GE105
Introduction to Engineering Design
College of Engineering
King Saud University

Studio 5.
Need Analysis

FALL 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
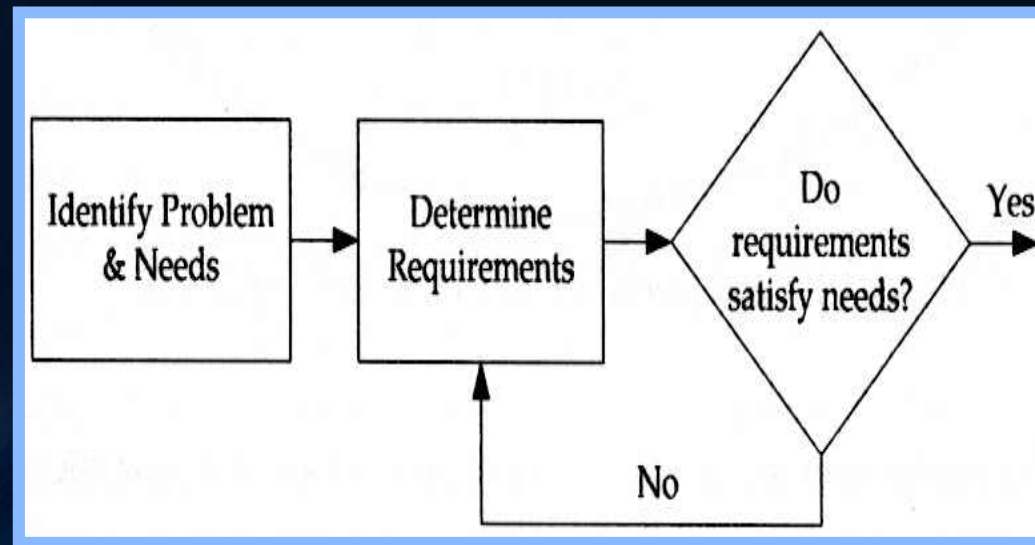


Bad Design Can Kill You!

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

Introduction

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

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Example Needs Hierarchy*
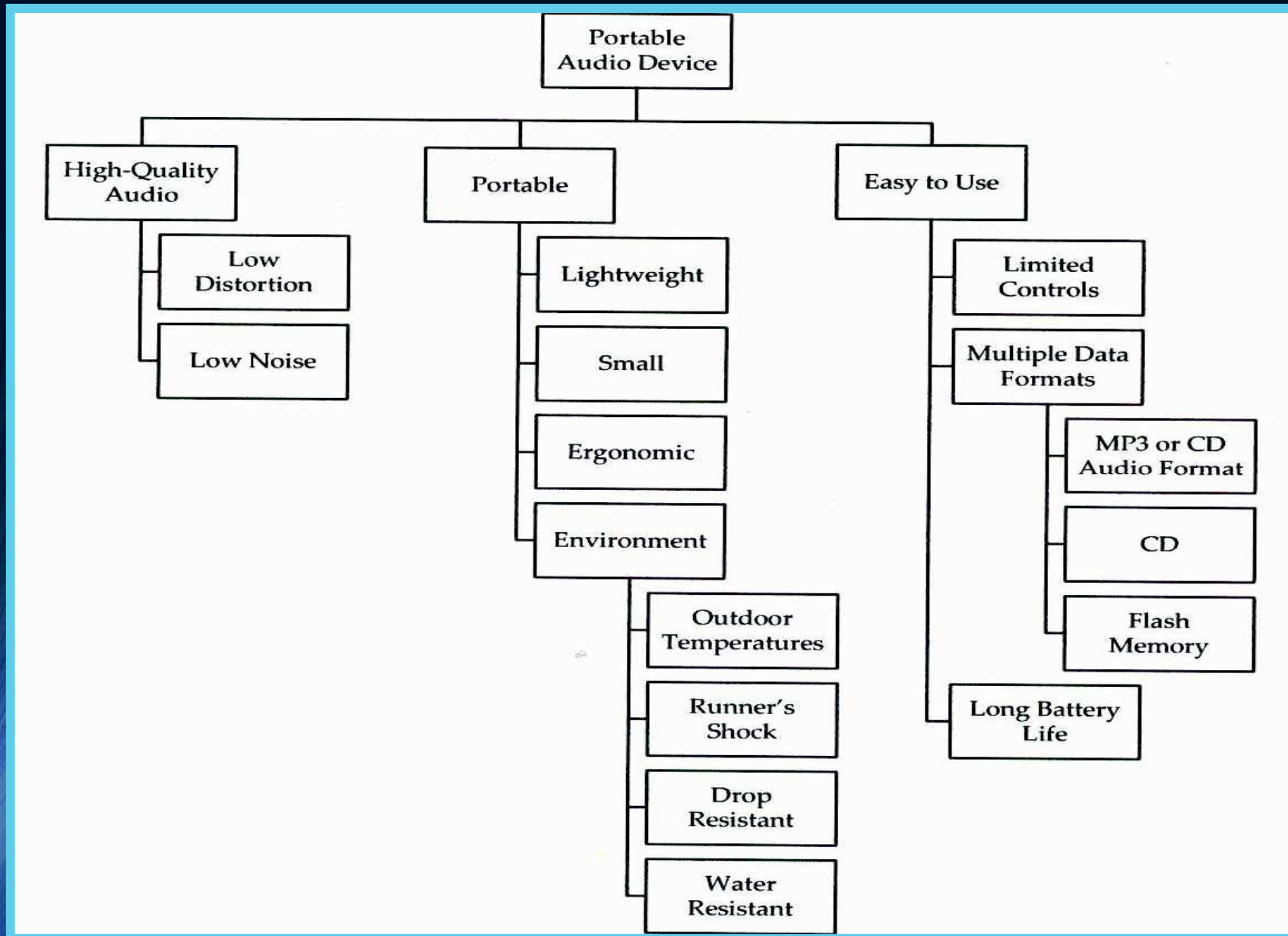
**Example: <u>Improve</u> an existing <u>motorcycle</u>**

What info would help us understand this design problem?

- How quickly should the cycle <u>accelerate to 80 km/h</u>?

- Is <u>fuel consumption</u> less important than acceleration?

- Will the customer tolerate a <u>liquid cooling system</u>?

- What should the <u>top speed</u> be?

- What <u>riding comforts</u> are expected?

- Is an <u>electric starter</u> desired?

- Will customer care about <u>beauty</u>?

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
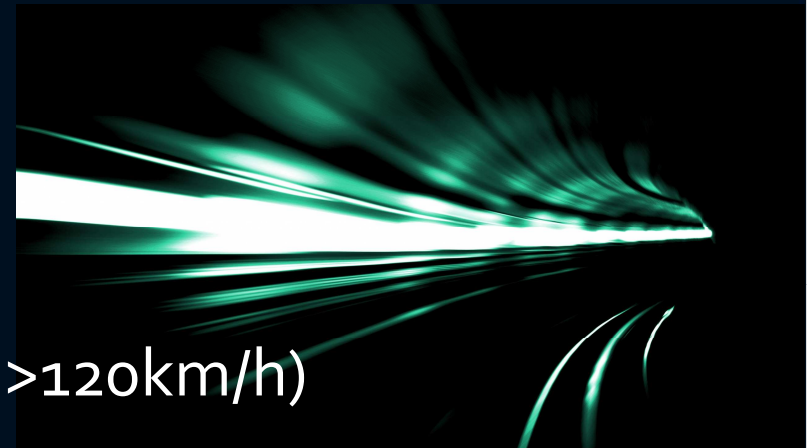
Example: Portable Audio Player Requirements

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

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

Functional Requirements

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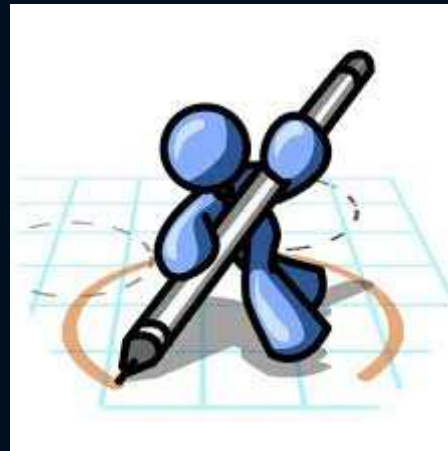
Safety Requirements

- <u>Operational</u> – direct, indirect, hazard elimination
- <u>Human</u> – warnings, training
- <u>Environmental</u> – land, sea, air, noise, light, radiation, transport
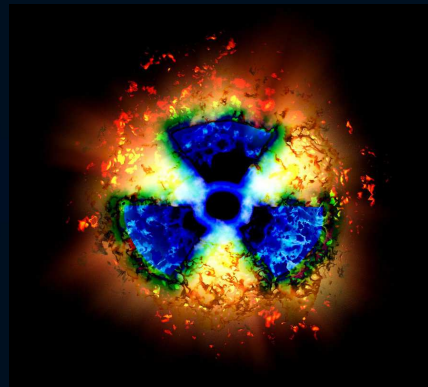
Quality Requirements

- Quality <u>assurance</u> – regulations, standards, codes
- Quality <u>control</u> – inspection, testing, labeling
- <u>Reliability</u> – design life, failures, statistics

Manufacturing Requirements

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

Timing Requirements

- <u>Design schedule</u> – project planning, project control
- <u>Development</u> schedule – design detailing, compliance tests
- <u>Production</u> schedule – manufacture, assembly, packing, transport
- <u>Delivery</u> schedule – delivery date, distribution network, supply chains
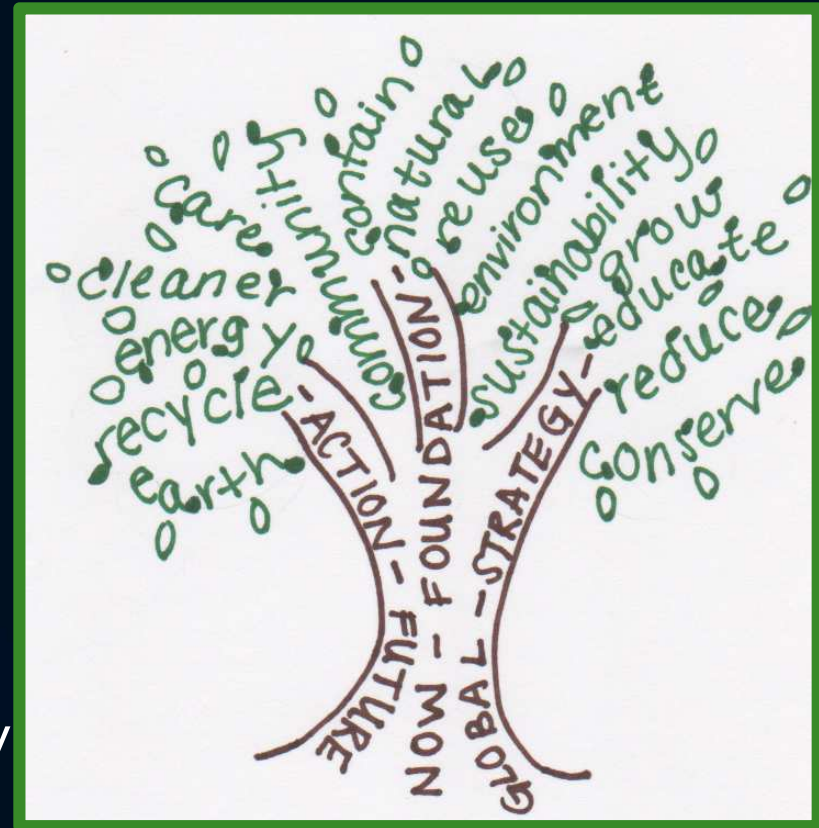
Economic Requirements

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

Ecological Requirements

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

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

Legal/Ethical Requirements

- <u>Regulations</u> –FDA, other rules
- <u>Ethics</u> – public safety, health, welfare and integrity
- <u>Intellectual Property</u> – patents, trademarks, copyrights
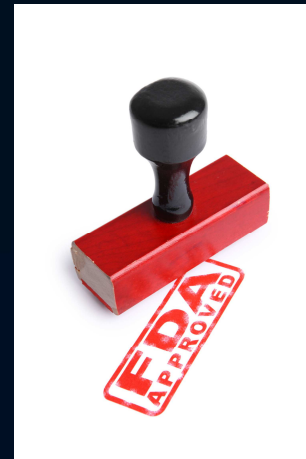
Activity

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

- <u>Requirement hierarchy</u>
- Primary objectives[1]
- Secondary Objectives[1]
- Constraints[2]
- Criteria[3]
- Problem statement[4]