions on a thermostat

■ Redundant cueing (e.g., voice communications and signage) in airports, train stations, and subway cars

5) TOLERANCE FOR ERROR

The design minimizes hazards and the adverse consequences of accidental or unintended actions.



GUIDELINES:

5a. Arrange elements to minimize hazards and errors: most used elements, most accessible; hazardous elements eliminated, isolated, or shielded.

5b. Provide warnings of hazards and errors.

5c. Provide fail safe features.

5d. Discourage unconscious action in tasks that require vigilance.

EXAMPLES:

■ A double-cut car key easily inserted into a recessed keyhole in either of two ways

■ An "undo" feature in computer software that allows the user to correct mistakes without penalty

6) LOW PHYSICAL EFFORT

The design can be used efficiently and comfortably and with a minimum of fatigue.

GUIDELINES:

6a. Allow user to maintain a neutral body position.

6b. Use reasonable operating forces.

6c. Minimize repetitive actions.

6d. Minimize sustained physical effort.

EXAMPLES:

■ Lever or loop handles on doors and faucets

■ Touch lamps operated without a switch

7) SIZE AND SPACE FOR APPROACH AND USE

Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility.

GUIDELINES:

7a. Provide a clear line of sight to important elements for any seated or standing user.

7b. Make reach to all components comfortable for any seated or standing user.

7c. Accommodate variations in hand and grip size.

7d. Provide adequate space for the use of assistive devices or personal assistance.

EXAMPLES:

■ Controls on the front and clear floor space around appliances, mailboxes, dumpsters, and other elements

■ Wide gates at subway stations that accommodate all users

UNIT – IV– Product Design – SDE 3502

PRACTICAL ASPECTS

Consumer Motivations Identification of user needs and Driving Factors; Emotional Design, Sensibility, Social Ethics and Concerns; Market Gaps, Market Oriented Innovation; Business Evolution Product, Planning for the future, Disruptive Innovation; Basic understanding of construction principles, modelling, rapid prototyping, with broad orientation to socio cultural and historical context of the sector. Orientation to Indian as well as global context of interiors, trends and market.

DESIGN STORIES

Various techniques can be used at the start of a design project to encourage designers to analyse the problem and use their imagination. One such technique involves writing a 'design story'.

During the early stages of the design project, try writing stories about the problem. The stories may be written from a variety of perspectives:

- Imagine that you were the product. What would it be like?
- Imagine life without the product.
- Imagine that you are in a shop trying to sell the product to someone. How would you convince them to buy this product?
- Imagine that you are trying to explain how to use the product to someone who has never seen it before.

For example, a product designer was asked to create a disposable scalpel for use by paramedics. She wrote the following design story:

'Joe is a paramedic. He's currently attending a multiple car accident on an isolated stretch of single tracked highland road. One of the cars has upturned in a ditch full of water. The passenger and driver are both unconscious and a failure to wear the seatbelt has resulted in serious facial injury to the passenger who appears to be breathing badly. It is dark, windy and the rain is hindering operations. There is a strong smell of petrol in the air, the vehicle lights are still working but the vehicle is creaking ominously. Joe's task is to perform an emergency tracheotomy, by torchlight, whilst lying on the wet grass leaning through the smashed passenger window'.

Her design story ensured that she researched visual, environmental and ergonomic issues. Specific areas of research which the story inspired were: investigation of luminous plastics, consideration of the use of the knife in one hand at arm's length; grip and surface texture. A design story ensures that open-mindedness and creativity are integral in research and development of the design specification.

INVESTIGATION

When researching into the areas identified in the analysis the designer will normally consider:

- **Function:** investigate the primary function, secondary function and fitness for purpose.
- **Performance:** research into planned obsolescence, value for money, maintenance, environmental concerns, materials & manufacturing processes.

• **Ergonomics:** find out about how humans will interact with the product which regards to physiology, psychology and anthropometrics.

• **Aesthetics:** research into the factors which influence aesthetics, fashion and market trends and style.

• **Market:** consideration of consumer demands, social expectations, market niche, branding and introducing a new product.

• **Economics:** investigation of cost (fixed and variable), safety, market opportunity, intellectual property rights, value for money and production systems.

RESEARCH

Research is a vital part of the design process. It is about gathering information that will help take the design forward and as such it must be relevant and taken from a variety of sources including:

• benchmarking – studying the "best in class" products in the target market. Dismantle and test to understand their design characteristics (reverse engineering); • on-site visits; • material testing;

• interviews with experts;

• questionnaires to users and consumers;

• Internet searches;

• safety & environmental investigation;

• patent office search;

• interview with the client and their sales department;

• review of governmental and EU regulations.

Knowing what information is required and being able to ask the correct questions is the key to collecting good research material. This research can be taken from primary or secondary sources. Primary research involves the designer gathering information themselves while secondary research makes use of the results of other people's investigation.

Whether using primary or secondary sources the aim is to gather detailed information about the problem and what the solution has to do. All relevant design aspects must be identified and the following list provides a guide into this information gathering:

Product analysis- Look into existing products to see their strengths and weaknesses.

Safety- Look into the safety aspects and regulations and consider how these will influence the product.

Materials- What materials and processes are available for suitable to manufacture this product and how may they affect the design?

Marketing- Investigate the target market - Who is the product aimed at and how would you describe them? i.e., age, gender, job, interests etc. Use a lifestyle board to show the features of this market niche.

Cost- Using market research to suggest a target price for the product.

Environment- The need to reduce waste and recycle materials during manufacture and when the product has outlived it usefulness.

User research- A marketable product is one which appeals to a wide range of people. To make your product desirable to the customer consider the views of the potential users by conducting a user trip and issuing a questionnaire to target the market.

Thematic research- Where style is an important aspect of a product, you may wish to use a theme as a starting point for your design work. The theme could be anything from natural forms to Bauhaus. This research is visual and may be presented as a fact sheet or poster.

PRODUCT FUNCTION:

Fitness for purpose

It is perhaps obvious that a product should do the job it was designed for. A can opener must open a tin and a car must be able to transport people from one place to another. But how well should a product do its job? Should a lightweight and portable can opener used for camping work as well as an electric opener designed for use in a restaurant/canteen? Should a small lightweight city car be as comfortable and as fast as an executive saloon?

Clearly these products are designed to carry out similar functions. However, in reality what is expected from each product is quite different. In the case of the camping can opener - as long as it compact, lightweight and opens cans then it fits its purpose. By contrast an industrial can opener should work very quickly and efficiently. It should be very reliable and durable. Cost, size and weight will all be of secondary importance.

When considering fitness for purpose, the designer should be clear about what the product must do, where it is likely to be used and who will use it. All the essential and desirable features of the product should be clearly researched and checked during the evaluation. Any secondary features will be a bonus and may help give the product an advantage over its competitors in the market place.

Question: Choose a simple everyday product that you feel is not suited to its purpose. Describe with the aid of a sketch the product's shortcomings.

Function: primary & secondary

In any product design specification there are always some aspects that are more important than others. These needs can be divided into either Primary or Secondary functions. The primary functions are those that are vital for the design to do its job, whilst the secondary functions are those which, although important, could be compromised for the benefit of the primary functions. Dividing the specification up in this way helps you to prioritise, especially in the early stages of a design, and allows you to focus on the important aspects of the product.

For example, the primary functions of a kettle could be listed as; boil 1.5 L of water and pour it safely. Identifying these functions will allow the designer to produce a range of sketches or models which do not get bogged down with such things as water level indicators, cordless design etc.

PERFORMANCE

Planned obsolescence

Planned obsolescence is a strategy used by manufacturers to make their products appear out of date and redundant. This can be done in a number of ways:

- Create a fashion change or a demand for a new style;
- Hold back attractive features and then introduce them on a later model;
- Produce a product that will break, wear, tear or rot after a set time. When the designer considers the materials and construction for a product they obviously have to take into account the following:
- How long the product should last for?
- How, and under what conditions, will the product be used (function, durability and safety)?
- Will be product have to be maintained or repaired?

In many instances it is possible to design a product that will last a lifetime. Is this necessary or even desirable? If a manufacturer designs an everlasting product, what impact will this have on the company? The product would be very expensive, it would soon become old fashioned and the customer would not get new advances in technological which could make future models more economic or environmentally friendly. The designer has therefore to find a balance between profit, value for money, durability and at the same time satisfying the customers desire to own the latest most fashionable model. Built-in obsolescence helps create a demand for a replacement model and at the same time satisfies the consumers' desire for the latest version of the product.

Most products then have a built in life expectancy. In general, a light bulb may only work for 2000 hours while a washing machine could need replaced every six years. Sometimes similar products are available with different lengths of planned obsolescence, for example up-market cars are designed to last for as long as 10 years without the need for major repairs (which is one of the reasons why they are so expensive) against a cheaper models designed to last for only 5 years. Successful companies must consider a programme of planned obsolescence if they are to remain competitive. Consumers now expect products to evolve and they demand new improved technology and cosmetic changes on a regular basis.

EASE OF MAINTENANCE

The maintenance of a product is something that can easily be overlooked with many designers focusing on function, ergonomics and aesthetics. Whilst maintenance is an aspect of function, it is secondary to how well the product does its job.

Consideration of maintenance depends to a large extent on the life expectancy of the product. A cheap down-market product will often sacrifice maintenance to cost. In this case the designer knows that the product will be thrown away when it ends its useful life. In contrast, more expensive up-market products will generally have much longer life expectancy and may therefore require periodic maintenance in order to keep them operating efficiently. Building in maintenance obviously adds to the cost of the product but can be justified by the higher retail price.

The trend of miniaturisation in electronic products is making goods more reliable. However, if a fault develops it can be impossible to repair and in some cases it is hardly economic to

maintain a product. For example, the HP 845C ink jet printer retails £45 while the cost of replacement ink cartridges is £50!

EFFICIENCY

One would expect that a cheap down-market product would serve its purpose, but only just. In contrast, you would imagine that a high quality product would fulfil its function with ease and give the user pleasure. A cheap kettle will boil water. A more expensive model will boil water quickly, use less energy, and be aesthetically pleasing and so on. The designed efficiency of the product will depend upon its intended market niche.

RUNNING COSTS

To the consumer, the running costs of a product may or may not be an issue. However, the designer must consider any running costs and balance these with all the other factors in relation to the intended market niche. In general, wealthy individuals buy products without considering factors such as running costs. Their primary concern may be function, aesthetics and image. The less wealthy individual will be much more concerned about running costs. Running costs are generally made up of energy/fuel use and maintenance. To reduce running costs it is not uncommon for less wealthy individuals to carry out their own maintenance.

CHOICE OF MATERIALS

When selecting a suitable material for a product the designer must consider a number of factors:

Use of the product

The choice of material has to take into account how and where the product will be used. For example, the plastic chosen for car's wing mirror will have to withstand wear and tear from stone chips, washing with detergents, sharp knocks from passing vehicles and at the same time tolerate temperatures from sub-zero to over 60°C. On some vehicles this component is painted to match body colour therefore material will also have to accept paint.

Quantity to be manufactured

Many components can be manufactured in a number of different ways. Often the decision depends on the quantity to be produced. Metal castings for example can be made in mid to low quantities using sand casting or produced in high volumes by die-casting. Although sand casting is labour intensive and relatively slow, the tooling costs are very low and so this process is ideal for small volumes (low 1000's). As soon as volume increases (10000's) then die-casting may be more appropriate. Here tooling costs are very high - but the high volume means that the cost of per item will be very small.

Market niche

If a product is to be sold at the bottom end of the market then the material will have to be as cheap as possible. As long as the material is able to carry out its function for a reasonable period them it will be deemed satisfactory. However with an up-market product, cost becomes less of an issue and the material chosen should perform well, should be long lasting and reflect the quality image of the product.

Some of the mechanical properties of materials that should be considered are:

STRENGTH: the ability to resist tensile, compressive or shear forces.

TOUGHNESS: the ability to absorb energy before fracture – a material that is not tough is brittle.

STIFFNESS: the ability of a material to deform temporarily and then return to its original shape.

DUCTILITY: the ability to be deformed permanently under tension without fracturing.

MALLEABILITY: the ability to be deformed in all directions without rupture.

FINISH

The choice of finish for a product is influenced by similar factors to those of materials: where the product will be used, the quantity to be manufactured and the target market niche.

ENVIRONMENTAL & SOCIAL CONSIDERATIONS

Every new product will have some impact on the environment. Designers must therefore consider carefully the environmental effect of a new product, from production of its raw material to its ultimate disposal or recycling. A product may impact on the following areas:

- Environment – aesthetic: as a result of the visual impact of the product with its surroundings;
- Environment – pollution: created by the manufacture, use and/or disposal of the product at the end of its life;
- Social - physical and social impact of the product on the user and society in general.

DURABILITY

The durability is how long a product will last in normal use without needing repaired or replaced. This depends on the materials chosen, manufacturing process used and fixing methods employed. However, obsolescence is also based on the planned obsolescence and market niche of the particular product. The actual use, care and maintenance of the product by the consumer may also have a bearing on how long the product will last or how often it needs repair.

MARKET

TECHNOLOGICAL PUSH VERSES MARKET PULL

There are new product innovations appearing every day, many happen as a result of new technology, while others are based on consumer demand. We can therefore consider product development and innovation as having two main driving forces: the push that is the result of new technological developments and the pull from consumer needs and wants.

TECHNOLOGICAL PUSH

Certain products are based on the result of technological innovation, referred to as technological push. In other words advances in technology create new products and therefore new markets. Sometimes the products are simply better versions of existing products but

occasionally products that have not existed before are produced creating a completely new market niche.

Launching a new product based on technological push can be risky for the manufacturer because:

- significant money may be required for research and development (R&D) refining the technology and this cost will only be recouped if the product is a success and sells well;
- new technology, by its very nature, is untried and therefore difficult to predict how reliable it will be in actual use;
- substantial investment may be required in new manufacturing systems and training of the workforce;
- considerable funds will be required before the product is launched to market the technology by educating and persuading the public of its advantages.

Despite these potential difficulties there are many examples of new groundbreaking products which have created market niches as a result of technological push:

- The microwave oven - developed as a consequence of research done by physicists into wave energy.
- Hand held satellite navigation systems using technology developed by the military for guiding missiles.
- Ceramic knives (the edge will last a lifetime) and ceramic engine components developed from research carried out by NASA engineers working on the ceramic tiles used to protect the shuttle's when it re-enters the Earth's atmosphere.
- MP3 player - this product was only possible through advances in electronic storage systems developed for computers and digital cameras. This product allows music to be downloaded and stored on the player without the need for discs or cassettes.

CONSUMER DEMAND: MARKET PULL

Consumers are now much more aware of good design than ever before. They expect products to function well, look good and remain competitive in a market where they are often spoilt for choice. The public are more aware of their rights and of the legal rules relating to consumer products. They have high expectations and demands of the goods they buy. Reliability, durability and userfriendliness must all be delivered at competitive prices whilst there is also the expectation that products will be 'environmentally friendly'. All of these things are brought to the public's attention by the media in consumer investigation, watchdogs reports, product reviews etc. To some extent, consumers are told what good design is without having to run the risk of trying product themselves.

Image and style are now important aspects in consumer choice. Manufacturers must respond to the customer's tastes and desires. Gone are the days of Henry Ford when the buyer of the Model T car could have 'any colour as long as it's black'. Consumers expect choice, variety and change. This presents a challenge to designers who compete in a global economy where most products are mass-produced. Mass production means that it is impossible to offer the variety and exclusivity found in small-scale production or handmade products. Today consumers expect choice but are reluctant to pay more for it.

Since the 1950s the marketplace has evolved from a situation of scarcity and need to the position of abundance and want. One can say that we now live in a market-led economy where consumers expect quality products which represent value for money. We also demand variety which in turn has resulted in products changing and being updated more often. It is almost as if consumers build in their own style obsolescence. Consumer demand, referred to as market pull, results in products being created to satisfy a particular need in the market place. In general the demand in a particular market niche is identified through market research (questionnaires, focus groups, user trails, interviews, observations etc). Any manufacturer that does not carry out thorough market research is taking a great risk. To invest large sums of money in the design, development and production of a new product without checking whether or not it is what the public wants, is very foolish.

Other successes in this area have been products that satisfy the need to provide for a healthy, environmentally sound, lifestyle. Examples of these are organic foods, biodegradable detergents and sports equipment such as home exercise equipment.

SOCIAL EXPECTATIONS

People's tastes differ. While this statement is true and each person can be regarded as an individual, on a global scale designers treat people as groups or segments differentiated by such factors as cultural differences, religious beliefs, lifestyle and age. They will design products for a particular market segment according to that group's perceived needs or wants. Lifestyle is a huge factor in the type of products now being designed. People's lifestyles have changed remarkably, especially since the 1950s. Post-war affluence has allowed more people to own a variety of different products. "There was a strange moment around the mid 1960s when people stopped needing and started wanting…" Terence Conran creator of Habitat stores The designer must consider changing patterns of social behaviour when working on new products. Aspects that would have been considered important in the design of products 50 years ago may not be seen as critical today. Washing machines, microwave ovens and hairdryers are no longer considered a luxury; they are now felt to be essential. Today people find themselves with more time on their hands. Working from home, longer holidays, shorter working hours have all contributed to people having more time for leisure pursuits. This has in turn lead to an increased demand for; entertainment such as stereo systems, DVD's and home cinema; DIY and gardening related products; gym memberships and home exercise machines.

Design and product development is now a part of most company business plans. The type and nature of the products developed must reflect the market niche's lifestyle and wants. These requirements can all be influenced by fashion, local customs, topical issues and changes in the law, for example in 2002 the UK the car tax rules changed which resulted in a huge growth in sales of diesel fuelled company cars.

HUMAN NEEDS

Human needs can be described as the feeling of being deprived. There are many human needs such as the basic physical need for food and clothing. There are other more socially interactive needs such as the needs to belong and for affection. There are also private individual needs for knowledge and self-expression. These needs are a basic part of human make-up and are not created by design companies or advertising campaigns. When any of these needs are not satisfied the individual may do one of two things:

- Look for an object or a product to satisfy the need;
- Try to reduce or eliminated the need.

A person will try to satisfy the most important need first. When that is done the individual move on to look to satisfy the next most important need. Maslow's hierarchy of needs is not true for all people in all cultures but market researchers and designers often use it as a general rule of thumb.

HUMAN WANTS

Wants are often described in terms of objects that will satisfy needs. These objects will depend upon an individual's personality, well-being and culture. A good example would be to consider a group of people who all need to eat. Each one of them, however, may want to eat different things.

Products too can fulfil different needs. Toys provide children with the opportunity to learn, relax and interact with their peers. However, children living in advanced economies would find it socially unacceptable to play with primitive toys that might be found in third-world cultures. They expect the latest toys and even at an early age they become image conscious, using material things to fulfil their needs for social acceptance, respect and friendship.

Research has shown that people from any culture will try to differentiate between social subgroups by forms of personal display. Domestic products provide further evidence of people's want for goods which say something about themselves. This means that the products they buy give them some kind of satisfaction through 'what they say' about them rather than just through 'what they do'. The ability to make such choice is the result of living in an affluent society where the basic function of a product is taken for granted. Customers view products as providing a benefit. They will choose the product that gives them the greatest benefit for their money. Given their wants, resources and interests, people will demand products that provide them with the greatest benefit.

NICHE MARKETING

Niche marketing is all about identifying a group of customers and targeting a product to meet their specific needs. If a manufacturer identifies a new niche and is the first to develop a product then they will have a monopoly in sales and will achieve 100% market share. Most manufacturers, whether big or small, carefully target particular market niches in order to maximise sales. HP, for example, markets all-in-one machines that print, fax and scan to segments of the home office market, while targeting larger businesses for higher-priced, single-function units.

Niche marketing can be extremely cost-effective. For instance, a manufacturer may target the product to a particular demographic group, such as teenagers. The company could advertise on pop radio or TV stations, which have considerably lower rates than those which cater for broader audiences. So the marketing budget would go a lot further, allowing the manufacturer to advertise with greater frequency or to use a more comprehensive media mix. Taking on a new niche can be a low-risk way to grow a business, as long as the company follows the three basis rules:

1. **Meet the customers' unique needs:** The benefits of the product must have special appeal to the market niche. What does the product provide that is new and compelling? Identify the unique needs of the potential customers and look for ways to

tailor the product to meet them. Start by considering all variations of the product. When it comes to marketing soap, for example, not much has changed over the years. But the company could develop a new shampoo to gently remove chlorine from swimmers' hair. They would then have something uniquely compelling to offer a market segment from recreational users of water parks right through to competitive swimmers.

2. **Say the right thing:** When approaching a new market niche, it is vital that the company speaks the users' language and researches the market's "hot buttons". They must be prepared to communicate with the target group as an understanding member and not as an outsider. In addition to launching a unique campaign for the new niche, the company may need to alter other, more basic elements, such as their slogan if it translates poorly to another language, for example.
3. **Always test-market:** Before moving ahead, the manufacturer will need to research the opposition in the market niche and determine how to best compete against them by reviewing their ads, brochures and Web sites, looking for their key selling points, along with pricing, delivery and other service characteristics. It is not always a good sign if there is no competition in a market, it could mean that other companies have not found the key to providing a product this niche will buy. However, it could also be that other companies have tried and failed to penetrate this segment. Manufacturers should always test-market carefully to gauge the customers' reaction to the product or service and their message.

MARKET SEGMENTS

Few products can be said to complete in the global market. Most companies use target marketing to direct products at one or more group of consumers who share the same needs and wants. Market segments can be thought of as groups of people who have something in common that will affect their choice of product. There are many ways to define a particular market group but generally they can be grouped into four categories:

- GEOGRAPHIC: such as countries, regions, cities
- DEMOGRAPHIC: such as age, sex, income, education, race
- PSYCHOGRAPHIC: such as personality, lifestyle, social class.
- BEHAVIOURISTIC: such as purchase frequency, usage, benefits sought, brand loyalty.

Each of these market segments can be broken down further and products can be targeted at a much narrower group of people. For example, age can be used to divide the population into six segments:

- 5 to 10 years: this age group could be classified as fun years
- 11 to 17 years: these are often fashion driven years
- 18 to 25: most people become independent.
- 26 to 35: many people are motivated by their career
- 36 to 55: often family becomes the major priority
- 56 +: this is a time when more choice is available.

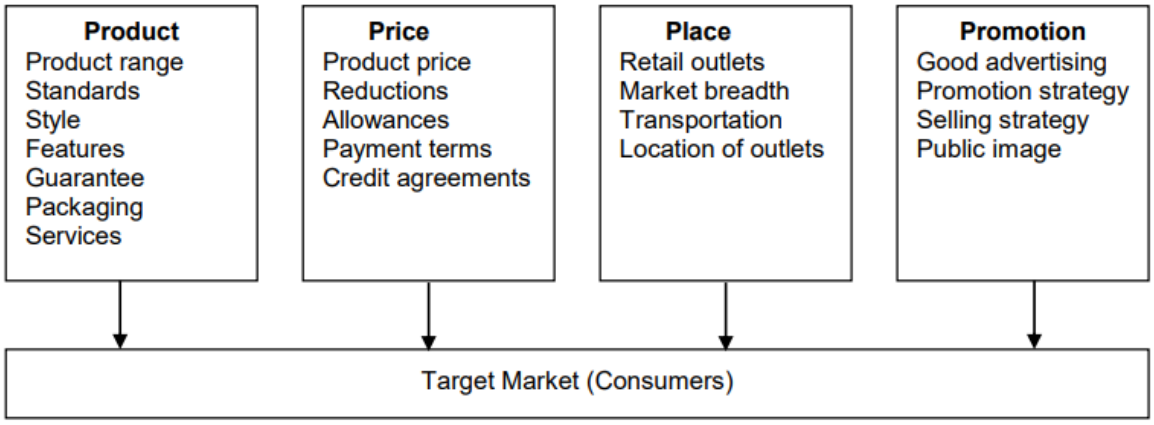
Specialised firms often divide the population into much smaller segments using behaviouristic aspects to restrict the target market. This strategy of identifying a segment is called niche marketing.

Once the market has been defined and the target group has been identified and researched, the company is ready to begin planning the details of the marketing mix. The marketing mix consists of everything that can be done to influence the demand for the product.

There are many factors that can influence the demand for a product but these can all be grouped together under four headings known as the Four P's

- Product: anything that can be offered to the market in order to satisfy a want or need.
- Price: the amount charged by the company or exchanged by the consumer for a product.
- Place: all the company's activities that make the product available to the consumer.
- Promotion: any activity which will advertise the product and its benefits to potential buyers.

The four P's sets out the marketing tools which can be used to influence potential buyers. If these four P's are to be successful, each must offer a benefit to the consumer.



CONSUMER BENEFITS

- Product: the consumer's wants and needs are met by the product.
- Price: the cost to the consumer is affordable and competitive
- Place: the product is accessable to the consumer to buy.
- Promotion: the product should appeal to the consumer

MARKETING & SALES

Gone are the days when the company could stick a 'for sale' sign on their product and then sit back waiting for customers to come flooding in. Today's market requires a more sophisticated approach and all successful manufacturers spend a lot time and money informing the public about their product and persuading us to buy it (about 5% of the price of a new car is spent on marketing). Marketing begins early in the design process by seeing what the customer wants/needs using questionnaires or focus groups. Some manufacturers carryout this market research themselves, but most use specialised organisations such as Mori. Here the key to accurate market research is in the balance of the sample group (age, gender, family, social class, education and income), rather than its overall size. Effective

marketing is about creating a positive image for the product (and company) by associating it with the lifestyle and aspirations of the target market. A marketing campaign may use some or all of the following marketing tools:

- ADVERTISING - to create awareness and help establish a positive image. Cinema, TV and radio commercials; press advertisements and billboard posters; are used to portray the product in an attractive manner that will make people want to buy it.

- SALES PROMOTIONS – these can add value (three for the price of two), or promote the product at the point of sale, hands on trails, or joint promotions with other brands which target a similar market (Coke Cola and MacDonald's linked to Euro Disney).

- PUBLIC RELATIONS (PR) – here the company will try to get as much free publicity as possible; regular press releases designed to get journalists to talk (write) about the product, celebrity endorsements and special events.

- SPONSORSHIP – of art or sporting events, which are associated with the potential interest of the target market ('T in the Park' targeting young adults with disposable incomes etc).

- DIRECT MARKETING – tailoring the message to the customer using databases, either compiled from existing customers (from returned guarantee cards) or bought from specialised companies, to help target the mail shots.

Demand-pull innovation and invention-push innovation

Most product designs fall under one of two categories: demand-pull innovation or invention-push innovation.

Demand-pull happens when there is an opportunity in the market to be explored by the design of a product. This product design attempts to solve a design problem. The design solution may be the development of a new product or developing a product that's already on the market, such as developing an existing invention for another purpose.

Invention-push innovation happens when there is an advancement in intelligence. This can occur through research or it can occur when the product designer comes up with a new product design idea.

Trends in product design

Product designers need to consider all of the details: the ways people use and abuse objects, faulty products, errors made in the design process, and the desirable ways in which people wish they could use objects. Many new designs will fail and many won't even make it to market. Some designs eventually become obsolete. The design process itself can be quite frustrating usually taking 5 or 6 tries to get the product design right. A product that fails in the marketplace the first time may be re-introduced to the market 2 more times. If it continues to fail, the product is then considered to be dead because the market believes it to be a failure. Most new products fail, even if there's a great idea behind them.

All types of product design are clearly linked to the economic health of manufacturing sectors. Innovation provides much of the competitive impetus for the development of new products, with new technology often requiring a new design interpretation. It only takes one manufacturer to create a new product paradigm to force the rest of the industry to catch up—fueling further innovation. Products designed to benefit people of all ages and abilities—without penalty to any group—accommodate our swelling aging population by extending

independence and supporting the changing physical and sensory needs we all encounter as we grow older.

Reference Link for Product design Trends- 2021

https://www.crowdspring.com/blog/product-design-trends-2021/

MAJOR FACTORS INFLUENCING CONSUMER BEHAVIOR FOR PRODUCTS

1. **Psychological Factors**
2. **Social Factors**
3. **Cultural Factors**
4. **Personal Factors**
5. **Economic Factors**

Consumer behavior is influenced by many different factors. A marketer should try to understand the factors that influence consumer behavior. Here are 5 major factors that influence consumer behavior:

1. PSYCHOLOGICAL FACTORS

Human psychology is a major determinant of consumer behavior. These factors are difficult to measure but are powerful enough to influence a buying decision.

Some of the important psychological factors are:

i. Motivation

When a person is motivated enough, it influences the buying behaviour of the person. A person has many needs such as the social needs, basic needs, security needs, esteem needs and self-actualization needs. Out of all these needs, the basic needs and security needs take a position above all other needs. Hence basic needs and security needs have the power to motivate a consumer to buy products and services.

ii. Perception

Consumer perception is a major factor that influences consumer behaviour. Customer perception is a process where a customer collects information about a product and interprets the information to make a meaningful image about a particular product.

When a customer sees advertisements, promotions, customer reviews, social media feedback, etc. relating to a product, they develop an impression about the product. Hence consumer perception becomes a great influence on the buying decision of consumers.

iii. Learning

When a person buys a product, he/she gets to learn something more about the product. Learning comes over a period of time through experience. A consumer's learning depends on skills and knowledge. While a skill can be gained through practice, knowledge can be acquired only through experience.

Learning can be either conditional or cognitive. In conditional learning the consumer is exposed to a situation repeatedly, thereby making a consumer to develop a response towards it.

Whereas in cognitive learning, the consumer will apply his knowledge and skills to find satisfaction and a solution from the product that he buys.

iv. Attitudes and Beliefs

Consumers have certain attitude and beliefs which influence the buying decisions of a consumer. Based on this attitude, the consumer behaves in a particular way towards a product. This attitude plays a significant role in defining the brand image of a product. Hence, the marketers try hard to understand the attitude of a consumer to design their marketing campaigns.

2. SOCIAL FACTORS

Humans are social beings and they live around many people who influence their buying behavior. Human try to imitate other humans and also wish to be socially accepted in the society. Hence their buying behavior is influenced by other people around them. These factors are considered as social factors. Some of the social factors are:

i. Family

Family plays a significant role in shaping the buying behavior of a person. A person develops preferences from his childhood by watching family buy products and continues to buy the same products even when they grow up.

ii. Reference Groups

Reference group is a group of people with whom a person associates himself. Generally, all the people in the reference group have common buying behavior and influence each other.

iii. Roles and status

A person is influenced by the role that he holds in the society. If a person is in a high position, his buying behavior will be influenced largely by his status. A person who is a Chief Executive Officer in a company will buy according to his status while a staff or an employee of the same company will have different buying pattern.

3. CULTURAL FACTORS

A group of people are associated with a set of values and ideologies that belong to a particular community. When a person comes from a particular community, his/her behavior is

highly influenced by the culture relating to that particular community. Some of the cultural factors are:

i. Culture

Cultural Factors have strong influence on consumer buyer behavior. Cultural Factors include the basic values, needs, wants, preferences, perceptions, and behaviors that are observed and learned by a consumer from their near family members and other important people around them.

ii. Subculture

Within a cultural group, there exists many subcultures. These subcultural groups share the same set of beliefs and values. Subcultures can consist of people from different religion, caste, geographies and nationalities. These subcultures by itself form a customer segment.

iii. Social Class

Each and every society across the globe has form of social class. The social class is not just determined by the income, but also other factors such as the occupation, family background, education and residence location. Social class is important to predict the consumer behavior.

4. PERSONAL FACTORS

Factors that are personal to the consumers influence their buying behavior. These personal factors differ from person to person, thereby producing different perceptions and consumer behavior.

Some of the personal factors are:

i. Age

Age is a major factor that influences buying behavior. The buying choices of youth differ from that of middle-aged people. Elderly people have a totally different buying behavior. Teenagers will be more interested in buying colorful clothes and beauty products. Middle-aged are focused on house, property and vehicle for the family.

ii. Income

Income has the ability to influence the buying behavior of a person. Higher income gives higher purchasing power to consumers. When a consumer has higher disposable income, it gives more opportunity for the consumer to spend on luxurious products. Whereas low-income or middle-income group consumers spend most of their income on basic needs such as groceries and clothes.

iii. Occupation

Occupation of a consumer influences the buying behavior. A person tends to buy things that are appropriate to this/her profession. For example, a doctor would buy clothes according to this profession while a professor will have different buying pattern.

iv. Lifestyle

Lifestyle is an attitude, and a way in which an individual stay in the society. The buying behavior is highly influenced by the lifestyle of a consumer. For example when a consumer leads a healthy lifestyle, then the products he buys will relate to healthy alternatives to junk food.

5. Economic Factors

The consumer buying habits and decisions greatly depend on the economic situation of a country or a market. When a nation is prosperous, the economy is strong, which leads to the greater money supply in the market and higher purchasing power for consumers. When consumers experience a positive economic environment, they are more confident to spend on buying products.

Whereas, a weak economy reflects a struggling market that is impacted by unemployment and lower purchasing power.

Economic factors bear a significant influence on the buying decision of a consumer. Some of the important economic factors are:

i. Personal Income

When a person has a higher disposable income, the purchasing power increases simultaneously. Disposable income refers to the money that is left after spending towards the basic needs of a person.

When there is an increase in disposable income, it leads to higher expenditure on various items. But when the disposable income reduces, parallelly the spending on multiple items also reduced.

ii. Family Income

Family income is the total income from all the members of a family. When more people are earning in the family, there is more income available for shopping basic needs and luxuries. Higher family income influences the people in the family to buy more. When there is a surplus income available for the family, the tendency is to buy more luxury items which otherwise a person might not have been able to buy.

iii. Consumer Credit

When a consumer is offered easy credit to purchase goods, it promotes higher spending. Sellers are making it easy for the consumers to avail credit in the form of credit cards, easy installments, bank loans, hire purchase, and many such other credit options. When there is higher credit available to consumers, the purchase of comfort and luxury items increases.

iv. Liquid Assets

Consumers who have liquid assets tend to spend more on comfort and luxuries. Liquid assets are those assets, which can be converted into cash very easily. Cash in hand, bank savings and securities are some examples of liquid assets. When a consumer has higher liquid assets, it gives him more confidence to buy luxury goods.

v. Savings

A consumer is highly influenced by the amount of savings he/she wishes to set aside from his income. If a consumer decided to save more, then his expenditure on buying reduces. Whereas if a consumer is interested in saving more, then most of his income will go towards buying products.

SUCCESSFUL PRODUCT LINE CASE STUDY: IKEA

IKEA is a company that mainly sells home and furniture products. Its products have very strong Nordic style characteristics, so it has also received people's attention and love. It also occupies a very large proportion in China's home market. Therefore, China's home

furnishing enterprises also need to study the design success factors of IKEA household products, and on this basis, continuously optimize and perfect their own product design work. In this paper, from market positioning, design concept and user experience these three aspects the in-depth analysis of the elements of IKEA product design success are carried out.

1. Introduction

IKEA is a Swedish-based seller of furniture and furniture products. Since entering the Chinese market in 1998, it has received wide acclaim from domestic consumers. It can be said that IKEA has broken the rigid warehouse sales model of the traditional furniture market in China, and has also injected new vitality into the domestic furniture home market. In addition, IKEA products inherit and develop the advantages of Nordic design style, which is also an important factor for IKEA to be favoured by consumers.

2. Market Positioning of IKEA

Household products mainly refer to all life-related products used in people's daily life, including furniture and daily necessities. Different consumer groups have very different needs for household products because of the different aesthetic methods and consumption concepts. This also requires market positioning in the home design process, in order to attract more consumers. Since its inception, IKEA furniture has been dedicated to designing and producing exquisite and durable low-priced products to meet the needs of the public for home consumption. Its color is mostly biased towards bright colors, and it also symbolizes the vitality of a new generation of young people. In addition, when IKEA enters the Chinese market, it targets the white-collar workers in the big cities. The Scandinavian style implicit in the design of IKEA also makes its products have a very strong concept of differentiation, and is loved by the majority of Chinese consumers. Therefore, IKEA mainly places the target market on the white-collar level in the process of market positioning, and it has developed rapidly in the Chinese market with its own unique design style.

3. IKEA Product Design Concept

3.1 Environmental Protection Concept in Material Selection

As people's awareness of environmental protection continues to increase, they also tend to be more sustainable in the consumption process. In IKEA products, recyclable materials such as wood, cotton, metal and glass are also used to meet the environmental protection needs of consumers. Wood is a commonly used material in home design. In the process of product design, IKEA will design the wood of the original exhaust gas into a new home by compressing, pulverizing and direct cutting without changing the materials of the home product. Fabrics such as sofas, carpets, and pillows in household products can be re-programmed after disinfection to achieve recyclability.

In addition, to reduce the dependence on cotton in the use of IKEA household products, the design and production of bedding products are also carried out by mixing 50% cotton with 50% lyocell fibre, so on the one hand that bedding is comforted, on the other hand, the chemicals required in the production process can be recycled in a closed system to reduce environmental impact and waste of resources.

3.2 Painting Blank Feelings

From the perspective of the appearance, IKEA will also be delicate and meticulous as an important design concept, and each product of IKEA can be enjoyed as an artwork, which is the most unique place for IKEA product design. As an important expression in traditional

Chinese art, white space has been widely used in many fields such as ceramics, painting and poetry. In the design process of IKEA, the concept of blanking is widely applied, which makes the ideology and artistic conception of IKEA products effectively reflected.

In addition, IKEA's product design process is also very functional, and also through the design of the white space to highlight the product features. The analysis of the Viterso table in IKEA household products is shown in Figure 1. The basic structure of the furniture product is a few steel bars, the table top is tempered glass, and the side table can hold things. In the set of table products, there is no added accessories, but the simple function of the material reveals its sense of function and structure. When the item is placed on the top of the set, the elegance of the item can be fully reflected, thereby giving people a beautiful enjoyment. It can be said that the set itself is a unique artistic conception, that is, the white design method in the home design.

Vitesse set table

3.3 Flat Packaging of Logistics

Logistics is an indispensable part of the product design, production and sales process. In the process of designing home products, designers also need to pay full attention to the logistics and transportation links of the home, thus reducing the consumption of logistics costs. The flat-panel packaging mode adopted by IKEA can greatly reduce the occupation volume in the home transportation process, thereby reducing the number of transportation times and effectively reducing the waste of resources and air pollution caused by the transportation of household products. However, not all IKEA products can be transported in a flat-package mode, which requires IKEA designers to fully consider the logistics costs in the later stages of product development and design. In addition, IKEA has established an outsourced manufacturing plant on a global scale, so that it can also obtain local materials during the production process, which leads to a significant reduction in packaging manufacturing costs and transportation costs. For example, the flat packaging in Shanghai Yijia Home is made of local materials, which can greatly reduce the manufacturing cost of IKEA.

3.4 Low Price and Humanized Creative Design

Low price and humanized creative design are also important factors in the success of IKEA home product design. In China's home market, many products sold by IKEA have the characteristics of lower price positioning compared with other similar products, which is also an important reason that attracting many users to go to IKEA to buy home products. In the production process of IKEA household products, the large-scale mass production mode of machinery is adopted, which can effectively reduce the labor cost required for production, thereby reducing the overall production cost of household products. IKEA's own sales volume is relatively large, so the sales price of the product can be positioned to a relatively low range to stimulate people's willingness to purchase. In addition to low prices, IKEA's products are also very creative, and product quality can be effectively guaranteed, which makes IKEA's home products popular with consumers. For example, the Hao Ke Tower floor

lamp shown in the figure uses an oversized lamp head and a slender tube, which allows people to create an impulse to touch. This design style is also exceptionally harmonious in the home environment, which is very good for consumers' favour

Hao Keta floor lamp

3.5 Mass Production Plus Modular Combination Design

All IKEA products are produced in batch production on a large scale. This production method can better meet the needs of the times and is a typical feature of modern industrial design. Although it is most famous for its traditional handicrafts in the Nordic design process, with the continuous development of society, people's demand for home has also improved, which has promoted the large-scale production of household products a further development. In addition, for better transportation, all products in IKEA are combined in a modular way. In IKEA Mall, all of its products can be found in the delivery area downstairs. After consumers find their favourite products upstairs, they can also ship directly downstairs. The area picks up the goods and can transport the unopened home products directly to their homes, which can then be used after a simple installation. It can be said that mass production and modular combination are also important factors for the successful development of IKEA business.

3.6 Simple Design and Diversified Fashion Design

Most of IKEA's products are based on simple style, and in the sales process of related products, users can also find some products that they are satisfied with, and go directly to the store to purchase these products. However, the simple products that IKEA sells are not only simple in shape but similar in shape, but also have the characteristics of simplicity and simplicity. In order to effectively compensate for the aesthetic fatigue brought by the simple design style, IKEA will adopt a diversified and fashionable route in the production and sales of similar products, which is also an important factor in the success of IKEA product design.

In order to provide users with more convenience, the designers of IKEA home products will also design a variety of design solutions, and put them into the IKEA store for sales, so that users can provide more choices. In order to fully meet the user's home product purchase needs. In addition, in the design process of IKEA products, different fashion treatments will be made for the same type of products. Some designers will also integrate traditional design with modern design in the product design process. Good production of many different types of products, and allows customers to have more choices in the process of product purchase. Therefore, in the IKEA product design process, although the design style is mainly simple, but IKEA products also have a variety of fashion design effects, which can provide consumers with more abundant purchase options.

4. IKEA's Unique User Experience

4.1 Outside the Product Design

The user of the product is a person, the good product can make people love to take it in their hands, the size of the home product itself is relatively large, so the designer needs to construct a complete process in the design process of the home product. The space allows people to integrate into it, in order to give people a better quality product experience, which is also the design outside the product.

In the sales process of the product, IKEA is perfectly integrated into this concept. Whether it is in the home experience store or in the product manual, IKEA will place all the home products in each complete sample space, so that let consumers have an intuitive understanding of the size, price and compatibility of the product with the surrounding environment, thereby enhancing the rationality of the selection of products and effectively avoiding the problem of uncoordinated household products.

4.2 Home-like Sense of Autonomy

In IKEA products, consumers can hang around in different products, and there is no staff to interfere. For home products, comfort is also an important factor in the user experience. Comfort refers to people's satisfaction with the physical and psychological aspects of the objective environment, and only in the state of freedom and relaxation, which can people be immersed in the experience of home products. In the self-consumption mode provided by IKEA, consumers can feel the comfort of home, so that users can feel the comfort brought by home products.

In addition, all IKEA products can directly find out who the designer is, which also provides more convenient shopping channels for some IKEA loyal customers. Consumers use one or more familiar designers to purchase products they like. In this shopping method, users can also feel a certain customized experience, which is also the unique user experience of IKEA.

4.3 Accompanying At Home

For families with children in their homes, IKEA can also provide children with meticulous care. These cares are not only reflected in the detailed design of the home, but also in the psychological care of the children. Because children are active and have a poor balance, they need to be protected in the design process of IKEA. The Patru Safety Protection Series shown in Figure is also a basic protective device in the home and can provide good care for the children. In the design process of children's products, it is also necessary to put the design focus on safety. Secondly, it is necessary to ensure the comfort of use and the humanized structure.

In the design process, children's psychological needs need to be fully considered. Children are in a process of continuous growth, and children of different ages also have different

needs. Therefore, in the IKEA home design process, students' needs should be fully considered, and the rational design of products should be carried out on this basis.

5. Conclusion

The design style and store space of IKEA show people not only home products, but also a more comfortable lifestyle. In the process of designing the home store space, IKEA can display a variety of styles and models to people, so that people can access different home environments. In the design process of IKEA products, the products designed by consumers' needs, so that they can fully satisfy people's various needs for household products, and reflect the good design concept of people-oriented.

Trends in Interior Design

Biophilic Design

- Indoor plants have become a completely new layer in interior design projects and large, oversized plants are a growing trend.
- In order to maintain a certain level of connection with nature, Biophilic Design aims to integrate nature into building architecture as a way to improve our health, psyche and overall ecosystem.
- The use of reclaimed wood, hanging plants, green walls and large green installations are some of the main trends that we are seeing and that will shape interior design in the next decade.

Natural Fiber Furniture

- The use of natural fibers such as rattan and wicker in furniture is becoming very popular in interior design.
- This traditional material is being used in chairs, carpets and lighting, mixed and matched with more modern design.

Chubby, curvy design

- Chairs, coffee tables, couches and even lamps are showing their best voluminous curves taking us back to childhood by giving our spaces a young, fun and modern look.
- This new trend is led by furniture with rounded edges and tubular forms, and also known as neotenic design, from the concept "neoteny"—the exaggeration of childlike features.
- An appropriate concept to describe the playfulness these pieces can add to any space!

Arches

- Archways are typical of traditional architecture and are now having a revival thanks to architects and designers adding curved doorways, rounded windows and arched mirrors to their interior design projects.
- Aligned with the "Chubby" and Biophilic Design trends, arches appear as a new way to add curves and more organic shapes inside our homes, not only through actual archways but also through decorative patterns painted on walls.

Niches & Nooks

- Flexibility at home is more important than ever now that working from home has become more common. In this context, working areas become less formal and can coexist with other living areas.
- This has led to the appearance of mini study nooks that are integrated into larger furniture pieces, such as hidden within closets or added to bookshelves.

Invisible Handles/ hardware

- We have recently been seeing how kitchen design has replaced handles and pulls on drawers and cabinets (especially the oversized ones) with invisible hardware.
- These range from Push Latches, a mechanical or magnetic device installed inside the cabinet that allows you to open the cabinet by pushing the door, to Integrated Handles where you can pull drawers thanks to inwardly beveled edges, and more simple solutions such as Hidden Pulls that are affixed to the top edge of each door so that just a sliver juts out.
- The objective is to have a minimal space with a seamless and sleek look.

Stairs Integrated with Furniture

- As a creative way of utilizing the space left under stairs, several interior design projects have added storage spaces or even the integration of the steps into a larger furniture design, such as a working area or shelving.

Colour pops

- In parallel to the more frequent use of bright and bold colors in walls and furniture, rooms and bathrooms have also begun to embrace color in a daring but elegant way.
- Architects and designers are lifting the energy inside these fundamental spaces through colors such as light pink, golden yellow, navy blue and olive green.

Open and Fluid Living Areas

- Living spaces are becoming more open and fluid, with the formal separation of spaces becoming less frequent.
- Ideas such as incorporating curtains and mobile panels into open spaces are becoming very popular as a solution to hide specific areas according to how we are using our spaces at home.

Terrazzo

- This typical marble flooring used in Venetian houses over 500 years ago had its initial comeback in the 1970's. The terrazzo we see nowadays is a mix of bigger chips of marble, quartz, granite and glass, with less density and a more striking graphic look
- We will probably continue to see this material being used not only in flooring but also applied to kitchens and living room furniture. This graphic pattern will appear printed on wallpapers, fabrics and even weaved into rugs!

Exposed wood and concrete

- Exposing wood and concrete as raw materials on walls, ceilings and floors is a trend architects and designers are using to achieve warmth and elegance for interior spaces without falling into expensive budgets.
- The combination of both is capable of engaging all senses beyond the visual and have attractive qualities such as durability and low maintenance.

TRENDS

https://www.architecturaldigest.com/story/design-trends-have-stood-the-test-of-time

http://www.ciaraeloise.com/blog/2016/2/21/interior-design-trends-throughout-the-20th-century