TALAT Lecture 2101.02

The Product Development Process

12 pages, 11 figures

Basic Level

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Objectives:

This chapter provides a brief introduction to the product development process and systematic design. The goals are:

- To generate interest in and a common understanding of the product development process.
- To tell about the basic principles and terminology used in connection with systematic design in order to facilitate the use of the four product design examples presented in this course (see TALAT lectures 2102.01 - .04)

Prerequisites:

The lecture is recommended for those situations, where a brief, general background information about aluminium is needed as an introduction of other subject areas of aluminium application technologies.

This lecture is part of the self-contained course „Aluminium in Product Development" which is treated under TALAT lectures 2100. It was originally developed by Skanaluminium, Oslo, and is reproduced for TALAT with kind permission of Skanaluminium. The translation from Norwegian into English was funded within the TALAT project.

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2101.02 The Product Development Process

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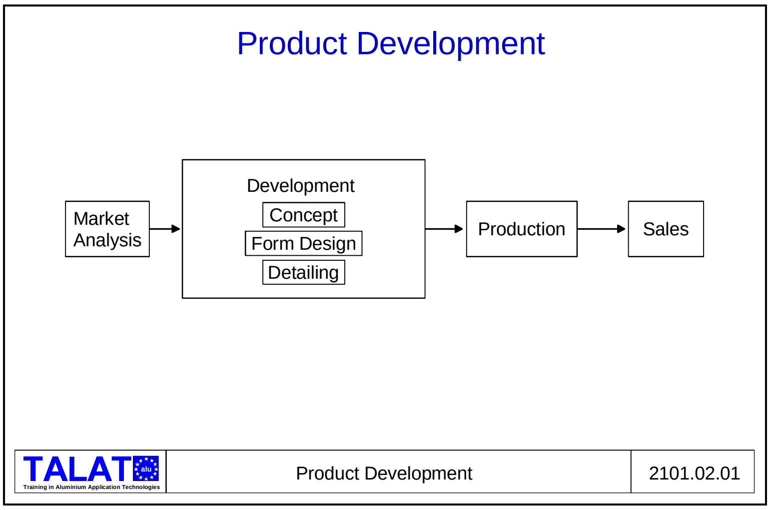
Product Development

The development of competitive new products is a prerequisite for many companies' success. Product development does not necessarily mean discovering revolutionary new inventions, nor does it just involve re-vamping old solutions. A successful product often results from thinking along new lines, free from conventional approaches and traditional choices of materials and designs.

Today, the word product can have many different meanings. Here, we will be using the term in the sense of a mechanical product. To a car salesman, a car is the product. But a car consists of a number of components which are often supplied by independent manufacturers. To an engine supplier, an engine is the product. To take this analogy one step further, an engine is also comprised of a number of different components, all of which may be viewed as separate products.

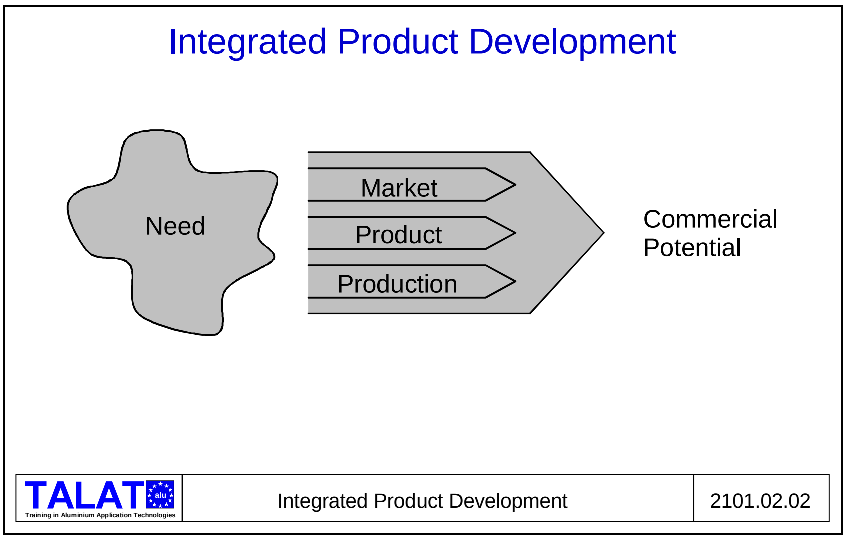
The task of developing a new product and, to an even greater extent, the task of designing a new product, may rightfully be called "creating" a product. Each individual step of the process has to be examined and approached as though it were a "development project" in its own right, whether we look at the car as a whole or at one of the components used to make it.



As a rule, the product development process is divided into several phases, and it may be structured in a variety of ways (see **Figure 2101.02.01).**

The process usually begins with market-oriented activities, such as determining the need for the product and analyzing the market. The process then moves on to the concept phase (when the product idea is formulated), a basic drafting phase and a more detailed design phase, when the product concept actually reaches maturity. The final phases are production and sales.

Integrated product development **(Figure 2101.02.02)** is when marketing and production preparation activities take place parallel to design activities.



The designer has the best chance of influencing the product itself during the concept phase..

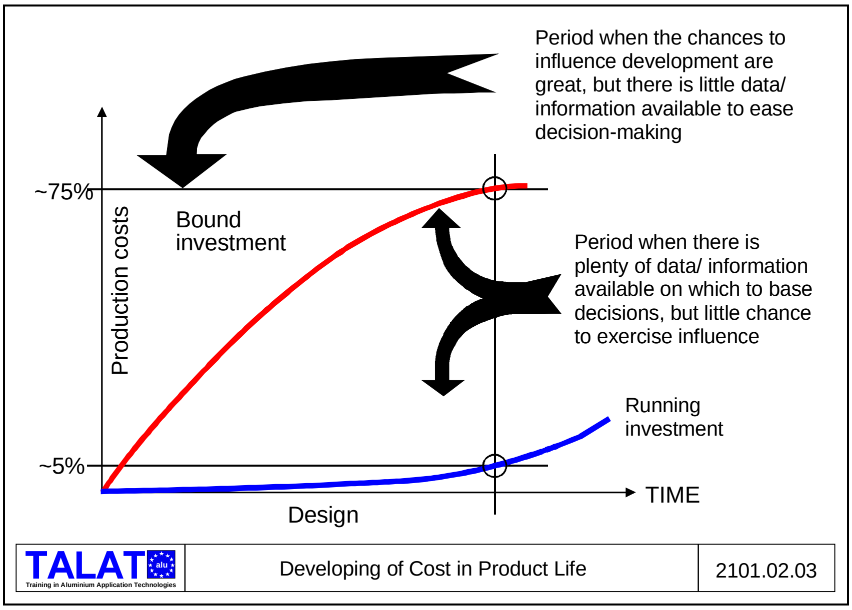


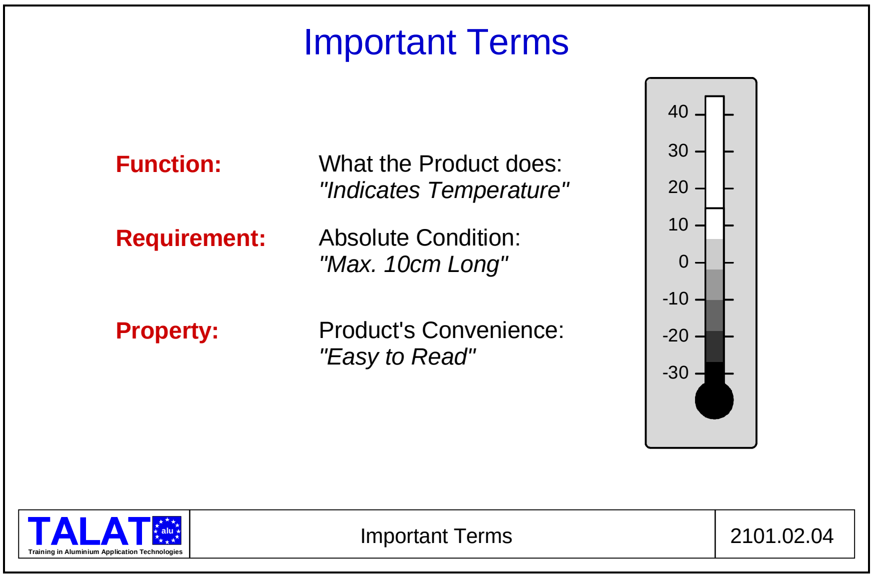
Figure 2101.02.03 illustrates how the average cost of a product develops in the custom engineering industry. As the graphs show, design activities account for about 5 per cent of the total cost of a product, while the same activities determine and therefore tie up about 75 per cent of the capital outlay involved.

At this early stage in the process, our decisions are often based on rather sketchy information. Unfortunately, at the stage where we could influence costs most, our grounds for making decisions are usually weakest. Thus our aim must be to discover a method that gives us the best possible grounds for making decisions as early as possible in the product development process.

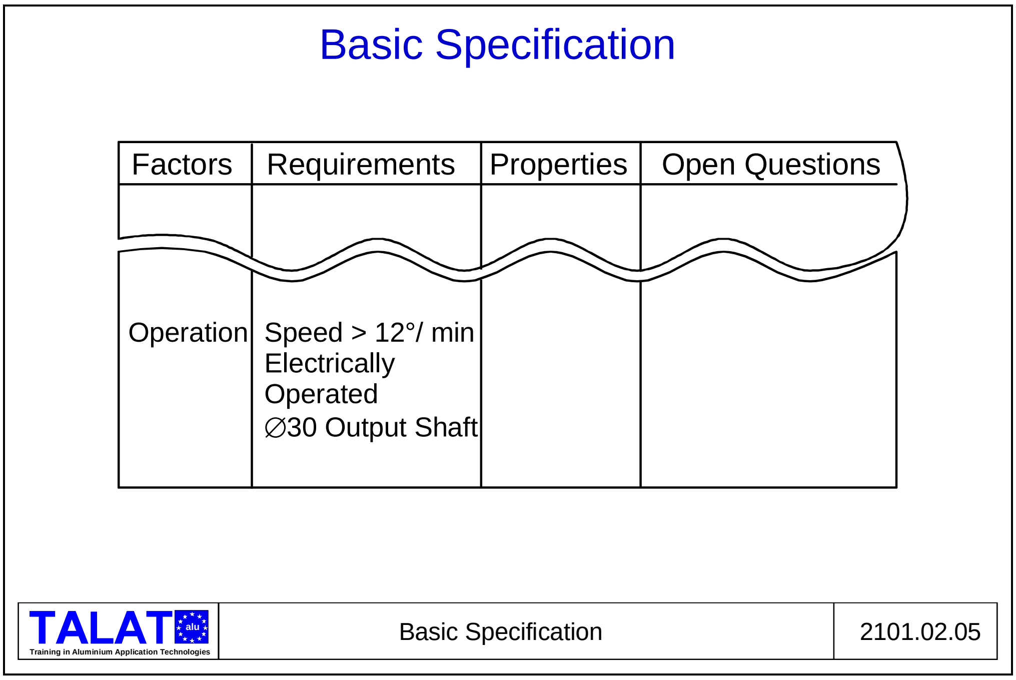
Design Methodology

Design methodology is a rapidly growing field. It deals with systematic design and the methods applied in connection with systematic design. There are several different theories on design methodology. The following is a brief outline of the principal features such a method brings into play during the concept stage of the product development process.

The first thing the design process has to clarify is which *functions* the product must perform to satisfy our needs and what properties it must have to be a good product **(Figure 2101.02.04).** In addition, the product has to satisfy *the* requirements. It is important to specify the product's functions in detail, and not to accept the first idea that comes along on the assumption that it will solve the problem.



A number of ideas will be generated once the product's most important functions have been identified. Initially, these ideas will be concepts for solutions, i.e. theoretical, general solutions. After eliminating any solutions that do not satisfy the criteria, one chooses the solution that comes closest to fulfilling the requirements listed in the *basic* specification **(Figure 2101.02.05).**



The concept selected can usually be subdivided into the various components of the tasks to be performed so that the product will work. Once the functions of the various components have been determined, we can begin to search for solutions as described above.

At a certain point in time, the process progresses from the conceptual level to the design level, i.e. the designer defines the components and their relation-ship to one another (assembly).

We have outlined this process in four examples of the product development process, but first we would like to go into a little more detail about making specifications and defining functions.

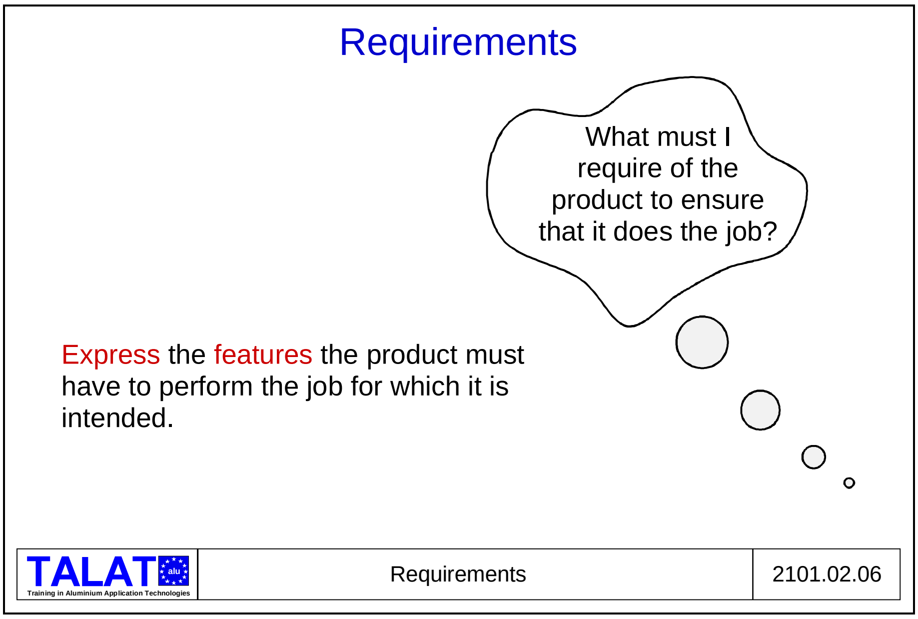
Basic Specification

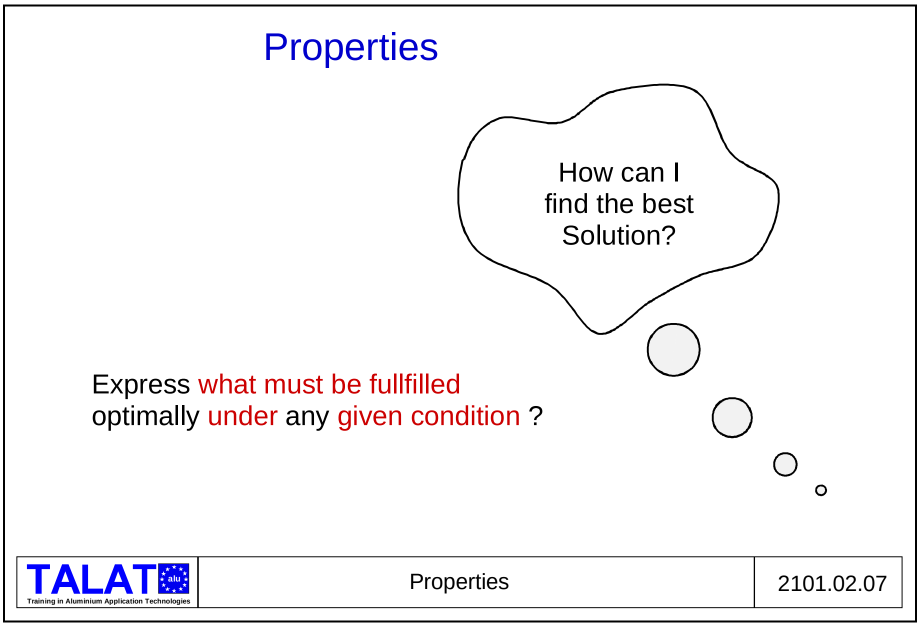
Even if one draws up general descriptions systematically, the work is not easy and does not result in straightforward, unambiguous answers. This is because the description depends on an interpretation of the need for the product and business decisions concerning how that need can best be met and how to compete on the market.

A basic specification is based on insight. However, it is possible to develop new insight during the course of the development process, meaning that the basic specification has to be revised often. As one moves from the general system to the sub-systems or components, it may also be necessary to draw up basic specifications for the sub-systems to ensure that the right decisions are taken, including the right choice of materials.

A basic specification consists of requirements and properties **(Figure 2101.02.06).**

The criteria distinguish viable solutions from non-viable solutions and thereby define the framework available to us. The properties express our understanding of what constitutes a good solution, and may be considered to be the "contours" within our framework. The basic specification is usually set up on a printed form that provides spaces for headings (factors) and questions **(Figure 2101.02.05).**

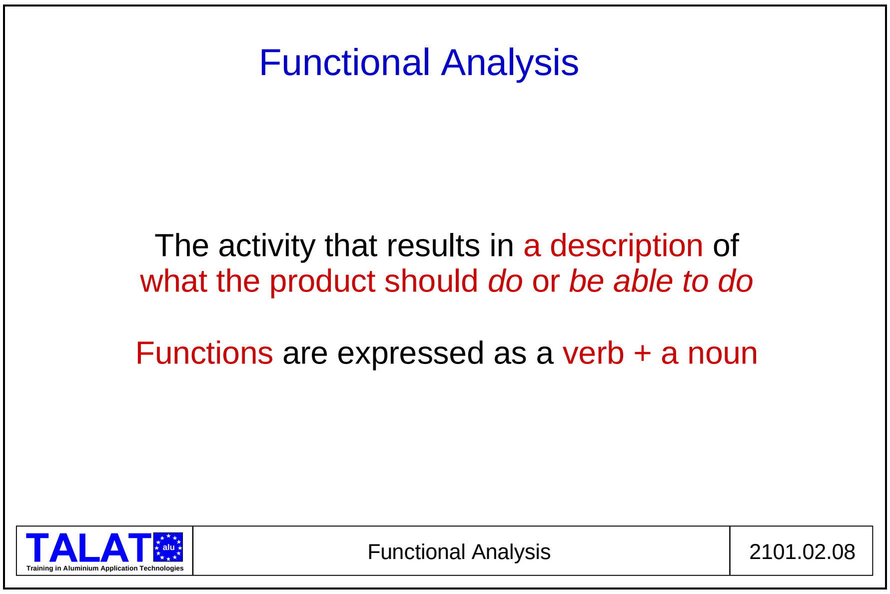




Functional Analysis

It may be useful to begin our search for a solution by making a functional analysis **(Figure 2101.02.08)**. We will start with the main function or purpose of the product ("Provide light" for a lamp, "store compressed air" for a pressure tank, "indicate temperature" for a thermometer, etc.).

Based on our ideas about the finished product's applications, we can make a list of some of the functions the product should have. The lists should not favour any particular solutions early in the process. For example, if we were searching for car door solutions, stating the "allowed rotation" would limit us to hinged doors. Stating the "allowed opening", on the other hand, permits a wider range of possibilities.



Functions are expressed as a verb plus a noun. For example:

To regulate temperature
To transmit momentum
To provide heat insulation
To ensure the power supply

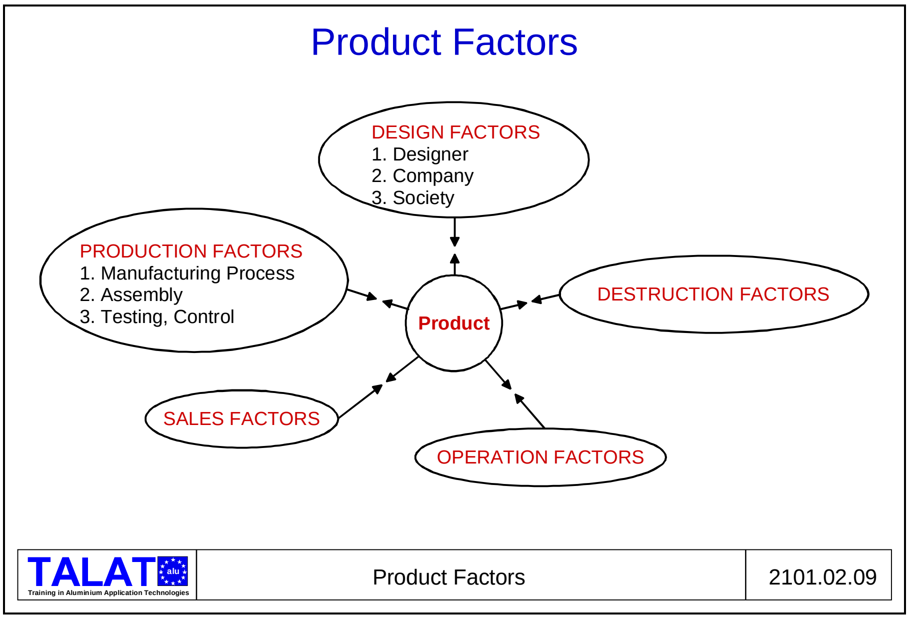
The functions form the point of departure for the act of synthesis, i.e. the inventive, creative and systematic process by which solutions are conceived. Many different solutions should be produced during this process because experience has taught us that the more potential solutions we have, the better the final solution will be.

Evaluations Based on the Criteria

Product criteria should be formulated so that the answer to whether they are satisfied is a simple "yes" or "no". This means the criteria must be quantified ("300 rpms", "accuracy greater than 0.1 per cent", "loudness < 45 dB") or that they involve specific characteristics that we are able to say something about ("3 speeds", "manual operation", "satisfies safety standard xxx").

On the other hand, it is not possible to use the following type of expressions as criteria: Reliable, quiet, user-friendly, etc. This is because such requirements cannot be satisfied absolutely and they are not measurable or quantifiable values.

The criteria that the product design must meet depend on a set of requirements related to the various phases of the product life. Ideally, a product should satisfy our expectations during all phases of its life. Criteria have to fulfill the requirements of the producer, the user and/or of authorities, e.g. in the form of normative, safety, and environmental standards **(Figure 2101.02.09)**.



Evaluation Based on Properties

Properties express which aspects of the product we want to optimalise. A property should therefore be expressed in such a way as to indicate the direction of optimalisation:

Low price
Easy to assemble
Easy to operate
Easy to maintain
Highly reliable
Very safe for users
Easy to transport
Easy to dismantle

If we are going to examine several solutions, we must therefore determine how good the different solutions' properties are. They may be expressed on a relative scale, for example, using two values - good/bad - or on a more finely divided scale - insufficient/mediocre/ acceptable/good.

It may be possible to measure some properties, e.g. US$ for price, time for simple assembly, etc., but others are almost impossible to quantify, e.g. easy to operate, good design.

One expression of how *good* a solution is may be calculated by adding up the values of the properties **(Figure 2101.02.10)**. Those which are particularly important may be assigned a weight factor. Although this calculation has no particular significance, when supplemented by common sense, it may facilitate the selection process.

Like criteria, properties depend on the product's stage of life: ideally, a product should be optimal at every stage of life.

Evaluation Based on Properties
(On a Scale of 1-4)

	A	B	C	D
Low Price	1	3	4	3
Easy to Use	2	2	2	4
High Reliability	2	3	3	2
Good Design	3	2	3	4
Total	8	10	12	13

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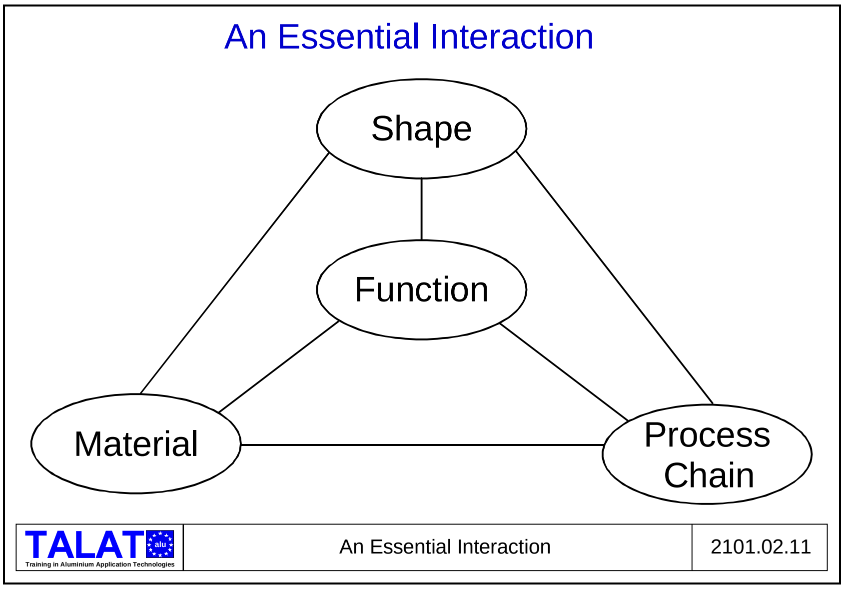
What Characterises a Good Product?

Suppose we examine a number of products proven to be of good design to see if they have anything in common. No doubt, we will repeatedly be struck by the harmony that exists between form, material and processing chain, and how well these elements realise the functions of the product. (The term processing chain refers to the sequence of production processes the material goes through on its way to becoming a finished product. The term is discussed in more detail in TALAT lecture 2101.01).

Figure 2101.02.11 illustrates this essential interaction. Clearly, it is impossible to choose any of the three elements independently of one another without upsetting the harmony of the finished product. Generally speaking, one of the three variables may be chosen on the basis of function, but that choice places restrictions on the next variable and even greater restrictions on the third one.



To fully appreciate the depth of this simple model, we must possess extensive knowledge of materials, forms and production processes, and the interaction between them. The next chapter, "Understanding Aluminium as a Material", and the four product examples will give you a good fundamental understanding of aluminium as a design material.

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