“Product Design Specifications”

14.09.2023

Learning Outcomes

At the end of the session today you will be able to,

- Understand the concept of product specification
- Learn to develop your own product specification
- Understand associated limitations and challenges

Introduction

Product Specification

- Also, commonly known as Requirements and in some circles Engineering Characteristics
- Product Specifications and Requirements are synonyms, and they **spell out in measurable detail what the product has to do**

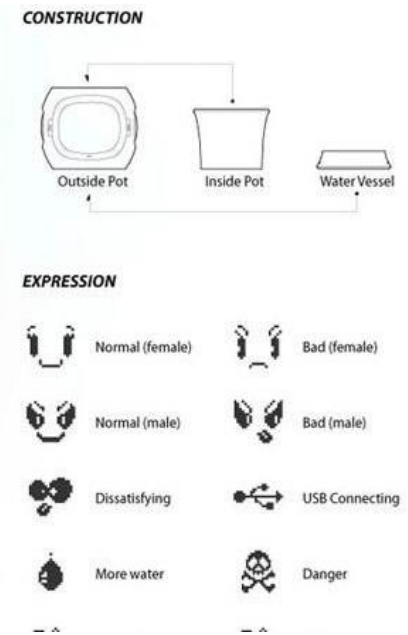
  For example, *The maximum height of the product is 80 cm, the Cooling capacity is the size of a water container (in liters)*, and *the manufacturing cost is under 100 €.*

Connection With Need Identification

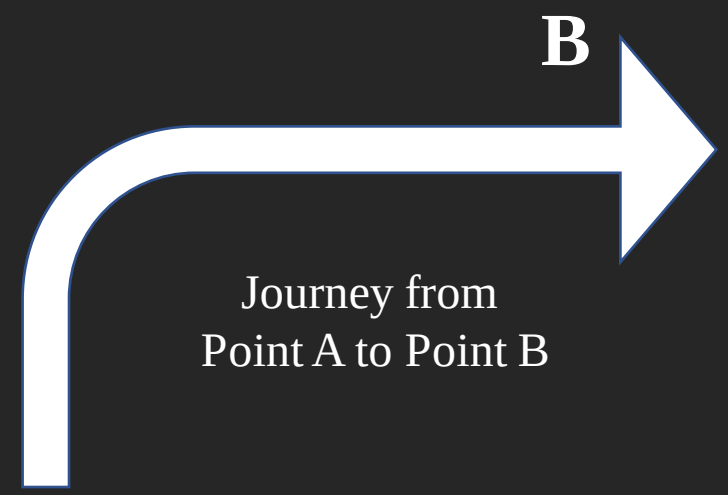
- You have clear ideas about ‘Must be’ Satisfied Need, ‘Optional Needs’ in layman’s terms
- You have a prioritized set of customer needs
- Benchmarking

Importance

- Process of converting VAGUE/Nonspecific Statements into Engineering Aspects
- Imagine if a user wants a product small. Does it mean small in **VOLUME** or **WEIGHT** or **LENGTH** or **THICKNESS** ??

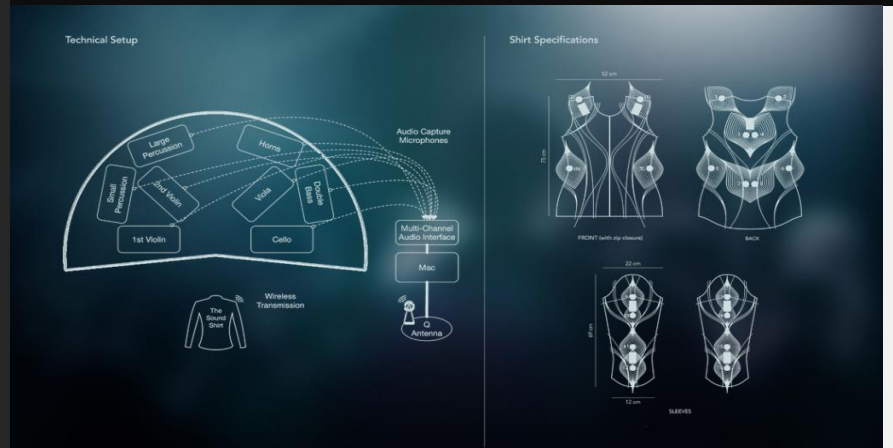


Digital Plant Pot



Vague ambiguous nature of the customer needs

- The shirt should feel good
- It should be comfortable to wear
- It should look good
- It should function
- Should not cause electrocution

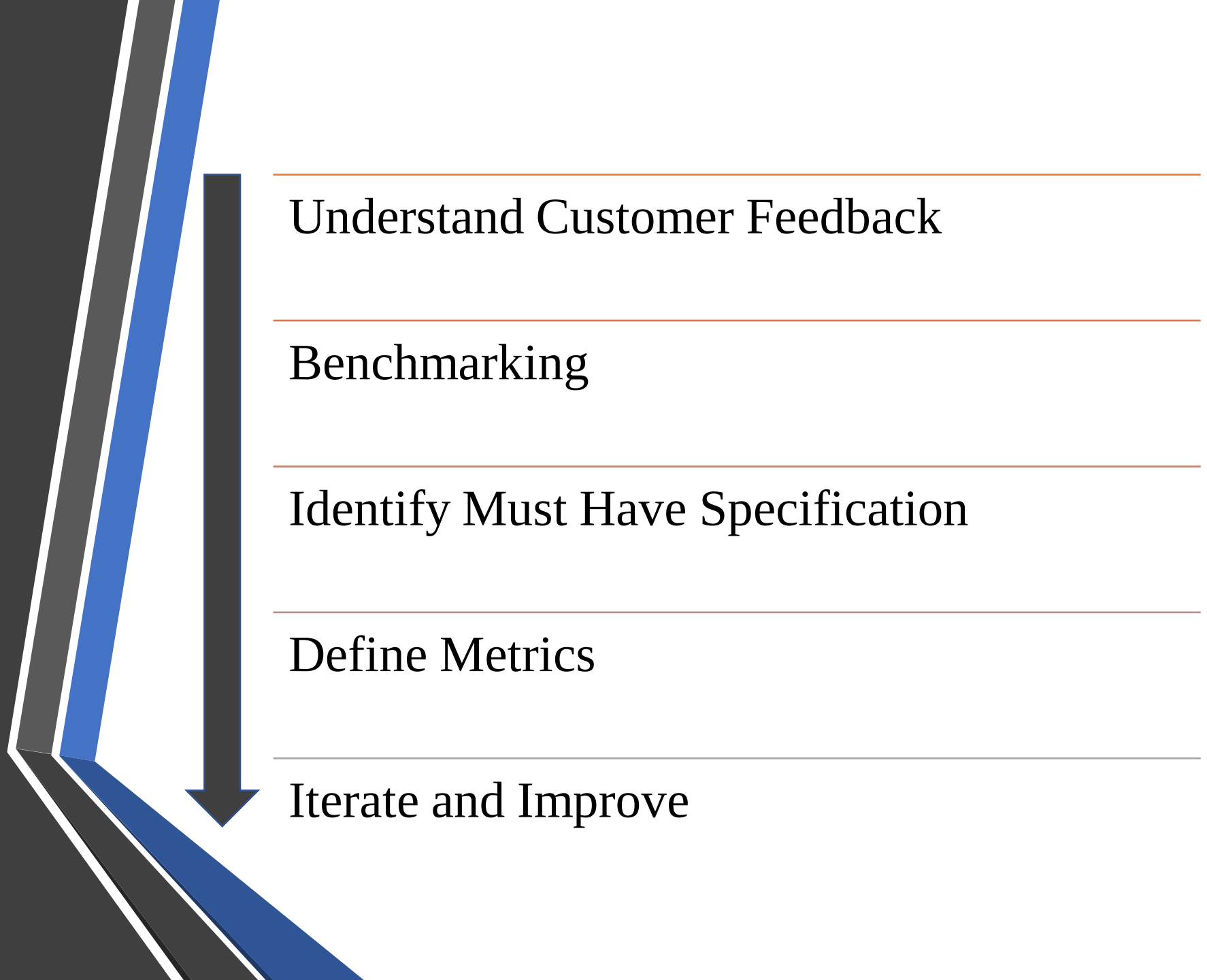


Sound Shirt

Product Specification

- Product Information
- Business Benefits
- Communication tool
- User Personas
- Product Designs
- Functional Specification
- Industry-specific standards
- Regulatory and legal considerations
- Certification requirements

Procedure to Define Product Specification



Understand Customer Feedback

Benchmarking

Identify Must Have Specification

Define Metrics

Iterate and Improve

“Fruit Juice Maker”

A Product Designer

Product Concept:

We are developing an automated fruit juicer where you can squeeze the fruits to get the juice out.

Identified Customer Needs:

- The fruit juicer is **small** that it does not take space on the counter or when stored
- The fruit juicer **squeezes quietly** so that I do not wake up others in the morning
- The fruit juicer is **affordable**
- The fruit juicer can be **stored easily** so that it fits in the kitchen cupboard
- The fruit juicer is **easy to keep clean**

Customer need	Specification	Target value
The fruit juicer is **small**	The footprint of the fruit juicer shall be less than 30 cm^2	< 30 cm^2
The fruit juicer **squeezes quietly**	The fruit juicer shall operate with noise level less than 70dB	<70dB
The fruit juicer is **affordable**	The fruit juicer unit material costs shall be < 20 €.	< 20€
The fruit juicer can be **stored easily** in the kitchen cupboard	The fruit juicer shall have a shape that is storable	Yes (binary)
The fruit juicer is **easy to clean**	The parts of the fruit juicer that come in contact with fruits can be washed in a dishwasher.	Yes (binary)

Initial Target Specification for the Fruit Juice Maker

A Few Samples of Product Specification Document

Product Specification Sheet

This one pager covers details regarding sample food product specification sheet in terms of product description, ingredients statement, nutritional information, regulatory claims, etc.

Product Description

- Food product is made by flour, water, salt and yeast
- All powders are mixed, and all liquids are added
- Add text here

Ingredient Statement

Ingredient include, flour, wheat starch, salt, vegetable fat, chicory fibers, yeast
Add text here

Nutritional Information

Servings	500g	Size	XXX
Calories	204 kCal	Protein	XXX
Total Fat	12.18g	Vitamin A	XXX
Saturated Fat	3g	Vitamin C	XXX
Trans fat	9.18g	Vitamin D	XXX
Cholesterol	0mg	Calcium	XXX
Sodium	272mg	Iron	XXX
Carbohydrates	40g	Potassium	XXX
Dietary Sugar	2g		
Sugars	30g		

Regulatory Claims

Claim	Status	Size	☑
Soy Free	☑	Gluten Free	☑
Peanut Free	☑	Natural Flavors	☑
Dairy Free	☑	Natural Colors	☑
GMO Free	☑	Certified Organic	☑

Physical Specifications

Viscosity	XXX
Color	White

Chemical Specifications

pH	5
Fat Content	XXXX

Shelf Life
12 weeks
Suggestive Storage
Refrigerated
Allergens
Eggs, milk or mil derivatives, nuts
Package Content
Packed under nitrogen atmospheres

Microbiological Specification	
Yeast	<10 cfu/g
Mold	<10 cfu/g
Add text here	Add text here

Version No.	Issue Date
12345	2 Sep' 2020

PRODUCT DESIGN SPECIFICATIONS

Parameters	Unit	Datum	Target Range
Drying Time	Days	6 - 9	2 - 4
Throughput	Bricks/Minute	4	2
Manufacturing Cost	USD	5	500
Maximum Compressive Force of Device on Clay	lbs-f	N/A	9,600
Number of Operators	People	1-2	1-2
Weight of Device	lbs	2	200
Percent Volume Compression	%	0	20-30
Life of Assembly	Months	3	48
Brick Composition	Type	Natural Clay, Dirt, Sand Sawdust	Model: Earthenware Clay, Sand Sawdust
Target Market	Type	N/A	Brick Makers in Third World Countries
Minimum Human Force Input for Compression	lbs-f	N/A	75
Power Source	Type	Manual (By Hand/Feet)	Manual (Compound Lever Force Multiplication)
Dimension of Brick	in (l,w,h)	12x5x2.5	12x5x2.5
Reloading/Forming Time	Minutes	0.5	1
Brick Density	lb/ft^3	50-60	70-75
Compression/Forming Time	Minutes	N/A	5

WORKING SPEC

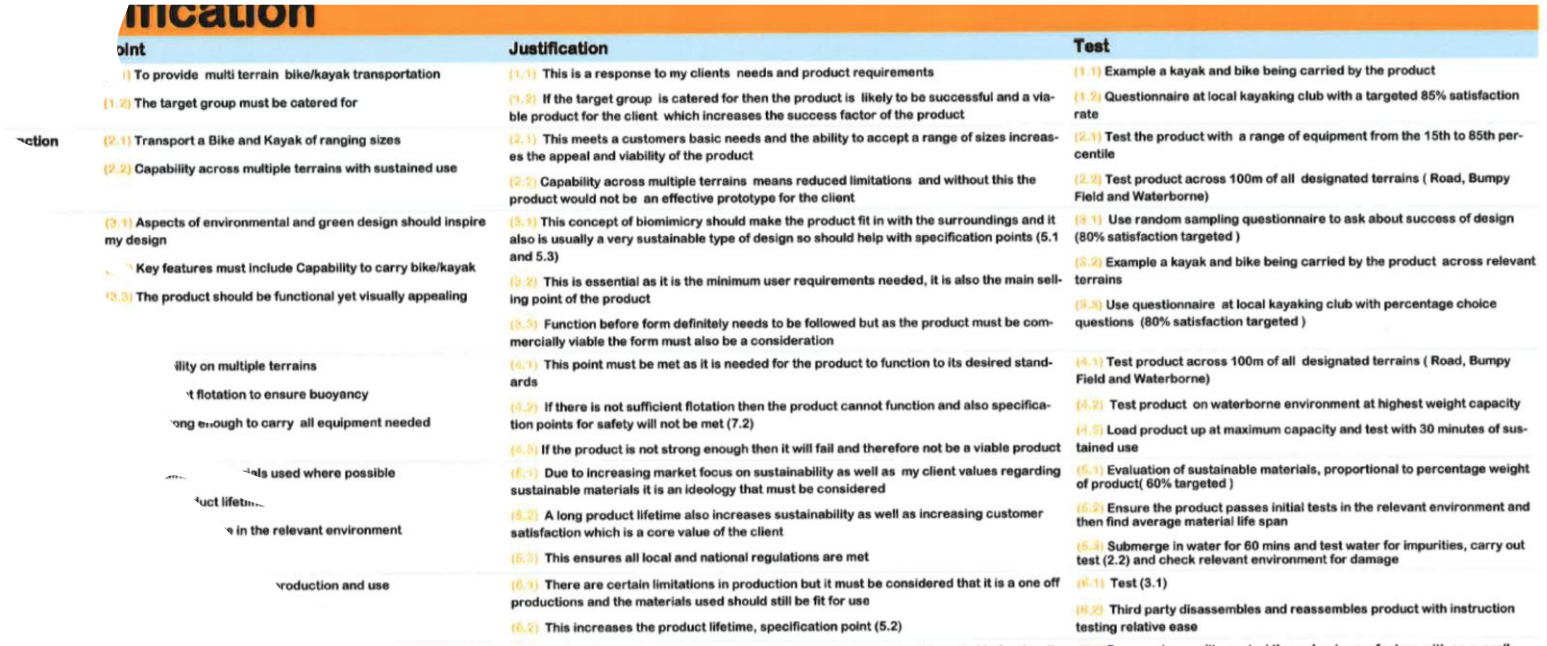
- Installed System Life: 7 years (industry standard) (60k hours)
- Operating Temp Range: -40 to 65C (industry standard)
- **Dimensions:**
  - **Overall height 27"**
    - **pole + ball: 18"**
  - **Main housing: cylinder**
    - **height: 9"**
    - **diameter: outside 5.5"**
  - **PCB Dimensions: TBD!**
- Weight: TDB g
- Force/Strain gauge measurements, 12-bit, 3 axis.
  - Implied wind range: 2 to 200 mph (1.5 to 90 m/s)
  - Implied wind accuracy: 1 mph (0.5 m/s)
  - Implied rain range: 0.1 in/hour to 4 in/hour
  - Implied rain accuracy: 2% < 0.5 in/hour
  - Implied hail range: ½ inch diameter and higher
  - Implied hail accuracy: ¼ inch diameter
- Temperature measurement:
  - Range: operating temp range (-40 to 65C)
  - Accuracy: 0.3 C
  - Aspirated temp. measurement required for industry standard accuracy
    - Direct sunlight causes significant temp offset.
    - Industry has tried to develop passive methods but aren't good enough
    - highly insulated thermocouple based solutions are used in very high end systems
  - Research option: measure sunlight w/ calibrated lux sensor and apply correct via thermal model
- Humidity
  - Range: 1 to 100% Relative Humidity
  - Accuracy: 1.8% Relative Humidity
- Sunlight sensor:
  - detects ambient light through the case (not through a clear window)
  - Light range: TBD lux
  - Light accuracy: probably doesn't need to be that good. Needs to be better if we

- **Indicators: TDB (brightness is probably important since these are up on poles and such)**
- **Power:**
  - **Receives IEC power cable, so 120VAC.**
  - **Power Rating: TBD W**
  - **Output voltages: TBD V**
    - **So far, need 3v3 and 5v0**
- On-board GPS: (battle between Alex and Bryan)
  - Tradeoffs: cost vs getting:
    - good timebase (which you need, can also pull from cell network, annoying to propagate through star or mesh network)
    - location (very useful for operations)
- **Battery Backup**
  - **Runtime: 1 day without power**
  - **Cell chemistry: rechargeable (TBD) (probably lead-acid or LiFE to hit operating life)**
  - **Cell configuration: TBD**
  - **Battery Dimensions: TBD L x W x H**
  - **Battery Capacity: TBD mAh**
  - **Gas Gauge indication**
- Locally logged data: (somewhat implied by battery backup --- failover for comm. outages)
  - Runtime: 4 years
  - Number of samples: 4 years @ every 5 seconds
  - Storage Capacity: 2 gb
  - Round-Robin ok (new data clobbers oldest data when buffer is full)
- Field Strategy:
  - Not field serviceable
  - System _should_ be robust to be installed and last for operating life
  - RMA strategy is provide new unit and swap out bad units.
  - (this implies no power switch or reset button)
- Wireless Firmware Update?
  - linux makes this easy, hard otherwise

Excellent Example for HomeWork

Check the link below

[A level of design and technology]



ification

oint	Justification	Test
) To provide multi terrain bike/kayak transportation	(1.1) This is a response to my clients needs and product requirements	(1.1) Example a kayak and bike being carried by the product
(1.2) The target group must be catered for	(1.2) If the target group is catered for then the product is likely to be successful and a viable product for the client which increases the success factor of the product	(1.2) Questionnaire at local kayaking club with a targeted 85% satisfaction rate
(2.1) Transport a Bike and Kayak of ranging sizes	(2.1) This meets a customers basic needs and the ability to accept a range of sizes increases the appeal and viability of the product	(2.1) Test the product with a range of equipment from the 15th to 85th percentile
(2.2) Capability across multiple terrains with sustained use	(2.2) Capability across multiple terrains means reduced limitations and without this the product would not be an effective prototype for the client	(2.2) Test product across 100m of all designated terrains (Road, Bumpy Field and Waterborne)
(3.1) Aspects of environmental and green design should inspire my design	(3.1) This concept of biomimicry should make the product fit in with the surroundings and it also is usually a very sustainable type of design so should help with specification points (5.1 and 5.3)	(3.1) Use random sampling questionnaire to ask about success of design (80% satisfaction targeted)
Key features must include Capability to carry bike/kayak	(3.2) This is essential as it is the minimum user requirements needed, it is also the main selling point of the product	(3.2) Example a kayak and bike being carried by the product across relevant terrains
(3.3) The product should be functional yet visually appealing	(3.3) Function before form definitely needs to be followed but as the product must be commercially viable the form must also be a consideration	(3.3) Use questionnaire at local kayaking club with percentage choice questions (80% satisfaction targeted)
ility on multiple terrains	(4.1) This point must be met as it is needed for the product to function to its desired standards	(4.1) Test product across 100m of all designated terrains (Road, Bumpy Field and Waterborne)
t flotation to ensure buoyancy	(4.2) If there is not sufficient flotation then the product cannot function and also specification points for safety will not be met (7.2)	(4.2) Test product on waterborne environment at highest weight capacity
ong enough to carry all equipment needed	(4.3) If the product is not strong enough then it will fail and therefore not be a viable product	(4.3) Load product up at maximum capacity and test with 30 minutes of sustained use
als used where possible	(5.1) Due to increasing market focus on sustainability as well as my client values regarding sustainable materials it is an ideology that must be considered	(5.1) Evaluation of sustainable materials, proportional to percentage weight of product(60% targeted)
duct lifetime	(5.2) A long product lifetime also increases sustainability as well as increasing customer satisfaction which is a core value of the client	(5.2) Ensure the product passes initial tests in the relevant environment and then find average material life span
s in the relevant environment	(5.3) This ensures all local and national regulations are met	(5.3) Submerge in water for 60 mins and test water for impurities, carry out test (2.2) and check relevant environment for damage
roduction and use	(6.1) There are certain limitations in production but it must be considered that it is a one off productions and the materials used should still be fit for use	(6.1) Test (3.1)
	(6.2) This increases the product lifetime, specification point (5.2)	(6.2) Third party disassembles and reassembles product with instruction testing relative ease

Courtesy: Yanko Design

Summary

- Convert vague, ambiguous customer needs and requirements into engineering-specific measurable variables.
- Be logical about what to include and what to exclude from the Final product.
- Writing a product design specification (PDS) is an iterative process that varies with different industries, products, requirements, and the company's operating procedure.

Questions?