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Ultimaker

Design Roadmapping
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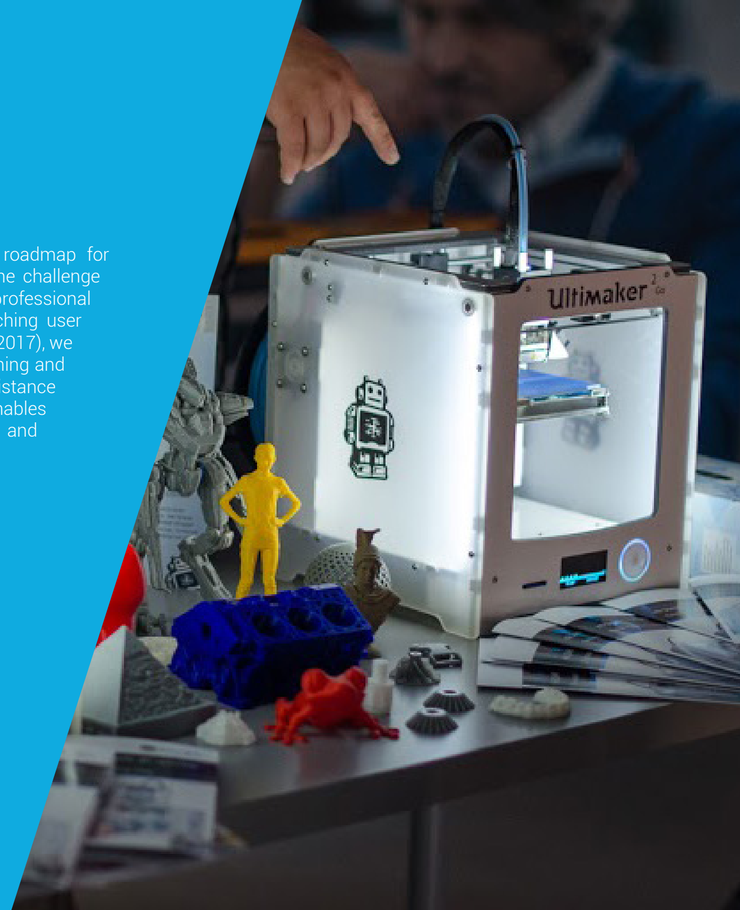
Group 24

Veerle van Engen (4974344)
Isabelle Nielen (4350359)
Stan van den Berg (4458842)
Jiahao Lu (4877136)

Abstract

This report contains a strategic and tactical service roadmap for Ultimaker, a company providing desktop 3D printers. The challenge is to overcome the knowledge barrier to 3D print in professional enterprises. Based on trend research, visioning, researching user values, scouting technologies and time pacing (Simonse, 2017), we propose ways to assist future 3D print users in their learning and modeling. Three horizons are: entry coaching, reactive assistance and proactive personalised assistance. This roadmap enables ultimaker to strengthen their core value 'helpfulness' and become a key player in servitization.



Index

1. Introduction

1.1 Roadmapping

A roadmap is a visual tool used by companies to define and communicate what they want to achieve in the future, why and how they will achieve this by having a step-based journey (Simonse, 2017). The goal is to respond to future trends, new user values and changes in the landscape to create a sustainable strategic advantage and be relevant in the future. This report contains a strategic and tactical service roadmap for 3D print company Ultimaker. It also addresses the steps that have been undertaken to reach the roadmaps, being 1) a trend and user values research, 2) vision creation 3) technology scouting and 4) Time pacing.

1.2 3D printing

3D printing, abbreviated to 3DP, is a technology to create 3D models by adding layers of material on top of each other. Most of the desktop 3D printers use plastic filaments which are melted in the head of the printer and extruded to create the layered 3D models. This is an automatic process which is based on a drawing, scanned object or imported object in a 3D modeling program.

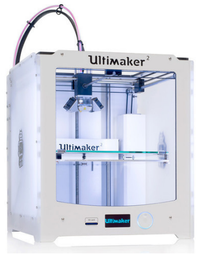


Fig. 1: A desktop 3D printer by Ultimaker.

1.2.1 3D print steps

We talked to a 3D print expert in the PMB lab at the faculty of Industrial Design at TU Delft and captured the steps needed to 3D print. In brief, if you would like to 3D print an object with Ultimaker there are a couple of steps you need to proceed.

First you need an idea of what kind of object you want to create (1). Think about in what shape and dimensions you want to make it. After you have got a clear idea of how the object must look, you can model it in a Computer Aided Design-programme (CAD-programme) (2). When the model is finalized, it must be saved as an .Stl file so it can be imported into the Ultimakers' Cura programme (3). In this programme you select the desired settings (4) and save the file as a .Gcode on a SD card. (5) This SD card then is placed into the Ultimaker machine, check if the glass plate is clean and make sure there is enough material available on the spool. Select 'Print' in the Ultimakers menu. Your object will be printed (6) and when done printing it can be removed from the glass plate in the Ultimaker. As final step, you can remove the excess material that served as support during 3D printing. (7)

1 2 3 4 5 6 7

1.2.2 History 3D printing

1984 - Birth of 3D printing (Jun Hao, 2014)
1986 - 3D print is patented
1988 - 3D print publically available
2002 - First functional healthcare related print (Kidney)
2007 - Food printing
2008 - Shapeways launches co-creation and community
2011 - Ultimaker founded (desktop 3D printer)

As we can see 3D printing is emerging slowly and is becoming more more accepted and used the recent years. According to Rong et al. (2018) there is a difficulty in the establishment of business models. Collaboration in the ecosystem and experimentation are key to find and finetune shared value propositions.

1.3 Ultimaker

Ultimaker, founded in 2011, is known for accessible desktop 3D printers. The mission of Ultimaker is to accelerate the world's transition to local digital manufacturing by offering reliable and accessible 3D Print (abbreviated to 3DP) to a large audience. At the moment Ultimaker has resellers in 50+ countries and an office in The Netherland and the USA with more than 300 employees. Core values of Ultimaker include reliability, playfulness, pioneering, informality and helpfulness (Ultimaker, n.d.).

1.3.1 Customers

Professional enterprises form the primary customer segment (60%), followed by educations, production and DIY, respectively 25%, 10% and 5%. 3DP is used to make concept models, visual prototypes, functional prototypes, production tools, specialised products and production of spare parts. Professional industries that use 3D Printing include architecture, aerospace, art labs, the automotive, fashion, design, medicine, research and humanitarian aid. An example is the creation of prosthetics, which as available open-source for 3D printer users to provide people with a cheap, functional prosthetic.

1.3.2 Ultimaker's ecosystem

The ecosystem of Ultimaker includes the product, services (for example, Ultimaker marketplace, Cura Connect; software to facilitate effective printing in a multiple-user, multiple-printers setting and the use of intelligence) and partners (3D software and materials). At the moment Ultimaker has a big online community that offer peer-to-peer support of varying quality, mostly focussed on the printing phase (and not the design phase) (Appendix 1).

1.3.3 Ultimaker's competitors

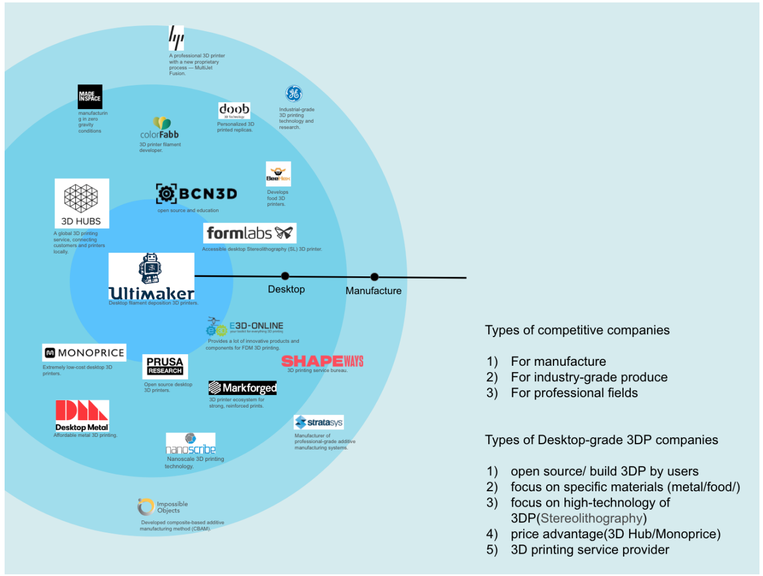
There are four kinds of companies in the 3DP-industry:

1. Companies that are designing and building big 3D printers for mass production.
2. Companies that design 3D printers that could be used to produce industry-grade products.
3. Companies that focus on applying their printers into a specific professional field such as the nanoscale 3DP and manufacturing in zero gravity conditions.
4. Companies that manufacture desktop 3D printers for amateurs and tech enthusiasts, enabling them to 3DP at home.

Ultimaker, which belongs to the companies that manufacture desktop 3D printers, has got five direct competitors:

1. Companies that provide open-source production of 3D printers or that sell 3D printer parts, which enables users to build it by themselves.
2. Companies that focus on 3D printing with specific materials (for example: metal or food).
3. Companies focussing on applying high-technology (Stereolithography) to make 3D printer usage more efficient.
4. Companies which provide 3D printers with price advantage (3D Hub/Monoprice).
5. Companies providing a 3D printing service.

1.3.4 Strengths and weaknesses



Types of competitive companies

1) For manufacture
2) For industry-grade produce
3) For professional fields

Types of Desktop-grade 3DP companies

1) open source/ build 3DP by users
2) focus on specific materials (metal/food/)
3) focus on high-technology of 3DP(Stereolithography)
4) price advantage(3D Hub/Monoprice)
5) 3D printing service provider

Fig. 2: Analysis competitors Ultimaker

The advantage of Ultimaker is that it's products are very accessible and can be used in the professional field, as well as non-professional field. Ultimaker helps companies to optimize products and the process of production. In the non-professional field, Ultimaker helps people to realize their own creativity and fulfill their needs.

A weakness of Ultimaker is that the 3DP technology is still not matured that much as we would expect it to be. With a big amount of emerging desktop 3DP companies, Ultimaker will need a field of expertise to be able to keep it's advantage.

1.4 The assignment

1.4.1 Problem statement by Ultimaker

Ultimaker frames the problem statement as overcoming the knowledge gap in designing for 3DP, for knowledge users in professional enterprises with rapidly changing technological possibilities and the need to translate 3DP to conventional production methods.

The online community misses standardization and does not meet the didactical quality standard for professional use. Therefore, Ultimaker challenges us to explore: 1) the division of role in education between CAD/CAM companies and Ultimaker, 2) how to approach specific niche market needs and 3) how to stimulate people to learn. The final outcome should be a service roadmap.

Current and envisioned solutions by and for Ultimaker to the aforementioned challenge include:
online modules, workshops, webinars, provision of warning, tips and guidance in print preparations and the creation of plug-ins with software partners to provide training. Moreover, Ultimaker explored creating their own modules, being an open source and community based and creating specific training with thrusted partners.

1.4.2 Our challenge

We identified two main possibilities why people would not want to use 3D printing in professional work environments. First, people may not see the added-value of using a 3DP, possibly because they are not aware of the diverse use and opportunities 3D printing facilitates. Second, people do not know where to begin the learning process of how to use a 3D printer as they are missing skills and knowledge.

In this assignment we specifically focus on the latter. There are many ways to learn 3D printing, such as classes, books, tutorials and platforms offered by an even bigger amount of sources. Most of the information is generic and people need to search for the tools and this could be experienced as overwhelming. What is relevant for me? What do I need to do to achieve my personal and profession specific skills?

One of the core values of Ultimaker is helpfulness (Appendix 2). We see opportunity to exploit this core value by assisting people in their personal needs. To specify this more, we decided to focus on users in design studios, because these group of people belong to Ultimaker's primary customer segment and they are more familiar with the possibilities of Ultimaker. Thus, we narrowed the problem statement to:

Assist 3D printing users of professional design studios by learning how to use the 3D printing technique, to reach their personal and profession-specific goals.

2. Trend research

To create a roadmap that fits the future, it is important to take into account the trends of future scenarios. The goal is to spot early signals of potential changes in future environments and respond to these in time.

2.1 Approach

According to Simonse (2017) there are four distinct ways to retrieve trends. Due to the limited access to the company Ultimaker, experts and time constraints, we decided to combine the two methods 'trend scenarios' and 'trend topics'.

1. In trend scenarios we perceived by carrying out a interview with 3D printer instructors in the prototyping lab at IDE (Delft University of Technology), attend a workshop by trendwatcher Suzanna Skalska and by searching for trend views by companies, trends watchers and consultancy firms on the internet (appendix 3).

2. For Trend topics we slightly changed the format as we had only limited experience and visual proof of visiting events. Events that we used as inspiration were Dutch Design Week expositions and workshops, for example projects with the theme Play and learn by Industrial Design of Eindhoven technical University. Additionally, we searched for blogs and news articles with visuals on future education, 3d-printing and emerging technologies. The visuals were clustered and for example resulted in interpreted insights such as 'embodied learning', 'immersive era' and 'sky is the limit' (Appendix 4).

2.2 Outcome

The aforementioned approaches were carried out individually by the team members. Together we discussed the trends and used the DETSEP technique to check if most of the relevant themes have been addressed. After, the themes have been roughly ranked on user impact and strategic fit with Ultimaker.

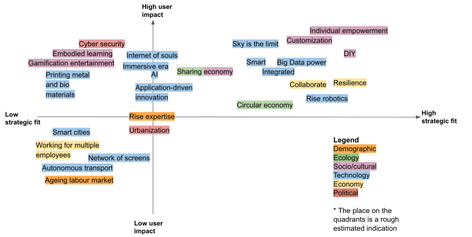


Fig. 3: The retrieved trends, labeled with DESTEP, ranked on user impact (y-axis) and strategic fit (x-axis).

The trends in the upper right quadrant have been discussed, possibly rephrased and grouped, to create the following top ten trends, which will function to drive our vision.

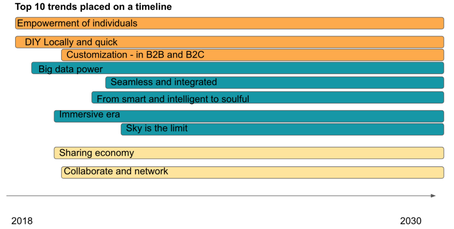


Fig. 4: The top 10 trends on a timeline of predicted relevance in the future. The orange blocks include social trends, the blue technological trends and the lower trends are economically oriented.

2.2.1 Trend elaboration

Empowerment of individuals. Due to the accessibility of knowledge and tools, all people will have equal chances to create. This reduces dependency on professional firms and therefore disrupts the ecosystem in terms of value propositions of professional firms and hierarchy.

DIY locally and quick. New technologies, such as 3D printing and robots, make local and do-it-yourself production possible. As a result, innovation and exploration processes can be performed in-place and at a higher pace, reducing the need of transport and possible enhancing the speed of innovation.

Customization (in B2B and B2C). Products are tailored to fit the user and/or goal. For example in B2B, application-driven products will become application specific. For B2C products can be made tailored to specific user needs, either in mass-production or small scale prototyping.

Big data power. Data, which increased due to Internet of things, is turned into valuable insights. The insights will be used to improve user experience, make decisions and predictions and can lead to self-service software.

Seamless and integrated. Technology will be embedded in the processes and routines of daily-life. Technology will shift towards peripheral interaction, where people effortlessly switch attention between technology, expanding the skillset of people, and everyday living.

Smart, intelligent and soulful.
Technology can turn into soulful by 'knowing', 'reading' or 'feeling' what the user needs or desires and respond to this.

Immersive era.
Technology will be in our surroundings and blend in our living and work-environments responding to all human senses such as visual, touch and smell. Example are VR and AR to assist us and deeply immerse people in stories.

Sky is the limit.
Due to emerging technologies and innovations, such as the ability to 3D print with tissue or concrete, will create completely new value propositions and applications. People will eventually be (almost) not restricted anymore to create what they imagine.

Sharing economy.
Resulting from the innovation from the World Wide Web, people will be sharing more. This sharing includes knowledge, durable and consumer goods, estates and space and services. This trend is a response to the value of being more sustainable and exploring new ways of making/saving money.

Collaborate and network.
Future societal challenges are wicked and the ecosystem involve numerous partners. Therefore both profit and non-profit firms will work together to create achievements and reinforce their markets. For employees this trend also translates to the shift from a single employer to (net)working with various employees and partners.

3. Value drivers

The top 10 trends are important for the 3D print industry. However, there are some specific user drivers which should also be taken into account for creating a vision and a roadmap that fits the user's wishes, desires and needs and the context of use. In this assignment we specifically investigate knowledge users in professional design enterprises. Examples of these users are architects, who 3D print mock-ups of new buildings and researchers, who use 3D printed artifacts for their research.

Based on an interview with the instructor of 3D print facilities at IDE Technical University Delft, we identified several values for the users. For example, we learned that they have some 3D printed artifacts to provide an impression of the possibilities and possible materials to users. Moreover, we learned that design students are offered workshops and classes on 3D printing. In these workshops students are assisted in their learning in an attractive, easy-to-follow, step-based and personal way.

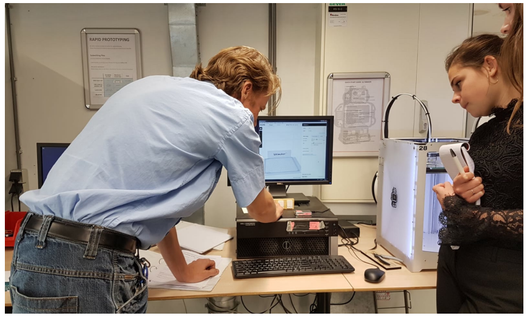


Fig. 5: Interview with the instructor of 3D print facilities at IDE.

From the insights from the interview, combined with expectations of future user needs and desires, we performed a value mapping session. The values were discussed together, double values were removed as well as the values with no full agreement. The resulting values were clustered and labeled with the value that drives this cluster of values. The value drivers that came up are being inspired, being assisted, result driven, personal development and being contented. The following list shows what values were clustered to reach the value drivers.

Being inspired.
Access, enhancing creativity, exploring, expressiveness, uniqueness, customization, intensify experience/rich experience, freedom, limitless, transparency, connected, collaboration

Being assisted.
Security, confidence, carefree, fitting, easy, educate, efficient, predictive, flexible

Result-driven.
Personal growth, sustainable, multi-purpose, affordable

Personal development.
Individuality, self-control, personal, adaptability, tailored

Contentment.
Entertaining, sensory, serving

3.1 User value drivers

1. Being inspired
Creating enthusiasm to use the 3D printer through intrinsic and extrinsic motivation. For example, role models can show how the 3D printer empowers them, improves the flow in their work and enhances visibility of results.

2. Being assisted
Learning a new complex technology is a stepwise process in which people should be guided and coached. People should be aware and respond to their personal strengths and shortcomings. Since output quality and time spending are key for professional workers, they may feel afraid to develop new skills and take on new responsibilities. Assistance can reduce these concerns and guide towards continuous personal growth. This value driver is in line with the core value

3. Result-drivenness
Professional users are result-driven. Their goal is to reach their goal in the most efficient way depending on the goal and use of the 3D print.

4. Personal development
It is people's tendency to grow, evolve, learn and become better or faster in certain tasks. Development also provides a feeling of pride and motivation to continue the activities and learning.

5. Contentment
In a world of automation, the future generation will primarily do the things they like. Therefore it is important that people enjoy learning and using the 3D printer. We see that learning becomes interactive, embodied and experience-rich.

4. Vision

The vision illustrates the desired state that a company wants to achieve and therefore marks the end of the roadmap. A good vision should be high in clarity, value and magnetism and materialised to inspire and create coherence by having a common goal.

These values were combined and rephrased to create the following vision statement:

Ultimaker **seamlessly assists** new users in design enterprises with **tailored support** to learn required 3D print skills.

Fig. 6: Our future vision for Ultimaker.

5. Technology Scouting Research

The 3D print journey, from initiating to 3D print to a finished model and maintenance of the 3D printer, has been mapped. For each of the steps, we analysed the system and scouted for servitization or product opportunities.

5.1 Steps 3D print journey

Pre
1. Aim to buy and use 3DP
2. Research
3. Purchase
4. Setting-up

Usage
5. Design idea
6. Sketch on paper
7. (Research in use 3DP and modelling)
8. Modelling
9. Cura
10. Printing
11. Print finished

After
12. Taking off print support
13. Finish model (painting etc)
14. (Maintenance printer)

5.2 Technology opportunities

For each of the steps new opportunities were explored. (For a full list see appendix 5) In this paragraph we highlight some of the discovered opportunities.

Service provision

• Based on a (online) questionnaire about a user's 3DP skills, Ultimaker can compose a personalised curriculum.

• Simplification of asking questions, for example virtual assistance which is voice-controlled.

• Integration of voice dictation in modelling software.

• Smart software that senses behavior, so Ultimaker can provide tailored assistance.

• Ultimaker can provide team activities to make a design team familiar with the basics of 3DP. For example, Ultimaker can have a Ultimaker 'bus' that visits companies, events and/or festivals in The Netherlands, to provide workshops.

Product-based

• Scan technologies in the 3D printer to convert sketch or clay model into a CAD model.

• Camera in 3D printer with image recognition to compare CAD model with final 3D printed object.

• Multiple nozzles for higher speed 3D printing and separate nozzles for 3D printing different material.

From this we propose new technologies to enhance the service and assistance provision. Voice assistance will be an important technology in this field. We envision that Ultimaker can offer voice assistance by means of a chatbot.

Moreover, we advise Ultimaker to collaborate with modelling software to collect data on behaviour in the program. Product-based, we see an opportunity to add a camera, so a feedback-loop can be established.

6. Time pacing

This chapter discusses the time pacing of the horizons by reflecting upon technological trends and briefly touching upon internal expertise and resources.

6.1 Internal expertise and resources

Currently Ultimaker offers webinars, online education content and active users of Ultimaker provide each other help at Ultimaker's online community platform. However according to Ultimaker, the online community does not meet the didactical quality standard for professional use. Ultimaker is a relatively young company, founded in 2011, therefore we need to aim for stepwise strategic changes and take into account that investments need to be spread out over years.

6.2 Technology scouting

6.2.1 Voice assistants

• **2014:** Siri, Apple's virtual assistant for it's operating systems, was launched (Cloosterman, 2018).

• **July 2018:** The first Dutch voice assistance was released by Google (Rahanmetan, 2018). Amazon Alexa also indicates to have Dutch language support available soon.

• **2020:** Half of the searches will be done via voice. Therefore it is important to be findable in voice-touchpoints (Zweers, 2017).

• In the coming years, virtual assistants will become smarter, by being able to sense user needs (Stjepanovic, 2018). Moreover, partnerships will be developed to offer users integrated and value-adding services. Third, virtual assistants will be connected to 'Internet of Things' (IoT) devices.

• In the future, it is expected that assistants will become more personal. New capabilities such as translation and dictation arise. Finally, machines will be controlled by voice (Stjepanovic, 2018).

As, to our knowledge, Ultimaker has no expertise yet in voice control, we believe that a timeframe of 5 years would be suitable. At 2023, Ultimaker should be able to have voice control attached to their chatbot. As they will not be the first company to do so, they can learn from how other companies achieve this. Before 2030, they should be able to add dictation and controlling machines by voice.

6.2.2 Artificial Intelligence

• **1948:** Three laws of robotics formulated (Miller, 2018)

• **1985:** First VR glasses

• **1990:** Augmented reality

• **2005:** Major achievement autonomous driving

• **2016:** First drone delivery

• In the near future, we see that virtual doctors check out vitals (Criteo, 2017).

• In the further future, nanobots inside our body can cure us.

From this we learn that VR and AR exists for quite some time, but still has not been fully embedded in the society. As robots will be able to sense and cure the vitals of humans, we expect that a sensing technology for non-vital signs and products will be available sooner. For example, sensing the emotion in voice and the process of printing. Technologies such as image recognition already exist and can therefore be implanted without much hassle.

6.2.3 CAD and education

• **2008:** MOOC, open online-courses (Maut, n.d.).

• **2018:** Autodesk, a software company, launched a virtual assistant (brandchannel, 2018).

• Recently, Seymourpowell developed software for VR modelling of cars (Griffin, 2018).

These events show that there is a trend of open-knowledge and assisting plug-ins going on in existing modelling software.

From the evidence listed above, we derive that suitable horizons are:

Horizon 1: Entry coaching - 2020

- Mainly small changes and gathering data for horizon 2.

Horizon 2 : Reactive Integrated Personal coach - 2023

- A virtual voice assistant and voice dictation in modelling software is added.

Horizon 3 : Pro-active assistance - 2030

- Sensing technologies are added to Ultimaker's 3D printer, CAD software and voice assistant.

7. Roadmaps

In this chapter we present a strategic and tactical service roadmap for Ultimaker, focussing on their core value helpfulness. As we saw opportunities to enhance this value, we decided to focus on assistance.

7.1 Process

In a pathway session we stated all the activities that were in line with our vision and started shuffling them to match technical innovations. For this we also took into account that changes need to be done step-wise as Ultimaker is a relatively young company with limited resources. Two important guidelines were the current product portfolio of Ultimaker and the time pacing outcomes for emerging technologies. We linked various future proposals and worked backwards to learn what Ultimaker needs to do tomorrow to achieve the future proposals.

For visualising the roadmaps we prioritized looks over the accessibility and ability for people to make changes in the document. The reason for this choice is that we think that the roadmap will be to inspire Ultimaker and will not be used as a base document. The roadmaps were created in an iterative process.

7.2 Clarification roadmaps

7.2.1 Focus
We chose to present a 'helping' hand that is being 3D printed to visually communicate that the focus of this roadmap is assistance and is future oriented.

7.2.2 Target audience
Portfolio development department, including Merijn Neeleman as manager and provider of this assignment.

7.2.3 Goal
The goal of this roadmap is to help Ultimaker reinforce their core value 'helpfulness' by envisioning and explaining how Ultimaker can support their future customers in the learning process and use. We believe enough educational resources are available, but users desire personal advice on what courses to follow and what tutorials to watch to meet their own personal needs.

7.2.4 Future context
New 3D printing technologies are emerging, think of new materials, new techniques and new printers. Therefore, continuous learning is required from the user side to optimally benefit from the 3D printing possibilities.

From the trend analysis we see that technology and services will be integrated to provide a seamless experience, where collaboration is key. We believe future users want to be inspired, assisted, grow, and enjoy their 3D printing experiences, while achieving their 3D print work in the easiest, most time-efficient way.

7.2.5 Horizons and time pacing
We defined three horizons based on technology scouting and required investments for the company. These are 1) **Entry coaching in 2020** 2) **Reactive Integrated Personal coaching in 2023** and 3) **Pro-active assistance in 2030**. These horizons are displayed on the arrow. For the first horizon all resources and technologies are present and can therefore be implemented quickly. The second horizon build primarily upon voice assistance, which is said to be used for 50% of searches in 2020 (Zweers, 2017). Data is required for achieving the second and third horizon. To create smart-sensing software data is required on behaviour in modelling software.

7.2.6 Products
In short, for horizon one we propose Ultimaker to provide an entry test and an educational curriculum based on the user's personal needs.

In the second horizon, Ultimaker provides a chatbot, which will be voice-controlled. Eventually, the voice assistant can be used to dictate modelling requests, for example: "create a sphere with a hole of 1 cm". This chatbot can move from being accessible on the website to being integrated in CAD software. Moreover, Ultimaker provides a workshop at clients and events to build a relationship, inspire and learn from emerging user needs and desires.

In the third horizon, an Ultimaker plug-in in CAD software senses user behaviour and provides assistance based on that behaviour. For example: the program can measure skills and notice struggles and respond to that. Moreover, the new Ultimaker printer contains a camera. This enables comparing the 3D printed outcome with the drawn CAD model using image recognition. Last, Ultimaker performs co-creation sessions to inspire people to use 3D printing and pro-actively learn about (latent) desires and needs.

Entry test

By means of an entry test, people can find out how much knowledge they already have on 3D printing. Ultimaker will use the results of the test to provide this user an educational package on 3D modelling containing courses and tutorials, tailored to the level of the user. Furthermore, the answers to the test will be used to collect data for the chatbot Ultimaker will introduce in horizon 2.

Horizon 1
Entry test will be available for Ultimaker's users.

Horizon 2
In horizon 2 the entry test will still be available for (new) users.

Horizon 3
In horizon 3 the entry test will be replaced with cocreate sessions.

Chatbot

Users will be able to communicate with Ultimaker by means of a chatbot. The chatbot will have a voice control function to be able to solve the problems of the user and answer their questions during the process of 3D printing. It will provide automated assistance through collection of data.

Horizon 1
Preparations for the chatbot will be made, so the chatbot can be introduced to Ultimaker's website in horizon 2.

Horizon 2
The chatbot will be implemented on Ultimaker's website to provide users assistance and will have the option to be voice controlled. This data will also be used for development of the CAD-plugin in horizon 3.

Horizon 3
In horizon 3 chatbot will still be available on Ultimaker's website.

Activities Ultimaker

Horizon 1
Due to the reactive nature of workshops, Ultimaker will not focus on this aspect in horizon 1.

Horizon 2
Ultimaker will provide workshops to inspire (new) users. They can show the possibilities of 3D printing and provide assistance face-to-face. These workshops will be given at the professional design studios or can be requested as team building activity.

Horizon 3
Ultimaker performs co-creation sessions to inspire people to use 3D printing and pro-actively learn about (latent) desires and needs.

CAD plugin

After certain technology development and partnership building with CAD, Ultimaker inserts a smart and sensing CAD-plugin which helps users to build a 3D model suitable for 3D printing. This plugin corrects the mistakes users make during 3D modelling.

Horizon 1
Data will be collected for CAD-plugin by means of the FAQ on Ultimaker's website and the entry test.

Horizon 2
Data will be collected for CAD-plugin that focuses on: knowledge level user, interaction and behaviour in software.

Horizon 3
CAD-plugin will be implemented.

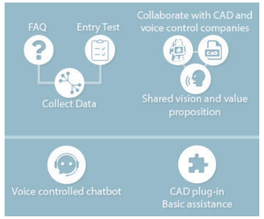
Automated re-iterative design development

The new Ultimaker printer contains a camera to take photos of the print outcome. This enables comparing the 3D printed outcome with the drawn CAD model using image recognition. In case of differences between the drawn model and printed model, the program automatically iterates upon the model to make sure that the print will eventually reflect the model the user wants.

7.2.7 Background activities Ultimaker

To achieve the aforementioned servitization, Ultimaker needs 1) data about user segments, their 3DP questions, skills and (profession-specific) needs, 2) data about behaviour in modelling software and 3) collaborations and shared value propositions with modelling software provider(s) and virtual, voice assistants.

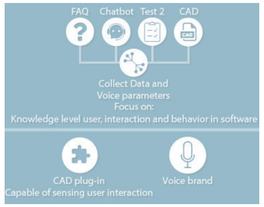
Horizon 1



The only touchpoints that we can collect data from are the FAQ section, and the entry test. We have the FAQ section and forums that we can collect frequent questions from, where Ultimaker comes in to create the answers to these. The second touchpoint is the entry test, which by now has evolved to a superior version. This test provides Ultimaker with data containing mostly the user's current skill level. This data will be used to create a voice controlled chatbot, in which there is a simple interaction between, where the user can ask a question and receive an answer from the database accordingly.

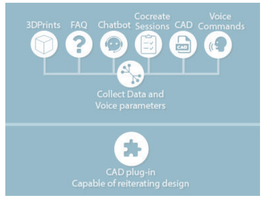
Ultimaker will collaborate with CAD software companies and companies which are experts in voice controlled products or services. The intent of this collaboration is to get a shared vision and value proposition. This would allow for both parties to focus on the same goal and work on a plugin for the CAD software, capable of voice control. Secondly it would allow for data collection from external sources as well.

Horizon 2



There are a lot more touchpoints by now from which we can collect data. The chatbot which has been implemented previously also provides frequent questions as well as user behavior. Another touchpoint from which we can collect user behavior data from is the collaboration with CAD software. This revolves around the user's behavior from within the software. All this data can be implemented to update the previous plug-in and make it sense user behavior. Next to this Ultimaker can create a voice brand, for recognizability.

Horizon 3



In this horizon Ultimaker will still collect data from all the previous sources, but will add voice commands, prints and co-creation sessions to the list of touchpoints. These will give more insights into user interaction with the plugin, reasons behind failed prints and consumer needs, respectively. All this data can be used to update the plugin to a more capable version, which includes automatically reiterating prints, and providing the user with helpful tools and tips without them asking for it.

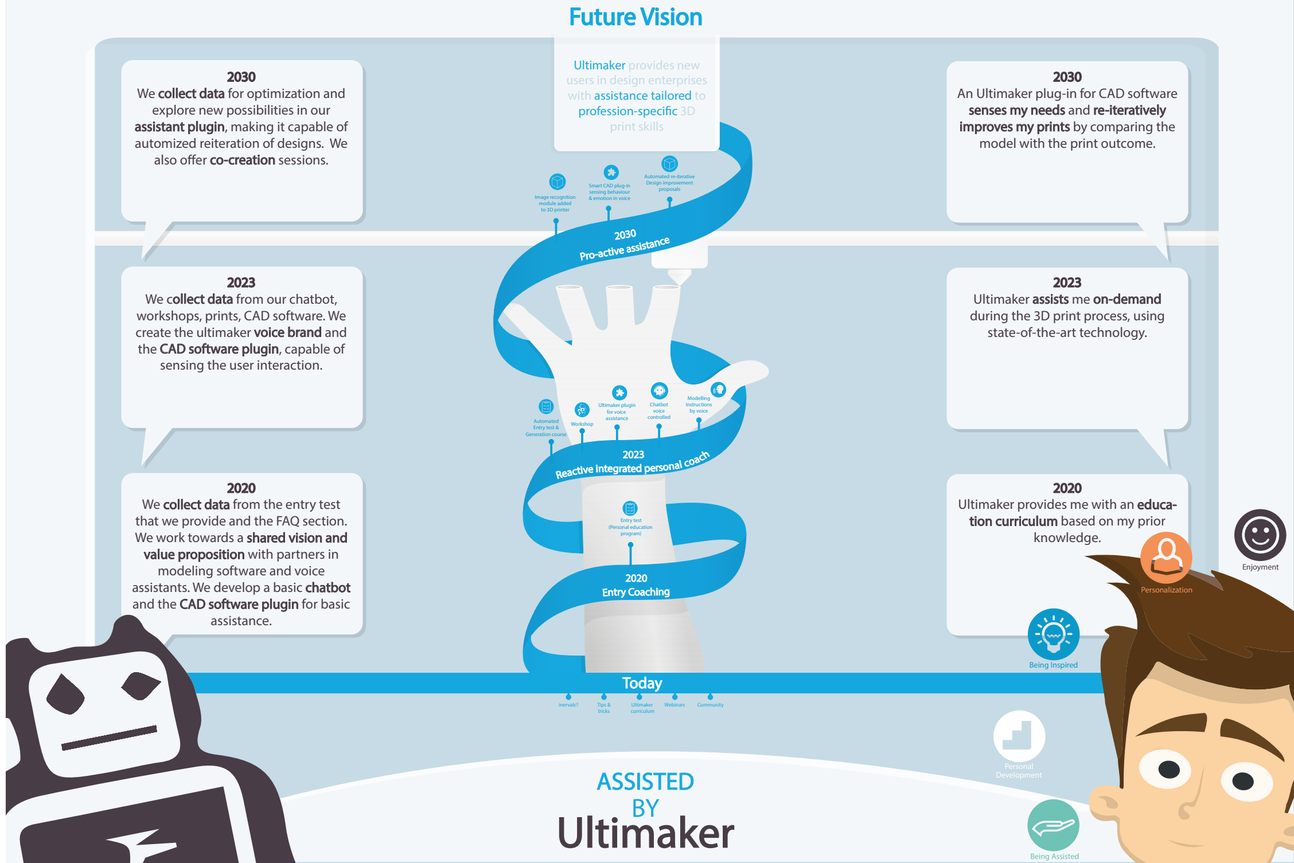
7.2.8 Value for Ultimaker

Offer unique service provision to their (future) clients. The service is tailored, it will lower thresholds in learning and make it more enjoyable and it will enable faster-paced progress and results. This service could be an incentive for customers to use and buy Ultimaker products to have access to this service. The service could come with purchase or be a paid subscription. For modelling software providers, having the Ultimaker Plug-in offers more value to their users.

7.3 Strategic roadmap

The strategic roadmap is used to convey the main message. It is a summary of the detailed roadmap and also includes where the company currently is.

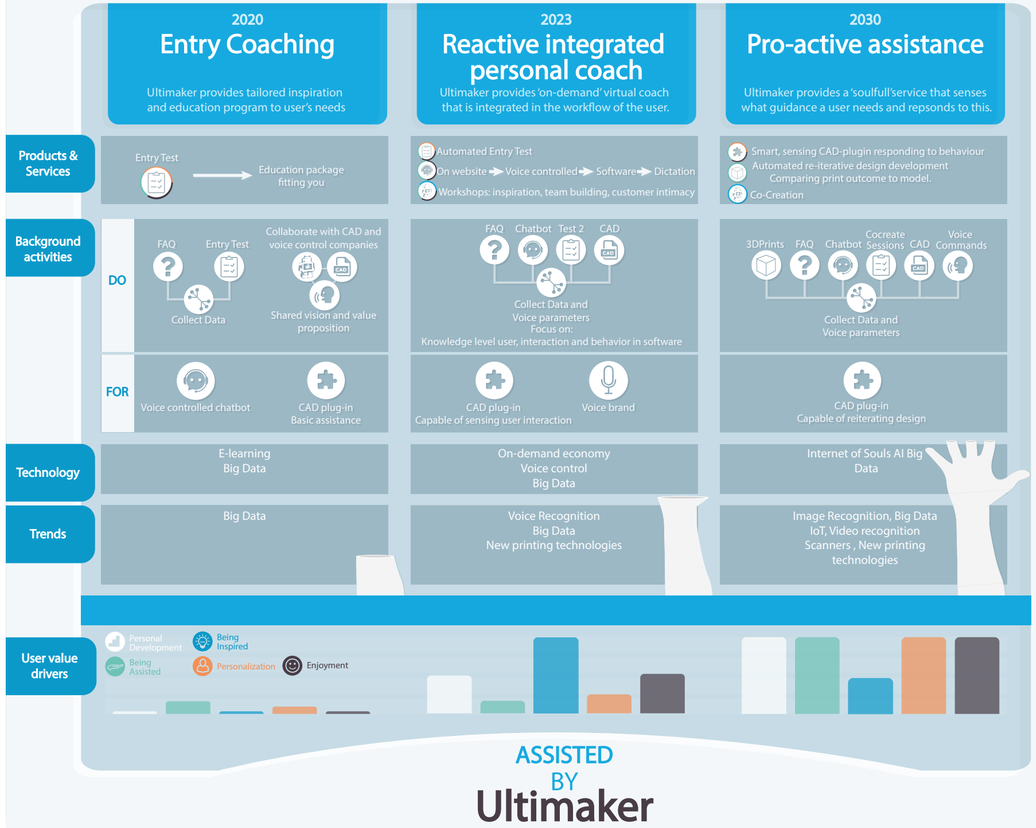
The black bullet points contain product and services that will be offered by Ultimaker. The two people represent the voice of the user ‘what do I get?’ and the company Ultimaker ‘what do we need to do?’.



7.4 Tactical roadmap

This roadmap shows a detailed overview of the activities and product/service portfolio that are required to work towards the vision. The relevance of the user values are mapped in small graphs, displaying how the importance of the values change over time.

The user values are linked to the proposed products and services. The connections are visualized using coloured rings around the products and services that correspond to the user values.



Future Vision

Ultimaker provides new users in design enterprises with assistance tailored to profession-specific 3D print skills

8. Wrap up

3D printing creates transitional times, in which users are empowered to express themselves using (emerging) new 3D print techniques and materials. Therefore, it is essential to learn how to create models and be up-to-date and keep learning to be aware of the latest techniques. Many resources for learning are available. Yet, in our view, people do not know where to start; what resources are helpful for their personal needs?

We believe users want to be inspired, assisted, grow, and enjoy their 3D printing experiences. Helpfulness if one of Ultimaker core values. We believe this helpfulness can take a more prominent role in the 3D printing process of (new) users. Therefore, we suggest Ultimaker to assist their users with tailored support.

To get back on our challenge: *Assist 3D printing users of professional design studios by learning how to use the 3D printing technique, to reach their personal and profession-specific goals.*

On a short term we envision personalised educational packages based on an entry test. A next step could be 24/7 responsive assistance by the use of (voice-controlled) chatbots. Last, we envision proactive support. based on the sensed user behaviour in the CAD software, an Ultimaker plug-in provides tailored advice. Technology and trends that pushes the proposed products are virtual assistants, voice-control, data-driven and soulful products.

To achieve this vision, it is essential for Ultimaker to collaborate with (CAD) modelling software. An Ultimaker plug-in will be available for Ultimaker users in the CAD modelling software. By creating 3D printing support in their software, Ultimaker can offer service value to their users and at the same time the CAD software can use this feature to attract customers to use their software.

So to conclude, we believe that tailored, 24/7, pro-active assistance can attract new customers to Ultimaker by lowering the thresholds to learn and use 3D printing. This service can foster a relationship between Ultimaker and users, and therefore brand loyalty. So create that helping hand!

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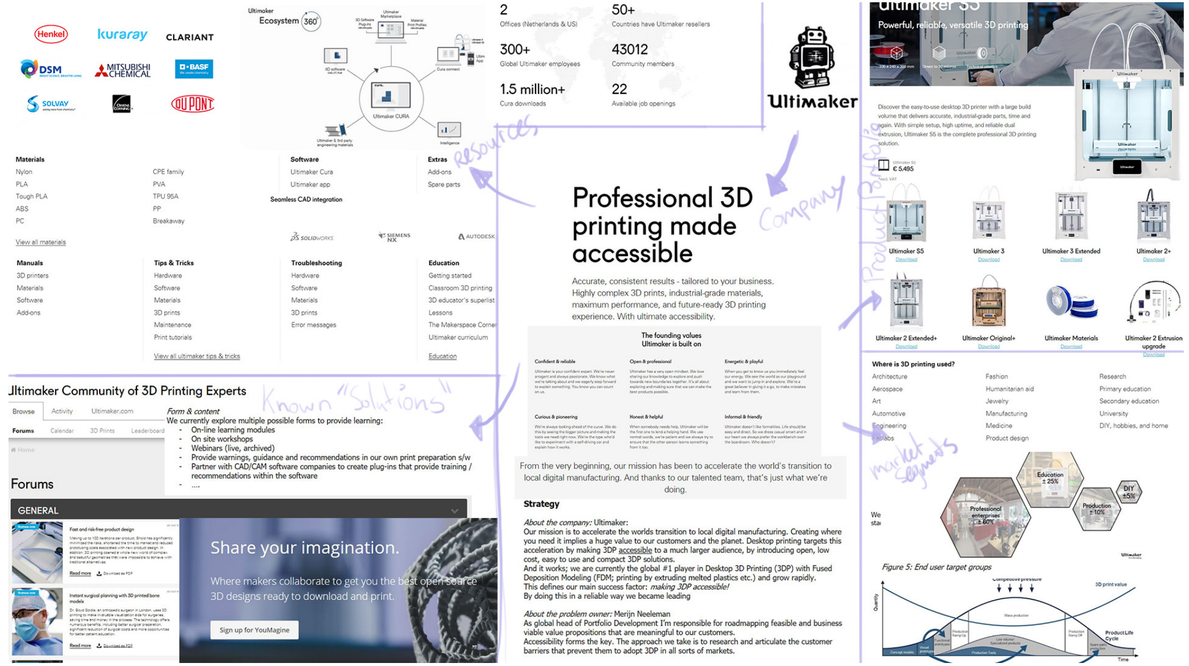
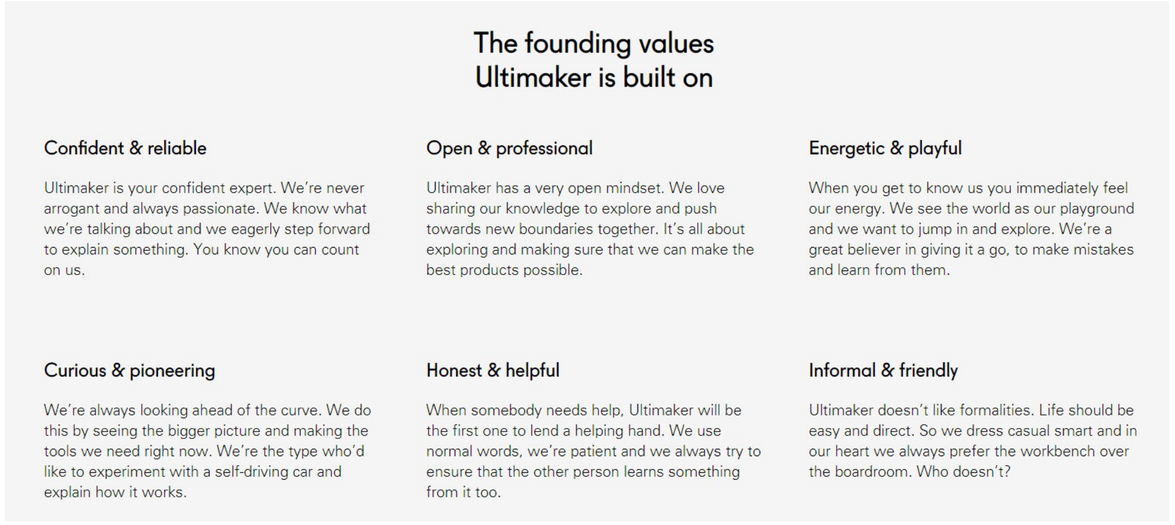
10. Appendix

Appendix 1: Ultimaker's ecosystem



Appendix 2: Ultimaker's core values



Source: https://ultimaker.com/en/about-ultimaker. (06-11-2018)

Appendix 3: Content used for trend scenario

Trend scenario
Combine the Tech trend "DIY" and educational trend "Embodied learning"
Scenario: The community center of the Ultimaker
The community center is the place where people can learn about the 3DP. These centers are setted in the communities, so people who are interest in 3DP can get to there easily. Meanwhile the center also has the course about how to use the 3D printers which people can pay for it. The center also provide the 3D printers for people to print whatever they want with a reasonable price. For people who want to use it more often, they can buy one printer at home and get any help from the staff at the community center anytime immediately.

Interview PMB lab IDE
Users of the Ultimaker 3DPs are students of the faculty of Industrial Design & Engineering in Delft. These students know how to use certain programs, for example: SolidWorks or Rhino, that can be converted to a 3D print ready file with the Ultimaker Cura computer programme.

When students come into the PMB lab where the Ultimakers are located, they need assistance to 3D print their project. Most problems occur with the layer height settings. The Cura programme works well for the students. But tips like where to place the project on the glass plate aren't provided by the programme, but by the assistance at the PMB lab.

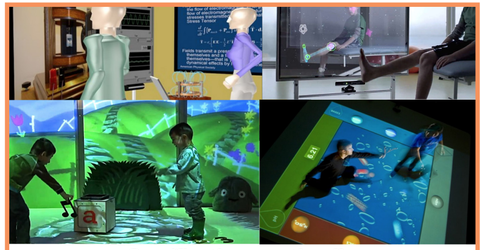
We asked the assistance at the PMB lab how they think the future will look like for 3D printers. Their answer is stated as followed: "Everyone will have a 3D printer at home. For example when the handle of your fridge breaks down, you are able to print the handle at home and replace it by yourself. When purchasing your fridge, you'll be provided with a SD-card that contains the needed file for 3D printing."

Since the printers are free, students just experiment and learn by doing (trial and error).

Appendix 4: Trend Topics

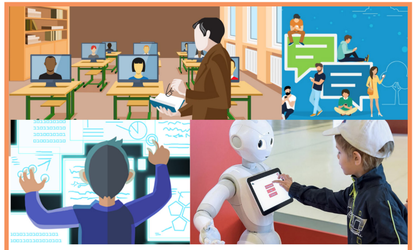
Embodied learning

Immersive era



Gamification as stimuli

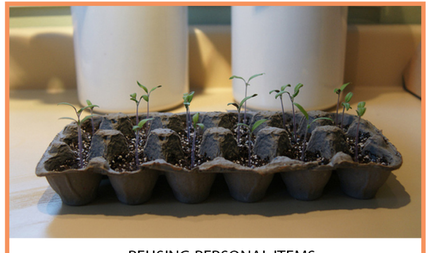
Sky is the limit



Network of screens

Smart Cities

Data driven souls



REUSING PERSONAL ITEMS

Appendix 5: Technology scouting

Pre

1. Aim to buy and use 3DP
• Ultimaker hosts niche specific events for networking and inspiration, such as breakfast sessions.
• Ultimaker Platform for companies to upload models, inspirations for others, free/advertisement for the companies. ´Created using Ultimaker´.

2. Research
• Based on questionnaire Ultimaker advises best type 3D printer for user's needs
• Entry test personal skills, Ultimaker provides service to create personalised curriculum to learn skills you need to achieve your professional-specific goals.

3. Purchase
• Free trial period
• Lease/subscription

4. Setting-up
• Voice instructions from printer
• Colour coded for easy instruction

Usage

5. Design idea

6. Sketch on paper
• Photo of sketch automatically translated to vector image in modelling software
• Possibility to make clay model and scan it to create model.

7. (Research in using 3DP and modelling)
• Virtual assistant/chatbox by voice
• Presets profession-specific
• MOOC course
• Team Activity by Ultimaker. Ultimaker 'bus' that drives to companies and events in country to facilitate enjoyable workshops to introduce the design team to the basics of 3DP.

8. Modelling
• Voice commands to modelling program.
• Hand gestures/ sculpting/ painting using VR combined with AI
• Search engine. Upload pictures and program creates a similar model.
• Cloud-based, so everybody can work together in file (like google drive)
• Virtual assistant/chatbox by voice
• Smart software that senses behavior and necessity for help

9. Cura
• Compatibility with more modeling software (sketchup, etc)

10. Printing
• Multiple nozzles -> higher speed.
• A separate nozzle for each unique material
• AI proposes improvements based on printing process analysis, using image recognition
• Be of value when not used for printing...? Can the 3DP print something useful which the company can sell?
• Detects errors in printing process and informs user

11. Print finished
• Marketplace for (used) prints.
• Integrated cruncher to reuse material.
• Contest by Ultimaker.

After

12. Taking off print support and finishing the model
• Integrated finishing options in printer (remove support, coat, paint..)

13. (Maintenance printer)
• Printer communicates maintenance errors
• Printer automatically orders required materials for maintenance
• Self-healing printer