AquaSPICE

Advancing Sustainability of Process Industries through Digital and Circular Water Use Innovations

Design and Development of innovative digital services for Water- Related Industrial Settings

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The AquaSPICE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 958396.

Intro and General Process

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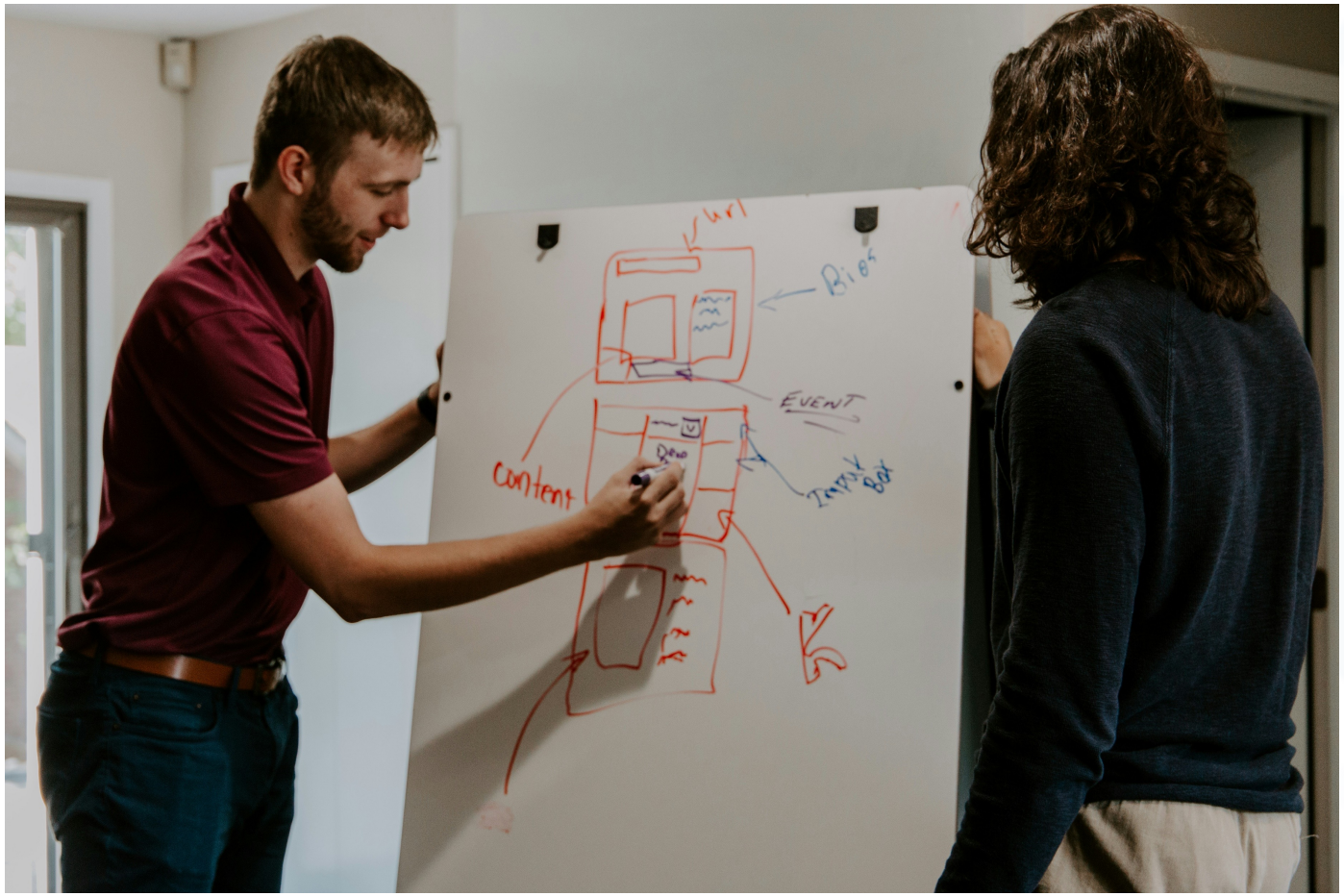
Design and Develop

Innovative Digital Services

Designing an innovative digital service involves several key steps that integrate creativity, user-centered design, and technological feasibility



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Creativity

- **Sensitivity to Problems**: Ability to notice problems that others might not see
- **Originality**: Solutions or approaches that are not immediately obvious

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- **Fluency**: Ease to find different responses to same thing
- **Flexibility**: Perspective Shift
- **Elaboration**: Ability to add detail and depth to ideas
- **Associative Thinking**: Make connections between seemingly unrelated concepts
- **Risk-Taking**: Exploring things that will fail
- **Curiosity**: Be a hacker
- **Imagination**: Envision possibilities
- **Persistence**: Determined despite challenges and setbacks
- **Playfulness**: Engage in playful thinking

User Centered Design

- User Involvement
- Iterative in nature
- Focus on Users and Tasks
- Usability
- Empathy
- Multidisciplinary teams
- User feedback
- Prototyping

- Design Thinking

Technological Feasibility

- Current Technologies
- Technical Expertise
- System Requirements
- Compatibility
- Scalability
- Reliability and Performance
- Security
- Cost / Resources
- Regulatory Compliance

1 Lecture – 1 Slide

Everything you need to know

1. Identify a Problem or Opportunity
2. Understand the Users
3. Define the Value Proposition
4. Ideation / Concept Development
5. Validation and Refinement
6. Service Design
7. Technical Feasibility and Development
8. Test and Iteration
9. Launch and Change Management
10. Measurement and Improving
11. And if it’s REALLY Good? -> Sell to others

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1. Identify a Problem or Opportunity

The Journey Begins

Identifying problems in an industrial setting to develop a new service involves a **systematic approach** to uncover pain points, inefficiencies, or unmet needs within the organization / industry.

1. Conduct a Thorough Research prior to Initiation
    1. Industry analysis
        1. Market Research: Examination of general trends, technology stacks and identified challenges of similar organizations / industries towards getting a grasp of the horizontally faced issues and current status
        2. Competitor Analysis: What others are doing to alleviate similar problems (from the solution provider side), What others are doing to not face similar problems (from the factory side)
        3. Technology Trends: Which diffused, or emerging technologies are available at the current industrial setting?
    2. Stakeholder Interviews with key individuals in the organization
        1. Key Personnel: Managers, Supervisors, Board of directors
        2. Employees: Individuals on the shopfloor *(tip: HERE is the actual insights into daily operational issues and problems)*

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2. Observation and Documentation of Processes / Data collection
    1. In the field / factory / on site
        1. Walkthrough: Passing through the departments that will utilize the solution
        2. Shadow roles: Just observe the day to day operation of actual employees / key personnel to get an empathic understanding of the processes and challenges
    2. Mapping of Processes
        1. Key processes -> Bottleneck Identification
        2. Value stream mapping -> Not all activities are value – adding, some may be value – removing
    3. Data collection
        1. Operational Data: COLLECT ALL RELEVANT DATA -> Production, Downtime, Maintenance, KPIs etc.
        2. Surveys: Employee satisfaction, safety incidents, proposals for changes needed

Process Mapping

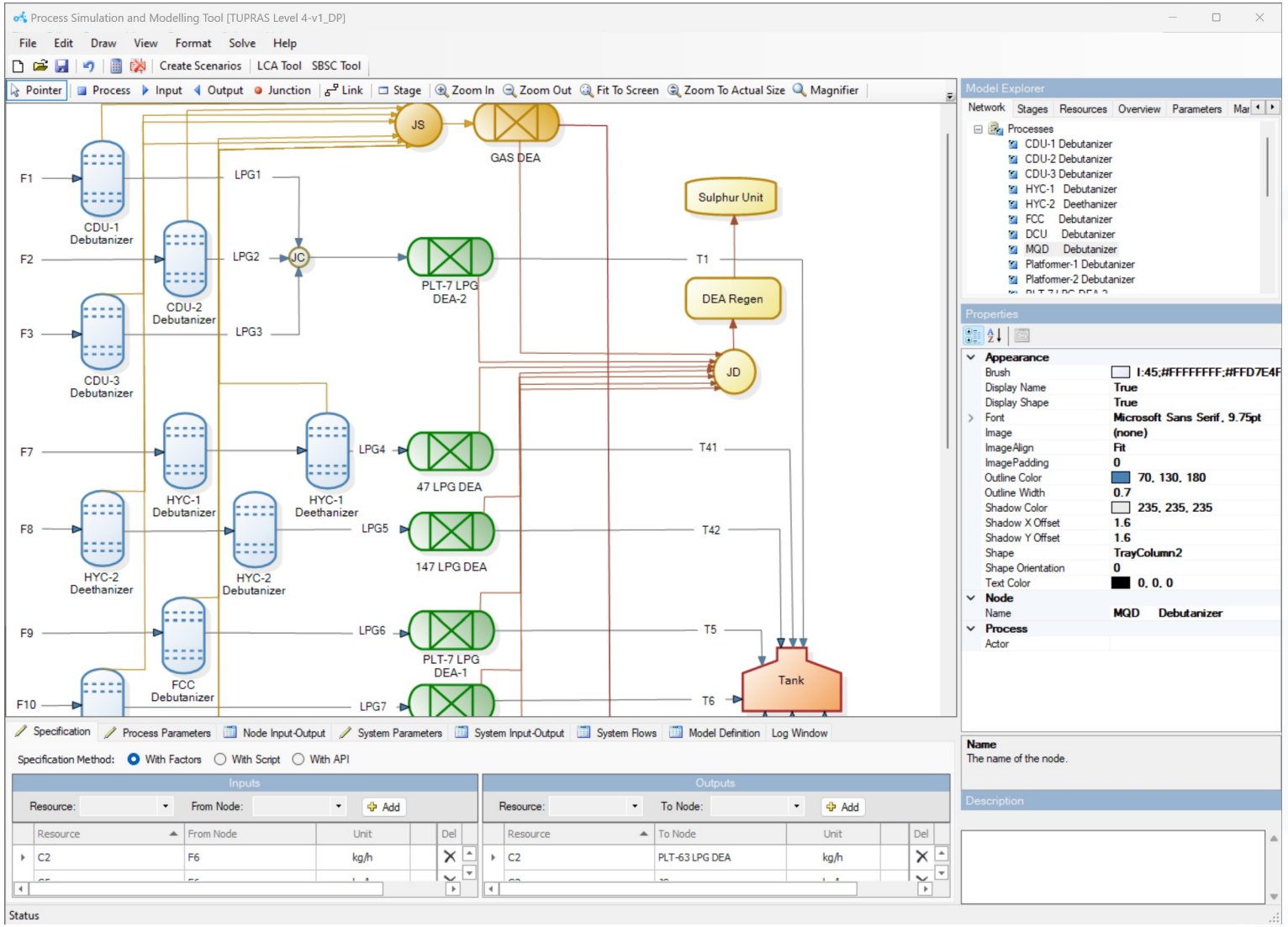

Image Source: TUC, Indigo, PSM Tool

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3. Data analysis
    1. Root Cause Analysis: WHAT creates our observed / identified problems? 5 Whys, Fishbone Diagram
    2. Statistical Analysis: Identification of problems (patterns and data correlations)
4. Pain Points -> Opportunities
    1. Priority Matrix (Importance VS Feasibility)
    2. Problem(s) Definition

NOW WE HAVE SOMETHING TO SOLVE

Priority Matrix

Importance refers to the significance or impact of the task or requirement

Feasibility refers to the practicality or ease of implementation

- Project Management
- Decision Making
- Product Development
- Risk Management

- Criteria Definition
- Weight Assignment
- Evaluation of ….
- Calculation of Score
- Matrix Plot
- Analysis and Prioritization

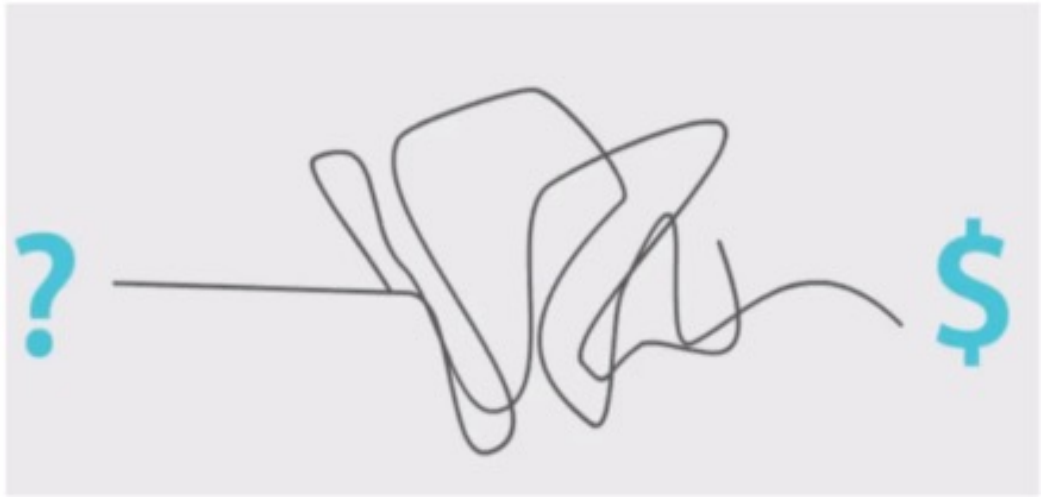
So how do we solve it ??

Wicked Problems require Wicked Solving approaches

Design Thinking

What is Design Thinking ?

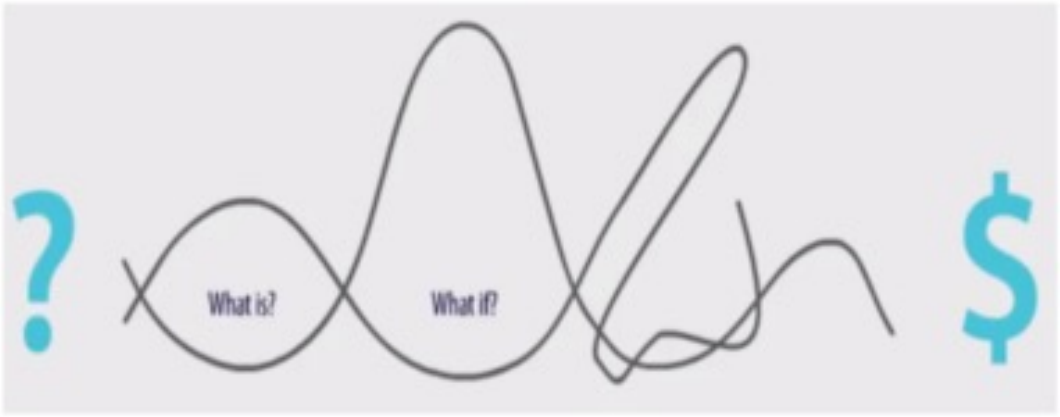
Towards an Innovative Digital Solution

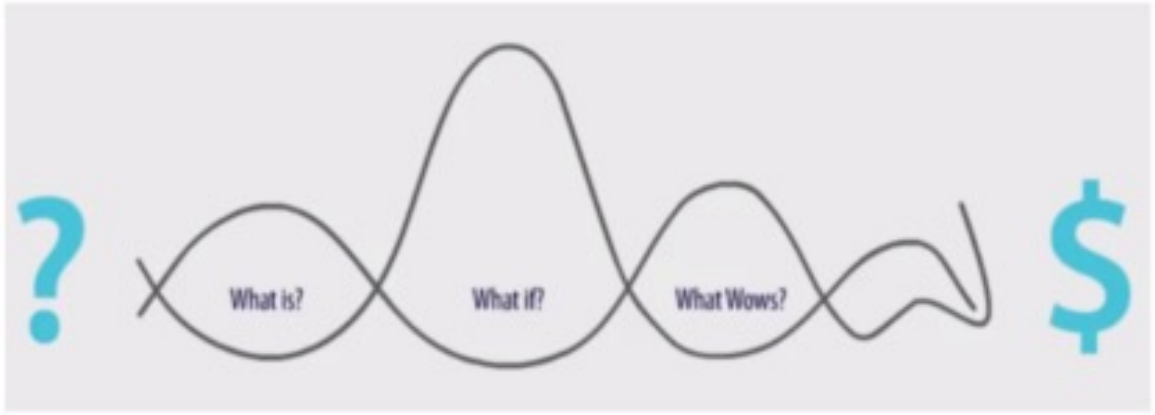


- A miracle happens when you raise your hands and pray.
- Genius -> Innovation
- The Moses Myth
- Innovation = Black box and the ability to think in a creative manner and design and develop valuable solutions is mysterious and belongs to specific people…

A different approach

One step at a time

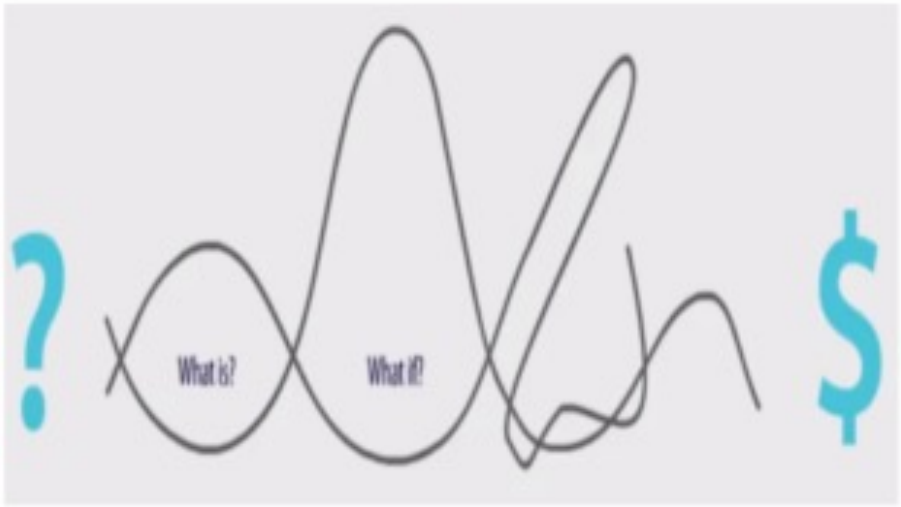




What is? What if?

The starting questions to solving the entanglement of innovation

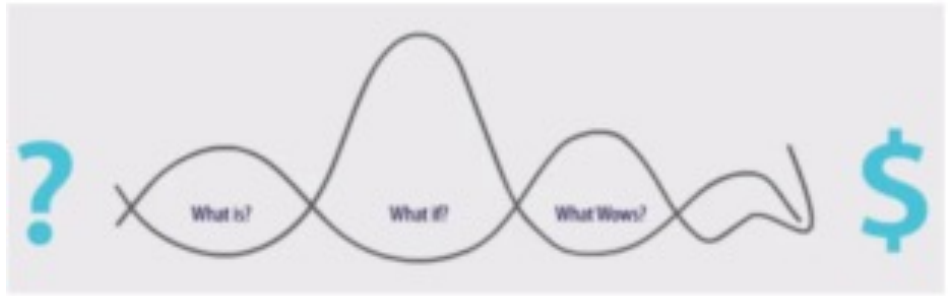
- Entangled becomes separated through a clear series of questions
- What is is the first question -> Current reality
- All innovative solutions start from a precise and valid understanding of the Reality.
- “Unarticulated employee needs”

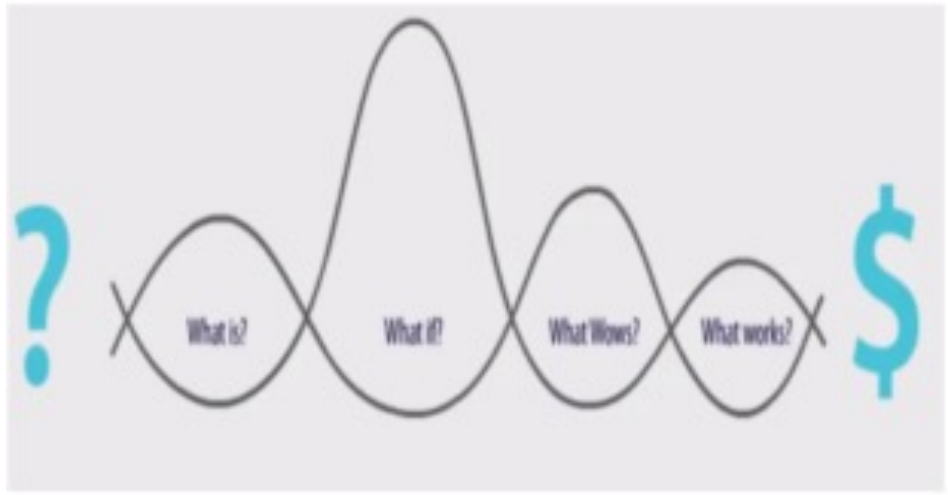


- Data revision, pattern recognition, knowledge to be introduced in the design space
- What if -> Many solutions -> Possibilities

What wows? What works?

The follow-up questions to solving the entanglement of innovation





- First stage of testing… what can work?
- Possible solution = Hypothesis -> Test via design criteria

- What actually works?
- Low fidelity versions of the actual system in different versions to harvest insigths
- Fail fast!!!

Design Thinking key characteristics

- **Human centered:** We start with the person, not demographically. Deep understanding of life and the problem for people who we want to create value (user-driven design). Qualitative methodologies. Co-creation.
- **Possibility driven:** We use the data to ask what we would do if everything was possible.
- **Option focused:** It aims to create multiple options. We expect to be often wrong because we want to know what the our stakeholders want
- **Iterative in approach:** Conducting cycles of experiments instead of analysis of historical data. Form Idea -> Test Idea -> Reform Idea
- **Theoretical Saturation:** Repeat until you know no more new things

Wicked Mysteries VS Tame Puzzles

Mysteries and Puzzles

- Puzzles are problems that when we have the absolute degree of the data then we can solve the problem.
- In case the previous is not true then we have mysteries. more than systems thinking is required "prototype / pilot / pivot".

Tame and Wicked

- In Tame we start with agreement on the definition of the problem. Enough about data and we can come up with Cause -> Effect.
- In Wicked we can't even agree on the problem, we don't know if the data is relevant (even though we have a lot of data) and we have to try something to see if it works.

Design Thinking Methodology

- It differs from the traditional way of design
- Design Thinking is more creative and human-centered than the traditional design techniques
- Methodology / Problem solving process
- As a methodology, Design Thinking is extremely useful for "wicked problems" as they are not properly formulated as problems as well as because their solution is not visibly connected to the problem.
- Even when the general direction of the problem is clear part of the effort lies in receiving requirements and thus in the actual definition and formulation of the problem
- The elucidation of the problem is therefore "creative, fluid, and open"

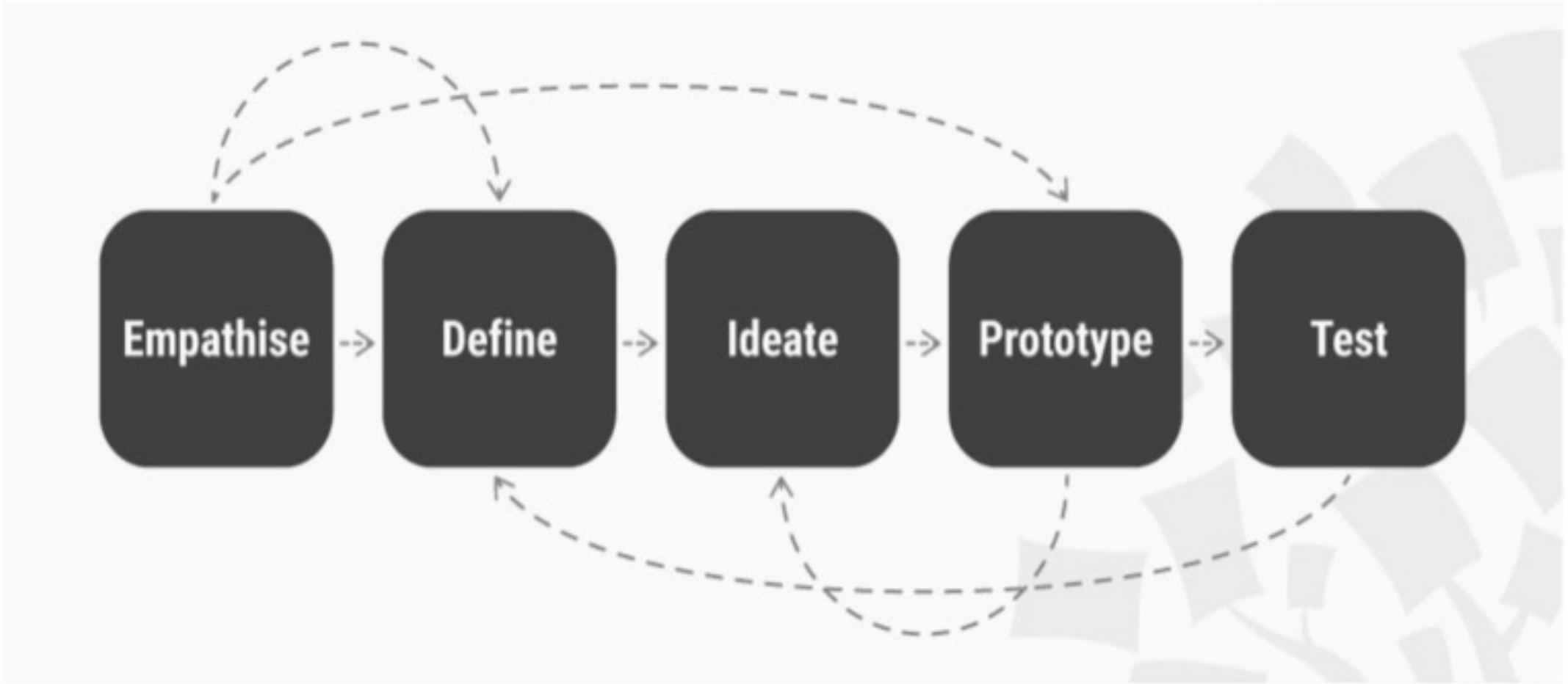
Key Characteristics

Attribute	Description	Comment
Ambiguity	Being comfortable when things are unclear or when you don't know the answer	Design Thinking addresses wicked = ill-defined and tricky problems.
Collaborative	Working together across disciplines	People design in interdisciplinary teams.
Constructive	Creating new ideas based on old ideas, which can also be the most successful ideas	Design Thinking is a solution-based approach that looks for an improved future result.
Curiosity	Being interested in things you don't understand or perceiving things with fresh eyes	Considerable time and effort is spent on clarifying the requirements. A large part of the problem solving activity, then, consists of problem definition and problem shaping.
Empathy	Seeing and understanding things from your customers' point of view	The focus is on user needs (problem context).
Holistic	Looking at the bigger context for the customer	Design Thinking attempts to meet user needs and also drive business success.
Iterative	A cyclical process where improvements are made to a solution or idea regardless of the phase	The Design Thinking process is typically non-sequential and may include feedback loops and cycles (see below).
Nonjudgmental	Creating ideas with no judgment toward the idea creator or the idea	Particularly in the brainstorming phase, there are no early judgments.
Open mindset	Embracing design thinking as an approach for any problem regardless of industry or scope	The method encourages "outside the box thinking" ("wild ideas"); it defies the obvious and embraces a more experimental approach.

Key Phases

Prototypical Stages	Wikipedia /Herbert Simon	IDEO Toolkit	Tim Brown (IDEO)	d.school/D-School (HPI)	d.school Bootcamp Bootleg (HPI) – Modes	Baeck & Gremett (2011)	Mark Dziersk (Fast Company)
Understand the problem	Define	Discovery	Inspiration	Understand	Empathize: Observe, engage, immerse	Define the problem to solve	(1) Define the problem
Observe users	Research			Observe		Look for inspiration	
Interpret the results		Interpretation		Point of View	Define (Problem statement)	—	
Generate ideas (Ideate)	Ideation	Ideation	Ideation	Ideate	Ideate	Ideate multiple ideas	(2) Create and consider many options
Prototype, experiment	Prototype	Experimentation	Implementation	Prototype	Prototype	Generate prototypes	(3) Refine selected directions(3.5) Repeat (optional; steps 2 and 3)
Test, implement, improve	Objectives/ChooseImplementLearn	Evolution		Test	Test (includes *refine* and *improve* solutions)	Solicit user feedback	(4) Pick the winner, execute

5 Basic Phases of Design Thinking



DT - 1. Empathise

Gaining an "empathic" understanding of the problem that you are trying to solve.

- Discover more about the problem and the overall context through:
  - Observation, interaction and understanding of the people involved /organizations to understand their experiences and motivations as well as
  - Placing yourself in the natural environment in order to gain a deeper and personal understanding of the issue being addressed.

"Empathy" is important in the process of human-centred design as it allows "design thinkers" to let go of their own preconceptions and assumptions about the world and understand their customers and their respective needs

Corresponding to the time constraints can be taken and important data which will be used in subsequent phases allowing the development of a deeper understanding of the users of the of the specific product (or service) to be developed

DT - 2. Define

- This step merges the outcomes of the previous step
- Analysis of comments and synthesis of the final "main" problem (or problems) that the team has identified so far so far. The problems should be defined through a a clear and concrete problem statement with a human-centred in a human-centred way
- Instead of defining the problem as we (or the company would like) : "We need to increase our food-product market share among young teenage girls by 5%," a better way would be "Teenage girls need to eat nutritious food in order to thrive, be healthy and grow.“
- This phase can help designers to collect ideas for the product or service that will allow potential customers to customers to solve their problem or at least solve their problem. their problem with relatively little difficulty (compared to....) .

DT - 3. Ideate

- At this stage the designers are ready to start produce ideas.
- You understand your users and their needs in “Empathise” and you have analyzed and synthesized your feedback in “Define” by concluding a problem with an anthropocentric de
- With the two previous steps the team can start to "think outside the box" to identify the new solution to the problem description.
- There are 100s of ways to generate Ideas like Brainstorm, Brainwrite, Worst Possible Idea, etc.
- It is important to generate as many ideas as possible in the initial step of creating solutions.
- *Important:* In the beginning we try to get the maximum possible of solutions so that we can then have a plethora of proposals to to try.

DT - 4. Prototype

- The design team will use the ideas and produce "low-cost" and "short-run" versions of the product; or service to be tested with potential customers.
- Prototypes are shared inside and outside of the company. team in predefined User testing sessions.
- At this stage there is experimentation.
- We're preparing the "Prototypes" so we can check if any changes are needed after the results of the next phase with the aim of defining each prototype as:
  - Accepted
  - To be improved and re-examined
  - Rejected

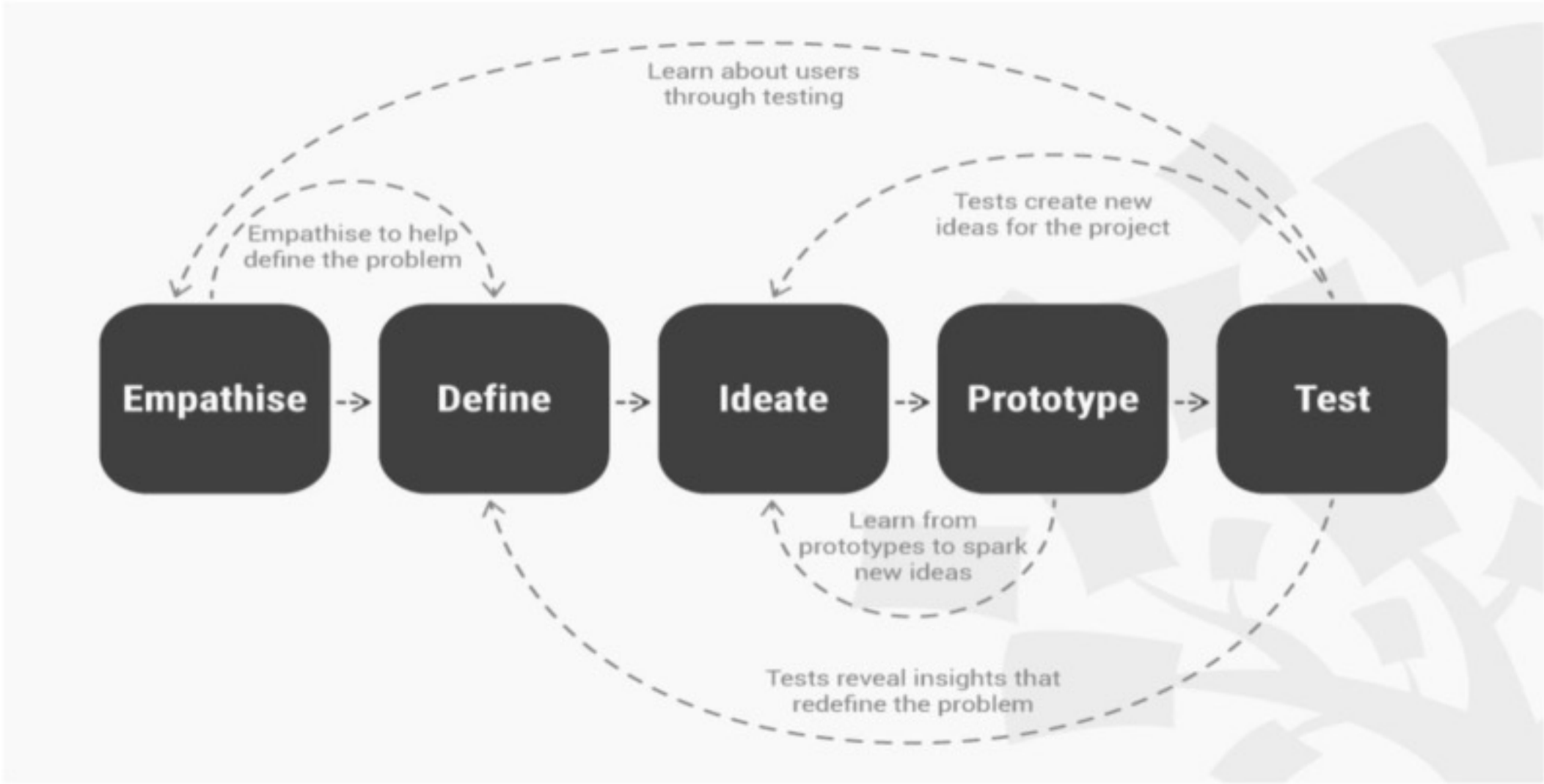
ALL BASED ON THE USER EXPERIENCE

DT - 5. Test

- The designers and evaluators examine the prototype with real users.
- The last step of Design Thinking
- And then we start again…

Theoretical Saturation

Not a Linear Process



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