PLASTICS

Functionality/Personality

&

Design Influences

Andy Tse
Plastic Basics

- Plastics are a type of polymer, which is a long chain of repeating monomers.

- Most common classes of polymers are composed of hydrocarbons.

- Polymers are usually divided into two groups, thermoplastics and thermosets.
What defines a plastic (or any other product)...

- Functionality.
  Its purpose and use.

- Personality.
  Its aesthetic appeal and satisfaction.
Functionality

- Plastics are all around us. They surround the environment we live in.

- They are versatile. This allows it to be used in a wide variety of things.

- They play a vital role in our lives as it makes things easier and simpler.
Examples of Uses

- Packaging
- Containers
- Body panels/construction
- Sports equipment
Personality

- Aesthetic appeal.
  How well it can convince people to buy and use it through looks and appearance.

- Customer satisfaction.
  How well it can satisfy and please the consumers.
Examples of Aesthetics

- Distinctive
- Shape
- Size
- Color
- Ease of use
- Brand name
- Life span
Design Influences

- Market
- Science and Technology
- Sustainability and Environment
- Investment Climate
- Industrial Design
Market

- Product (i.e. Plastic)
- Seller
- Buyer
- Transaction.

Supply and demand. Need vs. Greed (Desire).
U.S. Plastic Market

- Good and thriving marketplace.
- Plastic resins are used in a wide variety of end-markets.
- The biggest end-market is packaging. Packaging use has a direct correlation with the “retail” market, which improved 4% in 2004.
- Investments in buildings and structures were up 6.8% during 2004. Improved cash flow, rising incomes among consumers, low-interest rates, and a boom in mortgage refinancing all helped the building and construction market for plastics.
- In the transportation market, light vehicle sales were up from 16.6 million in 2002 to 16.8 million in 2004. Production of automotive parts were up a total of 3.9% in 2004.
- U.S. exports of plastic resins went up 18.9% to $24.91 billion with the recovery of world plastic markets and tighter global supply and demand.
- U.S. net trade surplus of plastics up 21.6% from $8.78 billion to $10.68 billion in 2004.

Data supplied by the American Plastics Council 2004 Year in Review report.
Science and Technology

- Little stagnation
- New technologies everyday
- Strive for the better
- Innovation
Science and Technology

- Less stagnation than many other products.

Cement and concrete, steels and light alloys have reached a high maturity level. However for plastics, there is still room for improvement.
New technologies and scientific breakthroughs allow for greater potential and benefits.

“Safety first.” In NASCAR racing, where a driver racing going at close to 200 MPH, good safety equipment is imperative. Nowadays in professional racing more complicated contraptions, other than a regular seatbelt and helmet, are needed to prevent injuries. Instead of your standard car seatbelt, drivers use a five-point harness with straps made of thick, padded nylon webbing. Instead of an old flimsy helmet, they use super strong helmets made up of several different layers to dissipate impact energy and to deflect flying debris. Kevlar is used in the outer shell. A special type of foam made from polystyrene is used in the liner. The inner lining is made of nylon or NOMEX (a special fire-retardant plastic material made by DuPont).
Science and Technology

- Strive for the better.

Plastic intelligent road studs alongside roads can help illuminate the road so the driver can better steer in the right direction during hazardous conditions.

These road studs are made of rugged polycarbonate discs. They can be visible by as much as 1000 feet away. They are equipped with 10 high-density light-emitting diodes which are connected to electricity by a polyethylene cable. Reports have shown that they are relatively easy to install and can be extremely durable.

Research is now being done in New Zealand to develop studs where its light color and intensity can be changed remotely. This will possibly allow the studs to shift traffic flows, warn drivers of imminent hazards, and help set speed limits.
Robert Langer, a chemical engineer and professor at MIT, is helping to revolutionize medicine delivery and tissue replacement through the use of biodegradable plastics. He is listed on some 300 patents, including the first new brain cancer treatment.

Some of his other innovations include:
- 70’s: a plastic embedded with proteins that can deliver large molecules of cancer-fighting medicine into the body at a gradual rate
- 80’s: a dime-sized wafer of dissolvable plastic that gradually releases chemotherapy drugs into the former site of an excised brain tumor
- 90’s: remote-controlled microchips embedded with medicine on one side and circuitry to control the medicine’s release on the other
- today: biodegradable plastic “scaffolds” that can be used to help regenerate some organ tissue
Sustainability and the Environment

- Life cycle
- Sustainability
- Interaction within the environment
- Recycling
Sustainability and the Environment

- Life cycle.

The life cycle of a plastic usually begins with the heating of crude oil or natural gas in a “cracking process.” This process results in a creation of hydrocarbon monomers. They are then polymerized.

Plastics are formed by several different processing methods. The four main methods are extrusion, injection molding, blow molding, and rotational molding.

These plastics are then used for some length in time. They will naturally degrade in use.

After a certain time when it can no longer do its job or serve its purpose, some plastics will undergo recycling, others will be discarded as waste.
Sustainability and the Environment

- Sustainability.

A plastic should sustain to be functional throughout its lifespan. The lifespan of a plastic should also be expected/determined. This will allow product designers to design a plastic accordingly to the degradation over some length of time. Product degradation comes in many forms, however there are inherent characteristics of plastics which help “destroy” itself. They are shrinkage and tolerance. There are also methods to help prolong its lifespan. They are heat generation and annealing (heat treatment).
Interaction with the environment.

- Plastics can be affected in different ways by temperature.

- Environmental stress cracking (the cracking of certain plastic products that become exposed to a chemical agent while it is under stress).

- Ultraviolet rays and the heat from solar rays degrade the natural molecular structure of certain plastics.

- Harmful weather components like oxygen, humidity, precipitation, wind, biological agents, and atmospheric impurities all can affect properties of plastics.
Sustainability and the Environment

- **Mechanical Recycling**
  The most common method used among regular consumers.
  - Collection of plastic bottles.
  - Sorted in single resin streams to increase product value at material recovery facilities (MRF’s).
  - Sorted plastic baled to reduce shipping costs to reclaimers.
  - Baled plastics are chopped into flakes and washed.
  - Sold to end users to manufacture new products.

- **Feedstock Recycling**
  Pyrolysis is used to heat plastics in the absence of oxygen to break down long polymer chains into small molecules.

- **Source Reduction**
  Unlike true recycling, source reduction is a reduction in waste. Activities are taken to reduce the amount of material that enters the waste management system.
  - Redesigning products to use less quantity of the material.
  - Using packaging that reduces the amount of damage to the product.
  - Reusing products already manufactured.
  - Managing organic wastes through backyard composting.
A design doesn’t always end in a product. There have been many designs that never reach the marketplace.

A design requires a heavy investment by the company before it is translated into a successful product.

A design can be considered successful by demonstrating economic viability. The final product has to have a value in the marketplace greater than its cost to justify an investment into the design. The more potential revenue it can generate the better.
Investment Climate

- **Investment Criteria**
  - Research and Development: Time it takes to develop the product.
  - Effective control: Properly trained employees.
  - Technical Cost Modeling: Cost of processing and cost due to economic parameters.
  - Mold/Die Cost: Cost of materials and mold building.
  - Cost-Benefit Analysis: Economic analysis of the production (cost vs. benefits) expressed in monetary values.
  - Energy: Energy required to process plastics and to recycle it.
  - Competition: Competition of one plastic from a company with another.
  - Market: Factors controlled by consumers.
Industrial Design

- “Form follows function.”
  A product designed to function properly will automatically have aesthetic appeal. A good technical design will lead to a good product, thus leaving industrial design to the packaging or looks.

- Thus industrial design is based mainly on aesthetics/physical appeal.
  A product’s appearance and aesthetic appeal plays to the consumers’ senses. They arouse interest and stimulate the mind. This defines a product’s personality.

- Aesthetics play a major role in a consumer’s choice even though it’s just physical appeal. Looks will usually sway a consumer’s position since most products usually cost and perform alike. Personality is just as important as functionality, if not more.
The aesthetic appeal of a product comes in many different forms.

- Product Differentiation: Products in competition with each other often have the same price and performance. Thus it is necessary to be distinct and distinguish a product through its personality.

- Simple Interfaces: Simplicity and size is key. Consumers want a product that’s simple to use, but compact in size. They want something easy to learn and understand.

- Corporate and Brand Identity: Brand name products carry an image. This image is an asset since consumer’s can establish a connection between the new product and old/current products offered by the company. Consumers are usually loyal to the brands which show satisfaction. They would rather buy from a company they trust than from a no-name one.

- Product Life: Consumers favor products that show longevity. They want a product that lasts a lifetime. Distinguished products show elegance and look timeless.

- A Necessary Balance: A consumer’s environment is enhanced by products which satisfy. This enhancement can be seen as an increase of quality of life, whether it is based on need or greed.
The End