CREATION OF THE PRODUCTION PROGRAM & PRODUCT DESIGN

Lecture 5

Production

- the step-by-step conversion of one form of material into another form through chemical or mechanical process to create or enhance the utility of the product to the user.

  ↳ *Production is thus a **value-added process**.*

- Main objective of production department of manufacturing companies: produce goods in desired quantity and at desired time so that to be available to end users when they demand it.
- Production includes many activities and operations which need to be planned appropriately and in turn controlled for the effective production of the output.
- Main purpose of production planning and control (PPC): to establish routes and schedules for the work that will ensure:

  > *the optimum utilization of materials, workers, and machines and to provide the means for ensuring the operation of the plant in accordance with these plans.*

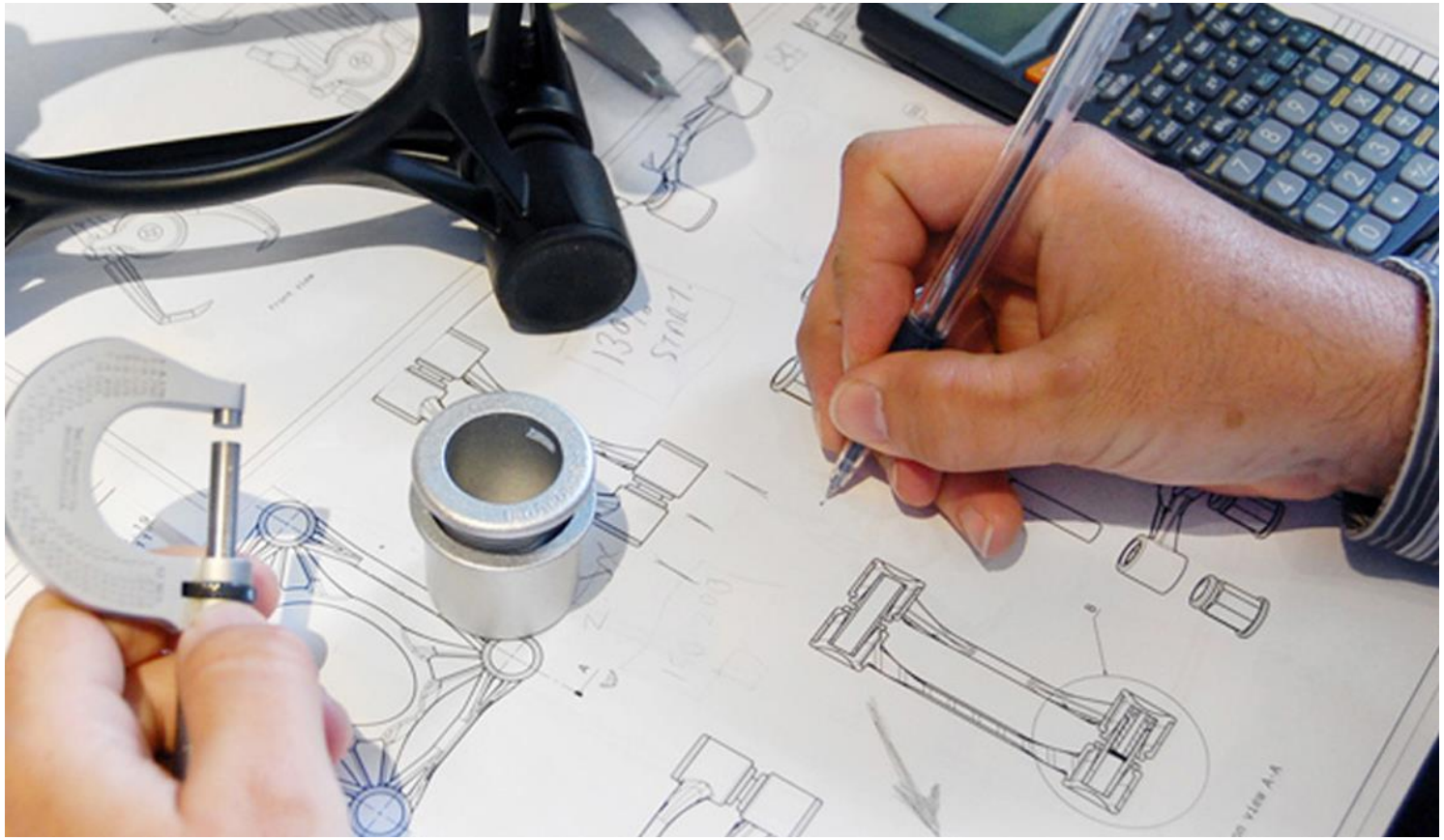
- Product development process can be fully automatic, semi-automatic, or completely manual.
- The core asset developers are responsible for creating the production plan that will communicate the production strategy to the product developers.

Product developer

- Product developer: person (or people) responsible for the creation of a specific product in the product line.
- The product developers create a product-specific production plan from the general production plan created by the core-asset developers.
- The product developers may also be responsible for specifying the product requirements, customizing the product line architecture and components, and tailoring the testing assets for the specific product.
- To max benefits of the product line approach to an organization, several issues must be considered:
  - What is the most efficient organization of the core assets?
  - How can core-asset creation be coordinated to support consistent and effective product development in a product line?
  - What information about the core assets would be most helpful to the product developers?
  - What variation mechanisms do the core assets provide?
  - How can the product developers efficiently utilize the variability mechanisms in the core assets?
  - What degree of flexibility should the product developers have in modifying the core assets of the product line?
  - Where can help be found when specific problems arise during integration of assets?
  - How can the specific product requirements be used to estimate cost and schedule?

Production plan/strategy

- Production plan: describes the process for building a product in the product line.
- The **production plan for a product line** follows the strategy for developing products from the core assets.
- The production strategy is based on the **product line goals** and influenced by the **technologies** to be used during production. This strategy specifies techniques and conditions for product development that support those goals.
- The production strategy coordinates the **design** and **use** of the core assets:
  - It begins as an informal notion,
  - evolves concurrently with the core assets, and
  - ultimately documented in the production plan.
- And it defines several **aspects of development**, including:
  - the **expertise** of the product developers
  - how the product developer **identifies** the product to be built
  - the product **development process**
  - the **technical environment**



Product design

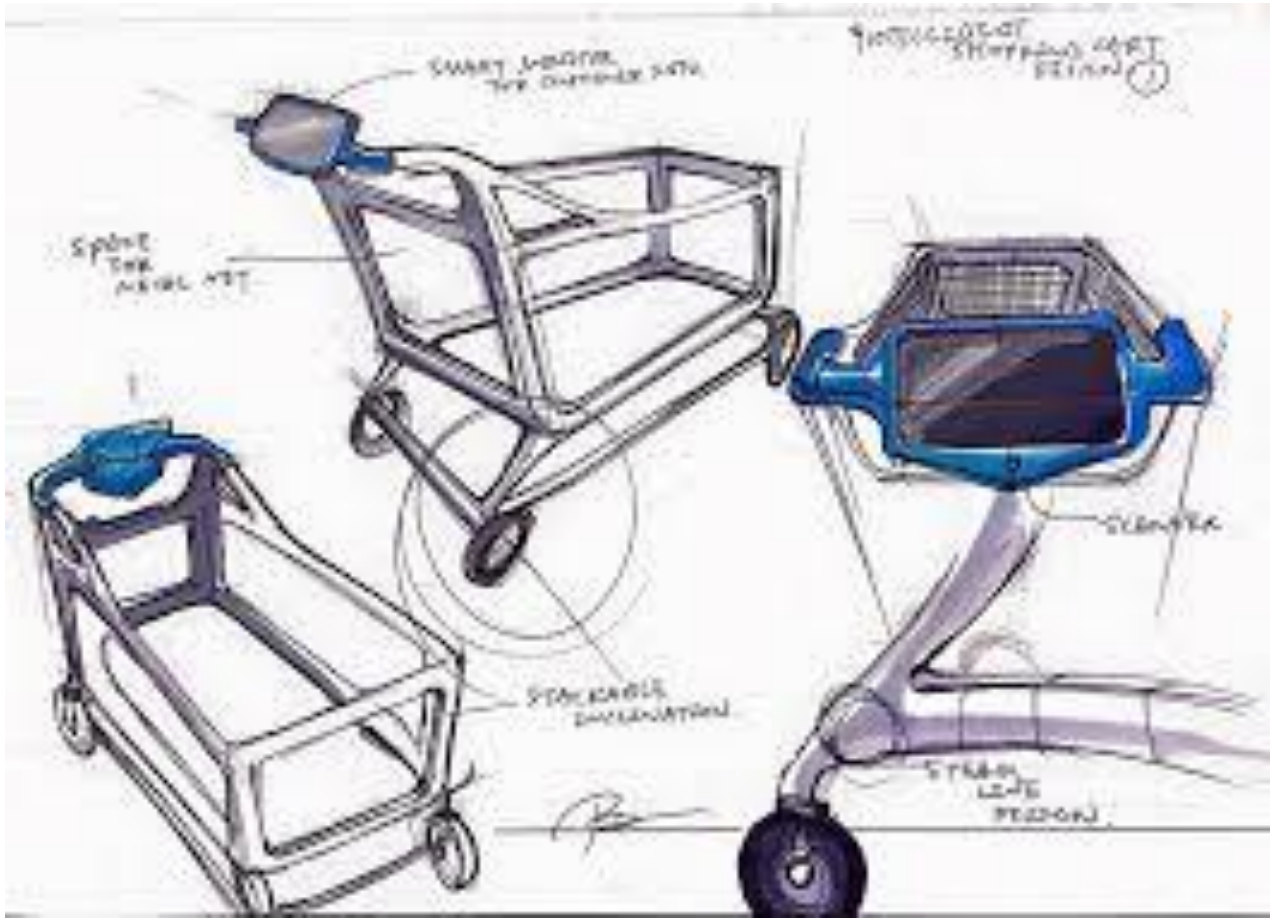
Broad definition: “The process of converting an idea into information from which a new product can be made” (Caldecote, 1979 cited in Walsh et. al, 1992)

Narrower definition: “Design is the very core of innovation, the moment when a new object is imagined, devised and shaped in prototype form” (OECD cited in Walsh et. al, 1992).

"The activity in which ideas and needs are given physical form, initially as solution concepts and then as a specific configuration or arrangement of elements, materials and components“ (Walsh et al., 1992)

Product design

- Depending on culture, design assumes various roles: UK gives to it a more analytical and marketing approach; in Japan it is more about what “could be”, i.e. a more creative process (Evans, 1986).
- Design covers a **broad spectrum of activities**: architecture, fashion design, craft work, product design, graphics and typography.
- **Multi-disciplinary process** which usually involves market and technological research, concept design, prototype development, final product development, testing and postproduction refinement.
- Product design can involve the adaptation of products for particular markets or environments.



Product design plan

- Targeting design program to **min time & costs + planning for it to be successfully completed within the allocated resources**.
- Some activities are worked in **sequence**, some in **parallel**.
- Multidisciplinary activities are focused on the same direction and coordinated in time. The master plan coordinates the various individuals and their mini-projects in an overall time and resource plan so that the product design can be controlled.
- The plan begins with **product design specifications** (included a profile of the product characteristics as defined by consumer). Many of them start as general descriptions; product design and process development focuses them into **definite, quantitative descriptions**.
- In the design process, the product and process development are integrated so that at the **end of the design stage there is a product with the optimum qualities, and a process to produce** it.

Product development plan

Product development is an interdisciplinary activity requiring contributions from nearly all the functions of a firm including finance and sales, concerned in the development of a new product.

Of particular relevance, **three functions** are almost always central to a product development project:

- **Marketing**: mediates the interactions firm - customers. Marketing often facilitates the identification of product opportunities, the definition of market segments, and of customer needs. Marketing also typically arranges for communication between the firm and its customers, sets target prices, and oversees the launch and promotion of the product.
- **Design**: The design function defines the physical form of the product to best meet customer needs. In this context, the design function includes **engineering design** (mechanical, electrical, software, etc.) and **industrial design** (aesthetics, ergonomics, user interfaces).
- **Manufacturing**: primarily responsible for **designing, operating, and/or coordinating the production system in order to produce the product**. Often, it includes purchasing, distribution, and installation (activities usually known as supply chain).

Product development teams

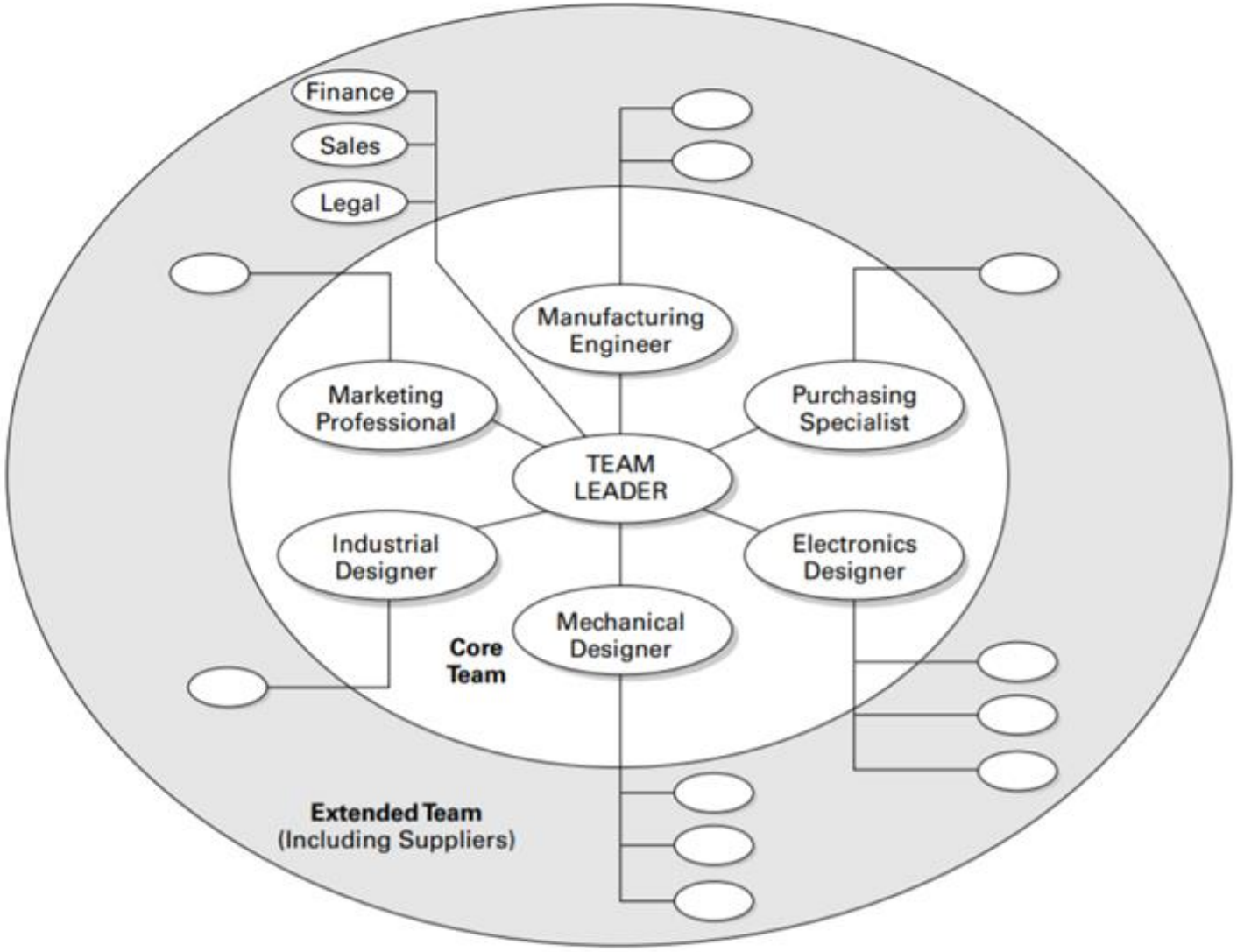
- **Different individuals** within these functions often have **specific disciplinary training** in areas such as market research, mechanical engineering, electrical engineering, materials science, or manufacturing operations.
- Depending on product characteristics, project **teams' composition vary** (individuals developing a product).

- Single team leader, who could be drawn from any of the functions of the firm.

- The team consists of a core team and an extended team. To work together effectively, the core team usually remains small enough to meet in a conference room, while the extended team may consist of dozens, hundreds, or even thousands of other members.

- The term team is inappropriate for a group of thousands but used to emphasize that the group must work toward a common goal. In most cases, a team within the firm will be supported by individuals or teams at partner companies, suppliers, and consulting firms.

Product development teams



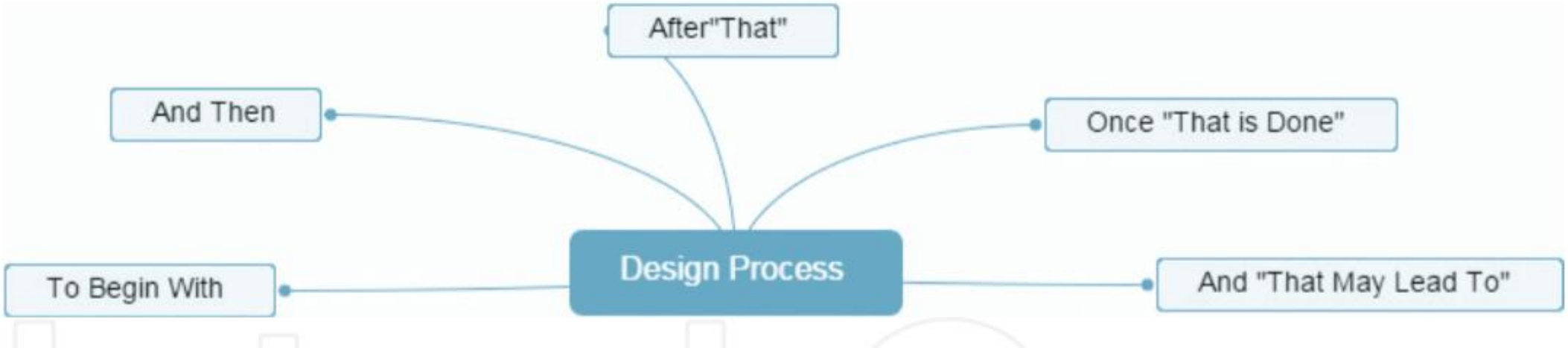
Design activities

- Design procedure is the basis for guiding the steps of design process,
- Design method guarantees for effectively developing the design process and improving its quality.

A clear and reasonable **process** can lead to a simple and smooth way to design, find a better way for problem solving in a wider range to develop and design a good product.

- Design process: a sequence of creative **problem finding, analyzing, and solving steps** used by the designer to develop an appropriate design solution for the given client, (organizational framework used by designers during the process of product design). Interlocking and not straightforward activities.

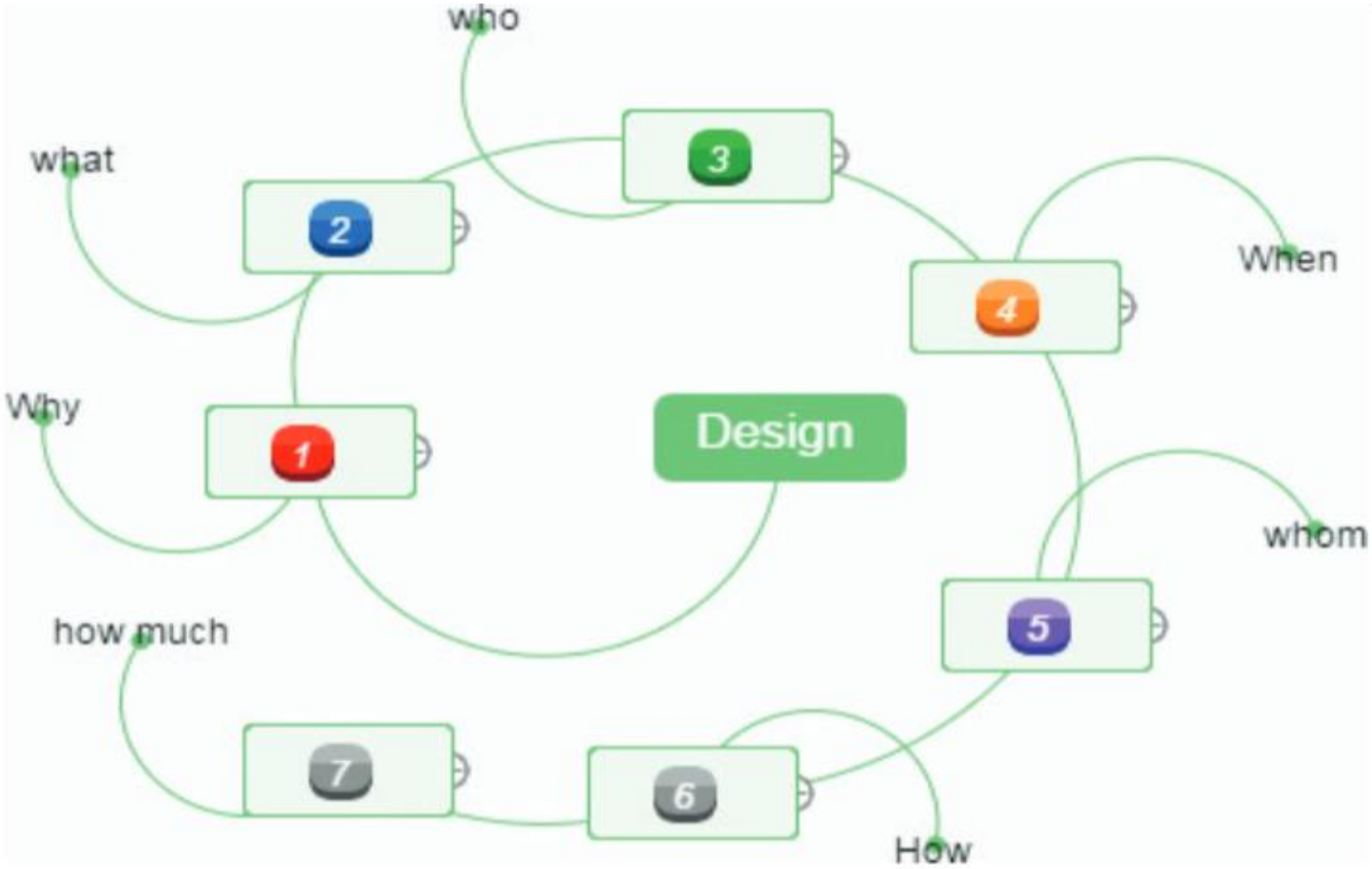
In a design process, there must be clear steps to **plan and integrate**, and the whole process should be rationally arranged following a scientific approach, so as to achieve the final design goals clearly.


After"That"
And Then
Once "That is Done"
Design Process
To Begin With
And "That May Lead To"

Design analyses

During the process:

- Series of problems and brand-new ideas will be brought in, to analyze to lead future products.



- We need to find key info **to explore product, know about the market and potential customers**, and get important **information about the variety of functions**.
- We need to deal with the whole developing and design operations and have control on its corresponding costs.
- The product is formed with a certain purpose to **meet the needs** of targeted people as well as nonphysical services

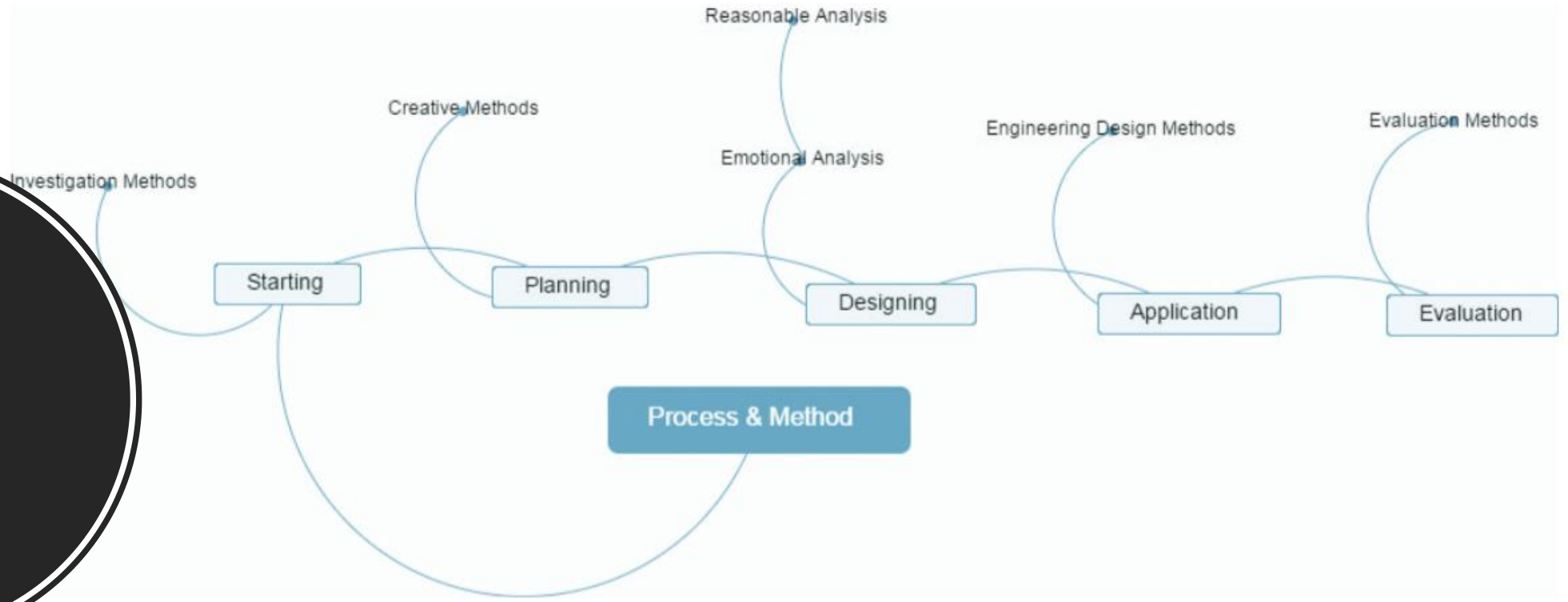
Modern product design analysis

- **Planned, step-by-step, targeted, and directional creative activity.**
- Refers to the development **process of the design and the order** in which the design tasks are completed.
- According to the arrangement the process, it can be divided into **linear, parallel, and complex programs.** It is an organic combination of finding, analyzing, and solving problems.

With the advancement of technology, computer-aided design and manufacturing introduced:

- For example, in the market research stage, computer data analysis can be introduced; in the concept stage, product sketc hes, renderings, and even real physical models are created through rapid prototyping based on computer-aided design, as well as design evaluation, reversing, and optimization iterations.
- You must have proper methods to be used for the process: they directly affect the success or failure of the work.

Modern product design analysis



- The main features of modern design are optimization, dynamics, diversification, and computerization.
- Commonly used design methods mainly include catastrophe method, information theory method, system theory method, discrete theory method, intelligent theory method,
  cybernetic method, correspondence theory method, optimization method, fuzzy theory method, and art theory methods

Product design process

(according to different design objects, the specific matters of each stage are slightly different and complicated):

1. research phase;
2. analysis and positioning;
3. conceptual design phase;
4. detailed design phase;
5. design output phase.

1. Research and design

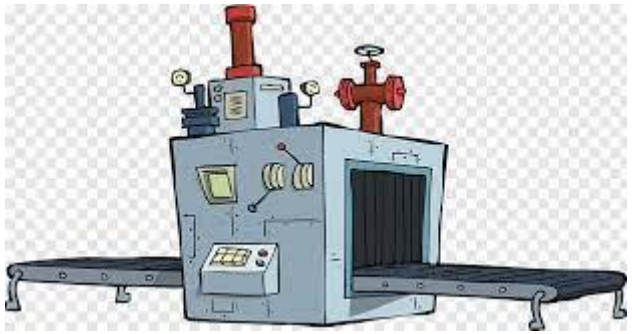
To know what we have, what we want, and where to get (and how to get) required information from seeing the micro-knowledge to know the meaning, using existing information as the starting point, by means of analysis and synthesis methods, etc.;

To integrate the important influencing factors of the products involved, so as to guide the follow-up design in a targeted manner;

Generally speaking, the research phase mainly focuses on:

People

Machines



Environment

- **People:** include target users, potential users, producers, sellers, recyclers, etc., which are related to the product life cycle; gender, age, education background, income level, social status, family conditions, as well as other fac-tors which reflects in status, lifestyle, and values all have a profound impact on the future direction of product design.
-

- **Machine**: refers the various attributes involved in the design object and related products including the current status of the market products and various property expectations of the products involved (function and attributes) and the existing attributes of the product market have a certain reference and guiding role for future design.
- From the existing market survey, we can understand the distribution and gathering of market products, to find the opportunity of post-development positioning. At the same time, the investigation of the attributes of future products can further clarify the product characteristics and gradually deepen the refinement of product concept until the entire product design process is completed.

- **Environment**: mainly refers to the natural and human context in which the design object is located. Any product is used in a certain time and space and social environment, and the product status should match the current environment, which can highlight the design intent and the characteristics of the times.

Product design process-
2. Analysis and positioning

- With the available information collected in the precedent step, we can analyze the direct and potential needs of the users, so as to achieve design customization in a targeted manner.
- Secondly, the investigation of the machine can be intuitive and effective in discovering market development opportunities.

In general, we can explore products from **two points of view**:

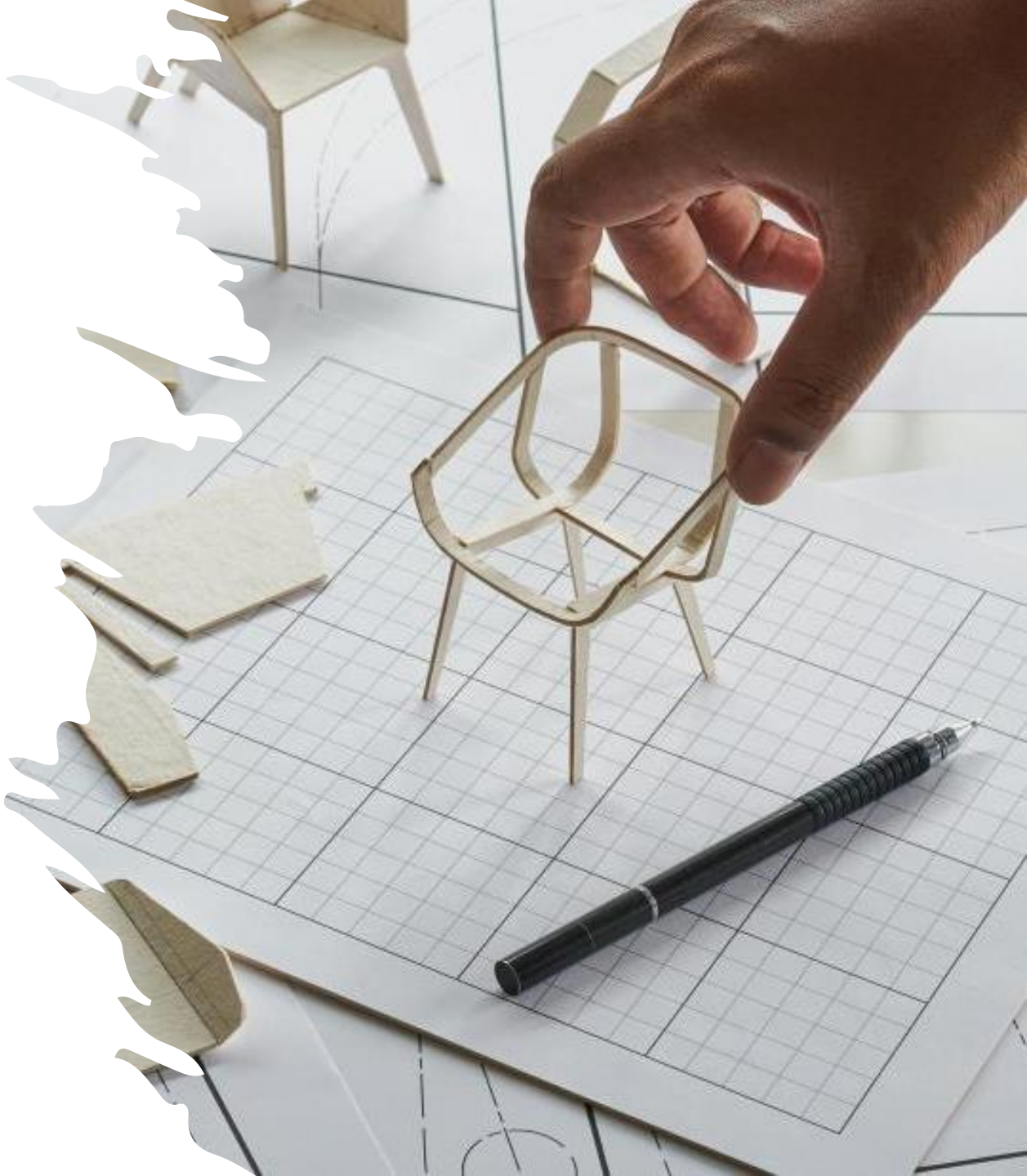
- In the **state of market agglomeration**: meaning that the product status is very suitable for the current trend and can meet the needs of most users. It can be used as a follow-up product development, taking the advantages of popular goods and targeting the mainstream of the market.
- As to the market's **unpopular performance, the challenge of the alternative way** of solving problems with the mutant thinking and the use of unique strategies to creatively complete the development of brand-new products can be reversely considered.

Product design process – 3. Conceptual design

- A series of **organized and targeted concepts** of concise design based on analysis of the previous market demand and user needs. It manifests itself as an evolving process from coarse to fine, from fuzzy to cl ear, and from abstract to concrete, which is a preparation stage for the visualization of the design conceptions after the above design positioning determined.
- Determines the **main purpose** and developing **direction** of the future product, through which we can save our resource input as much as possible, help the following production and sales, extend the profit margi n, and effectively estimate and guide the late recycling issues.
- Thus, conceptual design in the initial stage of product is undoubtedly a **crucial part** of product life cycle.

Product design process – 4. Detailed design

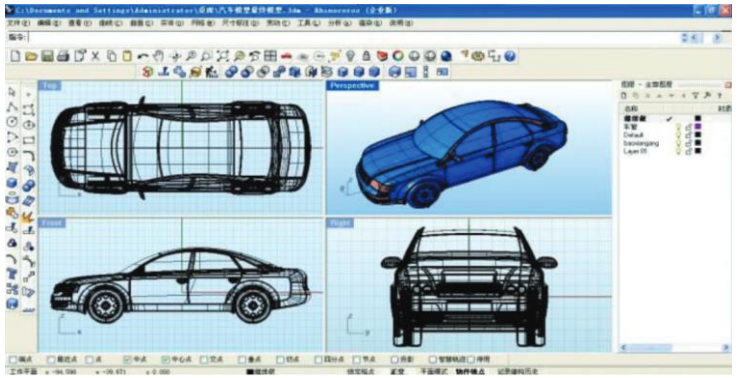
- A visualization process based on the previous design concepts. It is extending and diverging based on design concepts and gradually forms a visual clear plan.
- The process of design evaluation, program selection, optimization, and product expressions are carried out. With a same script, different interpretations produce different works.
- Focusing on the abstract design concept, divergent thinking, and extension, starting from different angles, different characteristics, different ways, etc., the abstract concept is gradually associated with concrete objects, and the design process is gradually cleared and definitely expressed.



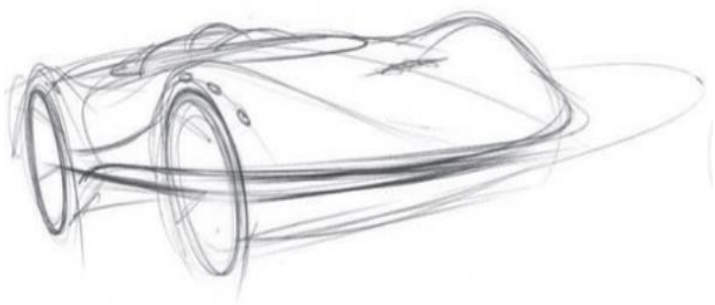
Product design process

Design evaluation:

- In terms of design evaluation, program selection, and optimization, based on the advancement and popularization of modern technology, computer-aided design and manufacturing technology can be fully utilized; digital models can be built with design sketches, and even 3D physical models can be obtained by using rapid prototyping technology.

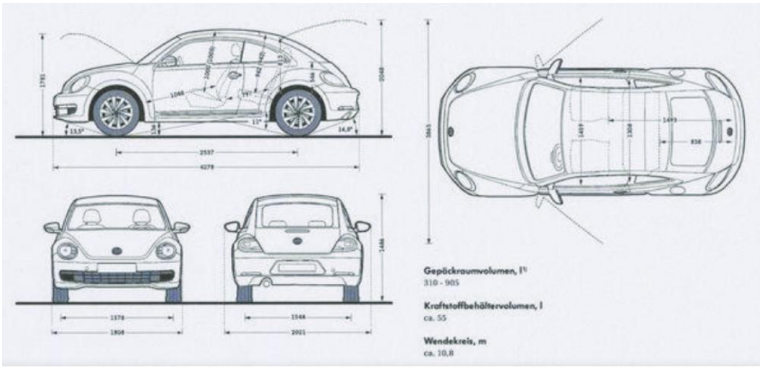


Computer-aided model



Original handmade sketch

Prototyping model



Computer-aided sketch

Product design process-5. Design output stage

- Mainly refers to the **expression of design results** and the preliminary preparation for the following production. At this stage, through the design renderings, **dimensional drawings, parts drawings, construction drawings, detail display drawings, structural drawings, etc., the design results are** presented in a detailed and complete manner.
- Through this way, the above design work is closed and integrated on one the hand. On the other hand, these outputs also provide the basis for production and construction after the design phase.

Product value

Product value

Value: in the pricing literature is the trade-off between customers' perceptions of benefits received and sacrifices incurred quality as customers' primary benefit. The sacrifice component exerts the greater influence on buyers' value perceptions. Scholars noted that the role of price is complex, and customers do not buy solely on the basis of low price.

Customers' value determination affected also by: the context, customers' access to information and past associations also affect price perceptions and consequently.

Other definitions of value have a broader interpretation of sacrifice, in which non-monetary factors such as time and effort are included. Sacrifice is again defined from the customer's perspective. Doyle's definition of value emphasizes it: **value is "not what the producer puts in, but what the consumer gets out".**

"Customer value is a customer's perceived preference for and evaluation of those product attributes, attribute performances, and consequences arising from use that facilitate (or block) achieving the customer's goals and purposes in use situations" (Woodruff, 1997, p. 42). This reflect the richness and complexity of the concept and it impedes its translation into a measurable operational definition.

The Four Consumer Buying Behaviors

Most consumers will adopt all the following buying behaviors, but to varying degrees, behaving in different ways according to the type of product they are purchasing and the purchase situation: brand-focused marketing, price sensitive, feature-savvy, advice-lead personal. However, each buying behavior group has different triggers in terms of information, support and persuasion.

1. Brand-focused marketing:

- **Communications across the differing buying behavior groups** vary enormously. For the brand-focused group, traditional advertising (posters, press and TV) will continue to play a part and a key message will be emotional reassurance that they are buying the 'right' brand.
- The brand should be dominant in all communications, especially in **nontraditional media presentations** (e.g. internet). Brand-focused consumers respond to strongly-branded consumer offers and merchandise via the post – good news for the direct marketing industry.
- This group requires **constant reassurance and the dissemination of information** will be particularly vital should the sector undergo rapid change or suffer some crisis.
- *Maintaining brand trus*t is critical to this behavior group.

The Four Consumer Buying Behaviors

2. Price-sensitive:

- Consumers need to experience value for money at every stage of the buying process. Marketers should build and maintain everyday low-price brand perceptions, and advertising should be key.
- Direct communications should be simple, appear inexpensive and emphasise special offers, moneyback deals and price comparisons with competitive brands.
- To drive this group on to the internet, demonstrate the low prices they can expect to find there. Communications must highlight value, and news of special prices or invitations to events such as special sales evenings will work well.

3. Feature-savvy:

- Consumers are information-hungry and will respond to direct marketing that offers product information such as comparisons with competitors and independent product reviews. Internet sites are ideal for presenting this information.
- Independent editorial will carry greater weight than paid-for advertising, so effective public relations will work. Call center personnel must be highly trained and knowledgeable about the brand they are representing. They should be able to answer complex questions and provide comparative details. *Brand* is *least important* to these consumers.

The Four Consumer Buying Behaviors

4. Advice-led Personal:

- **Interaction** is key to influencing the buying behavior of these consumers. Testimonials, access to online chat rooms and online shopping guides. *Word of mouth* will be the best reference, and in this respect, telephone operators will need to be both authoritative and reassuring at the same time.
- **Reassurance** can also be conveyed through moneyback guarantees and returns policies and can help to overcome post-purchase dissonance. These buying behaviors can be applied in different markets, although to varying degrees, and the communication is applied 'tweaked', accordingly.

Consumer values

Higher-level needs approach the status of values, which are critical determinants of behavior (Baier, 1969).

Value: “An enduring belief that a specific mode of conduct or end-state of existence is personally or socially preferable to an opposite or converse mode of conduct or end-state of existence’.

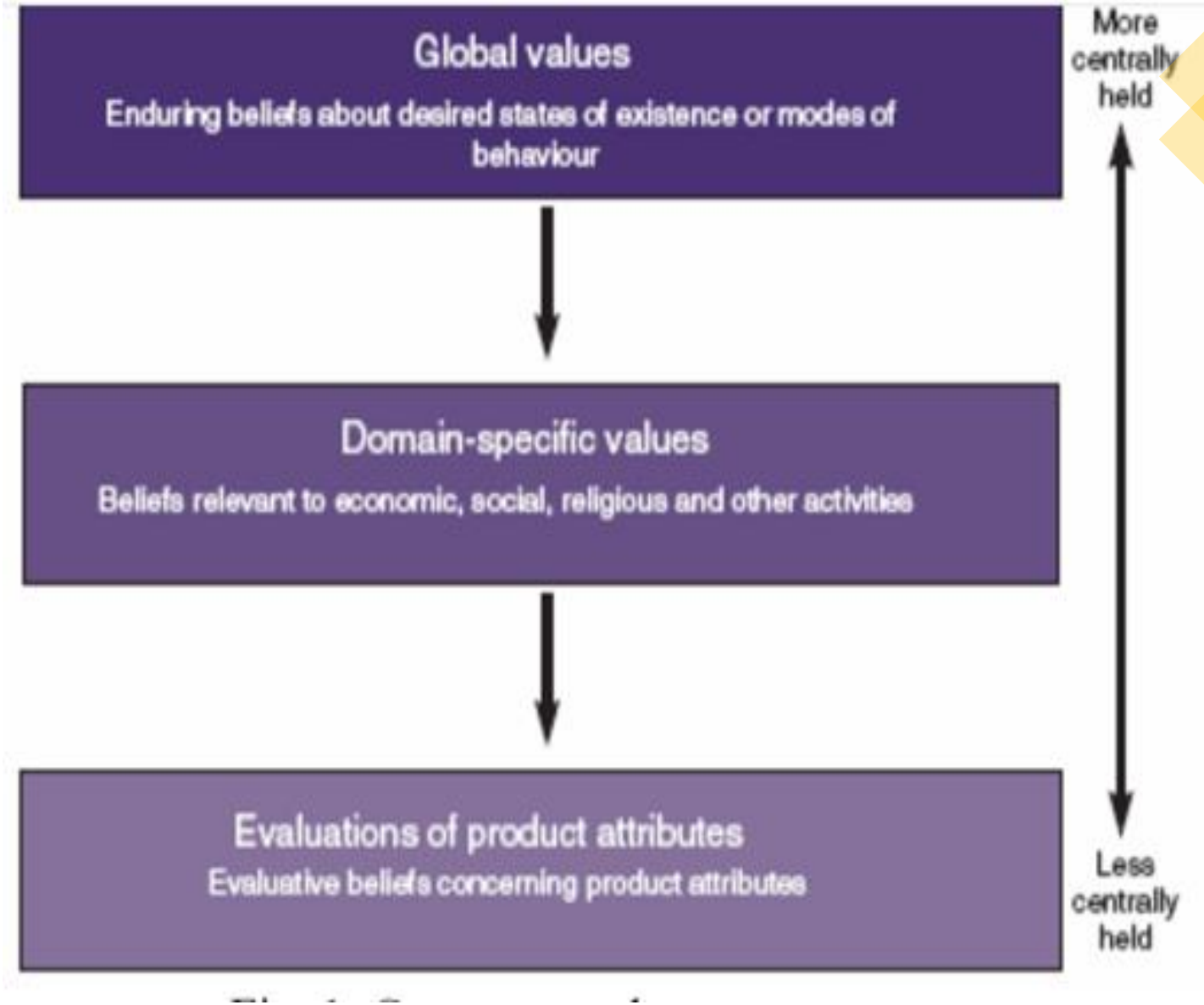
2 types of value:

Instrumental: related to preferred modes of conduct (honesty, friendliness) that allow people to be accepted by others: so this category is the mean to reach a goal. They are: ambitious, broad-minded, capable, cheerful, clean, courageous, helpful, etc.

Terminal values: related to end-state goals (wisdom, happiness and freedom). They are: comfortable life, exciting life, sense of accomplishment, world at peace, world of beauty, equality, family security, freedom, happiness, inner harmony.

Consumer values

- Vinson and Lamont (1977) devised a model of consumer value systems by arranging values at three different levels and giving a hierarchical arrangement to them.



Consumer value

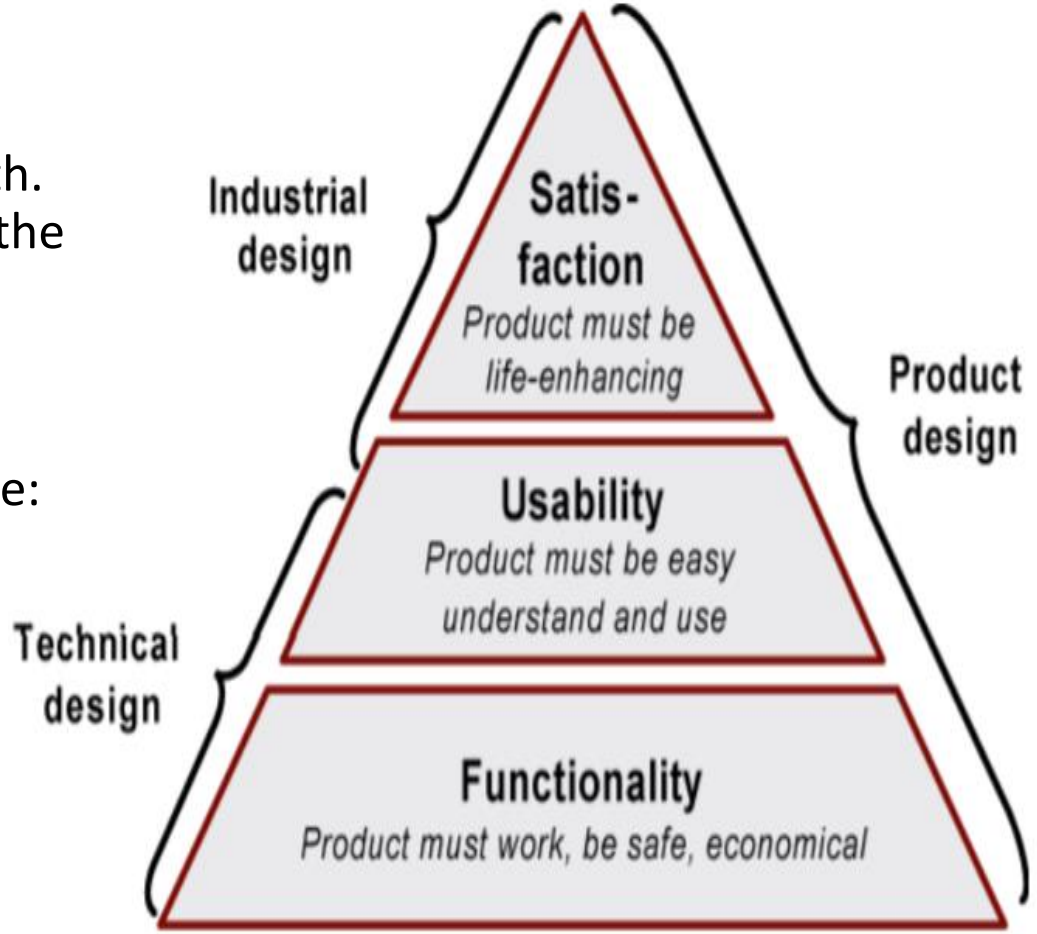
A product has:

- A cost: the outlay in manufacture and marketing.
- A price: how much it is sold to consumer.
- A value: a measure of what the consumer thinks it is worth. The expensive pens command the price they do because the consumer perceives their value to justify it.

What determines value?

- **Functionality**: provided by sound technical design, clearly plays a role. The requirements pyramid has this as its base: the product must work properly, be safe and economical.
- **Usability**: a product must be easy to understand and operate.
- **Satisfaction**: that it enhances the life of its owner.

The three together constitute the value of a product that meets (or exceeds consumer's expectations.



Consumer value

Example: pens

All pens in figure function properly and are easy to use.

- Difference: price and material. The upper pair of molded acrylic, the lower pair of gold, silver and enamel.
- Acrylic is the material of tooth-brush handles, something you throw away after use. Gold and silver are the materials of precious jewelry; they have associations of craftsmanship, of heirlooms passed from one generation to the next. So – the obvious question – how do you create product character?

figure courtesy of David Nishimura of Vintagepens.com

Thank you for your attention