GE105
Introduction to Engineering Design
College of Engineering
King Saud University

Studio 5.
Need Analysis

SPRING 2016

Before we Start

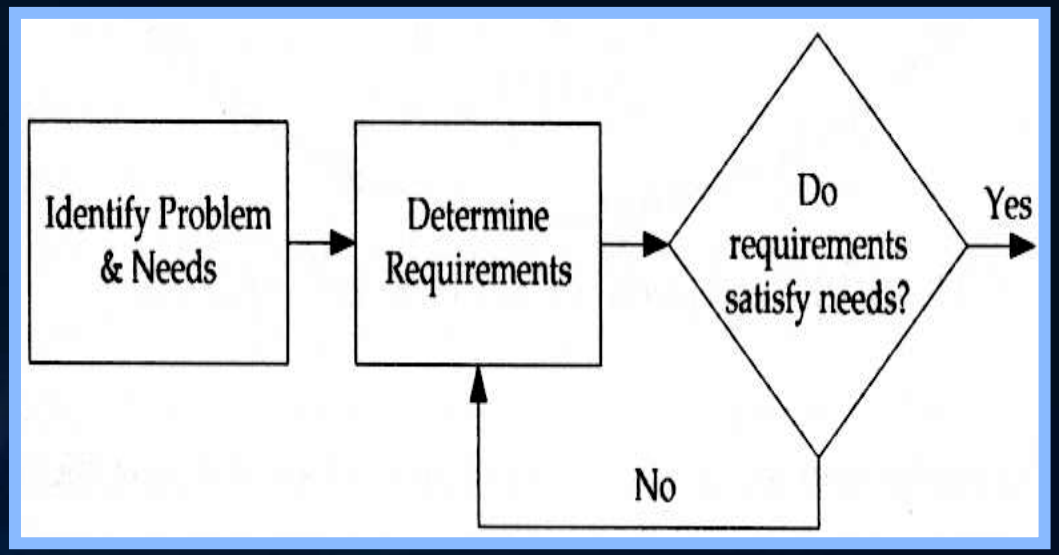
"Need Analysis" related difficulties are responsible for over 30% of project failures. **Billions of dollars** are spent annually on cancelled products

Bad Design Can Kill You!

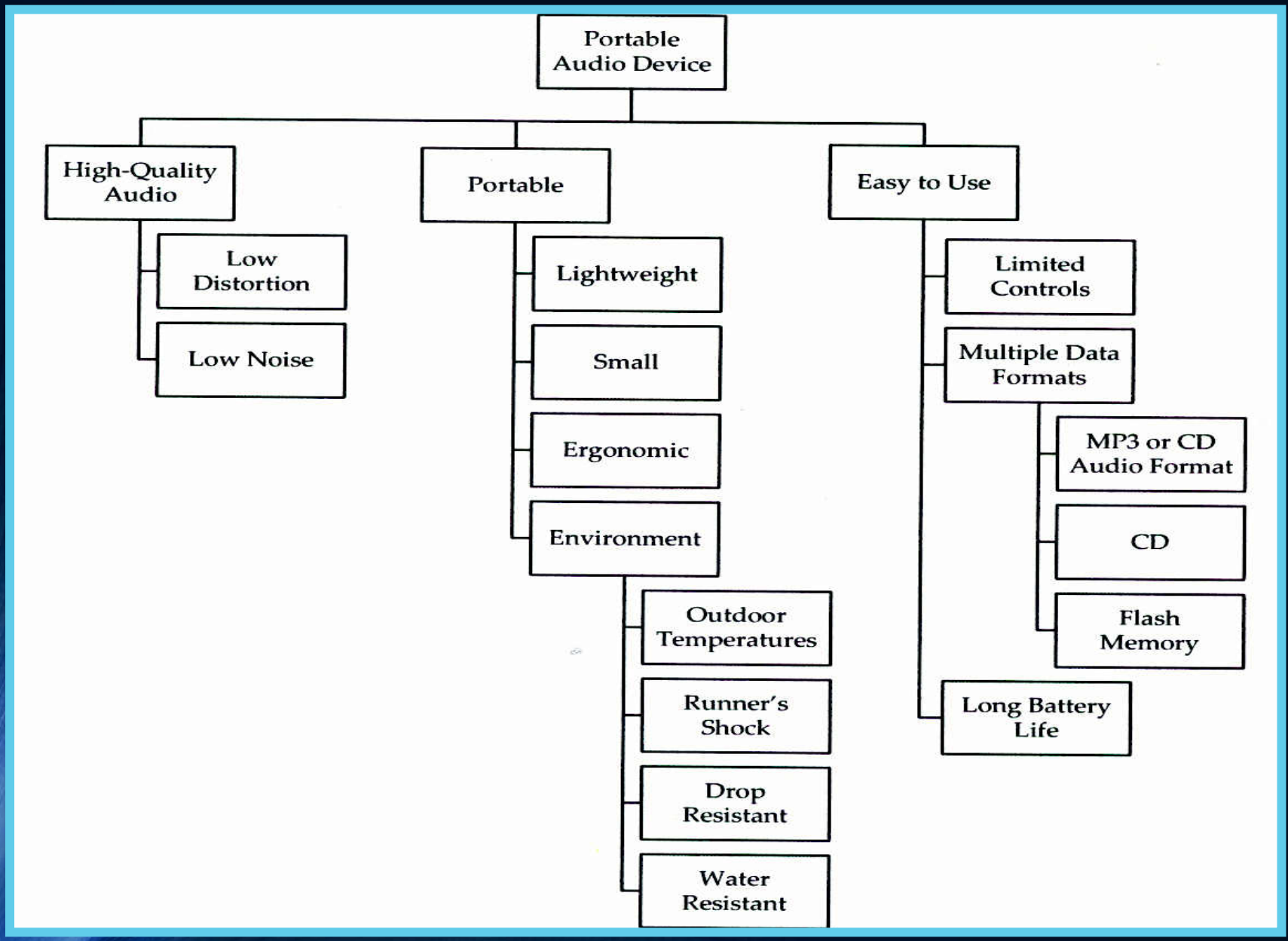
Now, start taking notes.
Today (in this studio) you will perform need analysis for your team project

Introduction

- A successful design is the one that *perfectly* answers 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 Needs Hierarchy



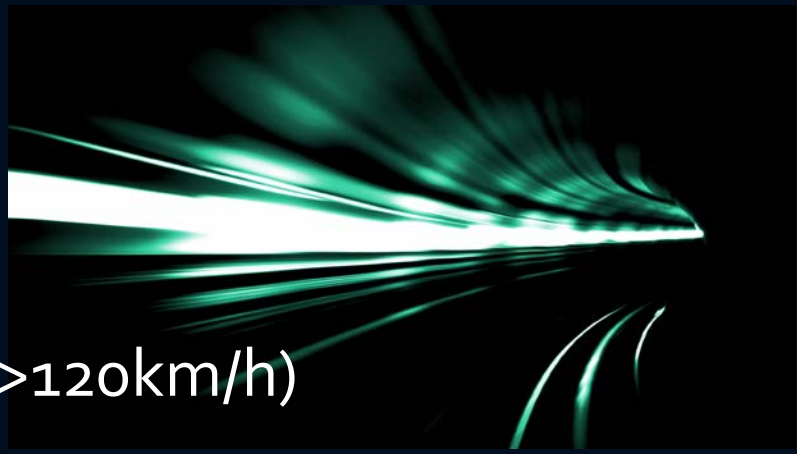
Example: Improve an existing motorcycle

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 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/sec^2 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

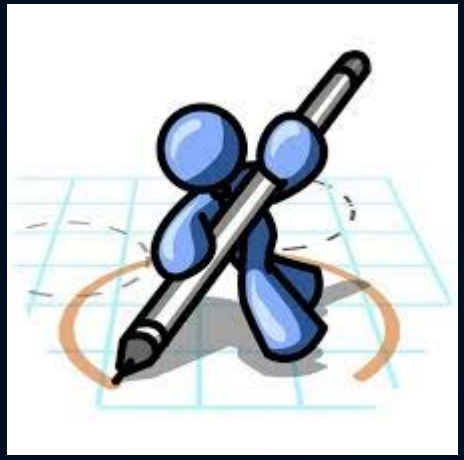
Example: Portable Audio Player Requirements

- Work under water (Able to withstand submersion to 5 feet)
- Temp Specs (Operate from 0 to 50 degrees 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
- Battery life (up to 8 hours of continuous play per charge)
- Standard Interfaces

- 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

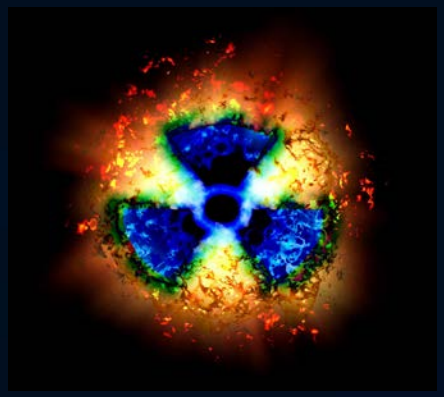
Functional Requirements

- 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

Activity

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

- Requirement hierarchy
- Primary objectives
- Secondary Objectives
- Constraints
- Criteria
- Problem statement