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

# 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. **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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Identifying problems in an industrial setting to develop a new service involves a **systematic approach** to uncover <u>pain points</u>, <u>inefficiencies</u>, or <u>unmet needs</u> 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)*

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

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
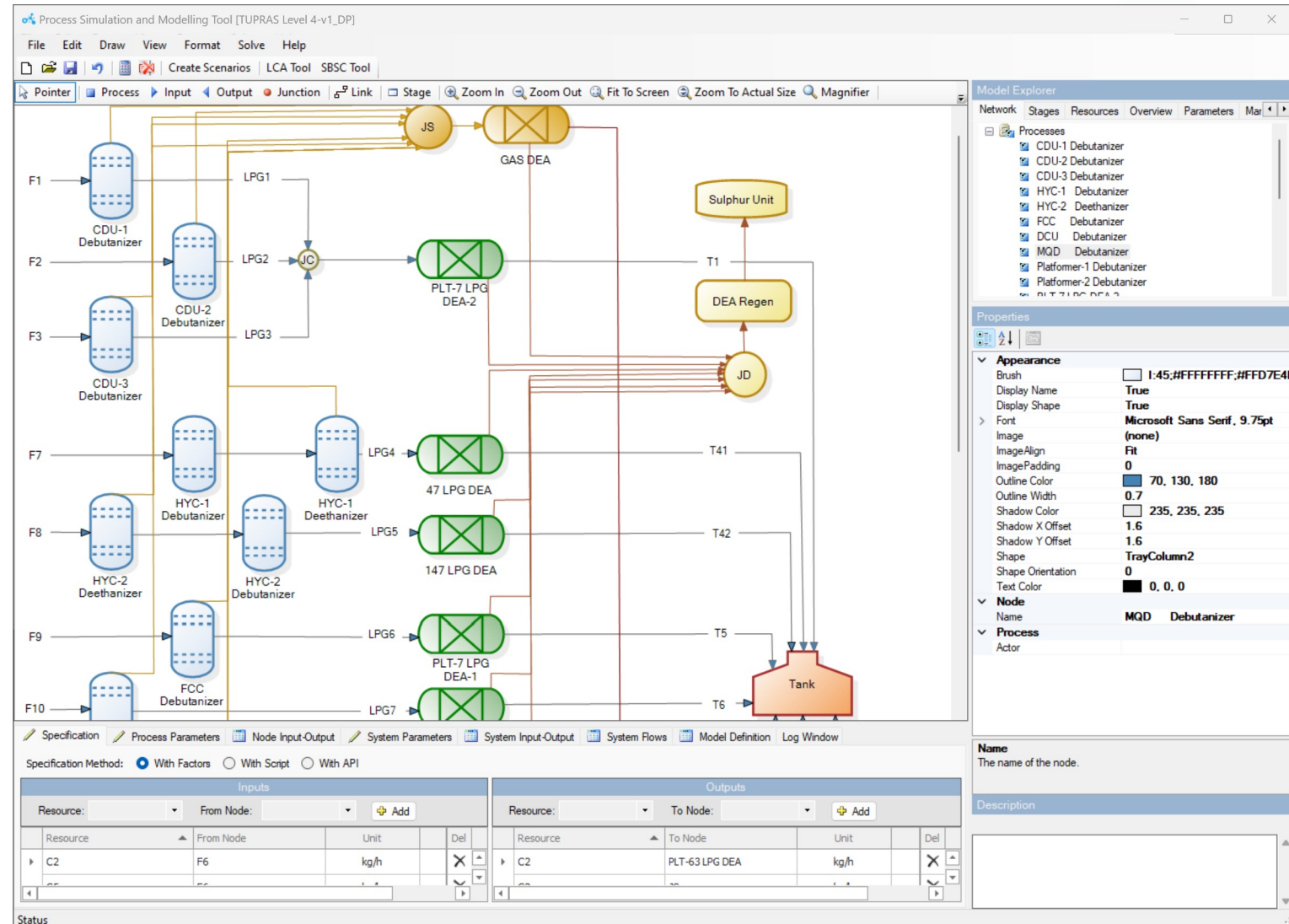


Image Source: TUC, Indigo, PSM Tool

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

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

- 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…
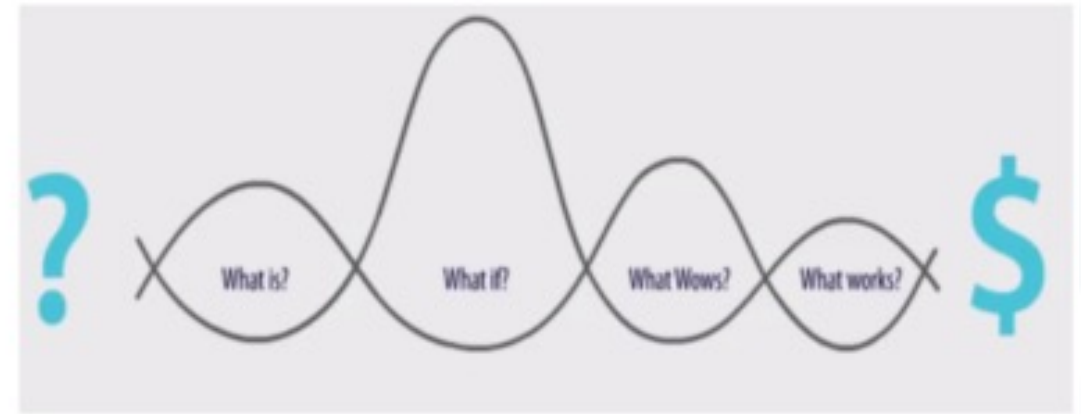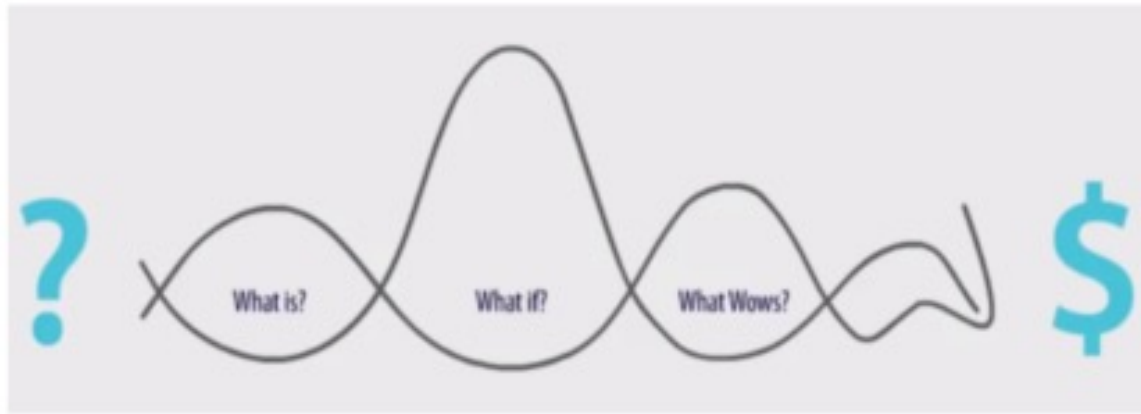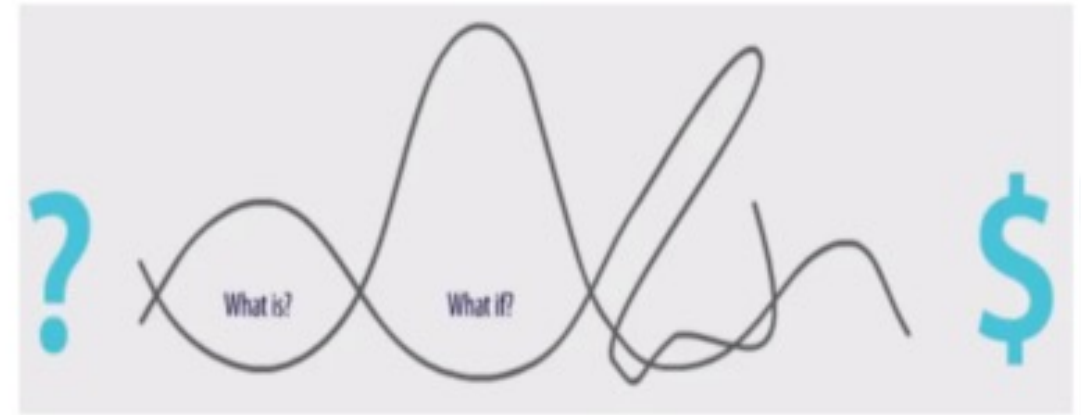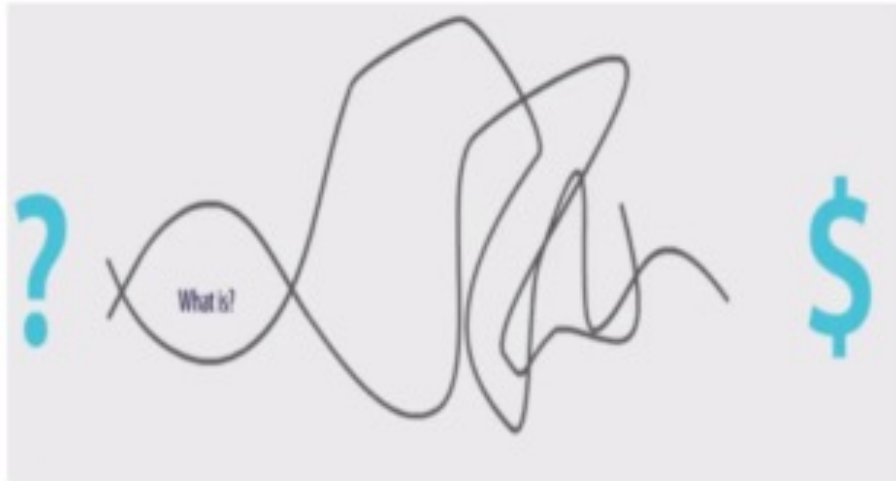
- Entangled becomes separated through a clear series of questions
- What is is the first question -> Current reality
- All innovative solutions start from a precise and valid understanding of the Reality.
- "Unarticulated employee needs"
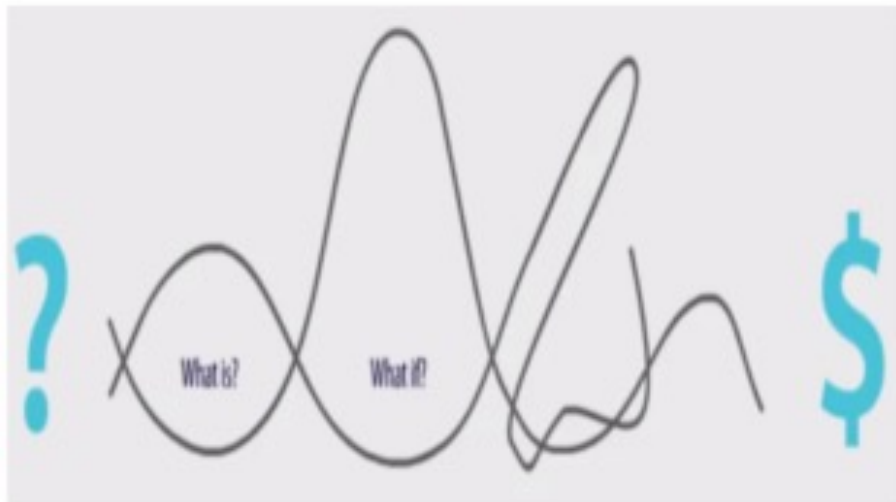
- Data revision, pattern recognition, knowledge to be introduced in the design space
- What if -> Many solutions -> Possibilities
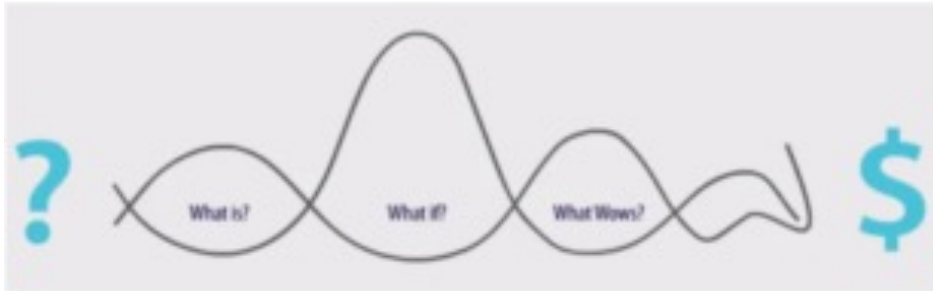
- First stage of testing... what can work?
- Possible solution = Hypothesis -> Test via design criteria

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

- **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

## 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.

- 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"

| 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. |

| 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 |

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

- 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....) .

- 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.

- 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

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

# Theoretical Saturation
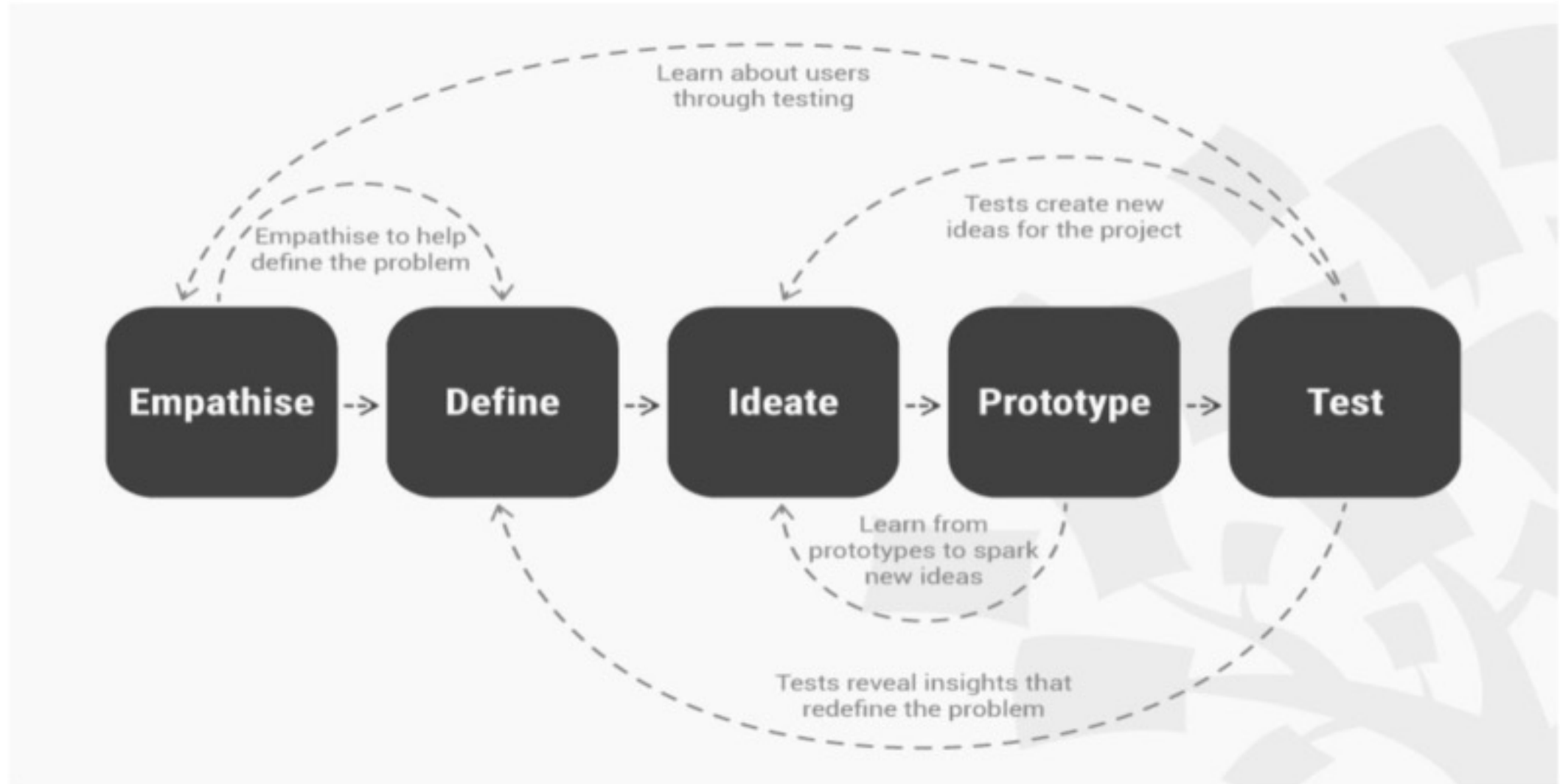
1. *[Empathise - Define]* Identify a Problem or Opportunity
2. *[Empathise]* Understand the Users
3. *[Empathise - Define]* Define the Value Proposition
4. *[Ideate]* Ideation / Concept Development
5. *[Ideate]* Validation and Refinement
6. *[Prototype]* Service Design
7. *[Prototype]* Technical Feasibility and Development
8. *[Test]* Test and Iteration
9. Launch and Change Management *[Empathise]*
10. Measurement and Improving *[Design Thinking]*
11. *If its good -> Sell it [THAT's Business]*

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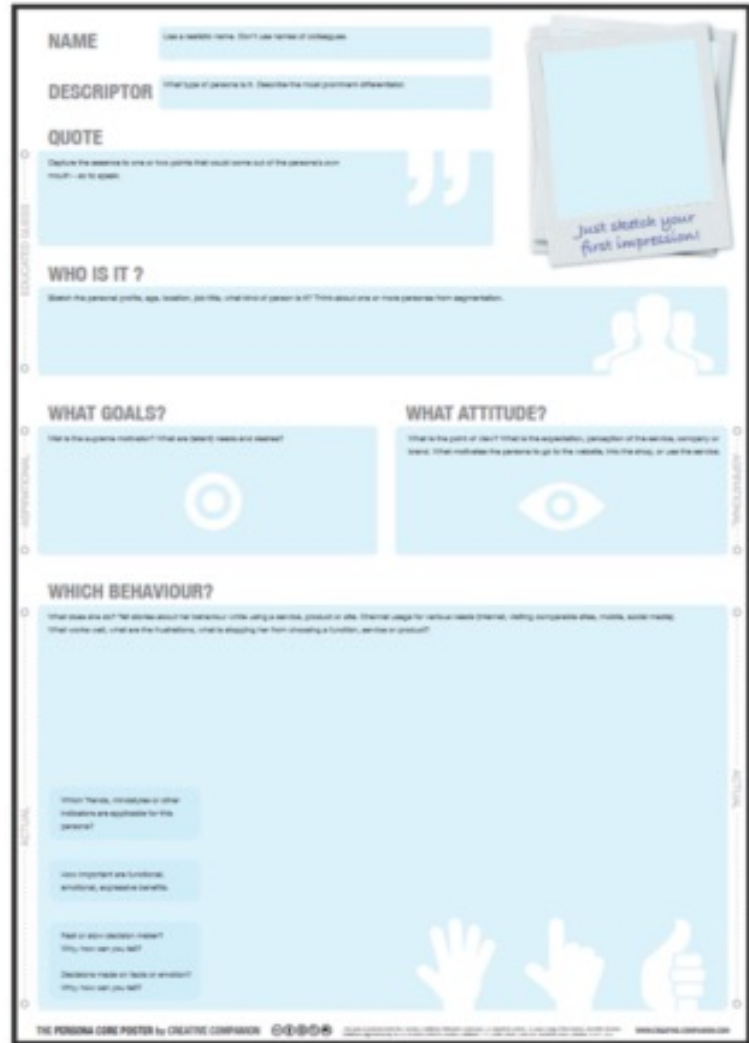
# User Persona

- A persona is a fictional, yet realistic, description of a typical or target user of the product. A persona is an archetype instead of an actual living human, but personas should be described as if they were real people.
  - How many archetypes in the factory ?
  - Who will use our system ?
- Name / Description / Role / Goals / Attitudes / Behavioural characteristics / Role in Organization / Match with Process / Performance evaluation / In-Factory KPI participation – relation
- Extra material for Persona Generation (Link)
- Online Persona Generation (Miro - Link)

# Interviewing towards the Persona

- Time with users is valuable

- Spontaneous, blissful user-guided conversation = Preparation

- Will we get an answer to everything ??

- The next user's answer is the previous user's validation

- Preparation
  - Brainstorm questions: Register all questions that will be asked
  - Identify and order themes: Interview Pillars
  - Refine questions: "Why" , "Tell me about the last time you _____ "

- Have in mind the Value Map for each Persona (end user)

# Value Proposition Canvas
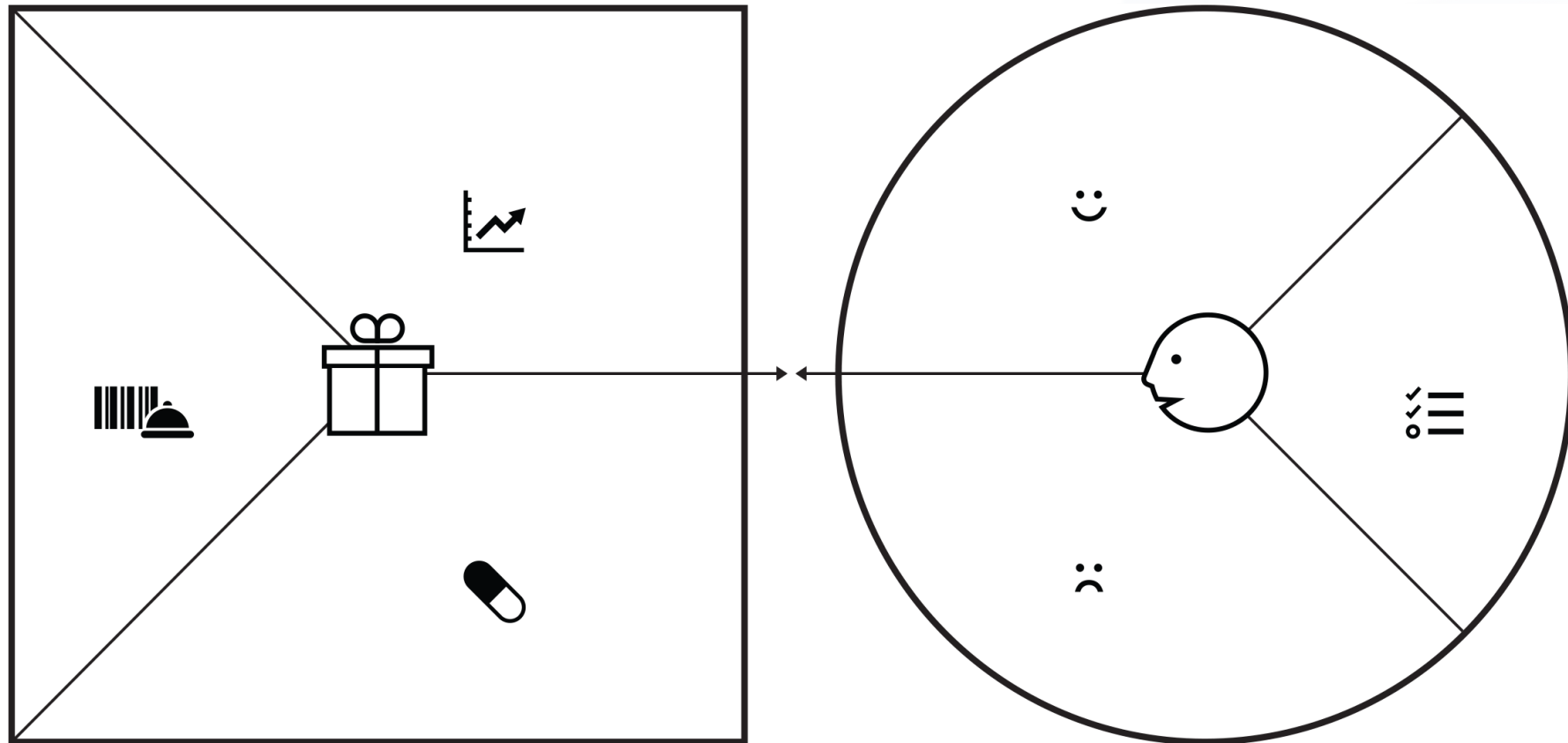


Value (Proposition) Map                    Customer (Segment) Profile

## Customer Profile

- **Customer Jobs** describe what your user-types are trying to get done in their work.

- **Pains** are the bad outcomes , the risks and obstacles that come into play when executing the job.

- **Expected gains** are the outcomes the users want to achieve through an offering
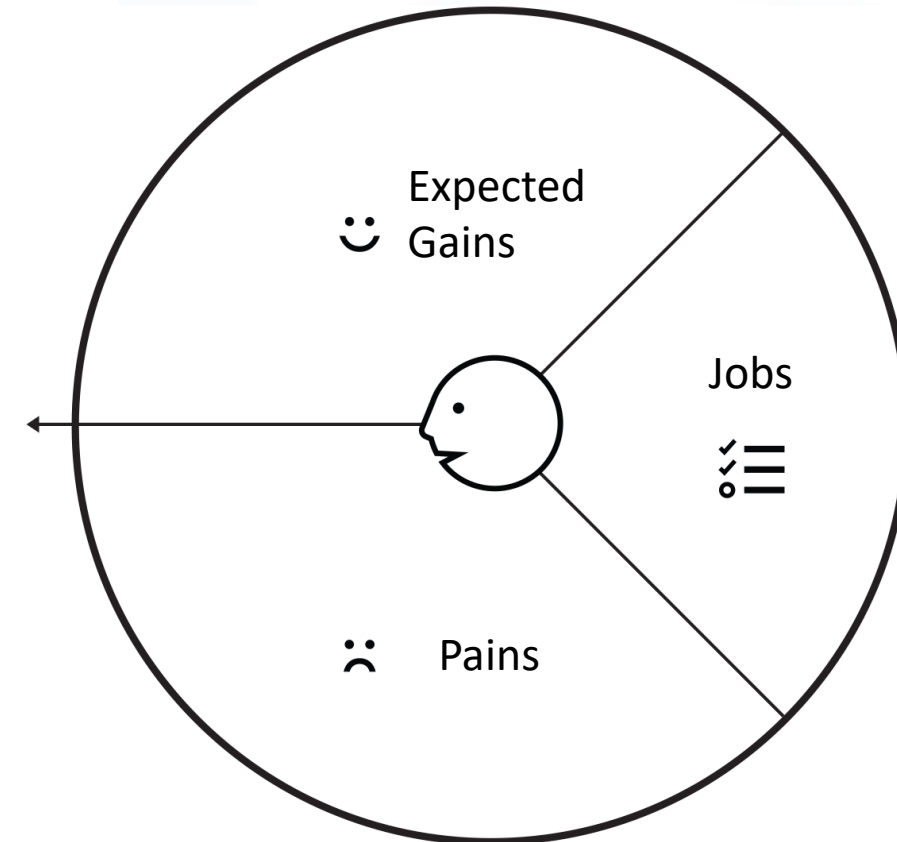
## Value Map
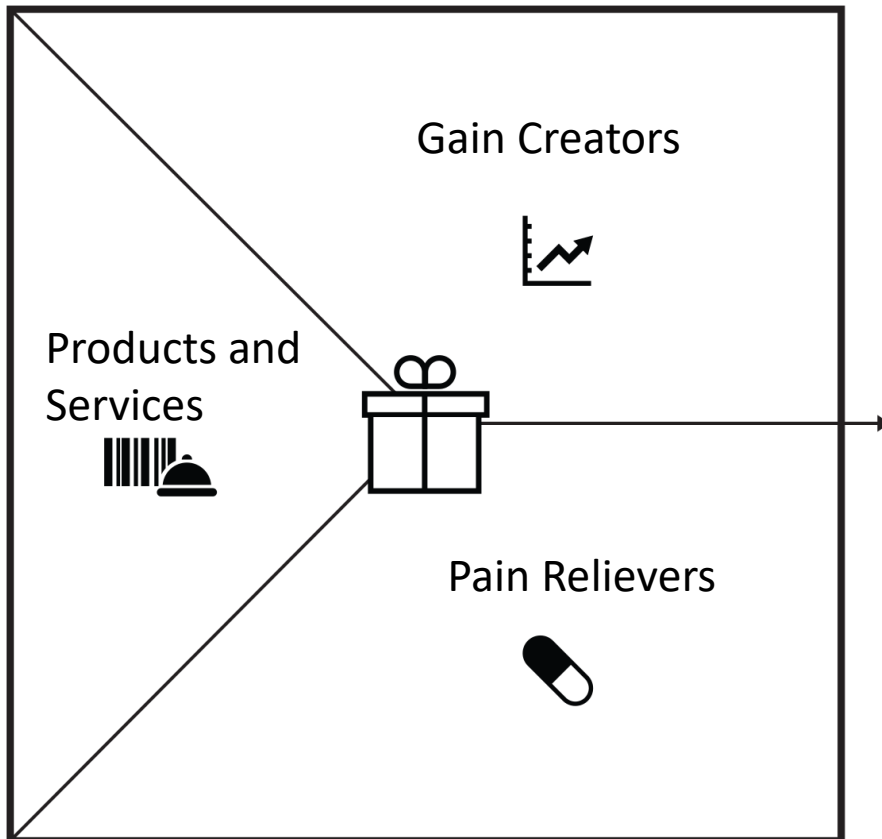


- **Products and Services** is the solution you will design / develop / offer as a list…

- **Pain relievers** describe how the products and services alleviate pains of users

- **Gain Creators** describe how our products and services create gains for the users

The process to follow to create the match between 1-4
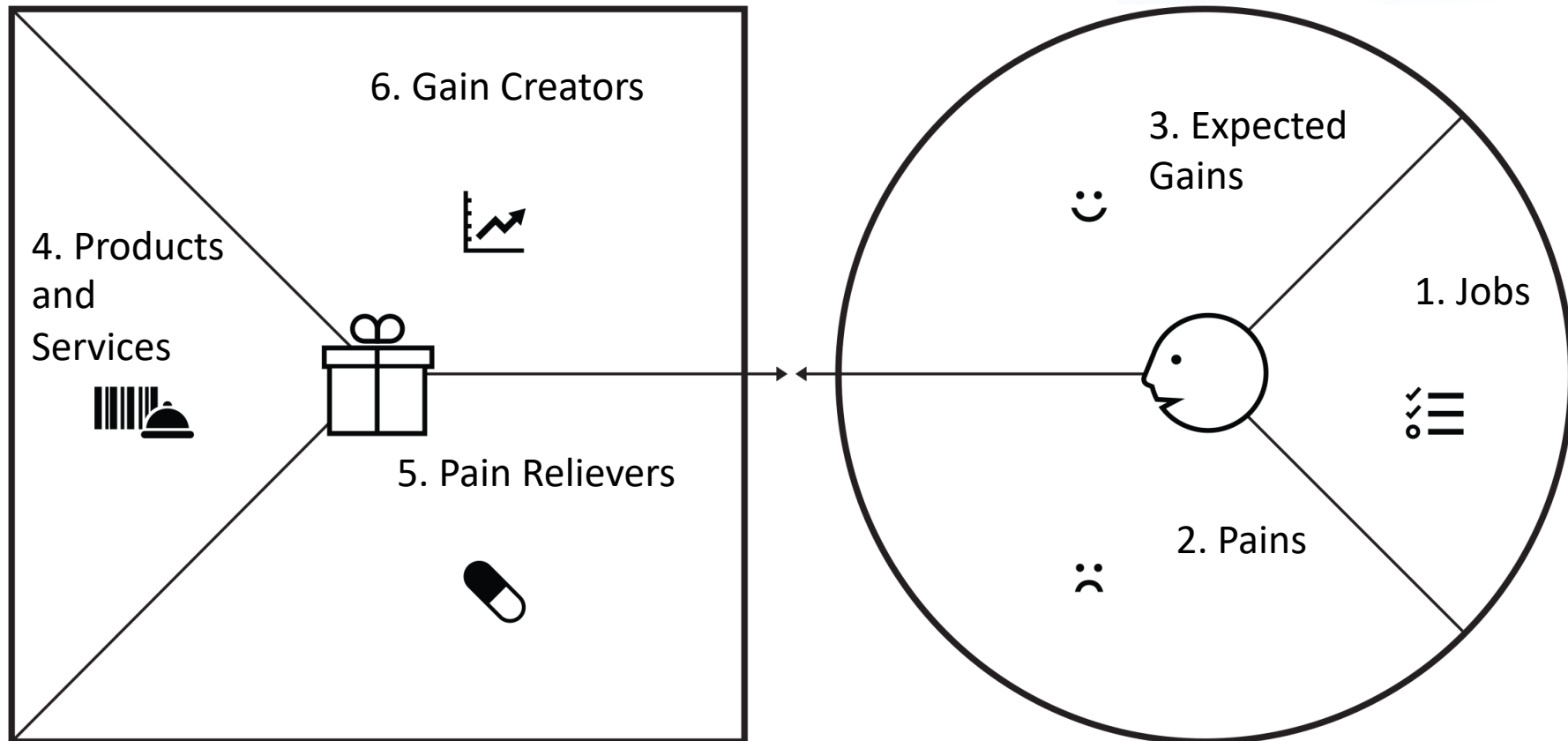


Value (Proposition) Map                    Customer (Segment) Profile

After the match between 1-4

# Minimum Viable Product

*A version of a new product which allows a team to collect the maximum amount of validated learning about customers with the least effort.*

- Examination of Competition (Services similar to yours that cover the same customer jobs)

- User stories generation

- Rapid development of potential solutions

- Selection / Storyboard generation

Study of competition and competing products solving the same or similar problems in the same or similar market

- Google is your ally

- There is always competition

- Examine all – Register to all – Demo all

- Feature compilation: We write down all features offered by competing products / services
  - *When all competitors offer a specific feature it probably is important to solving the problem and should be considered.*
  - *Cluster of features -> Main features = MVP*

- Print/Draw the most important functionalities that your service should consist of and go through the process as if you were a user
  - Map the user's story
  - Form a user flow
  - Online platform for user stories Stories On Board

- User story

- Separate the story into parts

- We have the distinct UX -> UI that we need to address

- In PostIt© note words / phrases / designs that come to mind
  - What does a user do here?
  - How can we measure success?
  - What happens next?
  - What are main hypothesis ?
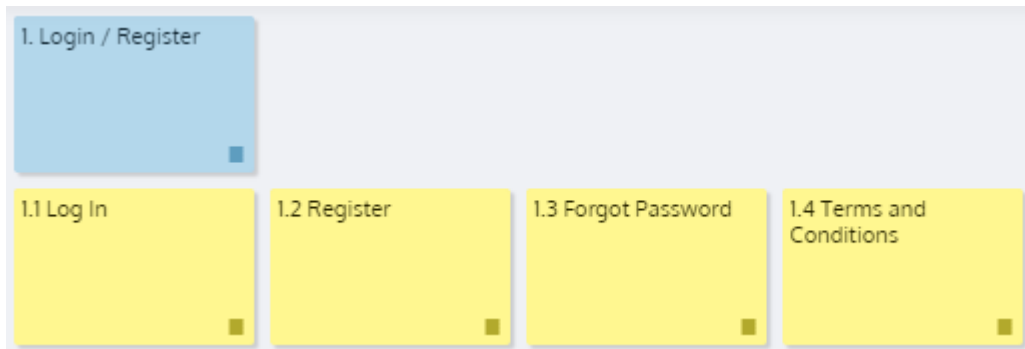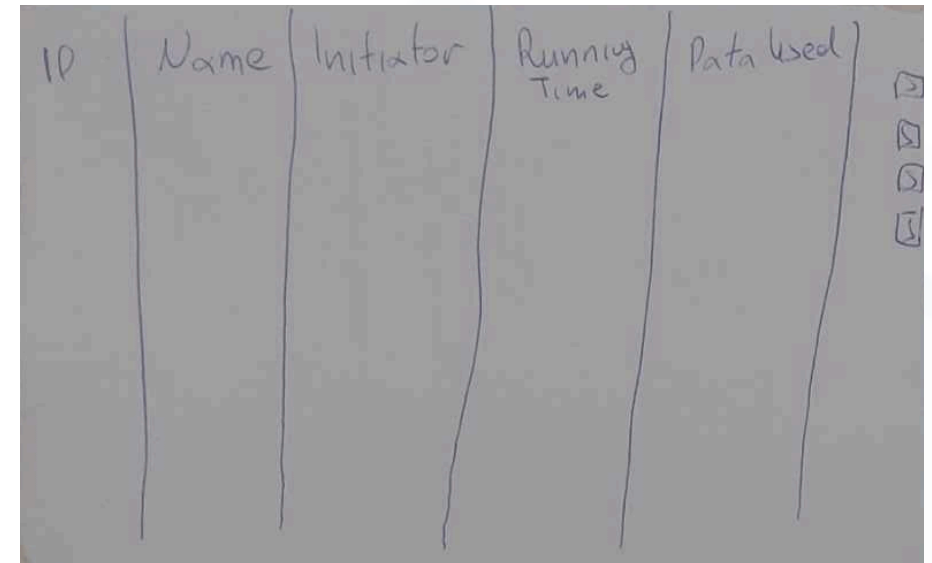
- E.g. Dashboard notes for *2.1 Ongoing optimization processes* notes
- In Post-It© note words / phrases / designs that come to mind
  - What does a user do here?
  - How can we measure success?
  - What happens next?
  - What are main hypothesis ?
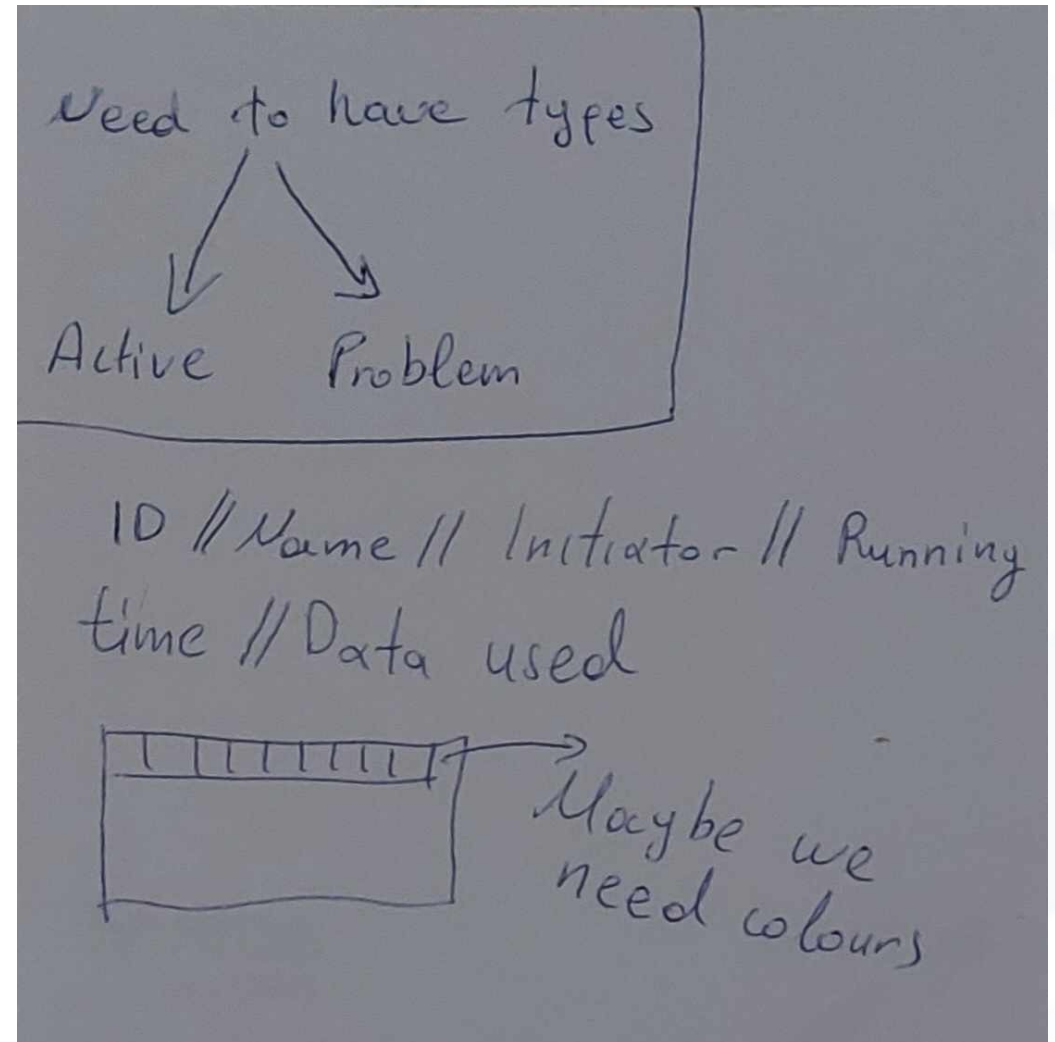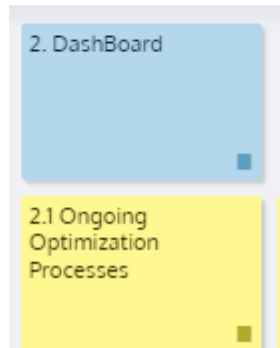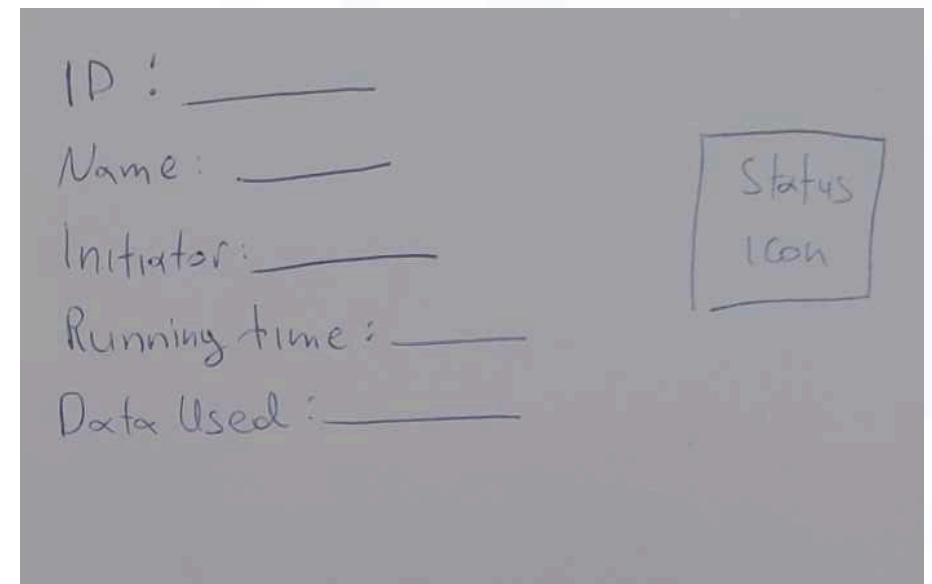
- For every step of the user story

- With all notes taken

- All members collaborate and perform the exercise of developing many "equal features" possible versions of the same functionality
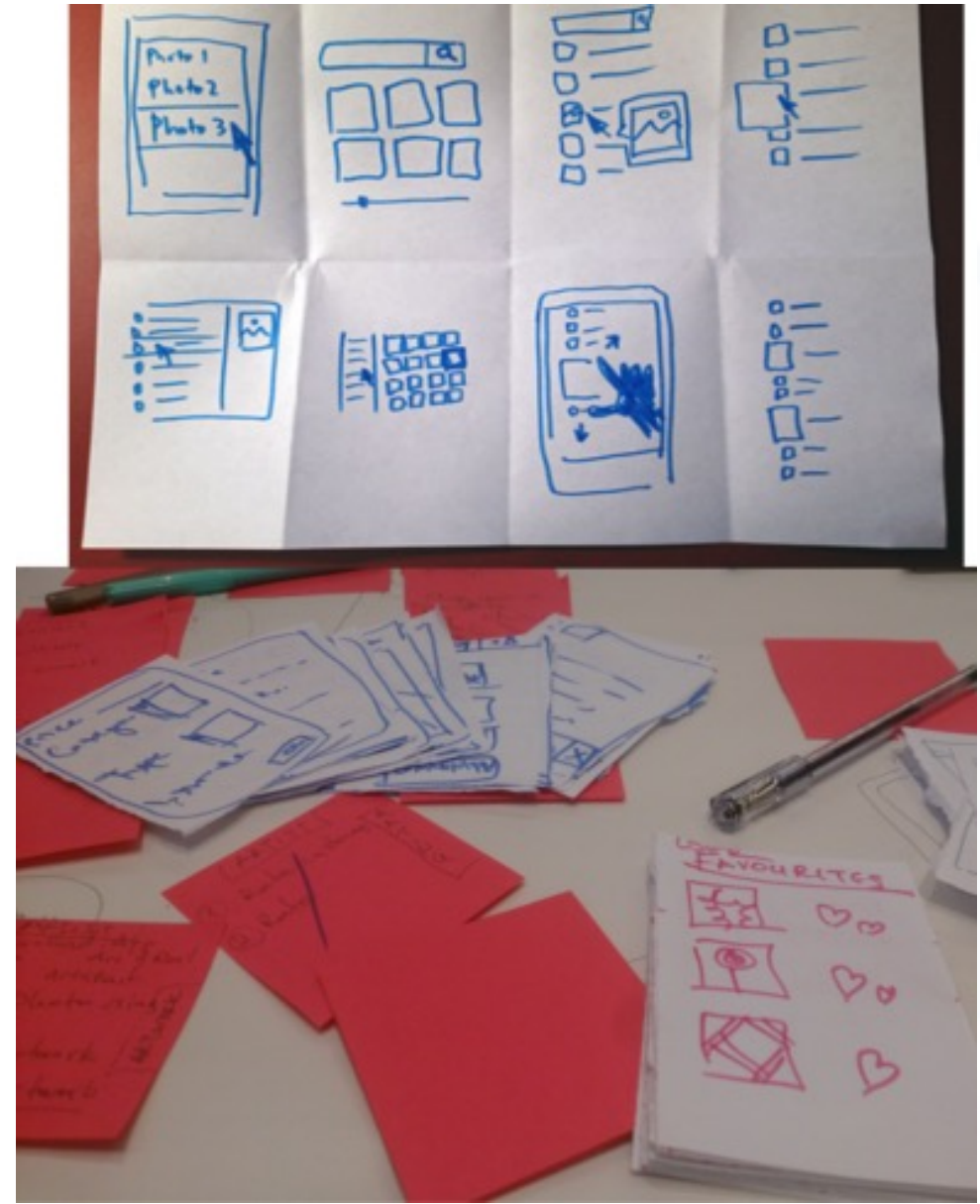
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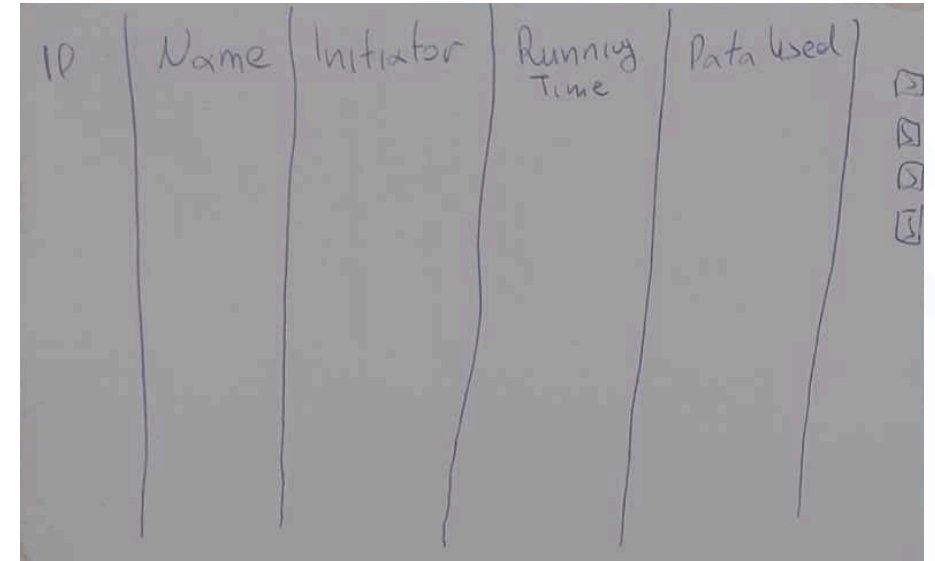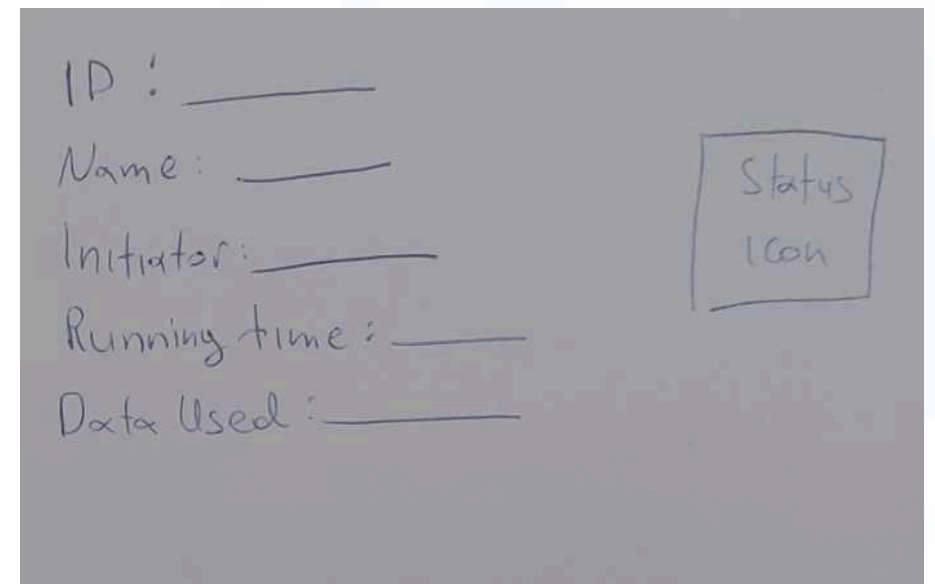
## Silent Positive Support / Voting

- All designs are placed on the wall relevant to each user story

- External users / Team members receive a predefined number of Dot-Stickers (=votes)

- Each member casts their vote by
  - Observing the designs
  - Selecting the version they believe that it adequately meets the requirements
  - Only positive votes
  - No judgment
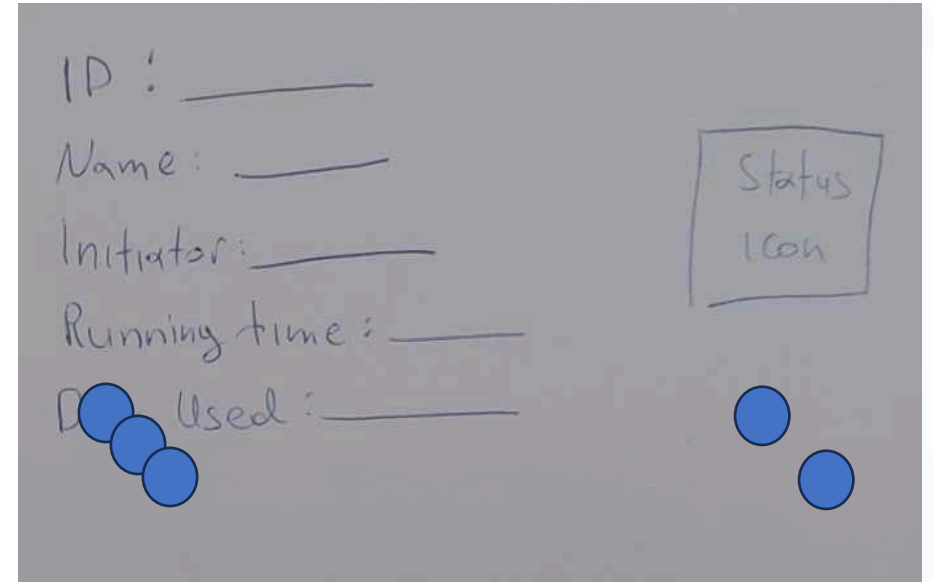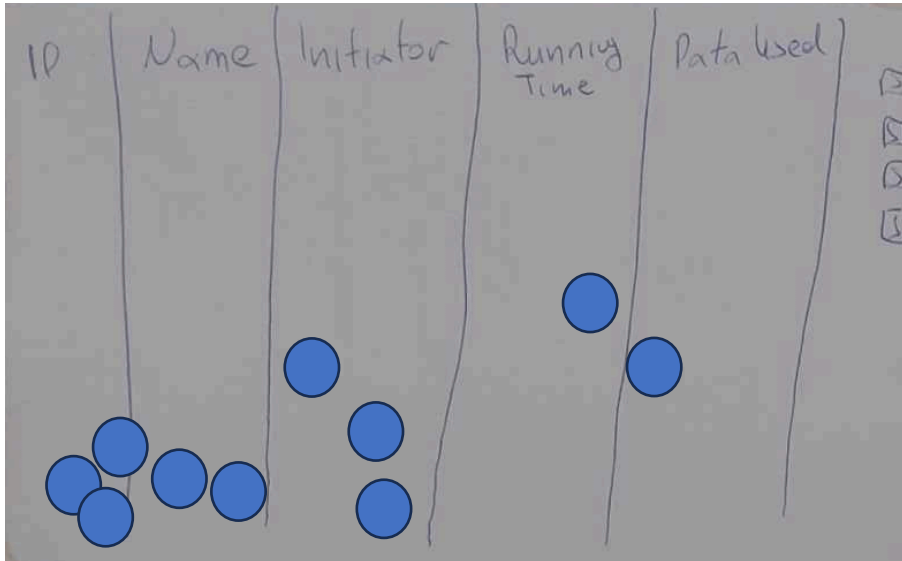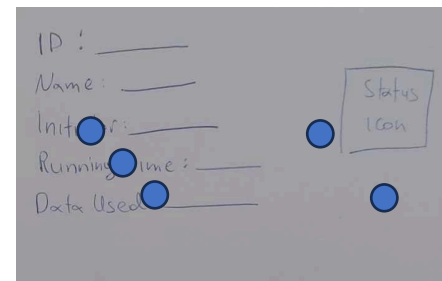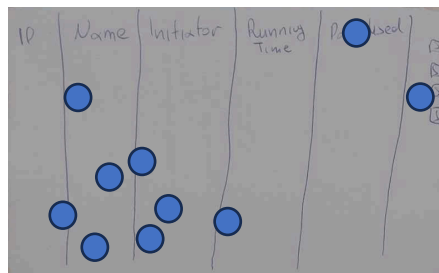
## Selection / Storyboard Generation / MVP

- All designs are then compared and at least one version proceeds to Storyboarding

- Final stage before prototyping

- A storyboard that shows Click-by-Click where the user can naviagate to and what (s)he can do
  - Templates relevant to the app we will develop
  - Naming conventions
  - Location in the user story
  - Functionality description and user interaction description
  - Wireframes

- Interactive Mockup Prototypes

- Fast implementation to test with actual users

- Minimally real prototypes
  - Actual text
  - Actual images

- Tools (Proto.io, Justinmind Prototyper, FluidUI etc. )
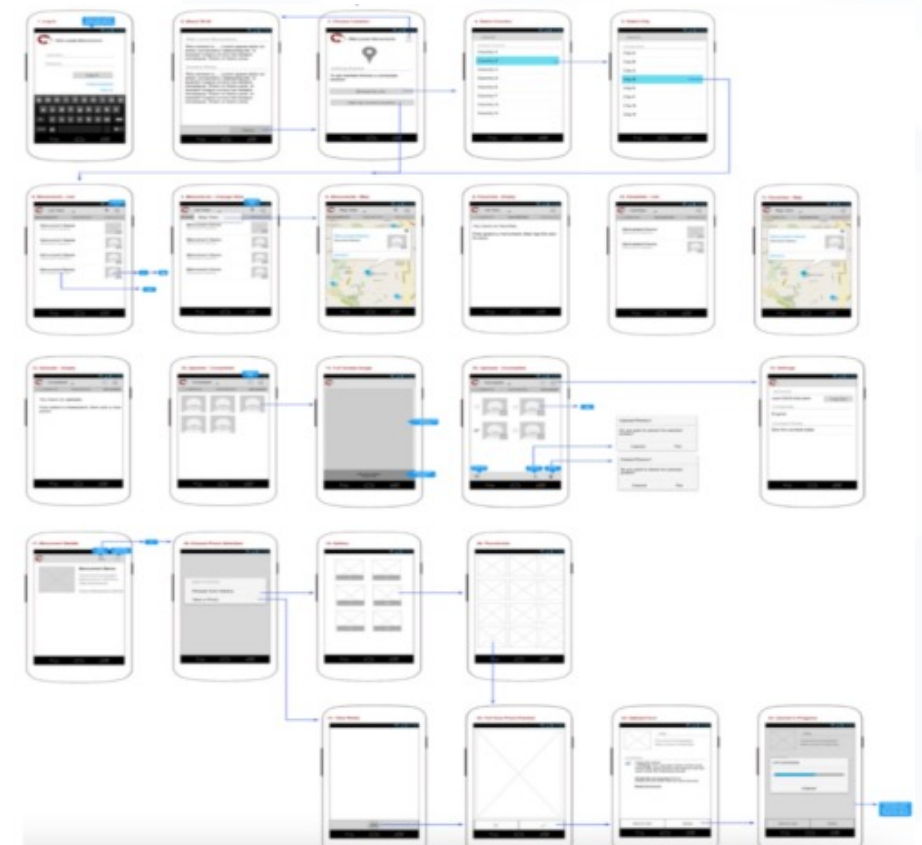


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1. Define Objectives and Goals

2. Identify and recruit users from the target users

3. Define and Create the Test Scenarios and User Tasks

4. Environment Preparation

5. Facilitation of the User study (Observation / Think Aloud / Minimal Interference)

6. Data reception (Recording / Qualitative analysis / Quantitative analysis)

7. Analysis (Identification of Issues and Prioritization of Fixes or Updates)



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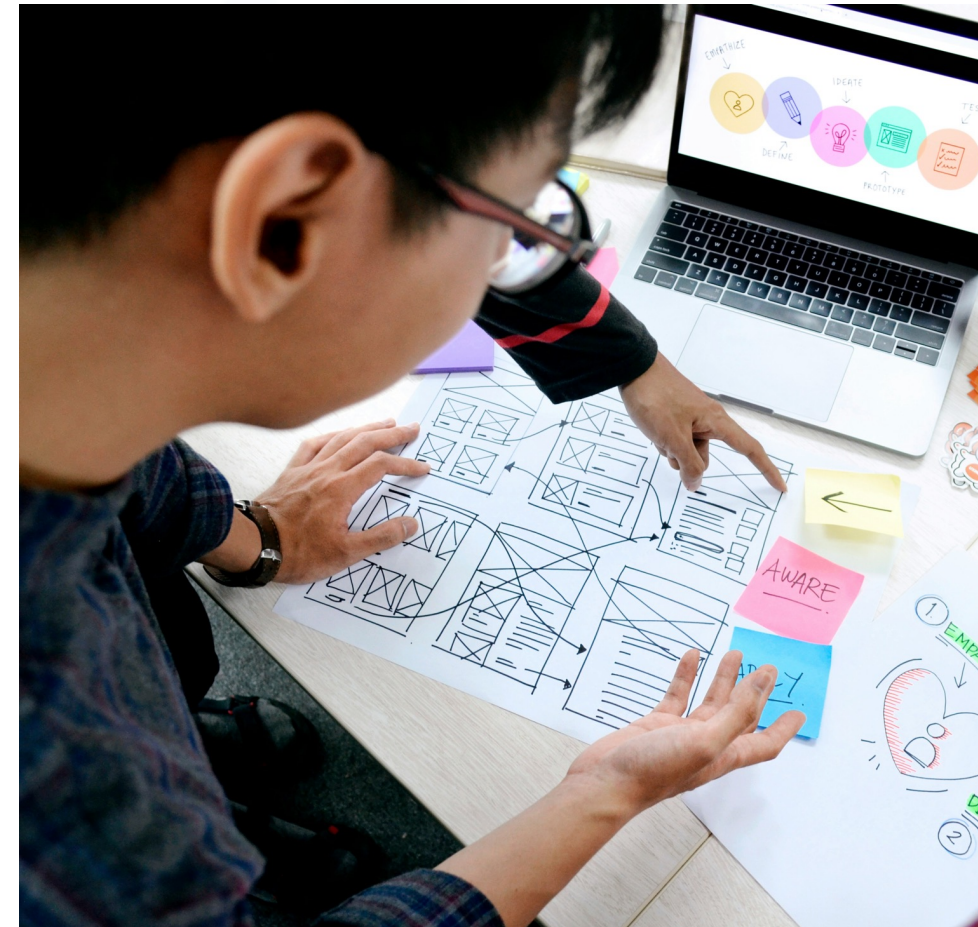
- Having all the results from the previous tests with the users, the next step is to finalize the design of the service towards its development.

- Integration with Existing Systems
  - Compatibility: Legacy systems, Machinery, Software
  - Data Interoperability: Ensuring of real-time information flow

- Scalability and Flexibility
  - Architecture: Need to design the architecture to be able to handle varying loads and scale with the industrial operations' needs
  - Flexible configuration: Customization for varied processes and user types

- Reliability and Performance

- UX design

- Security and Compliance
  - Data security
  - Compliance

- Supportive tools
  - Real time monitoring

- **Front-End:** React, Angular, Vue, HTML5, CSS, etc.
- **Back-End:** [Java, Python, C#, Node.js][Spring Boot, Django, ASP.NET Core]
- **DBs:** [PostgreSQL, MySQL, MS SQL Server][MongoDB, Cassandra, Redis]
- **Industrial Protocols and Middleware:** [OPC UA, Modbus, MQTT][Apache Kafka, RabbitMQ]
- **Cloud:** AWS, Azure
- **DevOps:** Containerization : Docker, Kubernetes - CI/CD: Jeknins, GitLab CI/CD – Monitoring and Logging: Prometheus, ELK stack

- **Unit Testing:** Developers write and run unit tests for individual components.

- **Integration Testing:** QA team performs integration tests to ensure components work together.

- **System Testing:** QA team conducts system testing to validate the complete system.

- **Acceptance Testing:** Business stakeholders and end-users perform UAT to verify the system meets business requirements.

- **Performance Testing:** Performance engineers test the system under various loads.

- **Security Testing:** Security experts perform penetration testing and vulnerability scanning.

- **Usability Testing:** UX team conducts usability tests with real users.

- **Compatibility Testing:** Test the application on different devices, browsers, and OS configurations.

- **Regression Testing:** Automated regression tests are run after every major code change.

- **End-to-End Testing:** Conduct end-to-end tests to validate complete workflows.

- **Alpha Testing:** Internal team performs alpha testing to catch early bugs.

- **Beta Testing:** Release a beta version to a select group of users for real-world testing.

- **Configuration Testing:** Test with various hardware and software configurations.



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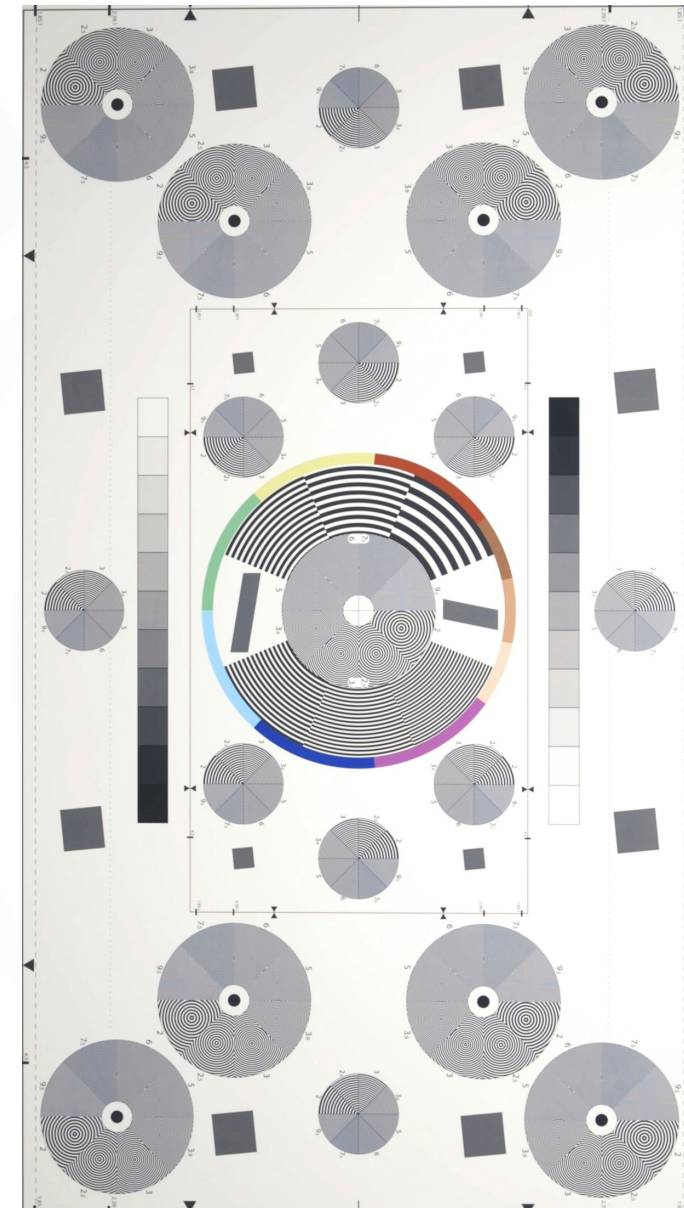
Change management for the new digital solution involves the structured approach to transitioning individuals, teams, and even the whole organization from their current state to the future state (with the new service operational in the day-to-day activities) while minimizing resistance and maximizing engagement and adoption, to harvest the envisaged benefits.

Goal

- Minimization of Disruption
- Maximization of Adoption
- Improvement of Efficiency
- Management of Resistance to change

- **Stakeholders**
  - Assessment of impact
  - Engagement

- **Communication plan**
  - Strategy of communication
  - Omni-channel approach

- **Training and support**
  - User manuals / guides
  - Training programs

- **Rollout plan**
  - Approach in phases
  - Pilot testing rollout
  - Feedback mechanism



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- Analytics: Implement analytics tools to track user behavior, engagement, and other key metrics.

- Continuous Improvement: Use the data to make informed decisions and continuously improve the service.

- KPIs… more KPIs… and even more KPIs…

- Go to slide #1… and start again…

- You developed something of value
- Maybe.. that value is not just for you
- *Others face the same / similar problems*
- ….
- IP Protection first…
- Spin off / Spin out

- **Copyrights**: Books, Music, Art, Photo, Movies, Games, SW, DBs…

- **Patents**: Patentable subject matter

- **Trademarks**

- **Design Rights**: Visual design

- **Trade Secrets**


- WIPO - World Intellectual Property Organization

- EPO – European Patent Office

- USPTO – US Patent and Trademark office


- European IP Helpdesk – Your guide to IP in Europe (Link)

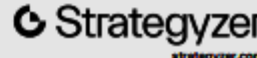■ For whom do we create value?

■ Who is the one using / Who is the one paying ?

■ Segmentation based on

- Value offered
- Channels used to approach
- Relations built
- Revenue sources
- …

# BMC – Value Proposition

- Set of services and products for a particular customer segment

- Solving a problem, Covering a need, Alleviating a pain, Offering gain(s)

- Segmentation based on
  - Quantitative nature (e.g. price, speed etc.)
  - Qualitative nature (e.g. Experience)

- Set of touchpoints between Us – Customer(s)

- Communication, Distribution, Sales, Support

- Segmentation based on
  - Owned
  - Not-Owned

# BMC – Customer Relationships

- Set of relationships we want to have with each CS

- To Acquire , To maintain, To enhance

- Segmentation based on
  - Owned
  - Not-Owned
- Human assistance, Self-service, Co-creation, Communities

# BMC – Revenue Streams

- Ways the customer(s) pay for receiving the value, through the products and services

- Transaction revenues / Recurring revenues

- Segmentation based on (but not limited to)
  - Usage fees
  - Subscription fees
  - Lending / Renting / Leasing
  - Licensing
  - Brokerage
  - Advertising

- What type of resources do we actually need (KEY) ?
- Segmentation based on (but not limited to)
  - Physical
  - Intellectual
  - Human
  - Financial

- What type of activities do we actually HAVE to do to maximize our offering (KEY) ?

- Segmentation based on (but not limited to)
  - Day to day operations…

- What type of Strategic Partnerships can we have to maximize our network of suppliers and co-operators ?
- Segmentation based on (and mostly limited to)
  - Strategic Alliances
  - Cooperation
  - Joint Venture
  - Buyer – Supplier relationships

- What are the costs we must endure to derive to sustainability and success ?
- Fixed / Variable Costs
- Economies of Scale
- Economies of Scope

AquaSPICE

THE E-BUSINESS RESEARCH CENTER
**ELTRUN**
ATHENS UNIVERSITY OF ECONOMICS AND BUSINESS

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

*Img src*

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

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