

College of Engineering

GE106:Introduction to Engineering Design

Need Analysis

By

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Outline

- **Opening Statement**
- **Introduction**
- Examples of Needs Hierarchy
- Example on How to Improve an Existing Motorcycle
- Example of a Portable Audio Player Requirements
- Examples of Different Types of Design Requirements (Specifications)
 - Functional Requirements
 - Safety Requirements
 - Quality Requirements
 - Manufacturing Requirements
 - Timing Requirements
 - Economic Requirements
 - Ecological Requirements
 - Aesthetic Requirements
 - Life-Cycle Requirements
 - Legal/Ethical Requirements
- **Group Activity**
- Closing Remarks

Opening Statement

“Need Analysis” related difficulties are responsible for over 30% of project failures. **Billions of dollars** are spent annually on **cancelled** products



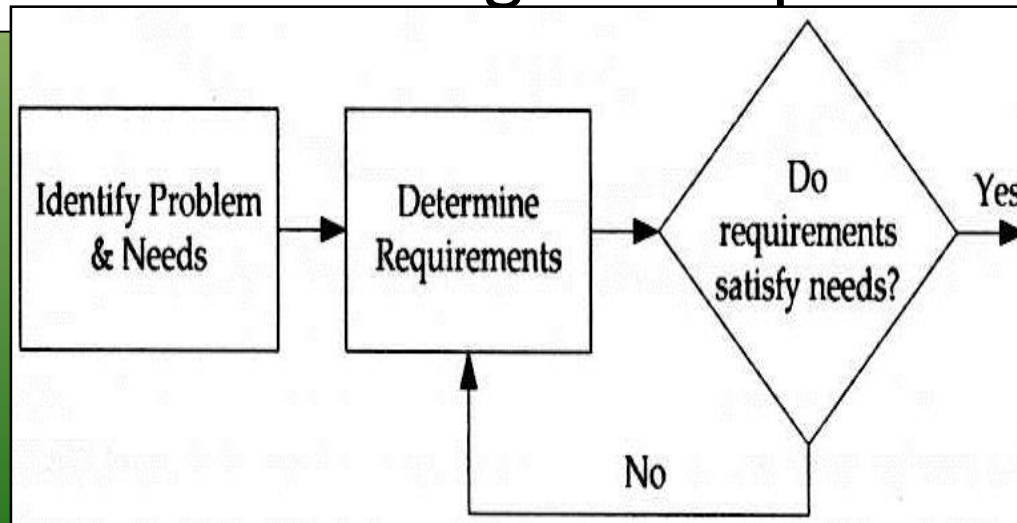
Bad Design Can Kill You!

Now, start taking notes.

Today (in this studio) you will perform need analysis for your team project.

Introduction

- A successful design is the one that perfectly answers (**fulfill**) the customer needs; **all the needs**.
- Needs are expressed by the customer, but collected and formulated by the designer for a good understanding of the problem.

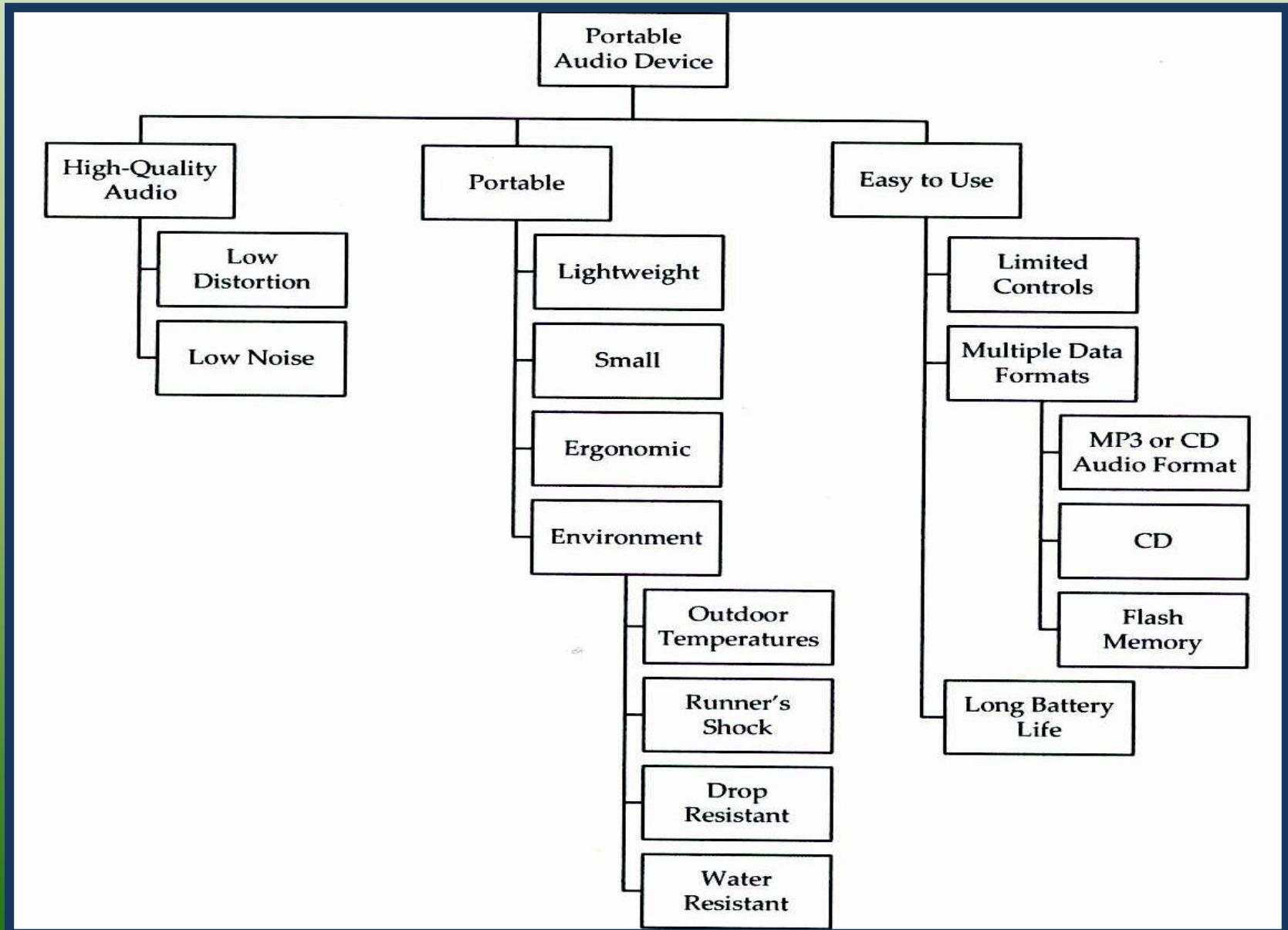


Example: Portable Audio Player Requirements

- Work under water (Able to withstand submersion to 5 feet)
- Temperature Specification (Operate from 0 to 50°C)
- Shock environment (Operate during shock created by jogger)
- Play multiple existing formats and should be upgradeable
- Fast/Easy Connection to a PC (connect within 5 seconds)
- Capable of “data” storage, other than audio
- Reliable (Mean time between failures greater than 10,000 hours)
- Size should be equal to or smaller than an average mobile phone
- Battery life (up to 8 hours of continuous play per charge)
- Standard Interfaces



Example Needs Hierarchy*



Example: Improve an existing motorcycle

What info would help us understand this design problem?

- How quickly should the cycle accelerate to 80 km/h?
- Is fuel consumption less important than acceleration?
- Will the customer tolerate a liquid cooling system?
- What should the top speed be?
- What riding comforts are expected?
- Is an electric starter desired?
- Will the customer care about beauty?



Remember

- Requirements*, constraints and criteria are interchangeable depending on the details of the design solution specification.
- Customer says, “I want a fast motorcycle.” What does “fast” mean?

- *120 mph top speed?*
- *32 ft/sec² acceleration?*
- *4,000 Hz engine frequency?*



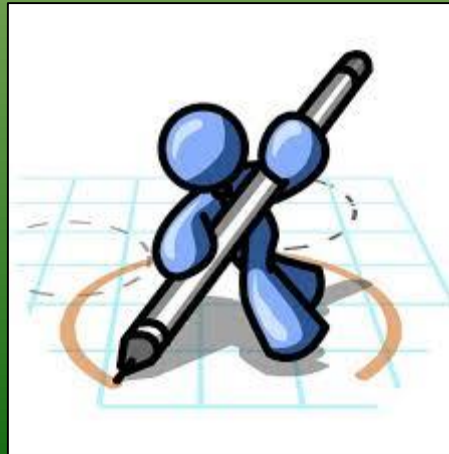
- Could be a constraint (top speed >120km/h)
- Could be a criterion (high speed)
- “must have” requirements = become design constraints
- “desirable” requirements = weighted by importance



- The next slides will quickly list some different types of requirements
- Take notes and identify what applies to your project
- Prepare yourself to perform a need analysis for your team project

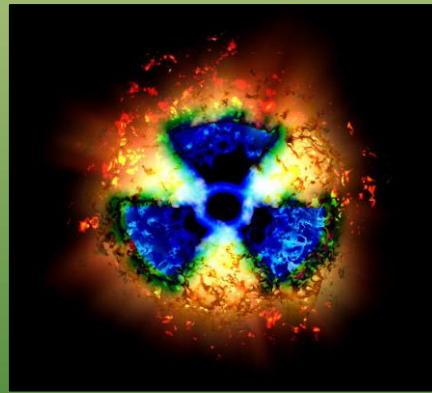
Functional Requirements

- **Overall Geometry** – size, width, space, arrangement
- **Motion of parts** – type, direction, velocities, acceleration
- **Forces involved** – load direction, magnitude, load, impact
- **Energy needed** – heating, cooling, conversion, pressure
- **Materials to be used** – flow, transport, properties
- **Control system** – electrical, hydraulic, mechanical, pneumatic
- **Information flow** – inputs, outputs, form, display



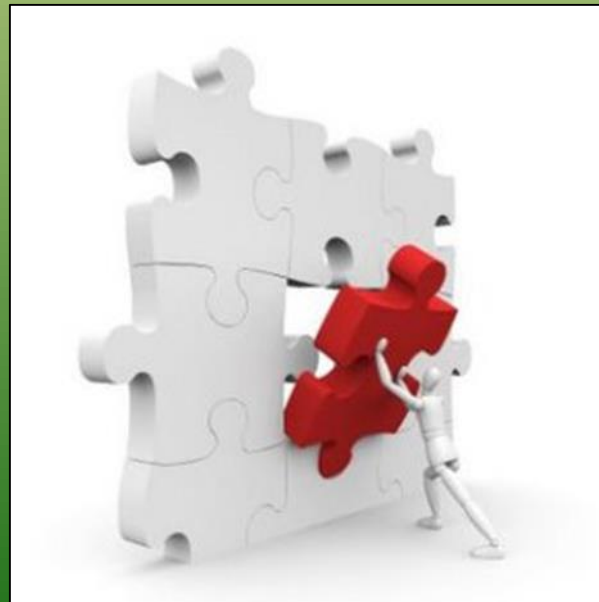
Safety Requirements

- **Operational** – direct, indirect, hazard elimination
- **Human** – warnings, training
- **Environmental** – land, sea, air, noise, light, radiation, transport



Quality Requirements

- **Quality assurance** – regulations, standards, codes
- **Quality control** – inspection, testing, labeling
- **Reliability** – design life, failures, statistics



Manufacturing Requirements

- **Production of components** – factory limitations, means of production, wastes
- **Purchase of components** – supplier quality, reliability, quality control, inspection
- **Assembly** – installation, foundations, bolting, welding
- **Transport** – material handling, clearance, packaging



Timing Requirements

- **Design schedule** – project planning, project control
- **Development schedule** – design detailing, compliance tests
- **Production schedule** – manufacture, assembly, packing, transport
- **Delivery schedule** – delivery date, distribution network, supply chains



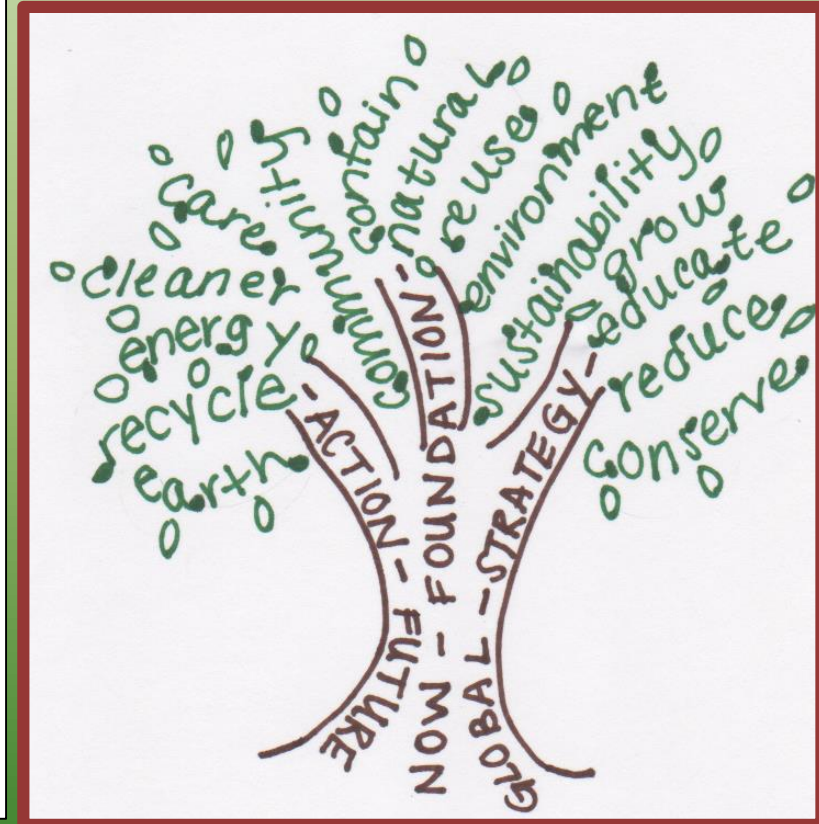
Economic Requirements

- **Marketing analysis** – size of market, distribution, market segments
- **Design costs** – design team computing, information retrieval
- **Development costs** – design detailing, supplier costs, testing costs
- **Manufacturing cost** - tooling, labor, overhead, assembly, inspection
- **Distribution costs** - packing, transport, service centers, spare parts, warranty
- **Resources** – time, budget, labor, capital, machines, material



Ecological Requirements

- **General environmental impact**
impact on natural resources, social resources
- **Sustainability**
political and commercial consequences, implications for following generations
- **Material selection**
solid, liquid, gas, stability, protection, toxicity
- **Working fluid selection**
fluid, gas, flammability, toxicity



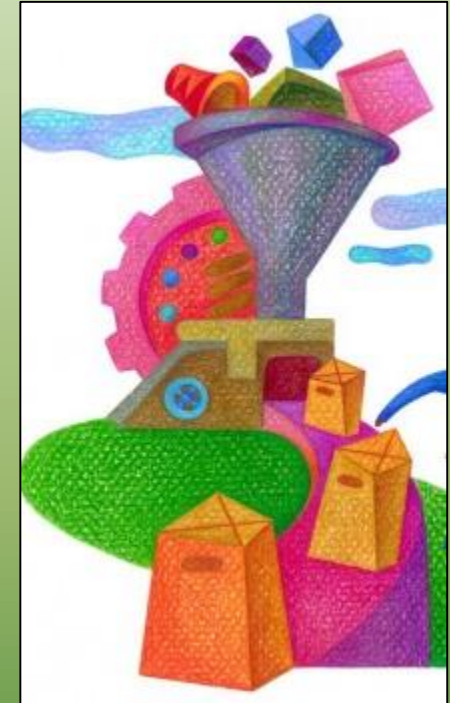
Aesthetic Requirements

- **Customer appeal** – shape, color, texture, form, feel, smell
- **Fashion** – culture, history, trends
- **Future expectations** – rate of change in technology, trends, product families



Life-Cycle Requirements

- **Distribution** – means of transport, nature and conditions of dispatch, rules, regulations
- **Operation** – quietness, wear, special uses, working environments
- **Maintenance** – servicing intervals, inspection, exchange and repair, cleaning, diagnostics
- **Disposal** – recycle, scrap



Legal/Ethical Requirements

- **Regulations** –FDA, other rules
- **Ethics** – public safety, health, welfare and integrity
- **Intellectual Property** – patents, trademarks, copyrights



Group Activity

Over the next **hour**, teams are required to perform need analysis for their projects:

- Requirement hierarchy
- Primary objectives¹
- Secondary Objectives¹
- Constraints²
- Criteria³
- Problem statement⁴



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