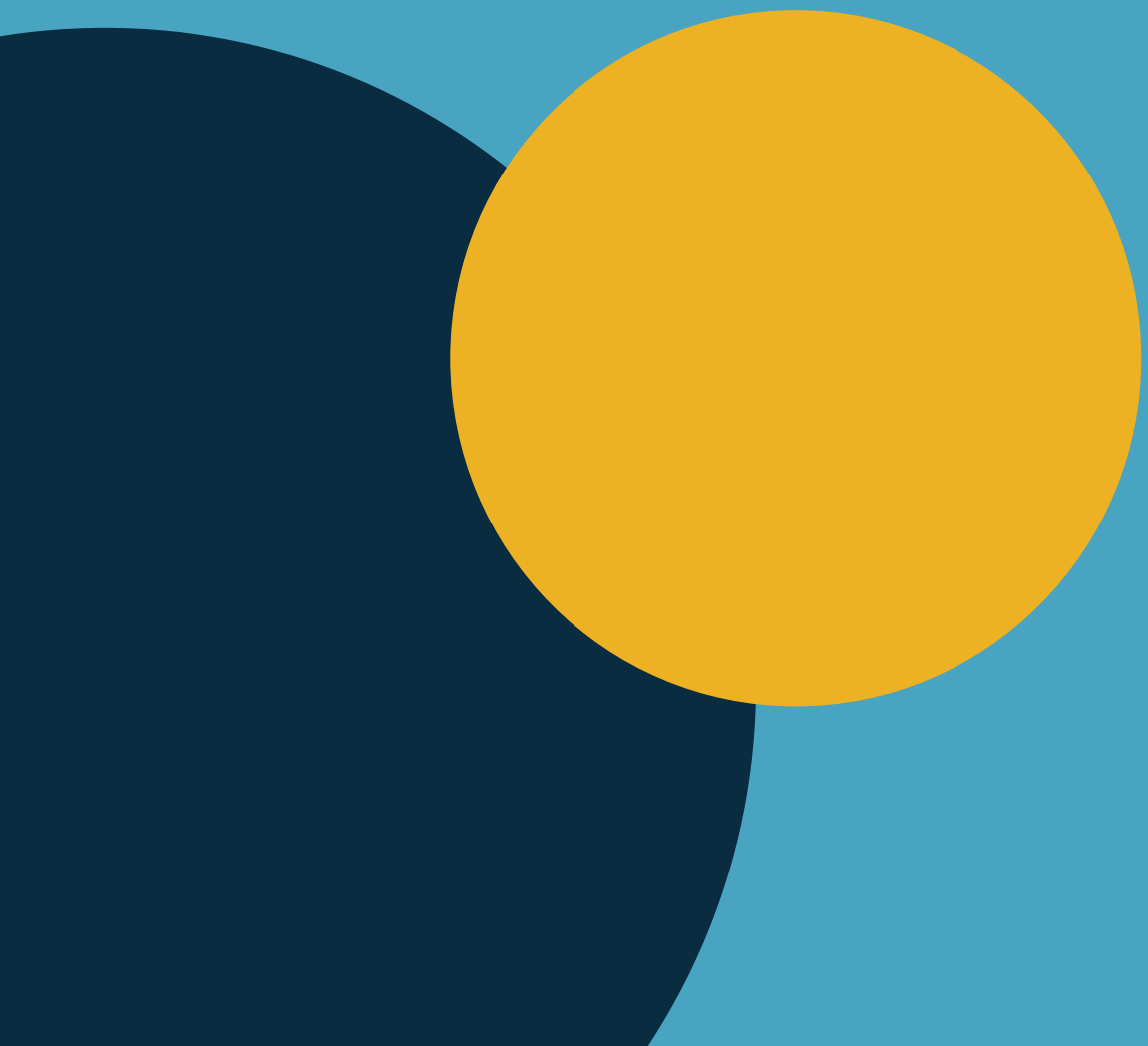
Toolkit co-design tool FRAIM & KLM Engines

Master Thesis



Introduction

This toolkit consists of the facilitator guide and the materials. The facilitator guide explains the role of the participants and the facilitator, what the exercises are and how the materials of the co-design tool should be used. The materials represent the components of the co-design tool. These materials are used during the co-design session and are needed to complete the exercises.

Table of contents

Facilitator guide

A co-design tool for KLM Engines
& FRAIM

Dear facilitator,

The technology of robots is improving rapidly and becomes more accessible in many industries. More and more organisations, including KLM Engines feel the need to optimise their work process, by automating parts of it using robots. Nevertheless, humans are still needed. Unfortunately, with the implementation of robots they are often forgotten. That's why FRAIM focusses on researching how robots can be implemented to optimise the work process, while also providing employees with meaningful work.

In this project, research have been carried out to find out what it means for KLM Engines to 'optimise' their work process and what makes work meaningful according to KLM Engines' employees. It then became clear, all knowledge is there. However, this knowledge is divided among different stakeholders. Thus, there is a need for these stakeholders to share knowledge and skills in order to explore and evaluate the different scenarios of robotising their work process. That's why this tool is designed. It can be used by KLM Engines and FRAIM to explore and evaluate the possibilities of robotising KLM Engines' work process. The focus of this tool is on the work process of the inspection department and only includes the activities of this process.

This facilitator guide is made to help you as a facilitator, to guide the project team through the co-design session, using the co-design tool. It explains all steps of the co-design process and how the exercises should be carried out.

Make sure to read this guide carefully, before the co-design session starts.

Have fun and good luck!

Tosca Horstink

Tips for the facilitator

Prepare well. You will guide the project team through the co-design tool. Thus, it is important that you know how the tool works.

Let the discussion be. The co-design tool is designed to provoke discussion. Don't be afraid to let the discussion be there.

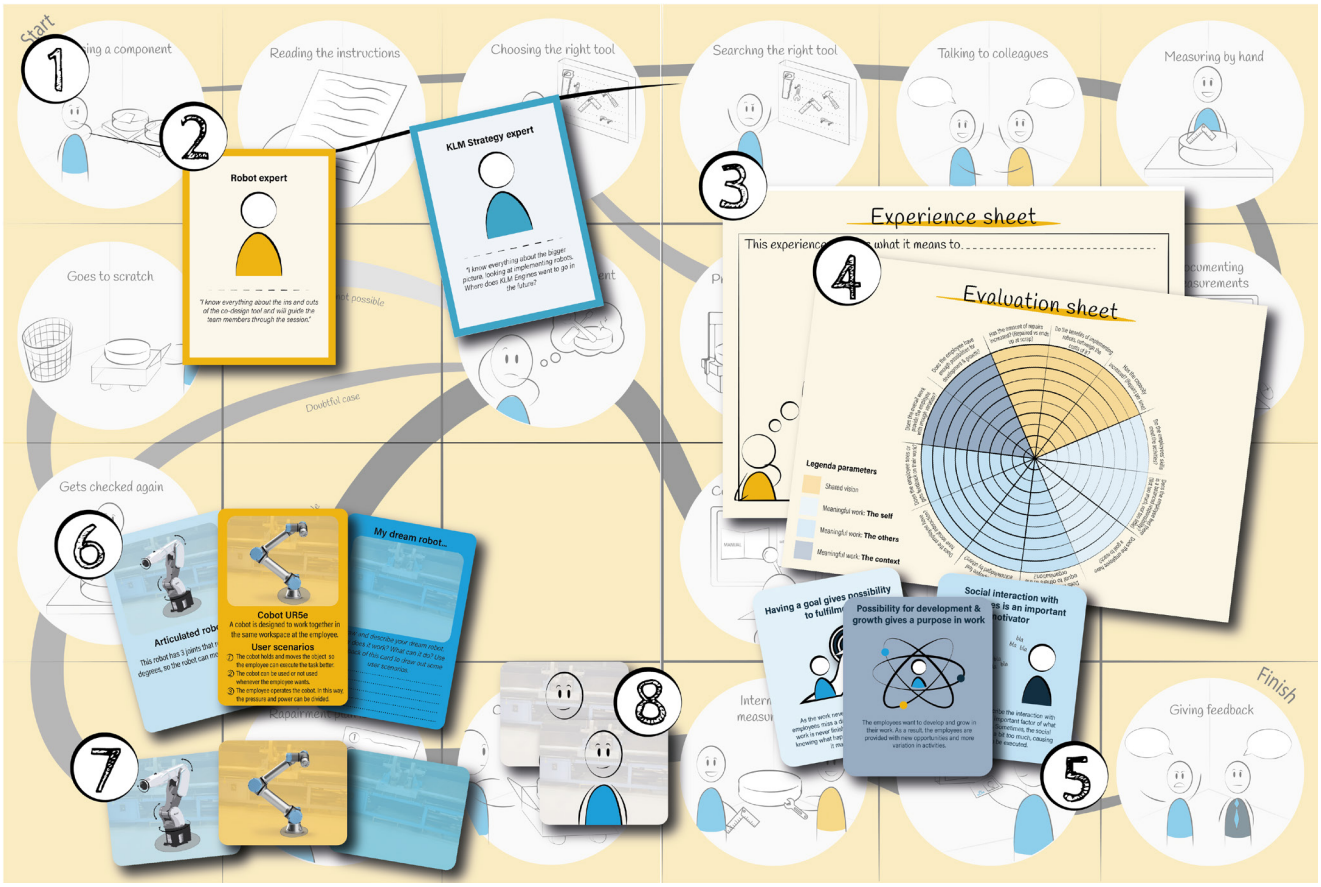
Be flexible. Although, the co-design tool is designed to use in a particular way, it might not be used in this way during the session. This is fine. Just try to go with the changes.

Include all team members. You might notice some team members talk easier than others. Try to motivate all team members to be involved during the co-design session.

Plan breaks. Try to plan sense the group energy and plan breaks if needed.

Index

Components

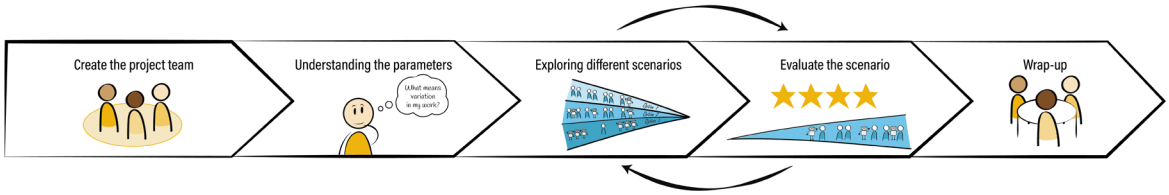


The tool consists of the following components:

1. Game board that visualises the work process of KLM Engines inspection The game board consists of activity blocks which can be added or removed from the board (A1 in total).
2. Team member cards and a string, to create a project team line..
3. Experience sheets (A3).
4. Evaluation sheets, to evaluate the created scenarios (A4 sheets).
5. Meaningful work evaluation cards, which explain and visualise the 9 themes of meaningful work.
6. Large robot cards on which different kind of robots are explained
   a. Light blue cards with the industrial robots currently used most.
   b. Yellow cards with cobots used at Robohouse.
   c. Empty blue cards, which can be used to draw and describe your dream robot.
7. Small robot cards which correspond with large robot cards and can be moved around the work process sheet.
8. Small worker cards which can be moved around the work process.

Next to this, a marker and pen are attached. Besides, the project team needs 1 mobile phone to take pictures and set timers.

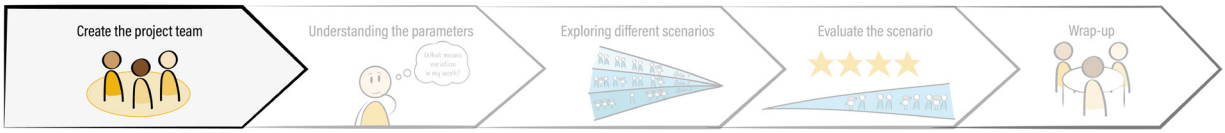
The co-design process



This co-design tool helps the project team to go through the 5 steps of the co-design process. At the end of the co-design session, the project team has explored and evaluated the different scenarios of implementing the work process of KLM Engines. Each step consists of several exercises, which are explained in this guide.

The co-design session

Create the project team



Before the co-design tool can be used, the project team has to be created. As KLM Engines and FRAIM know best who has the needed knowledge and skills, this will be done together. To help you, the team roles have already been decided. The different team members are described in the table below.

Team member:	Expertise:	From:
1. **Facilitator**	Expertise in the co-design tool. This team member knows how to use the co-design and can guide the other team members through the co-design session.	FRAIM
2. **Robot expert**	Expertise in robots and cobots. This team member knows the possibilities and limitations of the different kind of robots.	FRAIM/ Robohouse
3. **KLM Engines work process expert**	Expertise on the work process of KLM Engines. This team member knows everything about the strength and weaknesses of the activities and actions of the work process of KLM Engines and can thus imagine what the consequences of robotising the work process has on the activities itself.	KLM
4. **Employee KLM Engines inspection department**	Expertise on what the employees of KLM Engines feel, think and need. This team member is an employee and thus can imagine what the consequences of robotising the work process on the meaningfulness of work are. This team member can also provide the team with detailed information on the activities.	KLM
5. **KLM Strategy expert**	Expertise on the strategy of KLM. This team member knows everything about the bigger picture, looking at implementing robots. Where does KLM want to go in the future?	KLM
6. **Brightsky expert**	Expertise on the who is involved in the Brightsky project. This team member knows, which stakeholders need to be taken into account with the implementation of robots.	KLM/ FRAIM

1. Create the project team

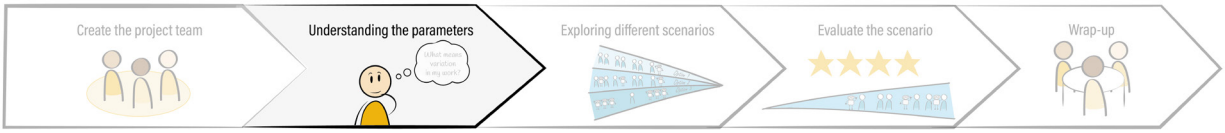
Decide, together with KLM Engines, who can represent the needed expertise and thus can join the project team. During the session, write down the names on the team member cards and hang them up with the attached line.

Note: some team members could represent several team roles. For example: the facilitator could also take the rol of robot expert.

2. Explore the co-design tool

During the session, lay down all the components of the co-design tool and discuss them shortly (see chapter 'components' for explanation.) Make sure, the game board is build up correctly with the different activity blocks.

Understanding the evaluation criteria



The second step of the co-design process is to get familiar with the evaluation criteria. The evaluation criteria are a result from the research done at KLM Engines. The criteria are representing the shared future vision of KLM Engines and the themes of meaningful work. As these themes have a different meaning for everyone, it is important to get an understanding of them before using them.

3. Getting familiar with the evaluation criteria

Let each team member take one experience sheets. At the top of the experience sheet you can read one of the following statements, which corresponds to the themes of meaningful work.

This experience explains what it means to...

1. ...execute work activities that meet my skills.
2. ...have balanced responsiblity.
3. ...have a goal to reach.
4. ...get feedback on my work.
5. ...feel part of the company.
6. ...have social interaction.
7. ...feel acknowledged.
8. ...have variation in my work.
9. ...have opportunities for development & growth

Think of an experience in your work that explains the meaning of these criteria. Set a timer for 1 minute and draw/describe this experiences on the experience sheets. Do 9 rounds of this exercise, so everyone covers each critiera once. The same experience sheet can be used. Afterwards, set a timer for 10 minutes and discuss the sheets.

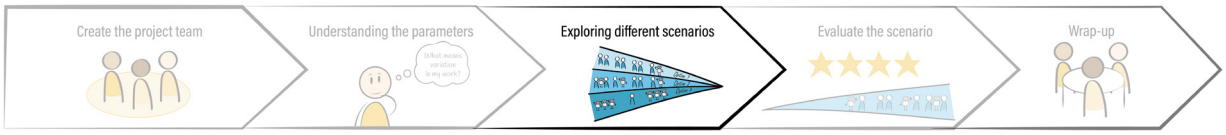
4. Evaluating the current scenario

Take the evaluation sheet which says 'current scenario'. The twelve evaluation criteria are placed on a circle diagram. The circle consists of ten levels going from low (the middle of the circle) to high (the border of the circle).

Set a timer for 10 minutes.

Discuss with the team how the current work process could be rated on the different evaluation criteria, going from high to low. Place dots for each criteria and connect the dots, so a diagram occurs (see 'Examples' to see how to do this correctly). The meaningful evaluation cards illustrate and explain the evaluation criteria from the employees point of view.

Create the scenario



5. Creating the first scenario

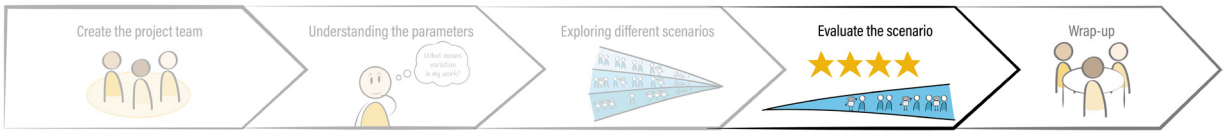
The game board visualises all activities of KLM Engines inspections' work process. The lines represent the order in which the activities are executed. The activities are The 14 large robots cards illustrate and explain the possibilities of robots. The small robot cards corresponds to the bigger ones and can be used to move around the work process sheet. Besides, the tool includes small worker cards, which can also be moved around the work process sheet.

Scenario 1: If money doesn't play a role, how would you implement robots?

Set a timer for 20 minutes. Discuss with the team where in the work process you would implement robots and what they would do if money didn't play a role. Place the small robot cards and discuss the team what the consequences are on the work process. Remove or add activities. If a new activity occurs, draw this on an empty activity block and add it to the work process.

Make a picture of the created scenario with your smartphone.

Evaluate the scenario



6. Evaluate the first scenario

Use the evaluation sheet to evaluate the created scenario. Do this in the same way as with the evaluation of the current scenario.

7. Exploring scenarios

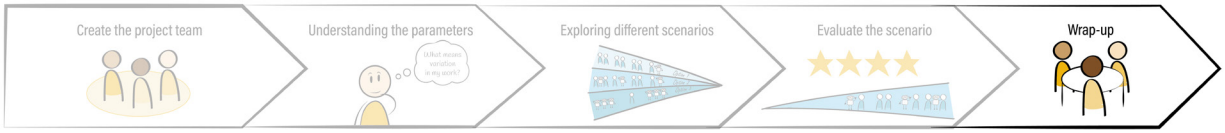
On the evaluation sheet a clear overview of the effect of the scenario on the evaluation criteria has occured. You may see, the meaningful work part has scored low, while the shared vision part has scored high. However, this is just one of the possible scenarios.
Time to create more! Set a timer for 120 minutes.

To get started you can give the project team an assignment. To help you, some examnples are given below.

1. Give the team a "what if..." assignment. For example, what if you would only focus on meaningful work.
2. Split the projec team up in two smaller groups. Let one team focus on meaningful work and let the other team focus on reaching the shared vision. Afterwards, come back together and dicuss the outcomes.

After a scenario is created, take a picture and fill in the evaluation sheet.

Wrap-up



8. Wrapping-up the co-design session

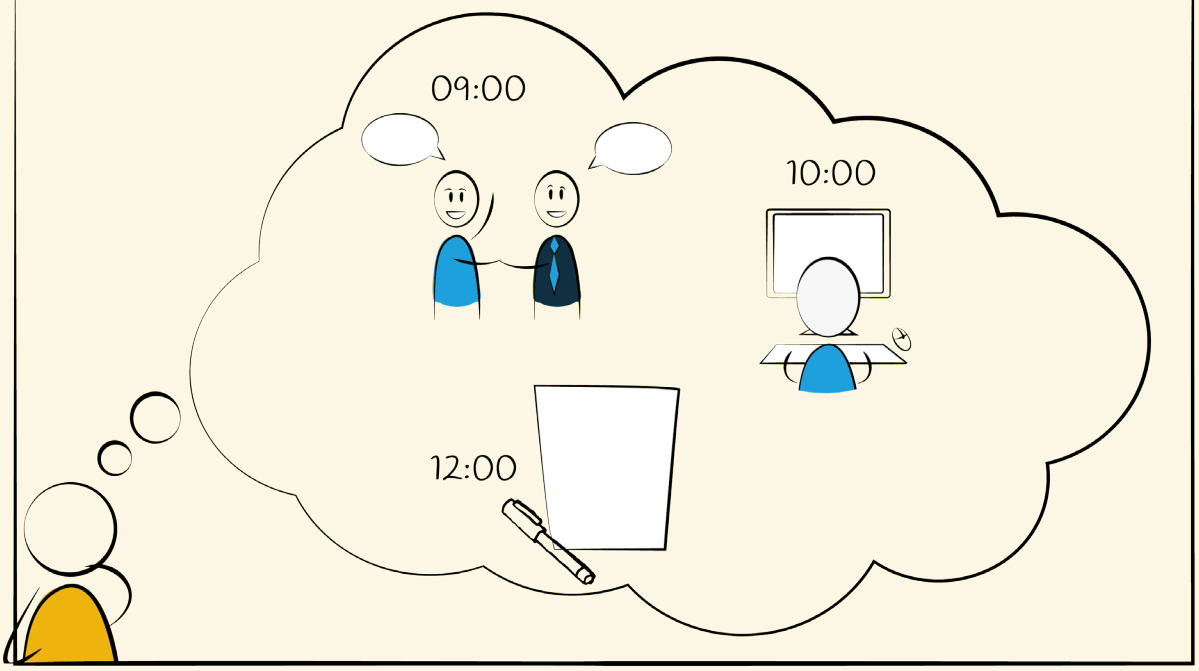
Time to wrap-up. Let each team member share one key-take away of the co-design session and how they will use this for next steps. Discuss together what should be the next step after leaving this meeting room. Don't take longer than 15 minutes for this.

Examples

1

Experience sheet

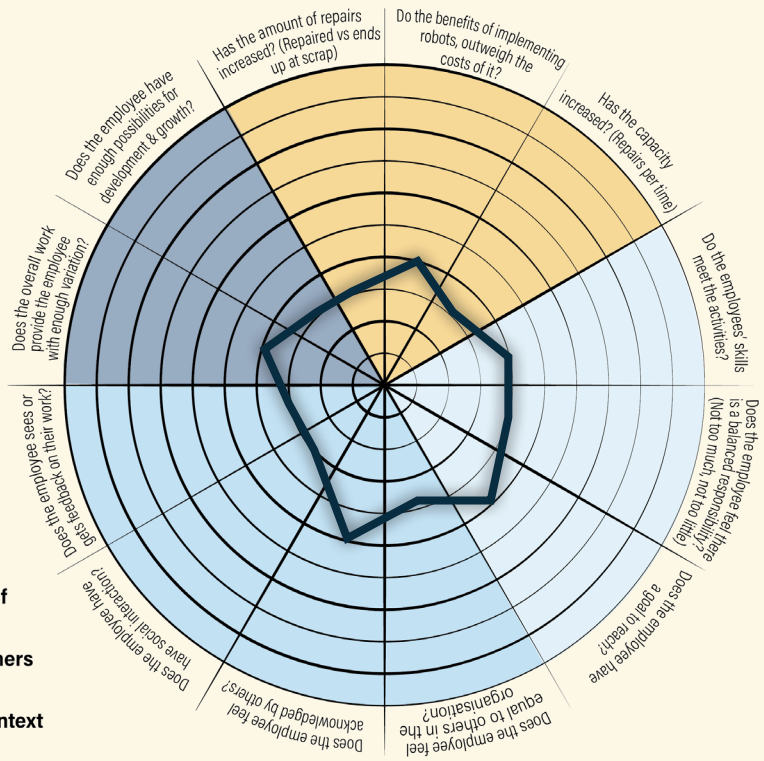
This experience explains what it means to. *have variation in work*



2

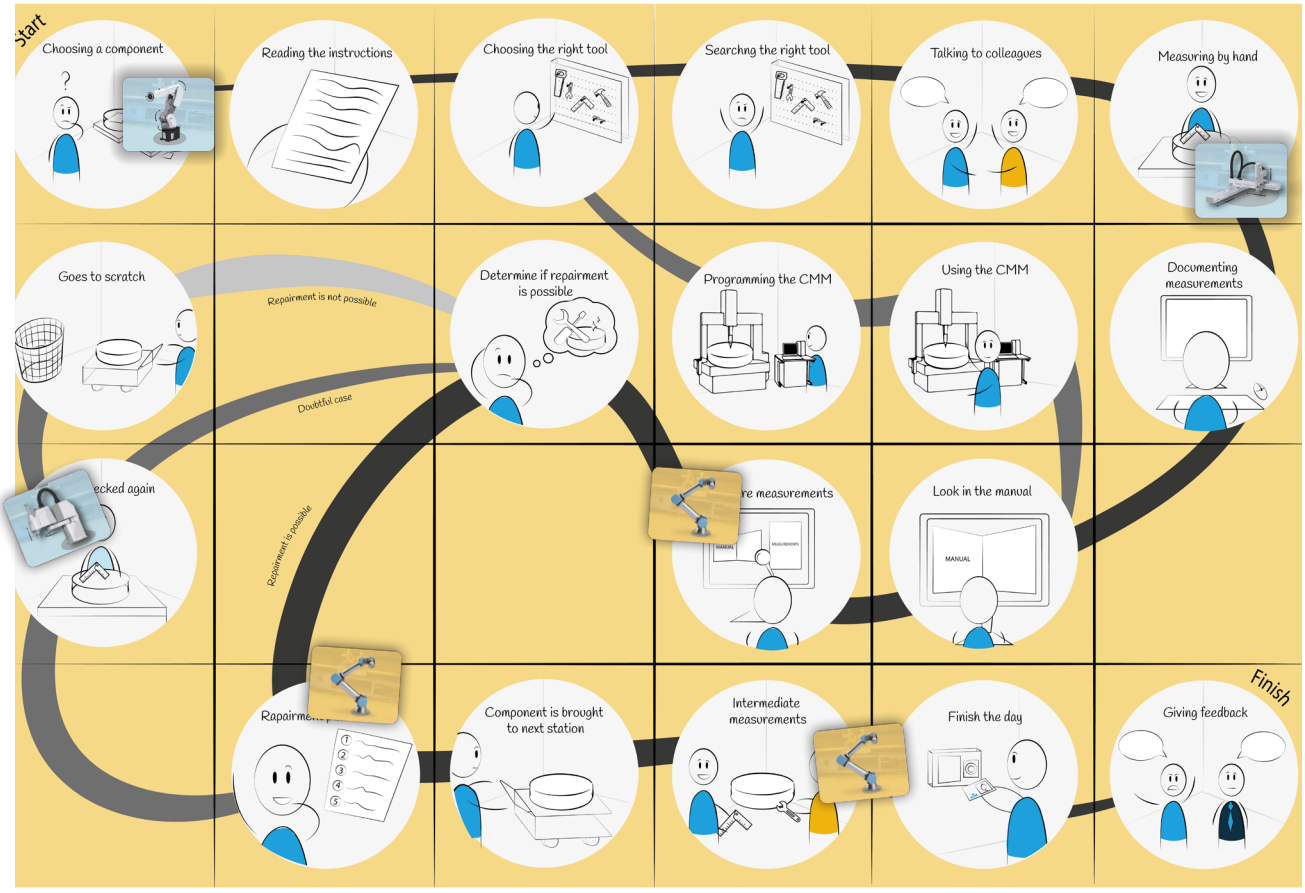
Evaluation sheet

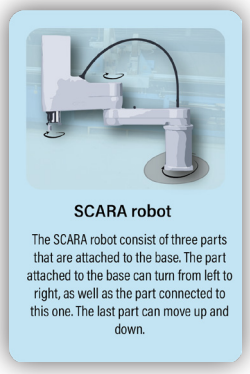
Current scenario



Legenda parameters

- Shared vision
- Meaningful work: **The self**
- Meaningful work: **The others**
- Meaningful work: **The context**





SCARA robot

The SCARA robot consist of three parts that are attached to the base. The part attached to the base can turn from left to right, as well as the part connected to this one. The last part can move up and down.

Used for...
- Sorting products
- Packaging
- Low-force assembly tasks
- Pick and place

Pros
- Very fast
- Large workspace
- Advanced software makes them very accurate and efficient

Cons
- Can only handle very light payloads.
- Wear and tear of parts by high movements.
- Expensive

Cobot KUKA

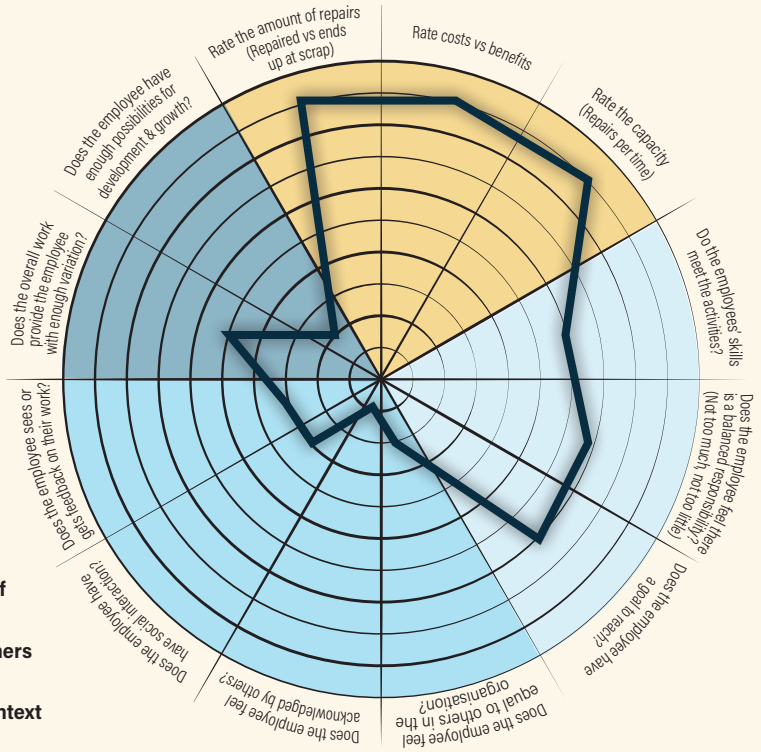
A cobot is designed to work together in the same workspace at the employee.

User scenarios

1. The employee can move the object around, by operating the cobot.
2. The cobot and employee can both work on the object at the same time.
3. The cobot can be handle many different tools, for example a grinding machine.

Scenario 1

Evaluation sheet



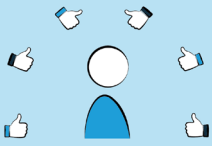
Legenda parameters

- Shared vision
- Meaningful work: **The self**
- Meaningful work: **The others**
- Meaningful work: **The context**

Having a goal gives possibility to fulfilment

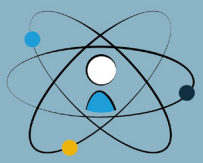
As the work never comes to an end, the employees miss a daily goal to reach. They feel work is never finished. Next to that, they miss knowing what happens to the component. Did it make the aircraft?

Acknowledgement is an important motivator



The employees are very proud of their work. They want others to acknowledge the importance of their work and the skills, knowledge and experience they have.

Possibility for development & growth gives a purpose in work



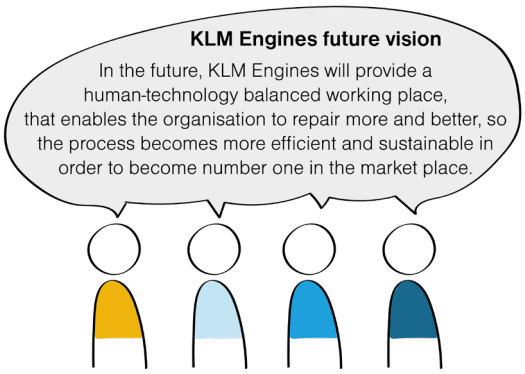
The employees want to develop and grow in their work. As a result, the employees are provided with new opportunities and more variation in activities.

The evaluation criteria

The evaluation criteria used for the evaluation sheet are a result of the research done with different employees of KLM Engines. The research consists of two parts. The identification of the stakeholders intentions, which has resulted in a shared vision and the identification of themes that play a role in the meaningfulness of work of the employees' of KLM Engines. The criteria of meaningful work are explained on the meaningful work evaluation cards. The shared vision criteria are explained below.

Shared vision

The shared vision created by different stakeholders within KLM Engines has been illustrated in the following illustration.



Three important factors in this vision are: a more efficient work process, a more sustainable work process and creating a human-technology balanced working place. These factors are written in two three evaluation criteria.

Has the amount of repairs increased? (Repaired vs end up at scrap)

If more components can be repaired, less new components have to be ordered. In this way, a circulair process becomes more achieveable. Next, less time gets waisted, waiting for the components to arrive. An other result of ordering less new components is the costs decreasing.

Do the benefits of implementing robots outweigh the cost of it?

If the amount of components treated in the same time increases, the total profit increases. This can be realised by decreasing the executing time.

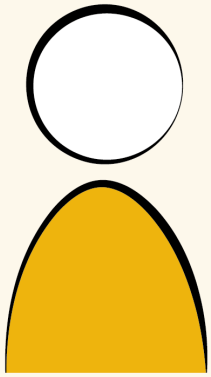
Has the capacity increased? (Repairs per time)

Implementing new technologies seem like a good solution to make the process more sustainable and more efficient. However, new technolgoies bring higher costs. That's why the the profit provided by the technology has to balance out the costs.

The Materials

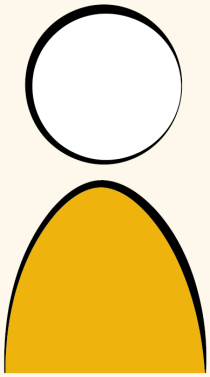
Create the project team

The facilitator



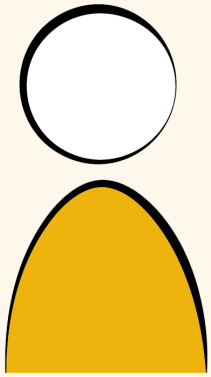
"I know everything about the ins and outs of the co-design tool and will guide the team members through the session."

Robot expert



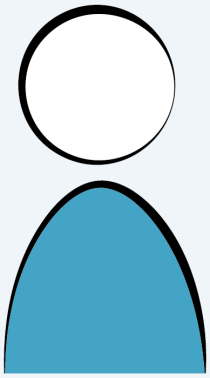
"I know everything about the possibilities and limitations of the different kind of robots."

Brightsky expert



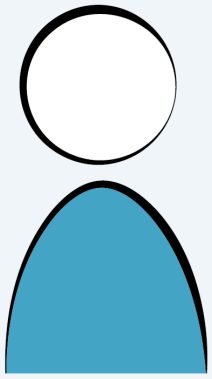
"I know everything about the Brightsky project. I know which stakeholders we should take into account with the robotisation of our work process."

KLM Engines work process expert



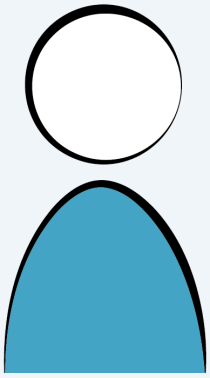
"I know everything about the activities and actions of the work process of KLM Engines and can thus imagine what the consequences of robotising the work process has on the activities itself.."

Brightsky expert



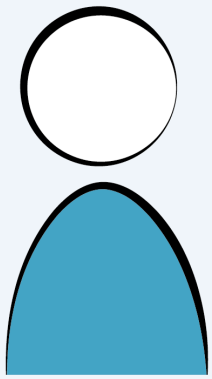
"I know everything about the Brightsky project. I know which stakeholders we should take into account with the robotisation of our work process."

KLM Strategy expert



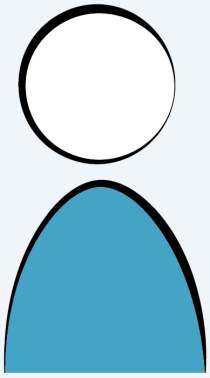
"I know everything about the bigger picture, looking at implementing robots. Where does KLM Engines want to go in the future?

KLM Engines inspection employee



"I am an employee at the inspection department off KLM Engines and can imagine the consequences of robotising the work process on the meaningfulness of my work.."

KLM Engines work process expert

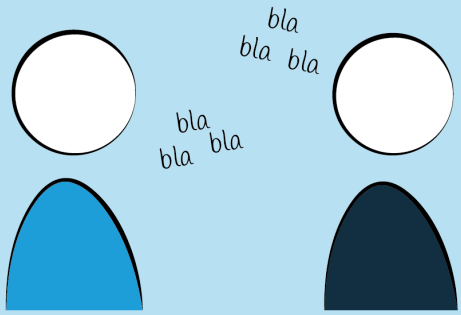


"I know everything about the activities and actions of the work process of KLM Engines and can thus imagine what the consequences of robotising the work process has on the activities itself.."

Scale (1:1,19)

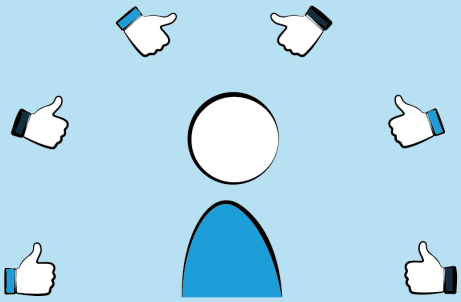
Meaningful work themes cards

Social interaction with colleagues is an important motivator



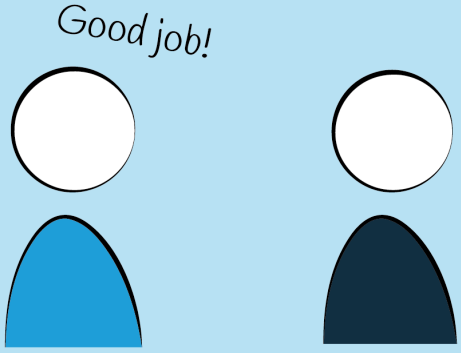
The employees describe the interaction with colleagues as a very important factor of what makes their job fun. Sometimes, the social interaction becomes a bit too much, causing less work to be executed.

Acknowledgement is an important motivator



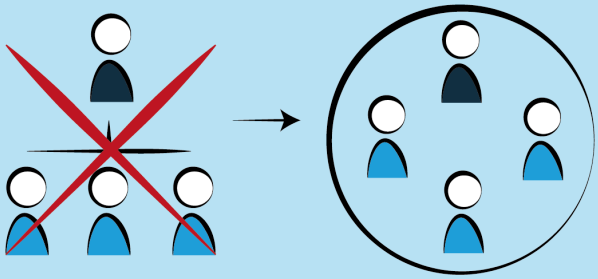
The employees are very proud of their work. They want others to acknowledge the importance of their work and the skills, knowledge and experience they have.

Feedback is an important motivator to keep acting



The employees miss feedback from colleagues and management. In this way, the employees feel they can not improve their work. Next to that the employees feel they are not involved in the company, as they don't get any response on their given feedback about the work process.

Being treated equally is desired

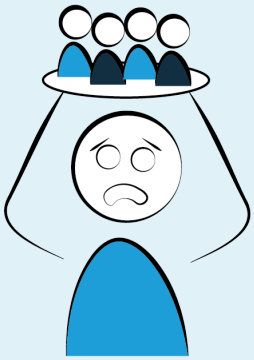


The employees want to be treated equally to colleagues. There is a strong feeling of "if they can, we can as well", for example, with colleagues leaving early.

Having a goal gives possibility to fulfilment

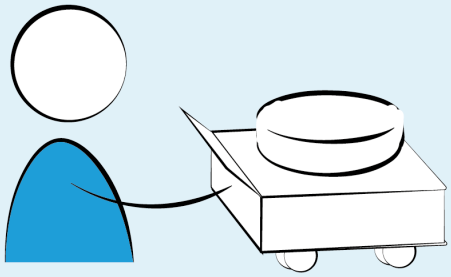
As the work never comes to an end, the employees miss a daily goal to reach. They feel work is never finished. Next to that, they miss knowing what happens to the component. Did it make the aircraft?

Too much responsibility leads to anxiety



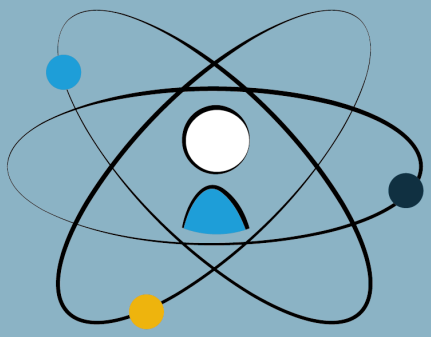
The employees don't want to take full responsibility of the work done. Although, KLM wants to provide a safe work space, most employees are afraid to admit mistakes.

Feeling undervalued when executing activities that don't meet the skills



The employees want to execute activities that meet their skills. The activities should not be too challenging, nor be too simple. If the activity is too easy, the employees feel they can do better.

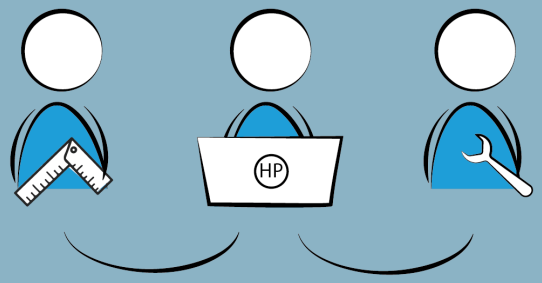
Possibility for development & growth gives a purpose in work



The employees want to develop and grow in their work. As a result, the employees are provided with new opportunities and more variation in activities.

Scale (1:1,1)

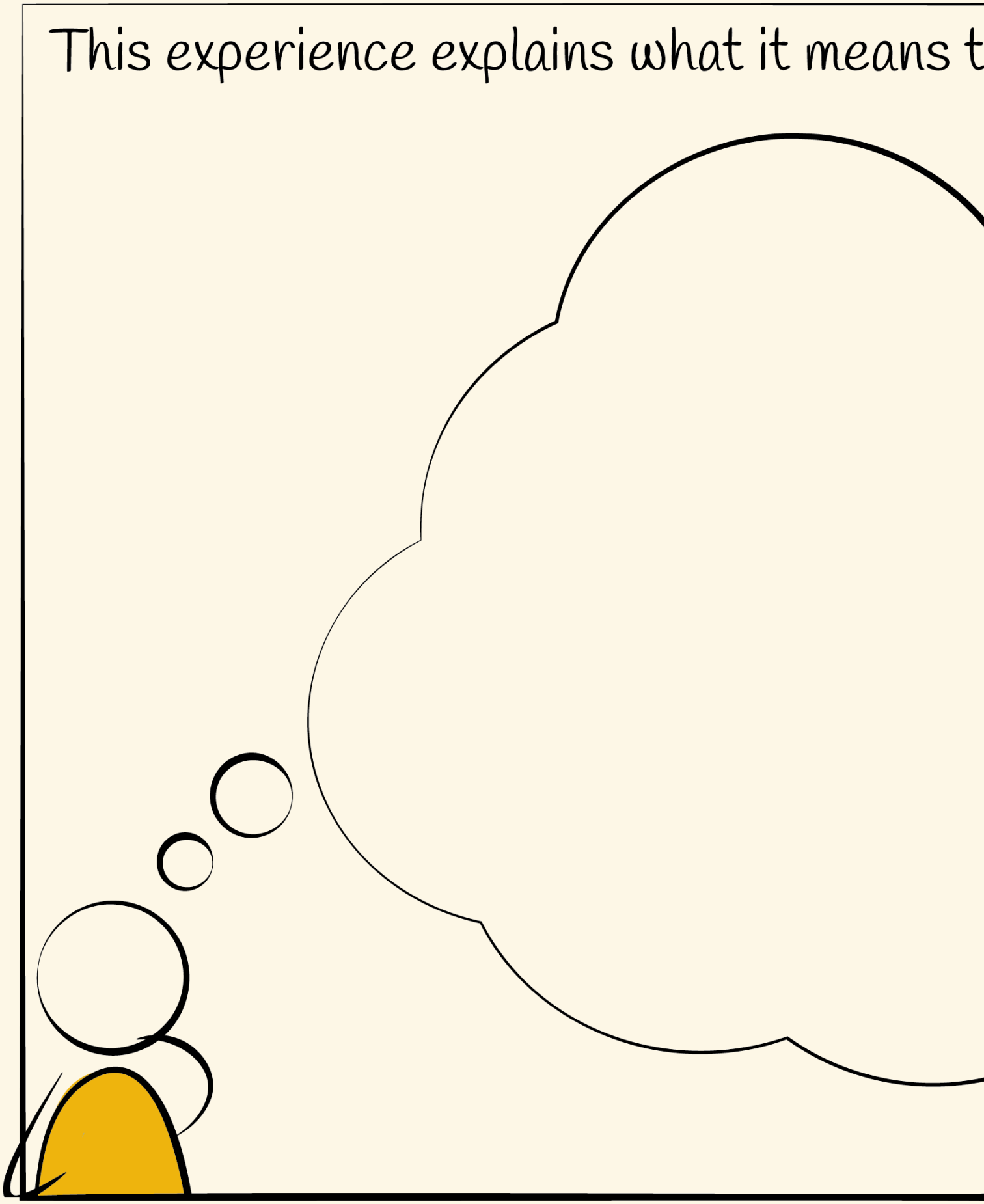
Variation in work makes work meaningful



The employees find the variation and unpredictability of their work an important motivator. They like not knowing how the day will look like. Besides, they like that each component needs a different treatment. Not one day is the same.

Experien

This experience explains what it means t



ce sheet

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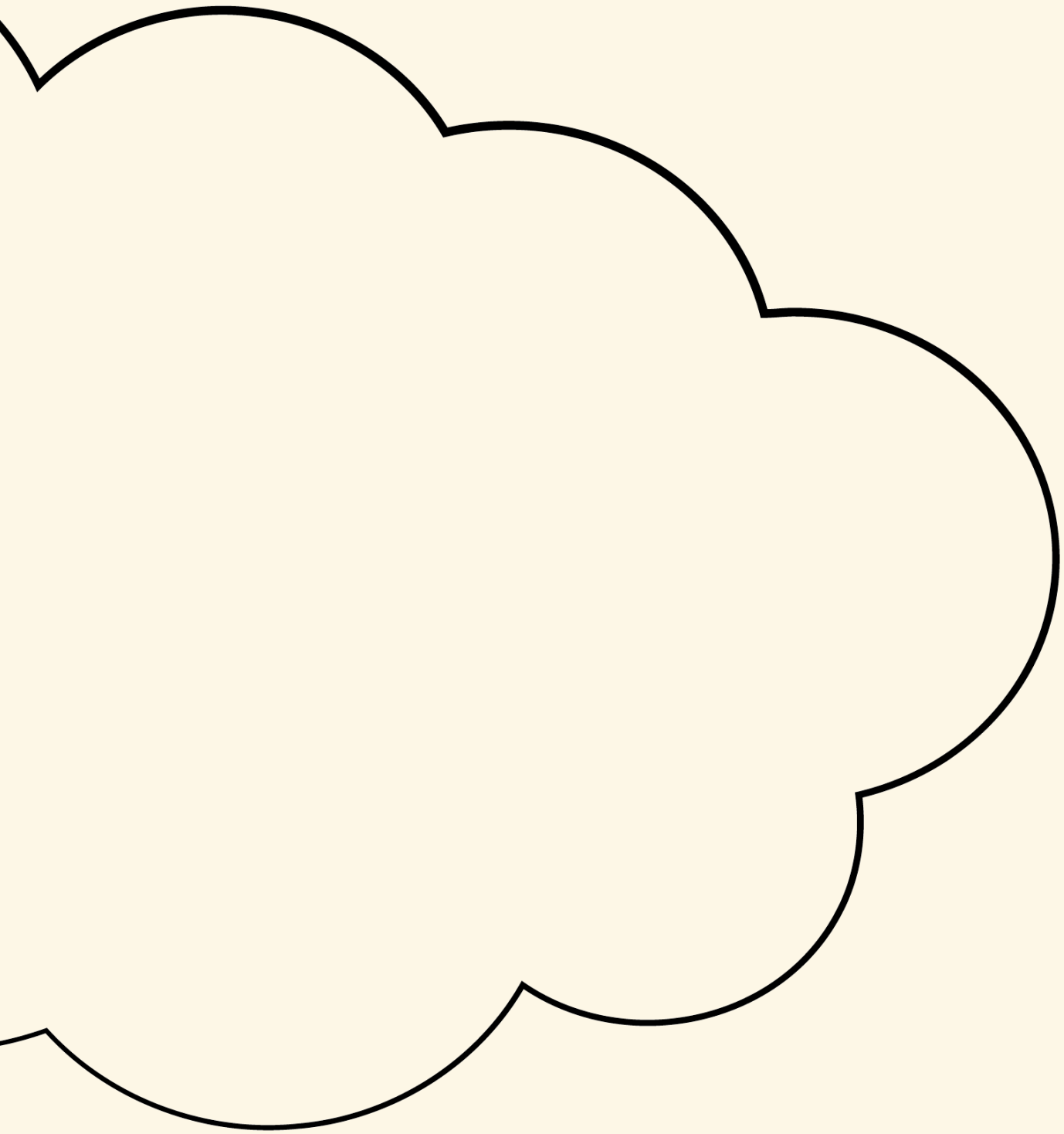
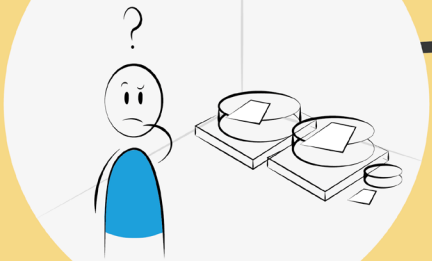


Game

Start

Choosing a component



Reading the instructions

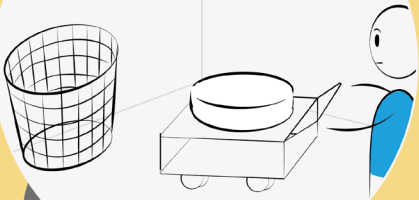
Choosing the right tool

Determine if repairment is possible

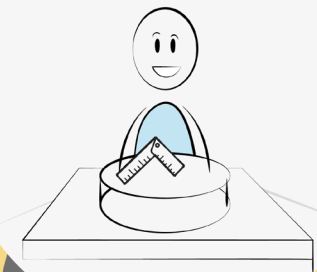
Repair is not possible

Doubtful case

Goes to scrap

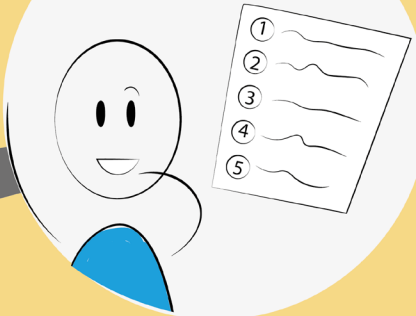


Gets checked again

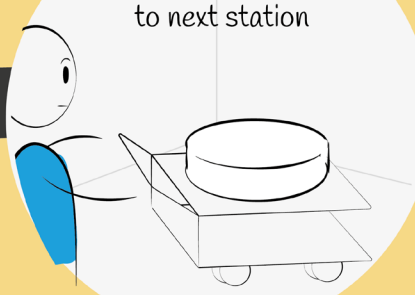


Repair is possible

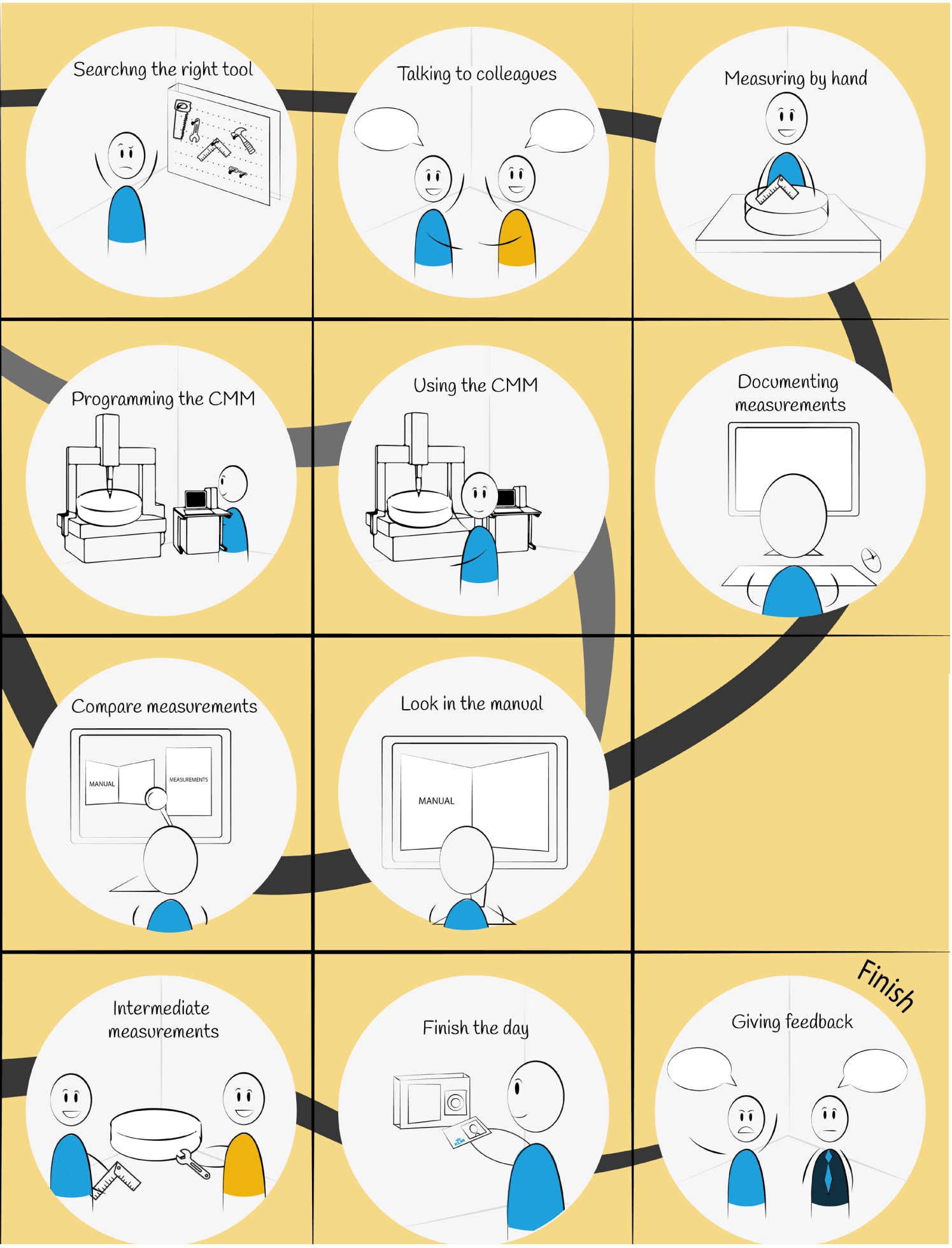
Rapair plan is made



Component is brought to next station



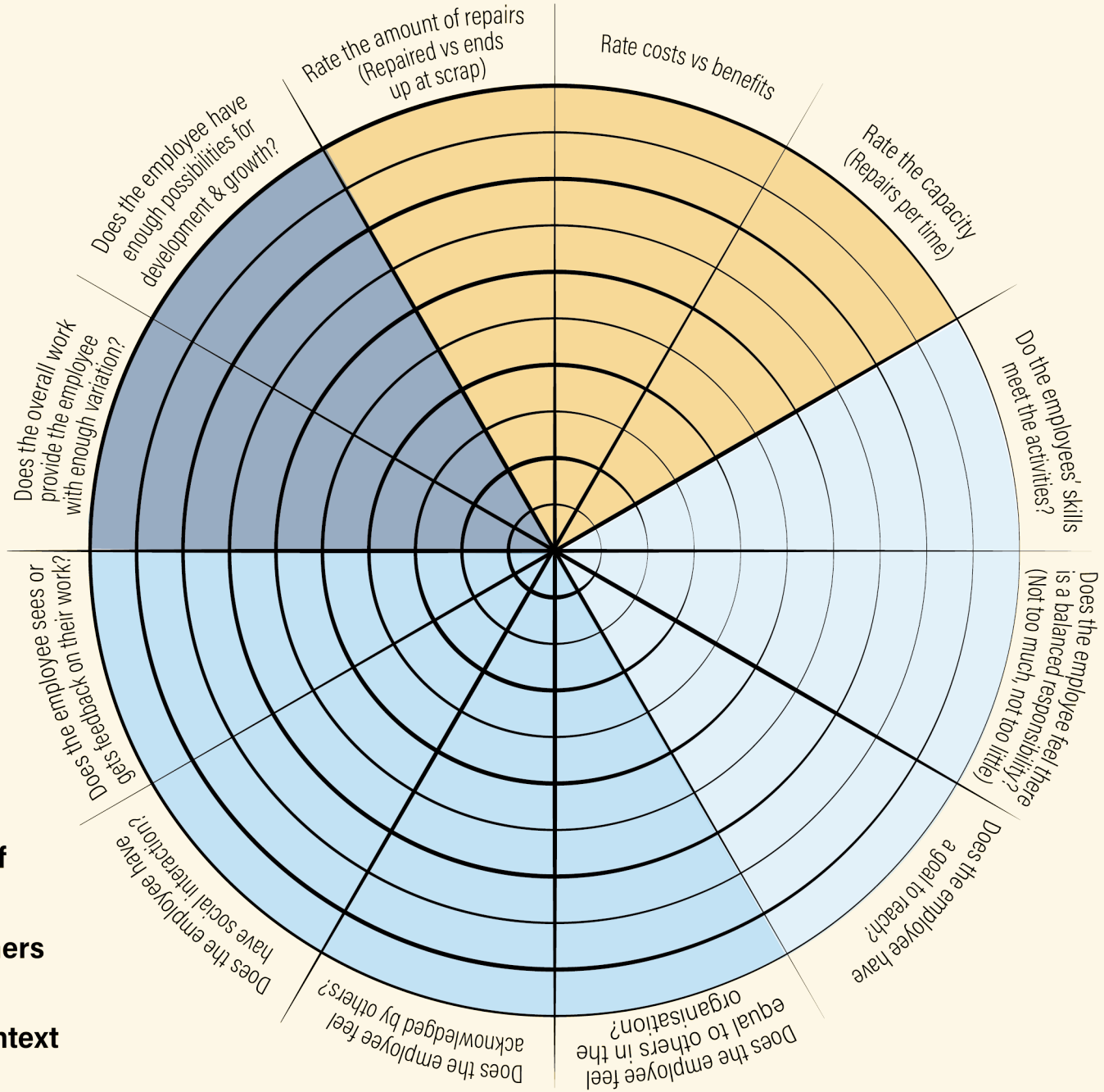
board



Scale (1:2)

Scale (1:1)

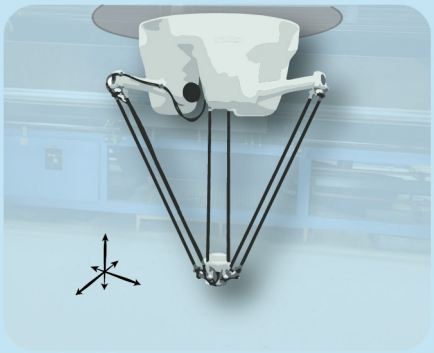
Evaluation sheet



Legenda parameters

- Shared vision
- Meaningful work: **The self**
- Meaningful work: **The others**
- Meaningful work: **The context**

Large robot cards



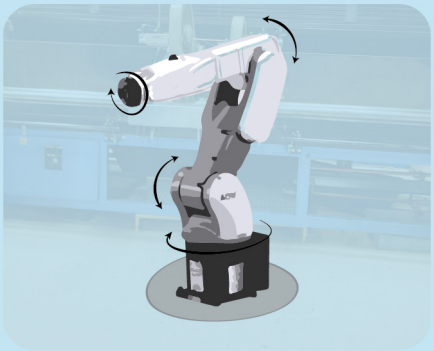
Delta robot

This robot consists of three arms attached to the base. These arms can all move back and forth. Besides, the base can move up and down.

Used for...
- Sorting products
- Packaging
- Low-force assembly tasks
- Pick and place

Pros
- Very fast
- Large workspace
- Advanced software makes them very accurate and efficient

Cons
- Can only handle very light payloads
- Wear and tear of parts by high movements
- Expensive



Articulated robot

This robot has 3 joints that rotate 360 degrees, so the robot can move in 6 axis.

Used for...
- Arc welding
- More complex assembly
- Packaging
- Foundry and forging tasks
- Steel cutting
- Material handling

Pros
- Way more flexible than other robots
- Covers a large working space
- High speed
- Large payloads

Cons
- Expensive
- Requires a controller
- Complicated to program

Polar robot

This robot has two joints that can move 360 degrees and one linear part that moves back and forth.

Used for...
- Sorting products
- Packaging
- Low-force assembly tasks
- Pick and place

Pros
- Very fast
- Large workspace
- Advanced software makes them very accurate and efficient

Cons
- Can only handle very light payloads.
- Wear and tear of parts by high movements.
- Expensive

SCARA robot

The SCARA robot consist of three parts that are attached to the base. The part attached to the base can turn from left to right, as well as the part connected to this one. The last part can move up and down.

Used for...

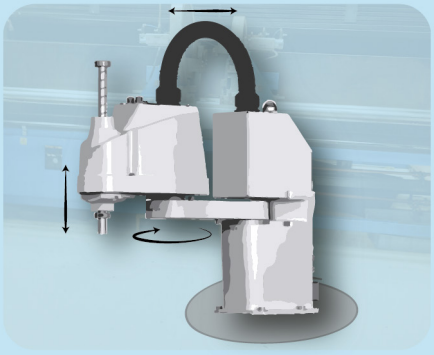
- Palletizing
- Loading
- Assembly
- Laser engraving
- Soldering

Pros

- Good accuracy
- Take large payloads
- Fast & flexible
- Don't take much space, but have a big workspace

Cons

- Can only be attached to a plane surface.
- Requires a controller



Cylindrical robot

This robot is a combination of a linear and a rotation part. In this way the arm can move up and down, back and forth and rotate around it's own axis.

Used for...

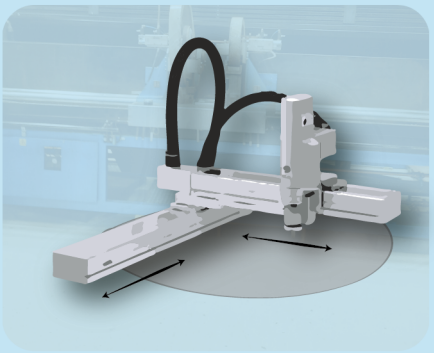
- Foundry and forging works
- Coating
- Die-casting
- Loading and unloading
- Simple assembly tasks

Pros

- Take large payloads
- Can turn 360 degrees one way
- Don't take much space

Cons

- Limited rotary motion
- Poor accuracy
- Not as versatile as other options



Cartesian robot

This robot is also called linear robot or granty robot and works on three linear axes (X,Y,Z). They move straight over these three lines. The robot is flexible as you can easily adapt the speed, precisi-on, stoke length and size.

Used for...

- Material processing (3D printing)
- Sealing tasks
- Loading and unloading
- Palletizing tasks

Pros

- Affordable
- Quite versatile
- Can be programmed online
- Good accuracy
- Take large payload

Cons

- Only one axe movement is possible
- Take up a lot of space
- Complex installation process

Scale (1:1)

Cobot FRANKA

A cobot is designed to work together in the same workspace at the employee.

User scenarios

① The cobot holds and moves the object so the employee can execute the task better.

② The cobot moves the object to the employees work space.

③ The employee operates the cobot. In this way, the pressure and power can be divided.

Cobot KUKA

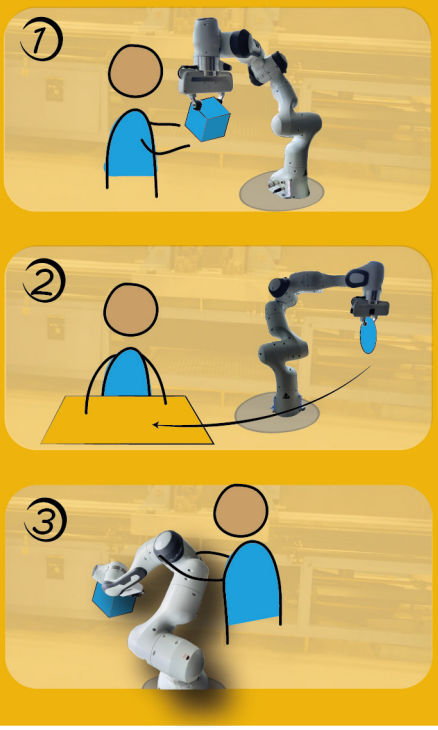
A cobot is designed to work together in the same workspace at the employee.

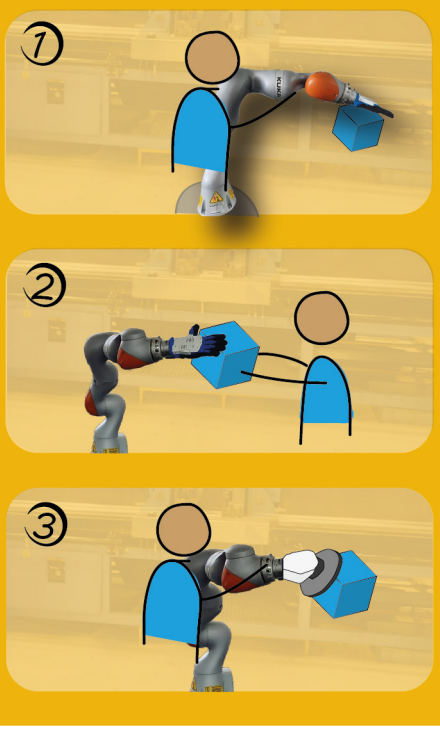
User scenarios

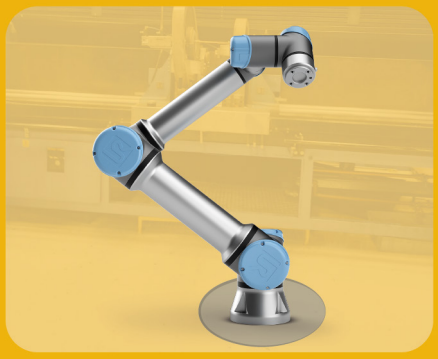
① The employee can move the object around, by operating the cobot.

② The cobot and employee can both work on the object at the same time.

③ The cobot can be handle many different tools, for example a grinding machine.







Cobot UR5e

A cobot is designed to work together in the same workspace at the employee.

User scenarios

1. The cobot holds and moves the object so the employee can execute the task better.
2. The cobot can be used or not used whenever the employee wants.
3. The employee operates the cobot. In this way, the pressure and power can be divided.

My dream robot...

Draw and describe your dream robot. How does it work? What can it do? Use the back of this card to draw out some user scenarios.

.....

.....

.....

.....

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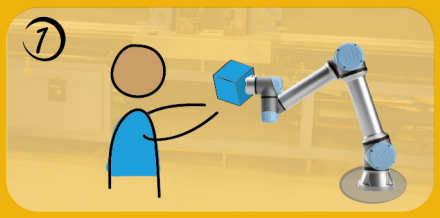
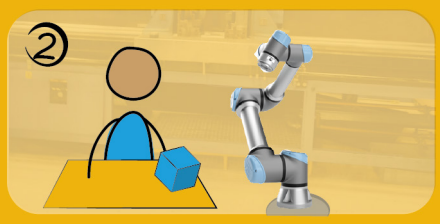
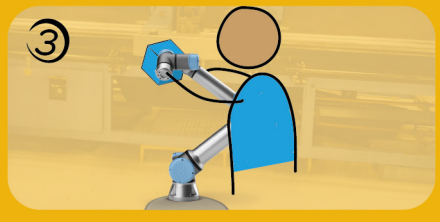




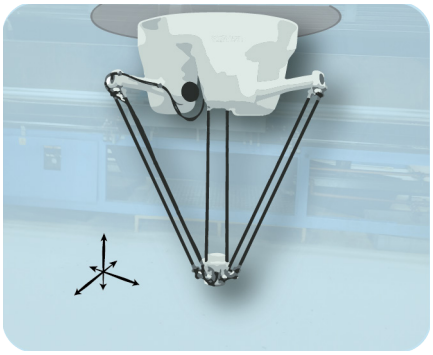


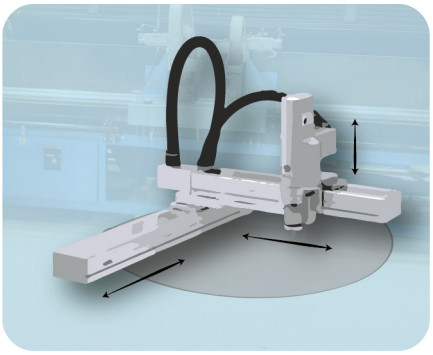
1

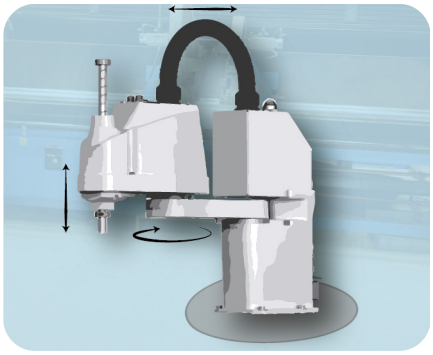
2

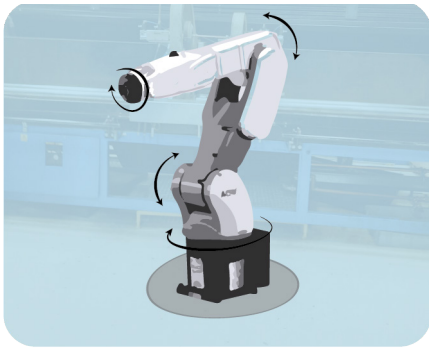
3

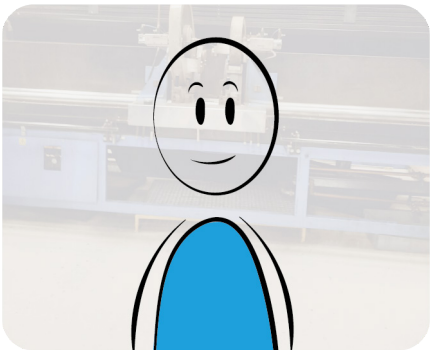
Small robot cards











Scale (1:1)