

Specifications continued + Concept Generation

MEC 3002 Methods in Early Product Development

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We are half way!

	Topic
Wed	9.9. Introduction - what is Product Development?
Fri	11.9. Opportunity Identification & Mission Stmtnt
Wed	16.9. Opportunities & Identifying customer needs
Fri	18.9. Identifying customer needs continued
Wed	23.9. Interpreting and Organizing customer needs
Fri	25.9. Product Specifications
Wed	30.10. Specifications continued + Concept generation
Fri	2.10. Concept generation
Wed	7.10. Concept Selection
Fri	9.10. Concept Testing
Wed	14.10. Winds of Change
Fri	16.10. Winds of Change

Learning objectives:

- Understands the different product development process models and its phases
- Is able to use need finding methods
- Is able to apply user centered design methods
- Is able to apply concept design methods
- Is able to define proper requirements and constraints

You choose your own objective, and learn from your peers

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Agenda

Product Specification homework discussion
Move from need finding toward concept generation
Seminar launch

3

Agenda

Product Specification homework discussion
Move from need finding toward concept generation
Seminar launch

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1/16 was done for the commute

Most well done. The discussion was a key to see how differently one can think about the need and what to measure and why.

Few teams well discussed the difficulty of defining specifications before we have a selected concept or the difficulty of solutions independent specifications – well done!

I left brief comments for each team in MyCourses, if you'd like more detailed feedback, simply ask.

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Specification examples 1

A way to inform driver about other road users' behavior in traffic

<ul style="list-style-type: none"> • Driver is informed visually or through audio the location of other cars within 50 meter range • Identify moving objects with a cross section larger than 0.8 m² 	<ul style="list-style-type: none"> • 50m • 0.8m²
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Detectable road user type	Pedestrians, cars, cyclists
Speed	Speed +- 10%
Direction	Angle 20 degree
Location	Inside 2 m ² area

Signalize future direction and speed of the other road user

Success rates of detection over 97%

A driver is informed of the behavior (=speed, direction and location) of other road user types (=pedestrians, road vehicles & cyclists) in time to react at current speed

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A driver is accurately informed of the behavior (=speed, direction and location) of other road user types (=pedestrians, road vehicles & cyclists) in time to react at current speed

A driver is accurately informed of speed of other road user types (=pedestrians, road vehicles & cyclists) in time to react at current speed **99% accuracy**
All <2 seconds

A driver is accurately informed of direction of other road user types (=pedestrians, road vehicles & cyclists) in time to react at current speed **99% accuracy**
All <2 seconds

A driver is accurately informed of location of other road user types (=pedestrians, road vehicles & cyclists) in time to react at current speed **99% accuracy**
All <2 seconds

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Specification examples 2

A way to increase the reliability and consistency of the device so that drivers can trust and rely on the device to adapt their behavior to it

- Is field tested to be consistent and reliable in at least 99% of cases.
- >99%

Reliability high Informs if the device is not working The device feels reliable (design and working principle ...) 99,99% YES Subj.	System accuracy should be presented by the collected information about successful predictions >70%
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- The device should allow accuracy rating for recommendations as well as error reports, user feedback and updates

Improve the relationship (trust) between device and user	100 % accuracy: Could be determined by making tests with for example thousands of car passing and the device needs to detect all of them.
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Specification examples 3

A way to find free parking slots

<ul style="list-style-type: none"> Prompt the driver about the available parking places within 200 meters of the car. 	<ul style="list-style-type: none"> <200m 	
Find available parking slots	Information of areas with free parking slots in contrast to driver's location.	1 km. around the car

- The device should detect spaces between parked cars at minimum within the drivers range of reaction time (2.3 s x current speed)

Discussion Examples

Some people had made assumptions about the needed technology. Assumed technologies varied depending on the team member. For example: A way to find a free parking slot, some of us assumed that the solution was based on radar like device whereas some of us assumed that it would be based on information provided in web app (Parkman, Easy Park). We agreed to do 10 customer need specification in more general level trying to avoid certain technologies behind.

When reflecting on the specifications, it is easy to fall into already determining a solution for it, before actually knowing if it is viable. It is easy to fall into our own bias, going for predetermined solutions that are probably not ideal. The error can be then carried forward unintentionally in the product development part. For example, when signaling something, it is easy to say: "Signalize risk with a light". There the solution (maybe not optimal, a sound could be better, like with untied seatbelts) is already determined, although it should not.

discussion about the first customer need "A way to inform driver about other road users' behavior in traffic" revolved around what informing the driver of other's behavior means. Does it mean that other road users' driving habits are informed to everyone using the product? Does it mean informing about someone's current behavior? Does it mean the product should predict other's behavior? So, we settled

The most challenging part was dealing with specifications that are hard to measure. For instance; half-spherical screen or ranges specified are easy to measure, but "non visible object" or "alarm" are concepts hard to measure or specify in design phase, although for instance "illumination intensity of 0,2 lux" or "beeping sound >80dB & @100Hz" isn't. We did perceive certain needs differently, in that some of us thought of complete systems in order to address the need (for example, selecting parking lots and getting alarms from when any has free space, which is like an app on its own, while someone else thought of it in terms of time optimization), but still we did not have difficulties agreeing.

Discussion Examples

We found that the longest and most thought-provoking discussions came from specifications that were somewhat broad and general. These tended to come up because customer needs also tended to be somewhat vague and broad.

It was noticed that when making a specification, it can unintentionally narrow down the solutions how to satisfy the need. For example, assuming that we need better wipers to improve visibility, when we could possibly replace the windscreen with a monitor.

Another disagreement/discussion we had revolved around the fact that some of the specifications were not quantitative enough, and were considered to be more of design choices than specifications. An example would be for customer need no.5, where we discuss visibility issues, it was hard to even define what 100% visibility is, even though 70-80-90-100% are quantitative numbers, it is hard to set a datum/baseline in which we can base our target value. Arguments such as "visibility is reduced by fog, rain and even a large lorry" and "visibility can be assumed based on weather in similar situations" were used to derive our specification above.

We believe this discussion would have benefited from a live session rather than online discussions, and this is because we find it easier to explain more abstract concepts to others in person, rather than online, where things could be misinterpreted and/or misheard.

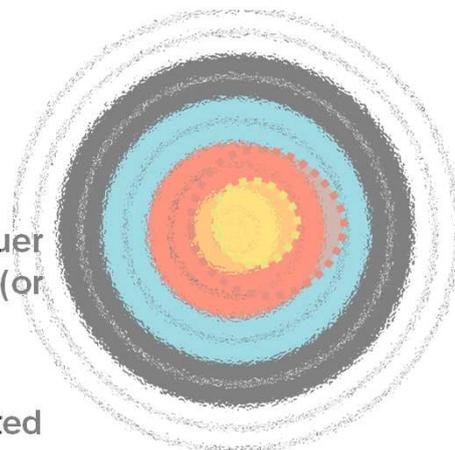
Take away message

There is not one correct way

As a team you are closer to correct than alone

Specification helps agree on target, vaguer the target, more likely you are to miss it (or aim for wrong misinterpreted target)

After concept selection, these are revisited and made more specific.



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Concept Generation

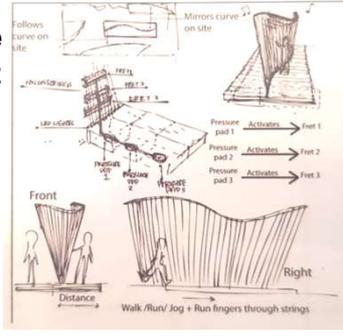
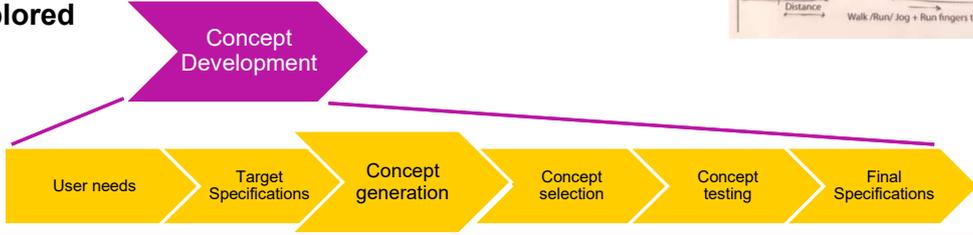
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Concept

- A product concept is an approximate description of the technology, working principles and form of the product
- Often in a form of an annotated sketch
- A suggestion for a solution for the design problem/opportunity
- Good concept generation leaves the team with confidence that the full space of alternatives has been explored


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Definitions

- Creative product $\text{Novel} \cap \text{Useful} = \text{Creative}$
- Creative person
- “The starting point for innovation is the generation of **creative** ideas. Innovation is the process of taking those ideas **to market or to usefulness**.” *Yuri Ijuri & Robert Lawrence Kuhn*

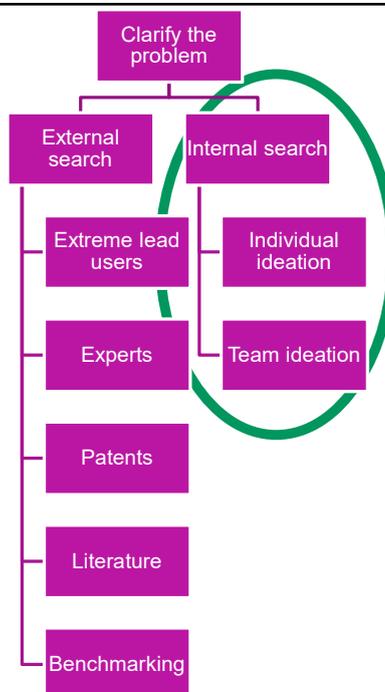
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Common issues in ad hoc concept generation

- Consideration of one or few alternatives suggested by most vocal team members
- Consideration of one idea at a time
- Endless discussions
- Failure to fully understand current competing offerings
- Involvement of only 1 or few people in the process, resulting in lack of commitment or confidence by the others
- Ineffective integration of partial ideas
- Failure to consider entire categories of solutions

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Approaches



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My belief:

Creativity is like any talent – it can be taught and learned

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Learning Objective:

Learn concept generation methods



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Some creativity methods

Round-robin brainstorming	Attribute listing	Greetings cards	Passive searching	Brainstorming
Rolestorming	Morphological analysis	Unfolding	Storyboarding	Reverse Brainstorming
Role-play	Matrix analysis	Value Engineering	Braindrawing	Starbursting
Electronic Brainstorming	Six thinking hats	Wishing	Brain sketching	The Charette Procedure
Brainwriting	Po (Provocation)	Concept metaphors and analogies	Nominal Group Technique	Crawford slip writing method
6_3_5	Talking pictures	Ideation game	Bodystorming	Chunking
Pool method	The list of 100	Word tree design by analogy	Assumption Busting	Mind-mapping
Idea card (pin card) method	Listing	Forward steps	Brainmapping	PSI
Post-Up	Heuristic ideation technique	Backward steps	Challenge	Random Words
Constrained brainwriting	(HIT)	Mash-up	Essence	Sensorial
Electronic Brainwriting	Design Heuristics	Bio-inspired ideation	Forced Conflict	AOKI
The spreadsheet technique	TRIZ	Designlibs	How-How Diagram	Vip design
Interactive brainwriting	C-Sketch	Cheatstorming	How to	EED
Brainwriting game	Concept generating matrix	6-3-5 Extended	The Kipling method	SIT
Metaphorical thinking	Ideation session	Extreme Characters	Lotus Blossom	Concrete stimuli
Reversal	SDI	Fictional Inquiry	Remembrance	Forced analogy
SCAMPER	Laddering	FUTURE WORKSHOP	Rubber-ducking	Gallery
Delphi Method	Synectics		Take a break	
			Pause	

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Any method is better than no method!

There's extensive research in this. Any method works (on average) better than no method and some methods have been shown to work better than others in certain situations. But since every team, problem, and project is different, no one method is truly superior to another.

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Problem definition impacts your ideation

Problem definition has a direct effect on your ideation results – do this well!

Problem definition should focus on the problem, the real problem

E.g. not design a new alarm clock, but design a way of waking a person up.

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Rules

Suspend judgment

Encourage wild ideas

Build on others

Stay focused on the topic

Be visual

Go for quantity

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Suite of methods

Brainstorming
Brainstorming w mindmapping
Reverse Brainstorming
Morphological analysis
SCAMPER
Random item/word
6-3-5
Bodystorming

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BRAINSTORMING

and variations of it

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Brainstorming Procedure

1. **Select a facilitator**
 - The facilitator should prevent judgments and encourage participation by all and record ideas.
2. **Form a group.** 5-15 people, with a variety of backgrounds and experiences. Avoid including bosses or supervisors in the groups.
3. **Review the problem** ~10 minutes - (task clarification, customer needs, specifications, etc.)
4. **Rapid idea generation** ~ 20-35 minutes

Quantity, not just quality

5. **When ideas trickle, either stop or use idea generators** (analogies, physical principles, etc.)

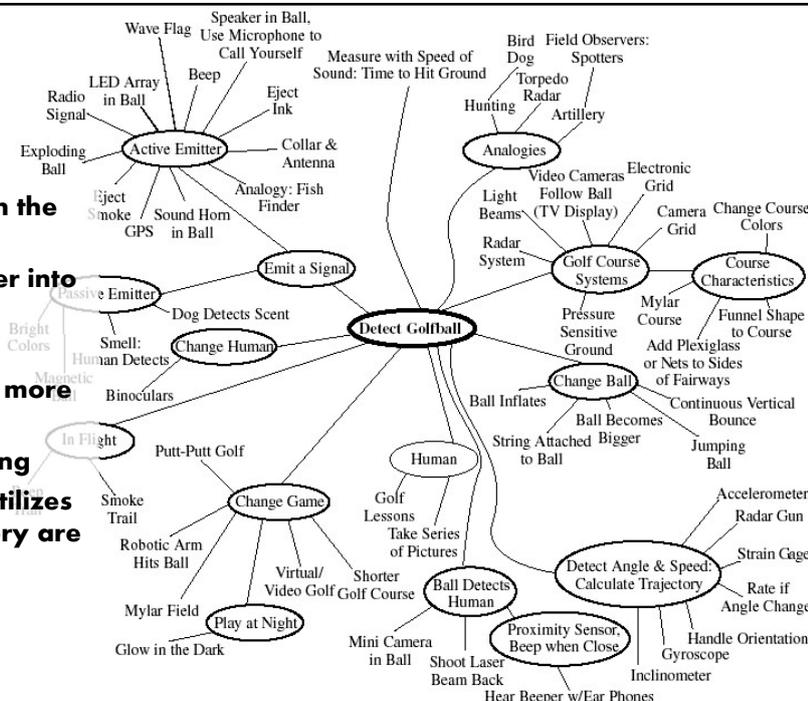


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Brainstorm using a Mind Map

- **Step 1: Write Problem in the center**
- **Step 2: Add ideas: cluster into hierarchical groupings**
- **Look for categories!!**
- **Groupings help lead to more ideas**
- **Documents brainstorming**
- **Power of technique – utilizes fact that ideas in memory are linked by association**



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MORPHOLOGICAL ANALYSIS



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Morphological analysis

- **Decompose to functions, sub-problems or sub-systems**
- **Generate multiple solutions for each function, sub-problem or sub-system**
- **Sketch concepts for multiple combinations**

Function 1	Function 2	...	Function n
Idea f1 1	Idea f2 1
Idea f1 2	Idea f2 2
Idea f1 3	Idea f2 3
...

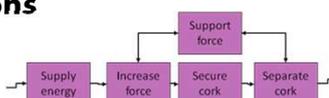


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Morphological analysis - Example (cont'd)

- **Generate multiple solutions for each function, sub-problem or sub-system**



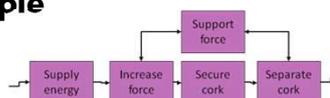
Supply Energy	Increase force	Support Force	Secure cork	Separate cork
Manual Electric Chemical	Lever Gears Rack & pinion Tackle Pneumatic Hydraulic	Bottle neck Table Other hand	Screw Suction Claws Umbrella None	Rotate Pull Push Pull & Push Pump Blast Dissolve

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Morphological analysis - Example (cont'd)

- **Sketch concepts for multiple combinations**

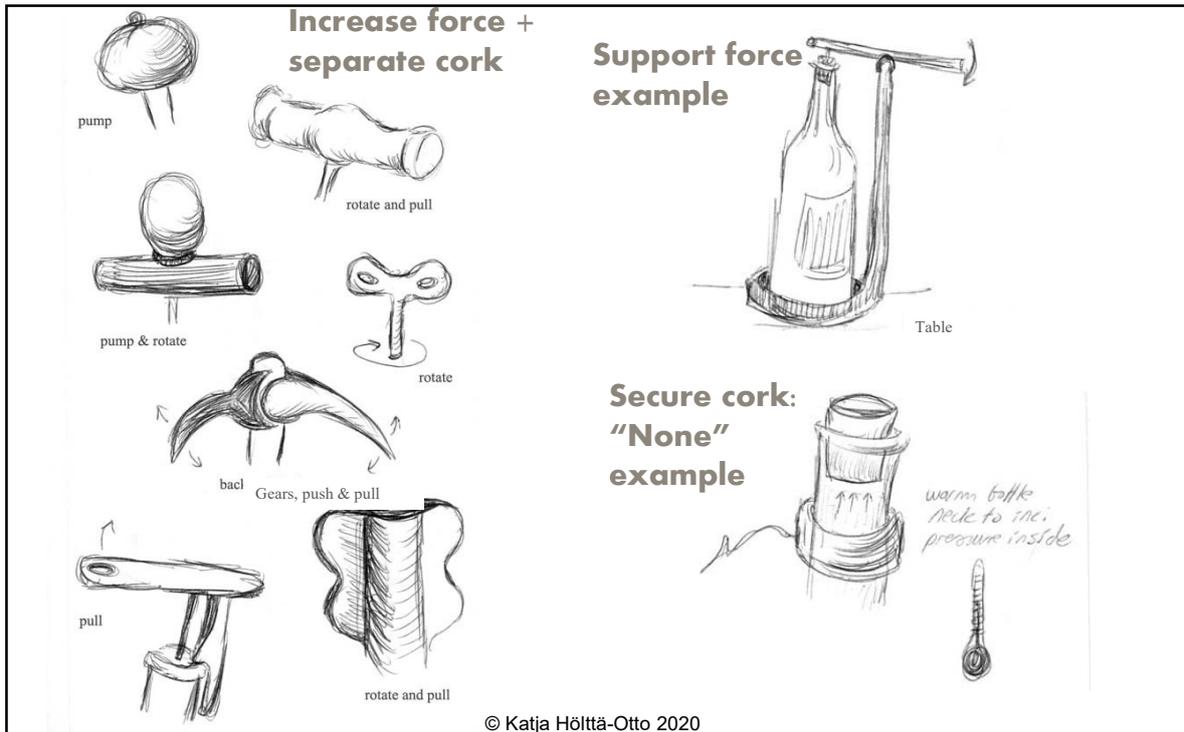


Supply Energy	Increase force	Support Force	Secure cork	Separate cork
Manual Electric Chemical	Lever Gears Rack & pinion Tackle Pneumatic Hydraulic	Bottle neck Table Other hand	Screw Suction Claws Umbrella None	Rotate Pull Push Pull & Push Pump Blast Dissolve

Note: Red arrows indicate connections between 'Manual' and 'Lever', 'Manual' and 'Gears', 'Manual' and 'Tackle', 'Electric' and 'Rack & pinion', 'Electric' and 'Tackle', 'Electric' and 'Pneumatic', 'Electric' and 'Hydraulic', 'Chemical' and 'Pneumatic', 'Chemical' and 'Hydraulic', 'Bottle neck' and 'Screw', 'Table' and 'Suction', 'Other hand' and 'Claws', 'Other hand' and 'Umbrella', 'Other hand' and 'None', 'Suction' and 'Pull', 'Claws' and 'Pull & Push', and 'None' and 'Pump'.

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Morphological analysis - Review

- **Breaks down problem to more manageable chunks**
- **Promotes abstract thinking**
 - Which allows for more creative problem solving
- **Can be even more powerful when combined with idea triggers (analogy, biomimicry, random word/object)**

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S.C.A.M.P.E.R.



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S.C.A.M.P.E.R.

- S** Substitute
- C** Combine
- A** Adapt
- M** Modify
- P** Put to other uses
- E** Eliminate
- R** Reverse



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RANDOM WORD/OBJECT/PICTURE



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Random word/object/picture



Take an item or generate a word
Let that inspire ideas

e.g. the fluffy snake is:

- soft
- green
- hairy
- long
- stuffed with something
- contradiction of scary and cute
- sheds skin
- senses with tongue
- borrowed

...



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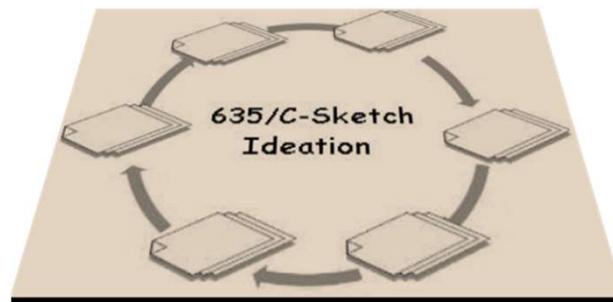
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6-3-5

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6-3-5

- 6 people – 3 ideas – 5 rounds
- Can be generalized to $n-3-(n-1)$; $n[4,7]$
- 4-3-3 when in teams of 4



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6-3-5

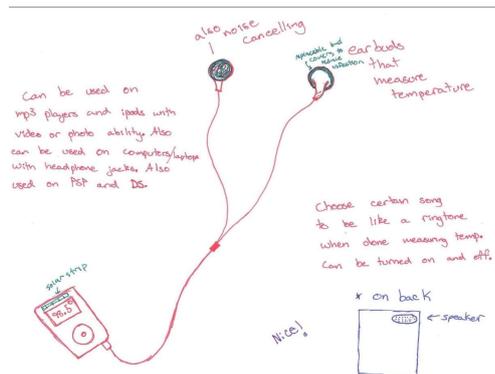
Each rotation allows adding to and combining ideas

Avoid negative comments

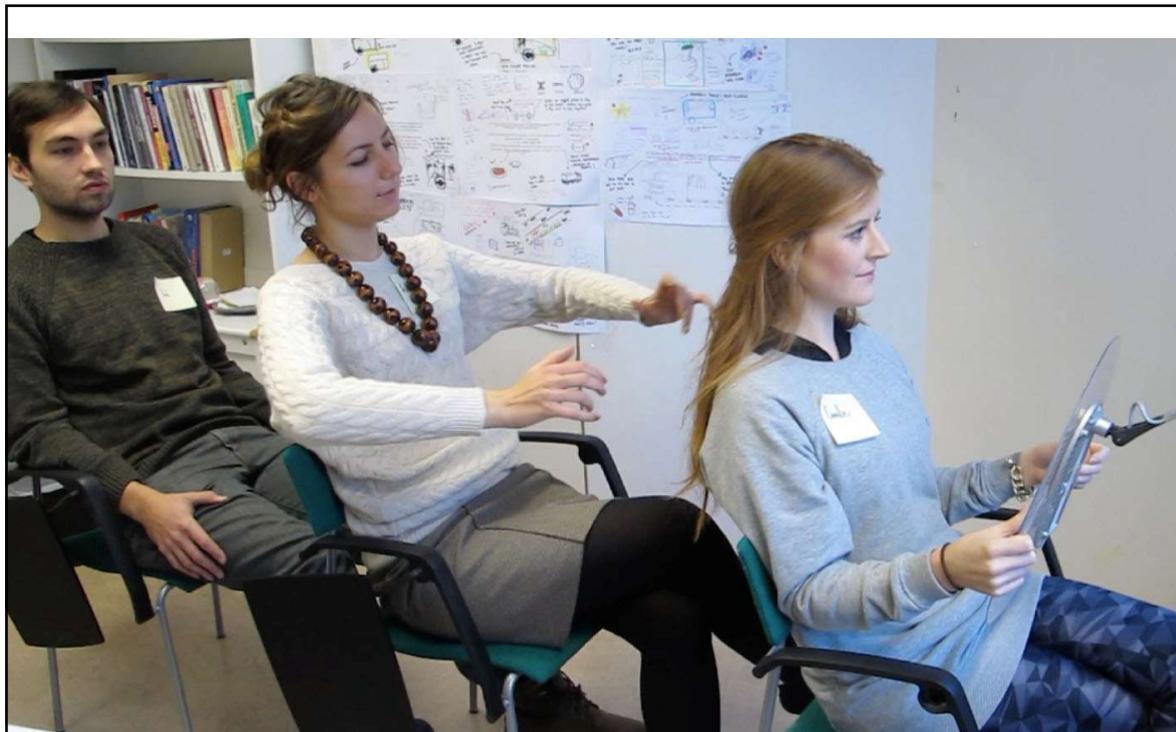
Sketches with brief keywords

No talking:

- Individual ideation AND group ideation
- Emphasizes sketching
- Reduce peer pressure



BODYSTORMING



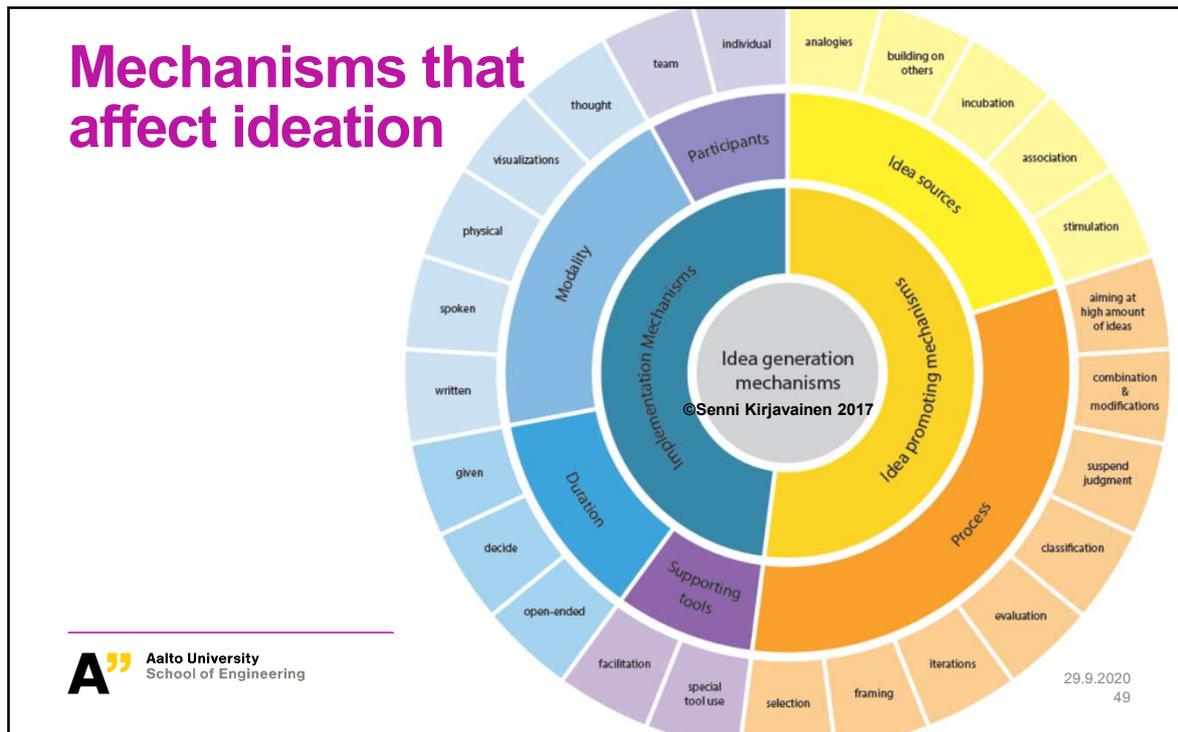
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Suite of methods

- Brainstorming
- Brainstorming w mindmapping
- Reverse Brainstorming
- Morphological analysis
- SCAMPER
- Random item/word
- 6-3-5
- Bodystorming

Select based on...
problem,
team,
preference
etc.

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Learning Objectives:

Learn concept generation methods

Creativity is like any talent – it can be taught and learned

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Winds of change

Seminar Launch

29.9.2020
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10 minute read/video

Teaching material/presentations by YOU

Groups of 4 people

- Let's post all teams in MyCourses so all can see in real time what topics are taken and which teams might need more people, etc.
- You can use the same forum to look for teammates.

Two themes:

- Additional Methods in Early Product Development
- Trends in Product Development/Design thinking

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Instructions

Prepare either a 10 minute video OR a document that take about 10 minutes to read (5-10 pages depending on your content)

Your goal is to teach your peers in the method or about the trend chosen. After the 10 minutes they should have learned what it is and how it impacts product development and be intrigued to find out more by themselves if the topic becomes relevant later in their careers.

I am looking for good immersion into the topic, use of proper references, understanding its relevance in (early) product development, and videos/reading material that teaches a new topic to a novice who is not familiar with it, yet.

Submit by sharing a link to the video, or the reading material in MyCourses by Friday 16.10. 10 am.

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Topics – Additional methods in Early PD

- Design by analogy
- Bio-inspired design
- DFE – Design for Environment
- Inclusive design
- Early low fidelity prototyping methods (earlier than 3D printing)
- Design for additive manufacturing
- Empathy map
- OR a Method of your choice (have it approved by Katja first)

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Topics – Trends in Early PD and their impact on (early) product development

- Virtual tools for Product Development
- Design for Circular economy
- Remanufacturing
- Personalized healthcare technologies
- Socially sustainable product development
- ISO 14001 standard
- OR Trend of your choice (have it approved by Katja first)

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Common pitfalls to avoid:

- Introduce area (e.g. circular economy) but **NOT** what that means for product development e.g. in terms of phases, skills, or something else
- Disjoint collection of material from many people
- Only words or images with no clear explanation of what it is
- No use of proper sources