



GE106

Introduction to Engineering Design

College of Engineering

King Saud University

Studio 5. *Need Analysis*

FALL 2022

Before we Start

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



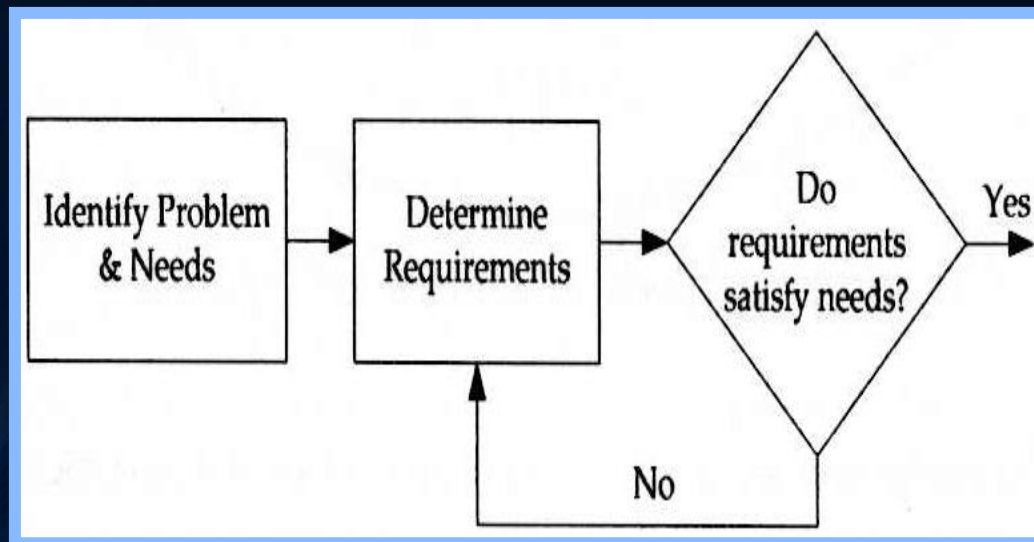
Bad Design Can Kill You!

Now, start taking notes.

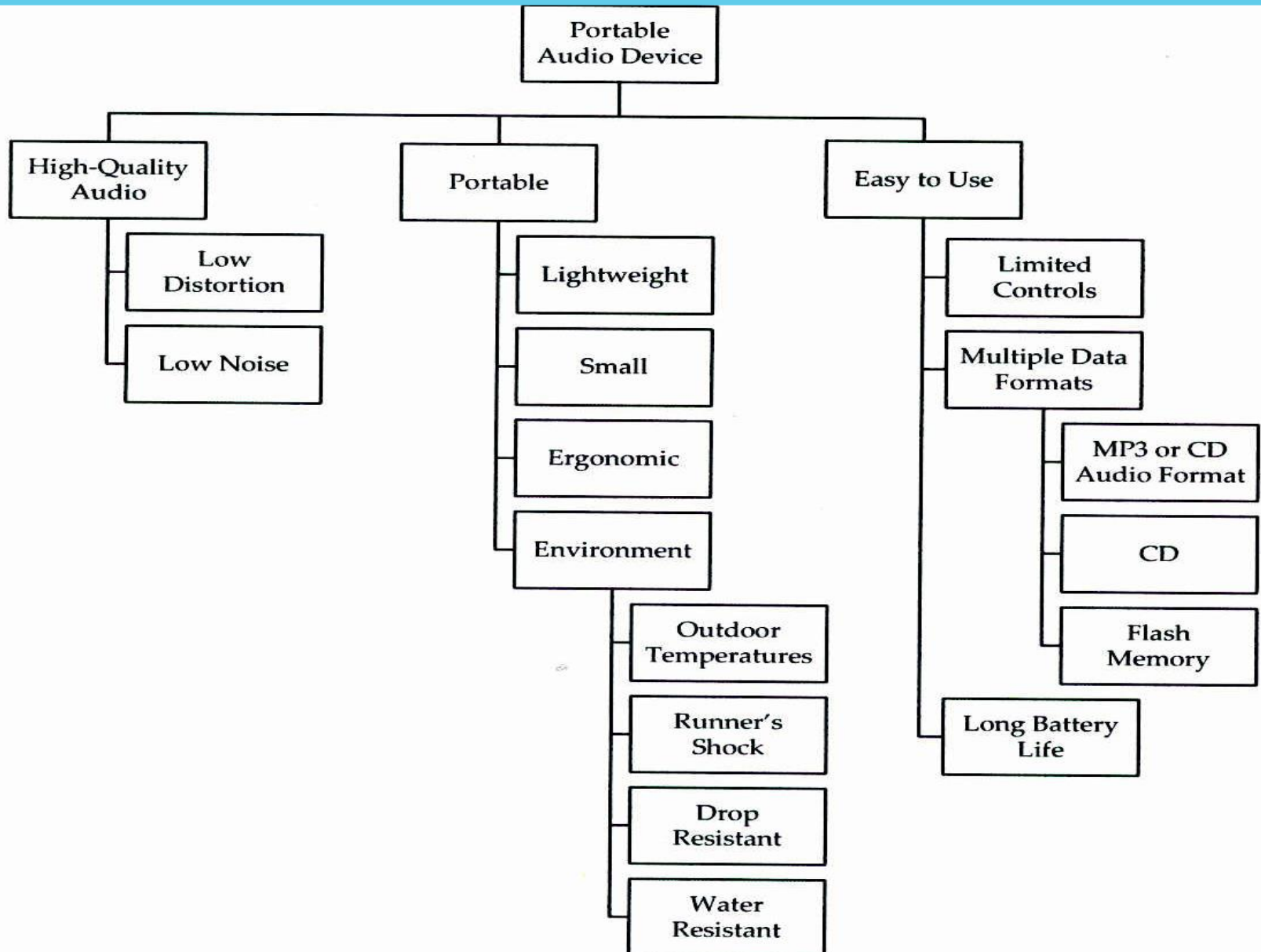
Today (in this studio) you will perform
need analysis for your team project

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

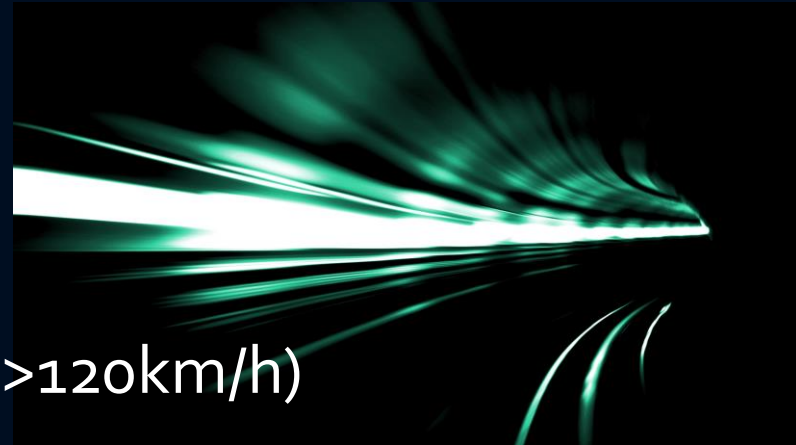
What info would help us understand this design problem?

- 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/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



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

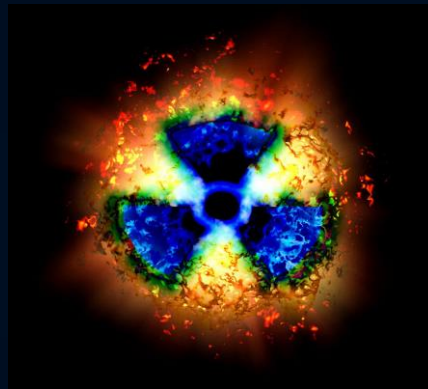
Functional Requirements

- 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



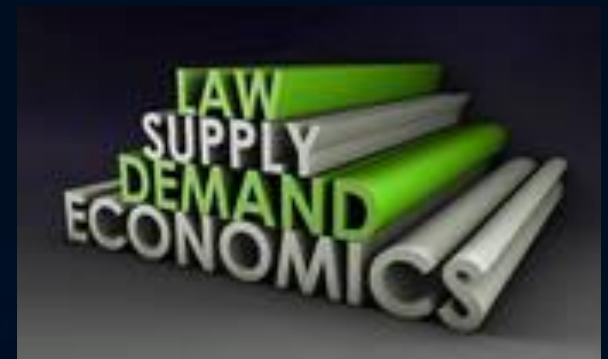
Timing Requirements

- 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



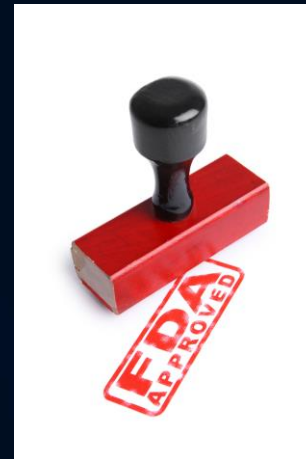
Life-Cycle Requirements

- 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 objectives¹
- Secondary Objectives¹
- Constraints²
- Criteria³
- Problem statement⁴

