Product Analysis

Everyday we use thousands of different products, from telephones to bikes and drinks cans to washing machines. But have you ever thought about how they work or the way they are made?

Every product is designed in a particular way - *product analysis* enables us to understand the important **materials**, **processing**, **economic** and **aesthetic** decisions which are required before any product can be manufactured. An understanding of these decisions can help us in designing and making for ourselves.

Getting started

The first task in product analysis is to become familiar with the product! What does it do? How does it do it? What does it look like? All these questions, and more, need to be asked before a product can be analysed. As well as considering the obvious mechanical (and possibly electrical) requirements, it is also important to consider the **ergonomics**, how the design has been made **user-friendly** and any **marketing** issues - these all have an impact on the later design decisions.

Let's take the example of a bike:

- What is the function of a bicycle?
- How does the function depend on the type of bike (e.g. racing, or about-town, or child's bike)?
- How is it made to be easily maintained?
- What should it cost?
- What should it look like (colours etc.)?
- How has it been made comfortable to ride?
- How do the mechanical bits work and interact?

If you do this exercise for various products, you will very quickly discover something interesting...

Systems and components

There are 2 main types of product - those that only have one component (e.g. a spatula) and those that have lots of components (e.g. a bike). Products with lots of components we call *systems*. For example:

Product	Components
Bike	Frame, wheels, pedals, forks, etc.
Drill	Case, chuck, drill bit, motor, etc.
Multi-gym	Seat, weights, frame, wire, handles, etc.

In product analysis, we start by considering the whole system. But, to understand why various materials and processes are used, we usually need to 'pull it apart' and think about each component as well. We can now analyse the function in more detail and draft a design specification.

Some important design questions

To build a design specification, consider questions like the following:

- What are the requirements on each part (electrical, mechanical, aesthetic, ergonomic, etc)?
- What is the function of each component, and how do they work?
- What is each part made of and why?
- How many of each part are going to be made?
- What manufacturing methods were used to make each part and why ?
- Are there alternative materials or designs in use and can you propose improvements?

These are only general questions, to act as a guide - you will need to think of the appropriate questions for the products and components you have to analyse. For a drinks container, a design specification would look something like:

- provide a leak free environment for storing liquid
- comply with food standards and protect the liquid from health hazards
- for fizzy drinks, withstand internal pressurisation and prevent escape of bubbles
- provide an aesthetically pleasing view or image of the product
- if possible create a brand identity
- be easy to open
- be easy to store and transport
- be cheap to produce for volumes of 10,000+

Once we have a specification, the next stage in the process is to understand how the materials are chosen.

Choosing the right materials

Given the specification of the requirements on each part, we can identify the material properties which will be important - for example:

Requirement	Material Property
must conduct electricity	electrical conductivity
must support loads without breaking	strength
cannot be too expensive	cost per kg

One way of selecting the best materials would be to look up values for the important properties in tables. But this is time-consuming, and a designer may miss materials which they simply forgot to consider. A better way is to plot 2 material properties on a graph, so that no materials are overlooked - this kind of graph is called a materials selection chart (these are covered in another part of the tutorial).

Once the materials have been chosen, the next step is normally to think about the processing options.

Choosing the right process

It is all very well to choose the perfect material, but somehow we have to make something out of it as well! An important part of understanding a product is to consider how it was made - in other words what manufacturing *processes* were used and why. There are 2 important stages to selecting a suitable process:

- **Technical performance:** can we make this product with the material and can we make it well?
- **Economics:** if we can make it, can we make it cheaply enough?

Process selection can be quite an involved problem - we deal with one way of approaching it in another part of the tutorial.

So, now we know why the product is designed a particular way, why particular materials are used and why the particular manufacturing processes have been chosen. Is there anything else to know?

Final remarks

Product analysis can seem to follow a fixed pattern:

1. Think about the design from an ergonomic and functional viewpoint.
2. Decide on the materials to fulfil the performance requirements.
3. Choose a suitable process that is also economic.

Whilst this approach will often work, design is really *holistic* - everything matters at once - so be careful to always think of the 'bigger picture'. For example:

- Is the product *performance* driven or *cost* driven? This makes a big difference when we choose materials. In a performance product, like a tennis racquet, cost is one of the last factors that needs to be considered. In a non-performance product, like a drinks bottle, cost is of primary importance - most materials will provide sufficient performance (e.g. although polymers aren't strong, they are strong enough).
- Although we usually choose the material first, sometimes it is the shape (and hence process) which is more limiting. With window frames, for example, we need long thin shaped sections - only extrusion will do and so only soft metals or polymers can be used (or wood as it grows like that!).