Creative Thinking in System Design

ICT 41205 Digital Control Systems

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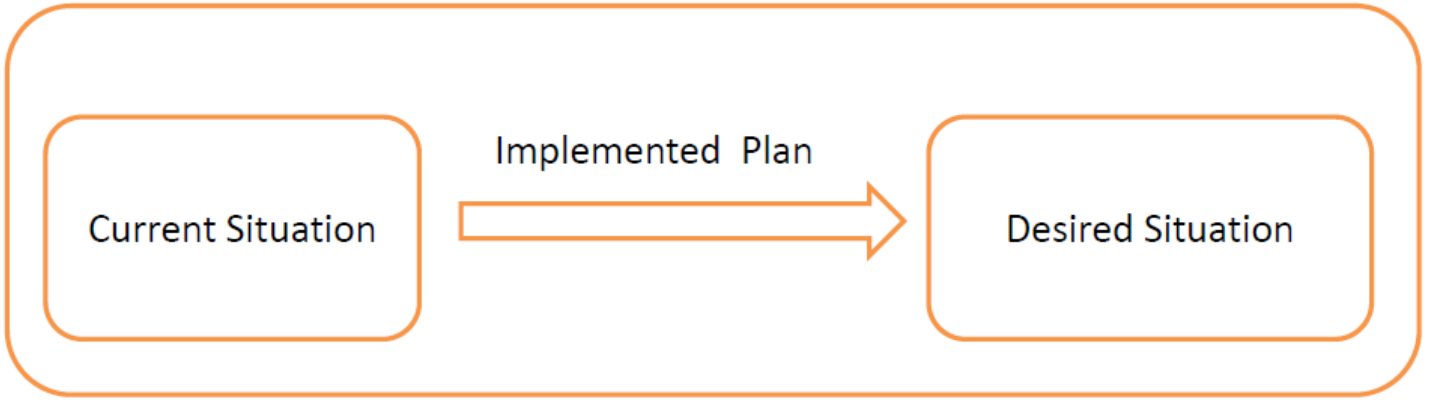
What is Design?

- Meaning as noun: a design
  - A **plan** for change from existing undesired to a desired situation
  - An engineering drawing, CAD model, flow chart etc.
- Meaning as verb: the act of designing
  - **Processes** through which designs are developed
  - Both **goal** and **plan**
- Designs can be for:
  - technical systems (power plant), educational systems (Montessori Method), aesthetic systems (logo designs, advertisements), legal systems, social, religious or cultural systems, theories, Models, etc.

What is Design?

- Village women walk to water source
- Roads to water source are bad
- Large distance away from home
- Carry clothes which become heavier
- Also carry water back
- For safety go in groups

- Women cycle to water source
- Carry clothes on cycle
- Also a washing machine
- Pedal cycle to power washing
- Less effort, faster washing
- Less effort, faster to water source



How to develop ‘good’ designs?

- Initially only **goals** are known better
- But, finally both goals and **plans** are known and more clearly
- Co-evolution: **both** goals and plans evolve together, one influencing the other

- Multiple goals: some goals are more **important** than others
- Multiple plans: some plans are **better** than others

- But, designing does **NOT** guarantee that designs will work. Some designing may be better than others in achieving goals.

How to develop ‘good’ designs?

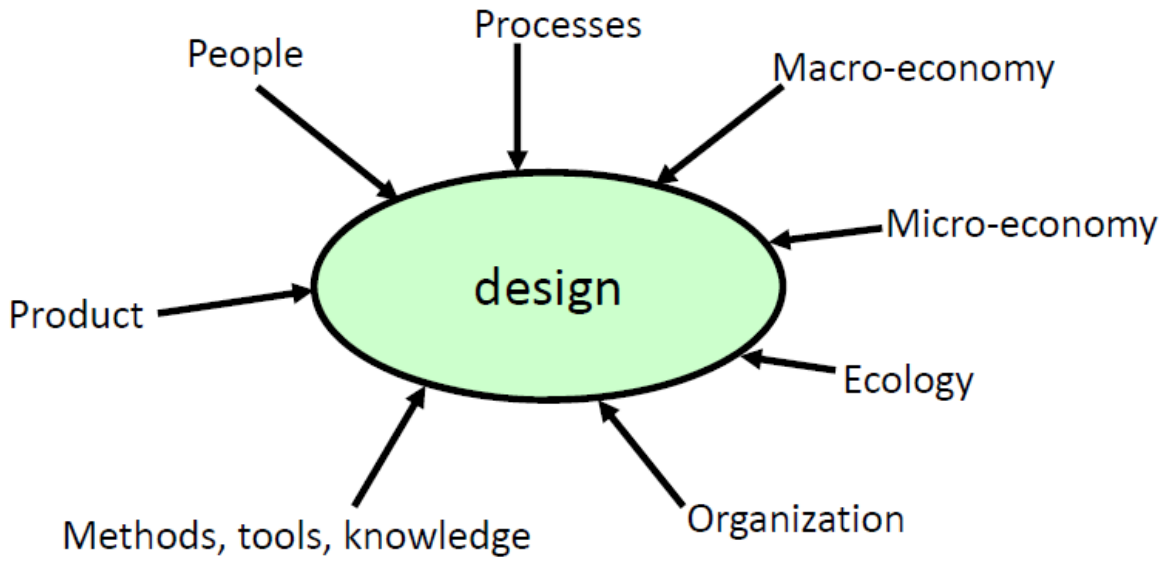
- Multiple goals: some goals are more important than others
- Multiple plans: some plans are better than others

- How to identify the goals?
- How to assess how important these goals are?
- How to a generate possible alternative plans?
- How to modify better plans based on this knowledge?
- How to assess which ones are better?

Design Thinking Process

Facets of Design

- Designing is planning for changing existing, undesired situations into preferred ones
- Influenced by people, product, process, tools, organization, economy and ecology
- Multi-disciplinary: uses knowledge from human, natural, engineering, ecological, etc. sciences
- Develops necessary knowledge when knowledge is not available for designing



Design Research

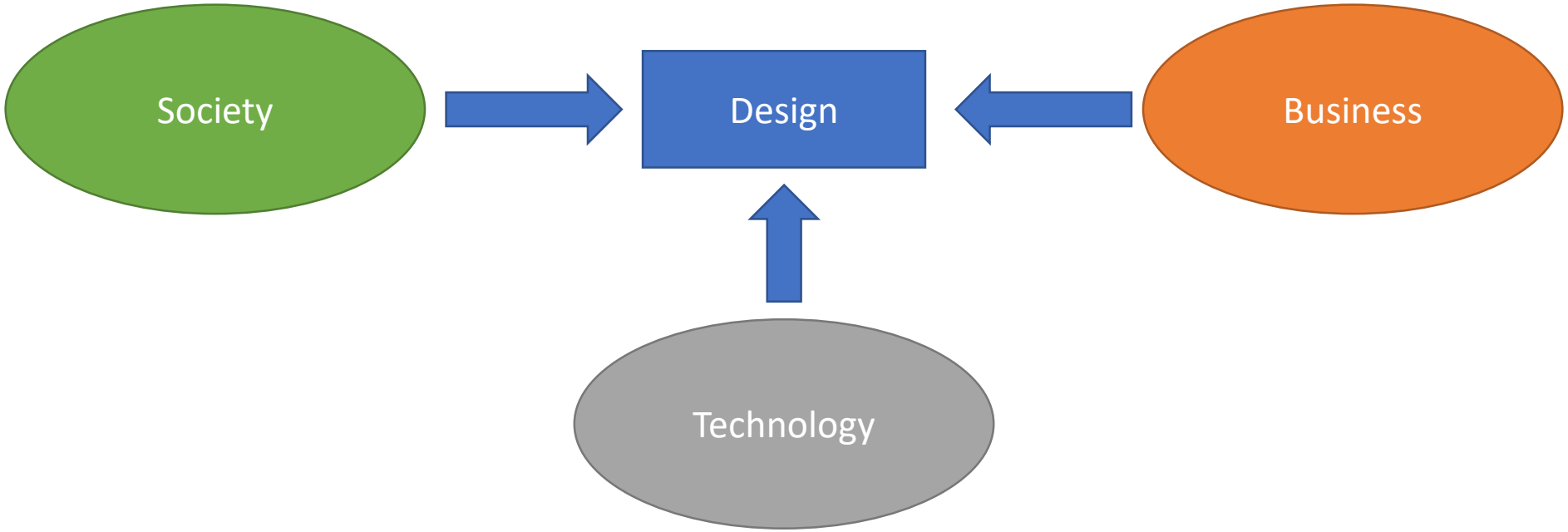
- Systematic study of design phenomena
- Develop knowledge about the design
  - Purposeful: Describes/explains/predicts design system behaviour
  - New: Not before
  - Generic: Applies to multiple things, cases, people…
  - Valid: Has some sense of truth

Design Research

- Develops knowledge in the form of
  - **Theories/models:** Theory of Technical Systems, Integrated Model of designing
  - **Guidelines:** Design for Manufacture and Assembly (Boothroyd-Dewhurst)
  - **Methods:** Weighted Objectives method for comparative evaluation
  - **Tools:** Sketchpad – a tool for sketching using GUI (Sutherland, 1963)
  - **Standards:** IDEF0 standards for representing processes
  - **Materials:** Ferromagnetic-composite material for light, conducting aircraft body
  - **Processes:** CNC processes for computer aided machining
  - **Technologies:** Graphical User Interfaces (GUI); micro-pressure-sensors…
- • To help develop successful products by making designing
  - **More effective:** better products – novelty, quality, reliability…
  - **More efficient:** less resources – less time to market, iterations, cost…

Society, Business, Technology

- Design draws knowledge from Society, Business and Technology
- Develops or integrates technology to provide value to society to fulfil its needs



Design for Society: Value

- Need domain knowledge of user/problem
- Processes of knowledge: how to find the needs of society
  - Focus groups
  - Innovation situation
  - Questionnaire
  - Immersion
- Products must perform (function) and be:
  - Safe
  - Reliable
  - Economic
  - Sustainable
  - Ergonomic
  - Aesthetic

Design for Business: Profit

- Need domain knowledge of costs of the materials, manufacturing, etc.
- If it is not affordable users will not buy, if it is not profitable the business will fail
- Process of knowledge: cost modelling
  - Life cycle costing
  - Concept costing
  - Cost to the environment

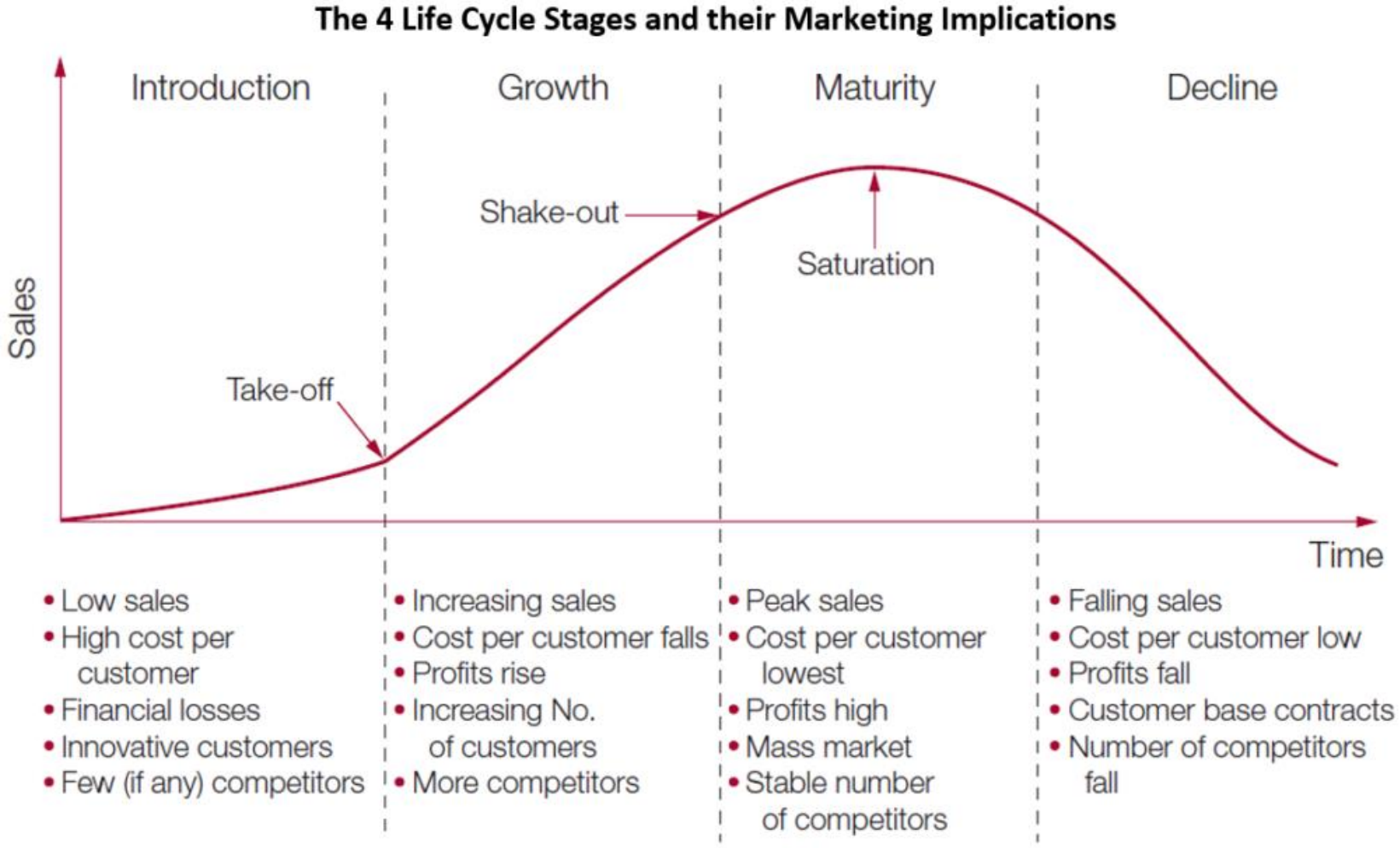
Design for Technology: Feasibility

- Need domain knowledge of various technologies, principles from sciences
- Process knowledge: how to create ideas
  - Brainstorming
  - Stimuli from nature: shrug, tail, sneeze

What is product design?

- A creative activity – involves bringing into being something new and useful that has not existed before (Reswick, 1965).
- Process of devising and laying down the plans needed for manufacturing a product.
- From:
  - Need: Not fully defined, not fully structured
- To:
  - Plan: Well-defined, well-structured

Why is design important?



Why is design important?

- Innovation is needed for continues success of any venture
- Product design is an essential part of the industrial innovation process which is important for both society and business
- Product design is an early stage of product development, where it is inexpensive to make changes, but consequences of changes is substantial