Aalto University
School of Engineering

Vikram Munigala

Anticipating plausible futures for innovative experimental ecosystems using foresight approach. Case: Design Factory

How Design Factory educates students by year 20x6, x = {2, 3}.

Master's Thesis
Espoo, November 30, 2017

Supervisor: Professor Kalevi Ekman, Aalto University

Instructors: Paivi Oinonen M.Sc
Elina Hiltunen PhD

Aalto University
School of Engineering
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ABSTRACT OF
MASTER'S THESIS

Author: Vikram Munigala

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Change-makers are visionaries who wish to bring change in their respective fields. Design Factory at Aalto University, as an innovative experimental ecosystem with inter-disciplinary principles and new teaching methodologies has been successful and at the forefront in educating the students to be change-makers. The students learn skills, knowledge and are provided with a safe environment that guides them to become a change-maker in their respective fields such as social organizations, entrepreneurship, and careers in start-up or industry.

Educating the students to be change-makers will evolve with future; the aim of the study is to holistically anticipate plausible futures for innovative experimental ecosystems utilizing foresight approach. The focus of the study is on Design Factory ways of working, spaces, and teaching methods which will support students in learning by year 20x6 {x = 2, 3}.

This study is about drawing virtual lines that connect the trends, future drivers, visions, and scenarios, using a contemporary approach that fuses qualitative and quantitative methods. The research on future trends and drivers were performed through semi structured interviews and environmental scanning. The drivers are evaluated through an online survey based on principles of the Delphi method. Further, the drivers are used to build mini scenarios which are further evaluated with the Design Factory stakeholders through a workshop. The results from the study are six future scenarios for the Aalto Design Factory. These results are expected to further foster or trigger new research and development experiments, directions on building radical environments, new teaching methods and ways of working.

Keywords: Foresight, Future ways of working, Future problem solving, Future scenarios, Future education, Future innovation spaces.

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Thank you Eetu for your warm encouragement and for giving me this incredible opportunity to work on this topic. Thank you Paivi for challenging and supporting me on every step, this thesis would not have taken shape without your advice. From defining the value of X for the thesis to introducing me to the foresight world, thank you for all the guidance Elina.

Thanks to all the participants who have taken part and supported the study with there valuable insights and active participation. Last but not least, to the wonderful ADF family who have inspired and supported me to think bold and out-of-box.

When I started this thesis, it has been more than two years I first visited Aalto Design Factory. I met many new people; I participated in many courses and spend most time of my master studies here. I was curious to see how this space will change in future.

Design Factory is a piece of inspiration and will remain a piece of inspiration. This work is an attempt to support and challenge the Design Factory to keep innovating and experimenting, so that it will still be inspirational for the future generations.

As they say it, the best master's thesis is the one which is finished. So here it is.

Espoo, November 30, 2017

Vikram Munigala

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Chapter 1

Introduction

1.1 Background and motivation

We will be living in a completely different lifestyle in next 20 years and the change is inevitable. The future mega trends like personal robots, Artificial intelligence, synthetic biology, drones, self-driving cars and globalization will influence the changes (OECD, 2016). These changes will also challenge the future innovation ecosystems to support the needs of future students/change-makers. To cope up with these changes and future needs, there is need for the current experimental ecosystems to focus on future demands and requirements. Design factory being a successful experimental ecosystem, strives for empirical changes that educate the students/change-makers. This could be a unique case to anticipate different futures for future innovative ecosystems and furthermore the study outcomes can be used to trigger the current research directions to future-proof the needs that will impact future experimental ecosystems and learning methodologies.

1.2 Thesis scope

The aim of thesis is twofold, first is to anticipate different plausible futures for Design Factory from the perspective of how Design Factory educates the students/change makers in future and second is to act as a thought exercise for the Design Factory to plan their future activities. This study acts as a starting point, addressing the research gap for Design Factory's interest to reinvent itself. As thesis writer, my goal is to holistically use foresight methods to address the research question which is, anticipating plausible futures for future innovative experimental educational ecosystems using foresight approach. The outcomes of this study are key drivers and six future scenarios for Design Factory ecosystem. These results are expected to foster or trigger new research directions on how Design Factory's philosophy should change with future trends, challenges & requirements such as new teaching and working methods, new product development methodologies and interdisciplinary methods. In addition, the insights and contributions of the thesis can be used to develop competence and knowledge in future foresight methods for other future product/service/business development projects.

one of the thought-provoking aspects for a foresight study is defining the time-frame. For this study the time-frame is defined as 20x6x=2,3, i.e the study is exploring the plausible futures in between year 2026 and 2036. 10 years from now provides the

sense of urgency and directly relates to the changes happening today, while 20 years gives freedom to explore new and broad topics for the research.

1.3 Thesis structure

This thesis is divided into 8 chapters. In Chapter **1 introduction**, the topic and background is introduced. Chapter **2 How to study the future**, introduces the field of future studies and the methods used in the study. In chapter **3 Hello Future**, outlines in-depth research about future trends in various fields. In chapter **4, past and present innovation models**, introduces the concept of innovation ecosystems with the examples from history. This chapter also presents the case for the study. In Chapter **5 drivers**, insights from pilot interviews are discussed and summarized. In addition, the future drivers are introduced and evaluated using Delphi method. Chapter **6 Building scenarios**, is about building primary scenarios from the drivers. Ideas are also open to brainstorm at this stage to understand and evaluate the scenario better. Testing and evaluating the future scenarios, concepts that are developed in chapter 5, 6 is also done. In chapter **7 Plausible Futures**, the scenarios for plausible future for Design Factory are finalized. In chapter **8 Final words**, key learning's from scenarios, observations and recommendations are summarized.

Chapter 2

How to study the future

Chapter Preview: The previous chapter presented the motivation for the study and has introduced the focused topic. This chapter introduces about future studies in detail. Section 2.2 introduces the methods in future studies. Section 2.3 and 2.5 describes more details about Delphi and Scenario planning. Section 2.6 visually summarizes the methodology that is been used for the thesis study.

2.1 Introduction to future studies

Research on future dates back to the ancient Greek eclipse forecasting using Antikythera mechanism (Freeth Tony et al., 2008) to ancient Chinese fortune telling methods to ancient Indian astrology based forecasting methods. Studying the future goes to the old days when humans progressed and started building civilizations. Later in medieval times, the perception towards future started to shape and be more coherent. Leonardo da Vinci who was an artist, inventor and visionary at the time of renaissance was designing machine ahead of his time. In 1863, future speculations of Jules Verne in his novel *Paris in the Twentieth Century* were strangely accurate that he envisioned of air conditioners, television, trains and more. What is evident from the works of Leonardo and Jules Vernes was that, they were working closely together with visionary scientists, engineers or experts of their time to make the speculations. (Kaku, 2012)

Post World War-II, the requirement of systematic approach to modern future research for public welfare and security of the United States lead to the formation of Research ANd Development Corporation(RAND). RAND was influential in promoting scientific, empirical and fact based analysis in order to analyze trends that impact local and global issues. Out of various methods developed here, the two methods that are most widely used are Delphi and Scenario planning (Helmer, 1967).

After the initial boom in future research or future studies, the later advancements has been mostly quantitative. In recent times, the future studies have become qualitative as the acceleration of change is increasing and the companies are strategically preparing for the future changes (Von der Gracht, 2008). Visioning about future is not always predicting future; the vision becomes a prediction either if we wait for the future or have a time machine to jump into time to see it to come true. The future is always challenging to speculate and human experience with speculations have often failed. The New York Times in 1936 speculated that a rocket will never be able to

leave the earths atmosphere, but now we are aiming to build the rockets, which will be powerful enough for interstellar travel in coming centuries.

Most of the futurists argue that we cannot predict future, but rather we can foresee multiple, diverse, and alternative futures. In the age of exponential growth of technology, humans haven't changed much in last 10000 years. However, the world or the societies around the humans are becoming more diversified, interconnected, and acting as catalyst for change. Now is the challenging and best time to anticipate the future to analyze how the high tech based world will influence the high touch based caveman-human.

The purpose of the thesis is not to predict how the world will be in 20x6 but rather to anticipate alternative futures and identify different drivers and function as a thought exercise and systematically prepare and educate the change makers in year 20x6.

2.1.1 Foresight approach

Foresight approach is part of future studies. It is defined as a process by which an organization can satisfactorily identify and understand the drivers that are impacting their long-term future, and which must be considered while decision making and strategy planning. These drivers can be directly related to the organizing activities in analysis. The foresight approach consists of qualitative and quantitative ways for scouting for upcoming trends, drivers, opportunities, and developments. (Coates et al., 1985)

With foresight approach organizations can plan for undesirable but plausible scenarios, and strategize to address the transformational opportunities of desired futures (GCPSE, 2015). The foresight in future studies sometimes also referred as strategic foresight. The use of foresight or strategic foresight approach has been increasing in large companies to spread innovation competence of the organization (Rohrbeck and Gemünden, 2011)(Rohrbeck et al., 2009), and support strategic management(Rohrbeck, 2010).

> A rocket will never be able to leave the Earth's atmosphere
>
> (New York Times, 1936)

2.2 Methods of futures studies

Future studies involve interdisciplinary approach to vision and narrate alternative futures. Around the world in business and academia, this field of work is cited as future studies, strategic foresight, futuristics, future thinking, futuring and futurology (Sardar, 2010). Most of the theories used in future studies assume that future is plural

not singular as it is difficult to say which entity will yield to be the future. The existing methods are based on collecting quantitative and qualitative data about the trends, areas of change, uncertainties, and wildcards. These insights are used to build a holistic view on plausible futures. Maicho Kaku suggests that based on experiences with future studies, there needs to be more scientific means to support methods and theories of future studies (Kaku, 2012). There exists various future studies methods but the prominent methods are Delphi method, causal layered analysis, environmental scanning, morphological analysis, scenario planning, future history, content analysis, back-view mirror analysis, cross-impact analysis, futures workshops, and futures wheel. Section 2.5 describes the method that is followed in this study.

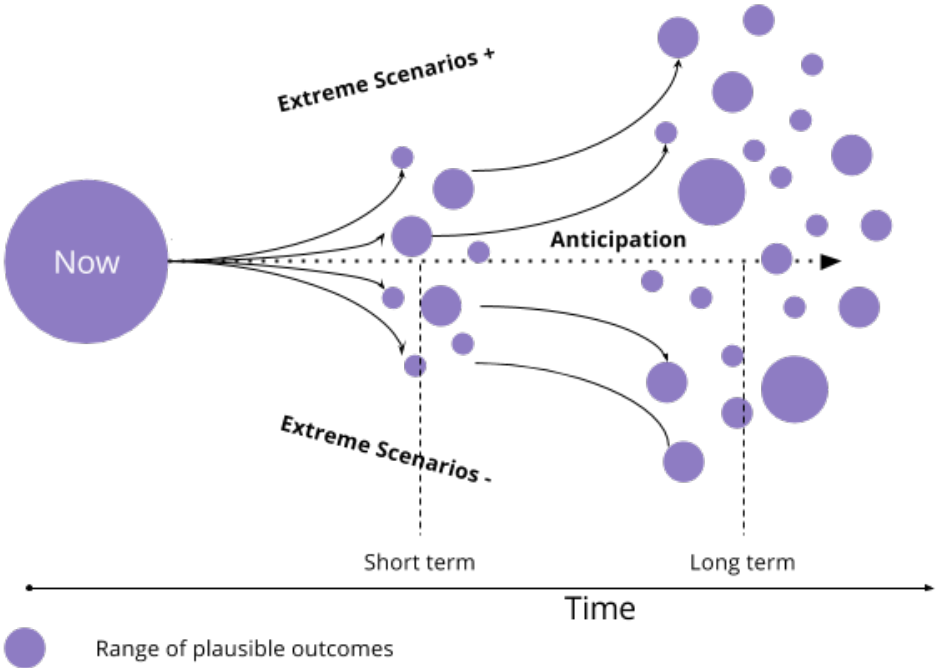


Figure 2.1: Plausible outcomes

2.3 Delphi method

Delphi is one the most notable method for future studies and it has been in use for almost half a century. After the release of first edition of book *the delphi method* by Linsone H and Turoff M, the use of this method has started with a slow phase but then it has thrived, being applied to various academic and business domain for varied applications. As the method has been used in various fields, it has evolved into multiple variants (Rowe and Wright, 2011). So, there is no one definition for this method. But Von der Gracht has collected few definitions from various sources. See figure (2.1).

Definitions of Delphi: A method for obtaining independent forecasts from an expert panel over two or more rounds with summaries of the anonymous forecasts (and perhaps reasons for them) provided after each round.
Delphi is the name of a set of procedures for eliciting and refining the opinions of a group of people. In practice, the procedures would be used with a group of experts or especially knowledgeable individuals.
Delphi is a group process which utilizes written responses as opposed to bringing individuals together ... it means aggregating the judgments of a number of individuals in order to improve the quality of decision making.
The Delphi technique is a judgmental forecasting procedure for obtaining, exchanging, and developing informed opinion about future events.
Delphi may be characterized as a method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem.
A method for the systematic solicitation and collation of informed judgments on a particular topic.

Table 2.1: Definitions of Delphi Methods, Adapted from the book *The Future of Logistics Scenarios for 2025* (Von der Gracht, 2008)

The Delphi method is a repeated process which includes various rounds of interaction with the experts through interviews or questionnaire. The first step involves interview with the participants based on open-ended questions. The primary focus of this round is not to find accurate answers for the questions but rather to find good questions for the next round. The second step is a questionnaire to the experts panel, after everyone responds to the questionnaire, the facilitator summarizes the responses and shares it with the experts and the experts again reiterate their answers based on the summary. This process is repeated until a consensus is achieved between the participants. See figure 2.2.

As Delphi is used to gather data, to fetch minimum quality insights there are four scales that should be used (Linstone et al., 1975), they are:

- Desirability (Effectiveness or Benefits)
- Feasibility (Practicality)
- Importance (Priority or Relevance)

- Confidence (In Validity of Argument or Premise)

The framing of question is critical to convey the argument. There has been few rules and principles on framing the questions. The length of the questions are advised to be in-between 20 to 25 words, as studies have shown that this will motivate the participant to respond (Salancik et al., 1971). As the statements for the question play critical role in conveying the opinion, the common rules for a Delphi researcher for the success of the study depends on the following (D, 2002):

- There must not be any ambiguity.
- Conditional statements that make the primary question depend on the fulfillment of a series of conditions.
- Statements where this occurs should be split into two or more separate statements.
- Any scientific or technological terms must be correct and verifiable;

There has been no mandate on number of participants, but 10 to 50 people are recommended for policy Delphi (Murray, 1970). The most common rounds in the Delphi study has been three, with the first one being pilot interviews.

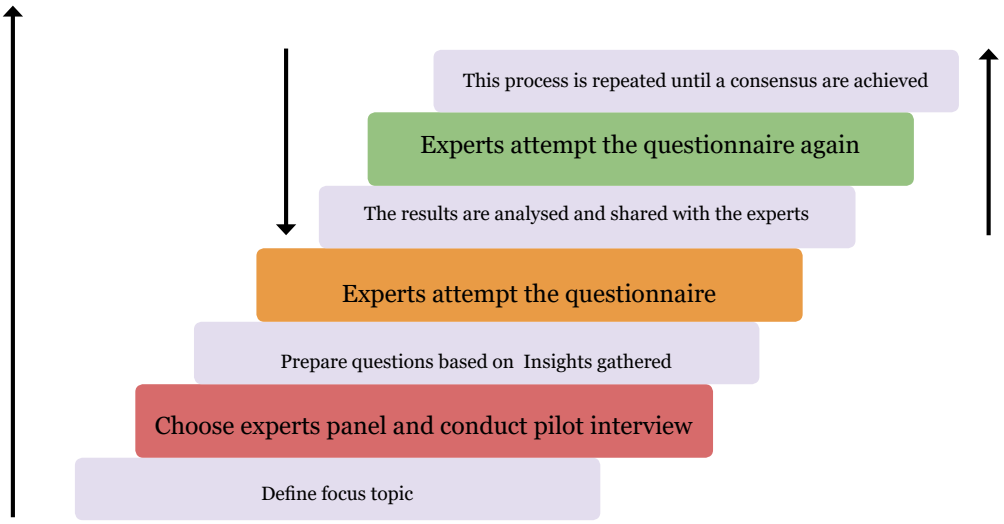


Figure 2.2: Steps in Delphi process

2.4 Scenario planning

Scenario is defined as a sketch about a scene, a plot, or sequence of events in future by Cambridge Dictionary. Using scenario for strategy dates back to Herman Kahn work at RAND corporation in 1961 for military applications at United States Air force. By 1970, various institutes and companies started exploring scenario planning for public policy, social forecasting. One of the critiqued case of usage of scenario planning for strategy application was at Royal Dutch Shell (Schoemaker, 1995*a*).

The goal of scenario making is to enable organizations to develop a strategy that optimizes chances of success under all possible scenarios (Meinert, 2014). Peter schwartz believes that scenario process is very intuitive and independent time should be spent thinking about important issues that come up in the process.

Lindgren and Bandhold argues that scenarios are powerful tools but their limitations restrict from wide application. The following are the reasons that makes scenarios powerful (Lindgren and Bandhold, 2003).

- Human way of thinking: The stories or visions that scenarios show can also be believed, as it is similar to how a human think. The stories or the images can easily be grasped and remembered.
- Showing different possible futures: The different future scenarios will push the mind towards divergent thinking. It further helps to think about the unthinkable and anticipate unusual events
- Easy to communicate: as scenarios are like a scene or visual from future, it is easy to understand.

There are many versions of scenario planning process. As per Polczynski, the following are the steps in scenario planning (Polczynski, 2009).

1. **What problem you are solving.**
   Define the scope and objectives of the thesis. Define the problem being solved.
2. **Gather information.**
   The information is gathered using the research on trends on different areas and from insights from pilot interviews.
3. **Identify driving forces.**
   Schwartz suggests that while planning the scenarios it is important to begin with looking for drivers. Drivers can be trends, mega trends that may originate from political, economic, social, technological, environmental, legal forces (PESTEL or STEEP) (Schoemaker, 1995*b*). These drivers can be from external environment and inside the organization. In these drivers, few will be predetermined and others will be highly uncertain. For this study, the drivers are mapped from different trends that has been discussed in chapter 3, Hello Future, and from the insights from the interviews.
4. **Identify critical uncertainties.**
   Key uncertain drivers which will build into uncertain outcomes in future can be identified by placing each driver on a simple graph with coordinate axes questions

about the happening of the driver and impact of the driver on the subject. See figure (2.3) (Lindgren and Bandhold, 2003)

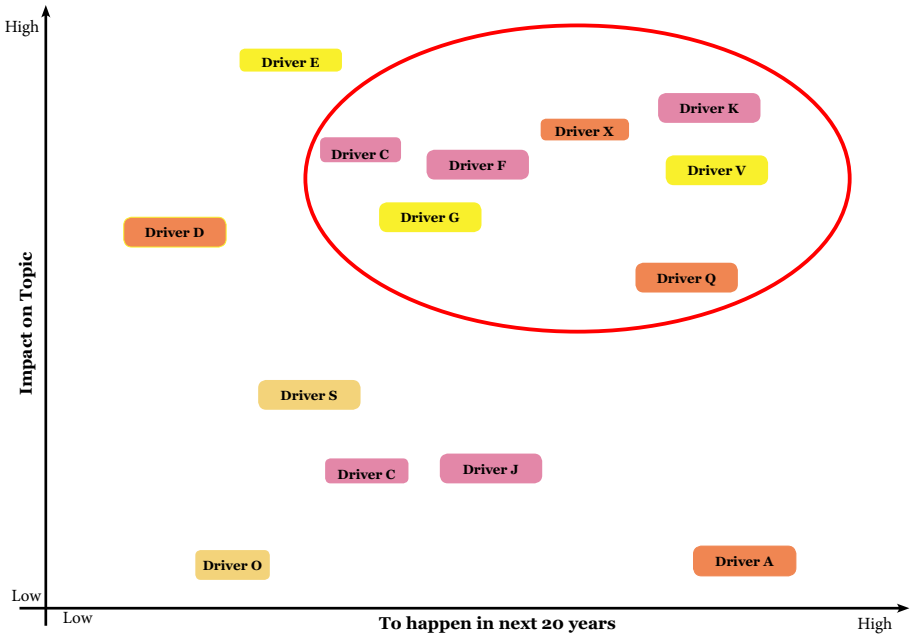


Figure 2.3: Primary model to sort the drivers

5. **Create scenarios**
   Lindgren and Bandhold suggests that the most productive and widely used approach for scenario building is by mapping two drivers on coordinate axes. This will give four scenarios, on in each quadrant formed. It is a time taking and tricky to find two uncertainties when used will give four different scenarios. Trial and error method is being used in the process to find a sensible combination for two drivers. (refer figure 2.4)

6. **Compose stories**
   Polczynski argues that it is important to give a story to each of the four scenarios mapped in the step 5.

7. **Scenarios application**
   Once there are four different variations or the stories, it is important to go back to the research question and validate how these visions give a strategy for each case. However, the scenarios are only stories about future,not strategies.

   Other interesting argument is to take inspiration from design thinking principles in the process.

8. **Identify key indicators**
   Key indicators that help in evaluating the scenarios are identified.

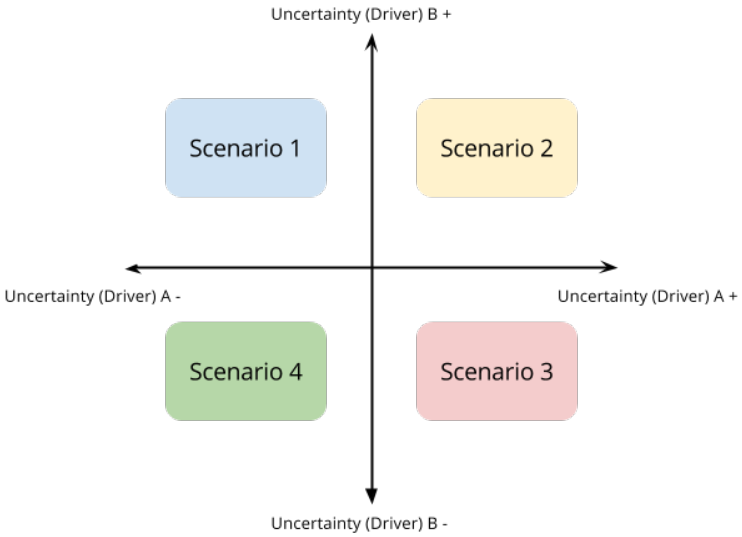


Figure 2.4: Primary model to build scenario

9. **Monitor key indicators**
   The scenarios are then evaluated with respect to the key indicators through a workshop with stakeholders of Design Factory.

10. **Update scenarios and strategies**
    The scenarios are updated based on the feedback from step 9.

2.5 Study process and methodology

For this study, combined approach of data collection and evaluating based on Delphi, as well as visualizing, and testing the results using scenarios was deployed. Brief description of the method can be seen in the figure 2.5. In addition, due to the nature of the topic, this process facilitates a comprehensive approach, while actively involving the participants in the process. The methods used are described in the later chapters. When using Delphi and scenario planning, the qualitative and quantitative methods are complimentary to each other and will bring more value to the study outcome. (Rowe and Wright, 2011),(Banuls and Turoff, 2011),(Nowack et al., 2011),(Tapio et al., 2011).

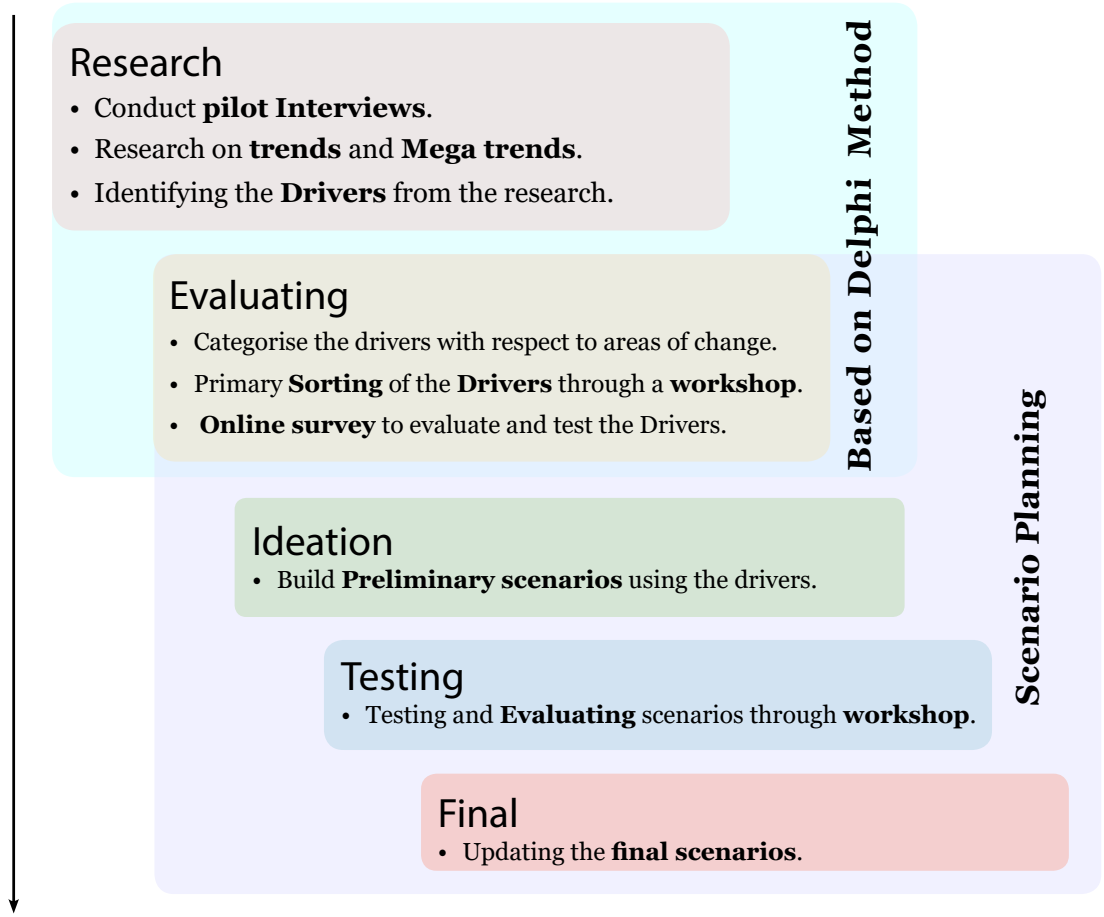


Figure 2.5: Process and methods description

Chapter 3

Hello Future - *where does the trends take us*

Chapter Preview:The previous chapter discussed about the methods that are been used for this future foresight exercise. This chapter outlines in-depth research on various trends and mega trends. Section 3.1 describes current mega trends and section 3.2 describes various trends.

The information about future events, trends, mega trends, issues, insights required for the study are gather through interviews and from various other sources such as similar studies, articles, websites, reports and talks. This process of gathering information on political, economic, societal, technological issues, event and trends is also defined as Environmental scanning(Choo et al., 2001). Elina Hiltunen argues that it is critical to choose topics covering wide areas in scanning process as it is easy to omit other trends or events if the scanning is focused on narrowed areas. For this study, the areas for the scanning are deliberately kept very wide and the basic principle of gathering information is borrowed from the method environmental scanning but the complete method containing various steps is not used.

> Megatrend is a word coined to describe and group a set of changes in our world that are enormous in their impact, and unprecedented in their magnitude. They are global, sustained and macroeconomic forces of development that influence business, economy, society, cultures, and personal lives, defining our future world and its increasing pace of change.
>
> (Charlie Helps FRSA, (Helps, 2016))

3.1 Megatrends

Various organizations such as think-thanks, consultancies, companies, national governments and cities publish various contents on current and future megatrends and trends every year.

The word megatrend was coined and made popular by John Naisbitt in 1989 with a book by same title where he discussed about ten new directions (megatrends) that will have impact on the world in 20th century. Naisbitt defines megatrends as large social, economical, political factors, which take time to take materialize, once they form they will have impact on humans globally for long time. Naisbitt and Aburdene also argues that in timeline of ten to fifteen years, the future human activities are affected by human and technological development powered by megatrends. In addition, it is important to consider them while developing distant future goals or visions (Guemes-Castorena, 2009).The following are the megatrends based on the mentioned sources:

3.1.1 Globalization 2.0

According to Georg Vielmetter, author of the book Leadership 2030, Globalisation 2.0 is radically different from its predecessor, as the global balance of power is shifting towards Asia and to the middle class. In BRICS (Brazil, Russia, India, China, South Africa), the middle class will grow by 150% to 2 billion people (Roland, 2011).

The growth of GDP of developing countries will be four times that of developed countries. By 2030, World GDP will grow to USD 135 Trillion and the exports will grow to USD 45 Trillion.

Beyond BRICS, NEXT 11 (Bangladesh, Egypt, Indonesia, Iran, Mexico, Nigeria, Pakistan, the Philippines, Turkey, South Korea and Vietnam) and NEXT Five (Indonesia, Malaysia, the Philippines, Singapore, and Thailand) are also considered to be growth hubs because of their favorable economic future. (Roland, 2011)

Values of the business practices of new emerging countries are different from west. The Asian management practices and models may become more influential. (Roland, 2011)

Trade between the developing countries will be more sustainable and flourishing. This will also result in leaving the western economies out of loop. Most of the global companies will have the motto of *think global and act local.* (Vielmetter and Sell, 2014)

3.1.2 Climate change

Environmental crisis or global warming: there are more studies now which support that climate change is real. When combined with the running out of critical natural resources like oil, water, and minerals the future scenario is alarming. Further this will trigger to regional and global conflicts. The average global temperature is expected to rise in-between 0.5 to 1.5 degree from 2016 and 2030.

With current business practices in agriculture and expansion of infrastructure by 2050, 7.5 million square kilometers (size of Australia) which constitutes to 11% of natural areas remaining in 2000 could be lost. By 2030, the average Agricultural land available will decrease to 0.4 acre per person, which is 0.5 acre today and was 0.8 acre

in 1960. By 2050, the cost of dealing with extreme weather would reach to 0.5% to 1% GDP per year.

Companies will revamp their brand values and will take advantage of opportunities that emerged due to climate change. They will clearly communicate their achievements in terms of environmental activities and will launch new eco-friendly products, technologies, and services. (Roland, 2011)

3.1.3 Demographic change, *urbanization, immigration, family structure*

In developed countries, 60+ age group will constitute to 29% of total population and they will be healthier than today. This will bring the need for products and services adaptable for them. By 2030, 8.3 billion people will be living on earth. In developed countries, 80% of total population will live in cities and in developing countries it will be 55% (Roland, 2011). For example, people from small cities in Finland will move to big cities like Helsinki. In Helsinki, immigration is expected to rise to 300,000 by 2030 (Dunne and Soila, 2013).

The foresight expert Fiona Bennie in her study *Future of Family* envisions the future of family structure in 2030. The following are the insights from her study. (Bennie, 2013)

- **Community living**
  The families with single parent will share one family home with their own private space within the house and share the common spaces like kitchen and living room. This co-living house is a element of a big community where facilities are shared supporting low cost, and collective living.

- **Wanderer, High service and Low ownership** home
  People will live in flexible homes around the world. That is, the nomadic professionals that travel around the world while working, don't have to move their baggage with them. For example, a person can take flexible home renting, can live in any location around the world.

- **Multi-generations**, The 70 years generation
  In order to support the interaction between generations, multi-generation of the family live together in a family. These families live in community centric villages, so they support active lifestyle and they exchange living arrangements. Income can also be made through day-to-day activities in local community by exchanging and using their skills and experience.

- **Hyper-connected living** in rural communities

  The local communities are almost self-sufficient with local available resources in food and energy, which are supported by high technology. The 3D printer movement will drive the local manufacturing supported by social relations.

3.1.4 Technological convergence

The current smart or connected systems or products are being derived by convergence of technology player in telecom, energy, infrastructure, automation, building control, information technology players (Singh, 2012). This is making the objects connected such as, connected homes, connected cities, connected infrastructure, connected energy, connected mobility, connected buildings,and connected textile. Further ahead, advanced technologies in nanotechnology, biotechnology, information and cognitive sciences will come together and help to build more efficient products. The collaboration between different disciplines, companies, and silos will foster new era of innovations in medicine, communications, manufacturing, energy, food production and more(Vielmetter and Sell, 2014).

Futurist Christopher Barnatt believes that in next 20 years advances in nanotechnology, genetic engineering, and bio computers will drive the new industrial convergence around manufacturing, medicine, and media. He compares it to the convergence that started in 1980 in the fields of communication, computing, and content creation and their impact in 2000 (Barnatt, 2016).

3.1.5 Digital world

Over the hype of digitization, the interactions between people, products, and planet are expected to yield new digital hyper-connected world. In addition, similar scenario in the industry is anticipated where the industry internet or industry 4.0 which involves connecting the machine, factories and supply chain also aims to bring the industry into digital world. Ernst & Young believes that the convergence of mobile cloud, social and the need for accessing information anytime anywhere is redefining the businesses and is driving the digital future. (Ernst and Young, 2015)

Business Insider in the article *21 technology tipping points we will reach by 2030* emphasizes on how the digital world would look like. The following are few of those insights from the article.(Thompson, 2015)

- BY 2018, 90% of the population will have access to free and unlimited data storage.
- By 2022, 1 trillion sensors will join the Internet. Connected clothes will reach to 10% of world's population.
- By 2025, smart phone can be implanted into body.
- By 2023, big-data driven and block-chain technologies will have impact on government policies.
- By 2023, 80% of world population will have online digital presence.
- 3D printed consumer products will constitute to over 5% of total consumer products.
- 10% of cars in United States will be autonomous.
- By 2026, Artificial intelligence powered machine will join a corporate board of directors.

- The smart city with no traffic lights, automated energy, material flow, waste handling, connected house and more will come into existence.

Currently the virtual reality, augmented reality or mixed reality are focused on games. However, in future it is anticipated to reach wider audience. Adario strange describes his experience of spending two weeks in social virtual reality network as the future. With big investments by companies like Facebook it not far from future that Virtual world will be reality.(Strange, 2017)

3.2 Trends

Trend is a very common word, which exists in various forms and that used to define from social media to stock market. According to oxford dictionaries the origin of the word trend comes from old English *Trendan* which means rotate or revolve. In its verb sense, trend is defined as adapt or evolve in a general direction. Trends are short-term events, that impact humans more locally compare to mega trends. In this topic, the trends on various areas are gathered.

> Workplaces will be digital, integrated and, fundamentally, built around you and me, and less about time and more about insight through data and collaboration.
>
> (Workplace 2030: Built for us, Deloitte)

3.2.1 Trends in future workspace

The purpose of having a workspace is to encourage collaboration and find right people at the right time. In last few years, there has been various changes such as moving from suit and tie to shorts and loafers, people rather committing to one job to jump from one to another within year. The following trends are anticipated to have an impact on workplaces.

- As the physical distance between city and work-space is getting smaller and smaller, it will converge as the towers and campuses co-working space in suburbs. Large corporations will also be taking an important role in this activity to move from headquarters to co-working and support communities around them. Not only will employer will play a critical role but also the cities, to attract the next generation workforce, as they constitute to half of the workforce by 2020.
- Moving from Traditional offices to Community co-working spaces (Gensler, 2014) (Slater and Granite, 2015)
  - The ability of combining big data and the demand by millennials will yield the spaces to be more transparent, nimble, and dynamic.
  - The workplace will also act as inspiration for the employees.
  - The workspace will be more like home to personalize.
  - The workspace will act as place to connect right people, right time, and right service.
  - In 2017, the co-working space are expected to increase by 22% worldwide.
- The **maker revolution**, back to local manufacturing: As 3D printers are becoming more able and readily available, they are adding artisanal element to fabrication and further, this will reshape the mainstream manufacturing (Gensler, 2014).

- Research lab-2.0, More **flexible, modular, and integrated lab**: To support the product teams and to not lose the momentum to innovate the labs will be more compact, modular, flexible and integrated with larger workspace (Gensler, 2014).

- **Health and well-being continues at workplace**: Already 10,000 companies worldwide provided their employees with the fitness trackers. The direct benefits of personal well-being of an employee to productive work has been given importance by the management and this will continue in future (Stranger, 2016) (Fox and O'Connor, 2015).

- **Freelancing websites, the new labor unions**: Due to availability of cloud computing and access to pool of skillful freelancer websites are redefining the traditional model to get the work done. By 2025, 540 million workers may use these freelancing platforms to earn living (James Manyika and Dobbs, 2015).

- **Retirement age vs capability**: People are expected to live longer in the future and the retirement does not depend on the age but their capability to work. In United Kingdom, the retirement age will be raised to 67 by 2028 (Stranger, 2016) (Fox and O'Connor, 2015).

- Corporate **Ladder** to corporate **Lattice**: In the last 25 years, companies have become more horizontal and flexible compared to traditional vertical ladder. Due to the diversity in work opportunities, availability of knowledge and resources, employees cannot be restricted to a fixed place and job. The traditional corporate ladder is moving towards a lattice model where employees can jump from one discipline to another, or directly interact with the management without going through systematically (Benko and Anderson, 2010)

- Robots and Artificial intelligence taking over the boring jobs, and it is not a best-kept secret anymore. If all these forecasts are true, robots might be taking over 40 to 70 million jobs worldwide by 2025 (Michael Chui and Miremadi, 2016).

- Need for new approach which should be based on **more creativity and knowledge**: As the robots and artificial intelligence will be taking over the routine jobs there will be demand for creative jobs. Humans with more creative knowledge, who can work together with robots are preferred.

3.2.2 Trends in future job title

Autodesk has envisioned that the design and engineering jobs in 2030 will be highly influenced by advanced technologies such as robotics, 3D printing, artificial intelligence, and generative design. It believes that the technology will free the worker from repetitive and hazardous job, which will help workers to concentrate on high value activities. The following are the job titles Autodesk believes to be possible by 2030. (Autodesk, 2016)

- **Robot Trainer**
  The need for human collaborating with robot will increase as robots are taking more wider jobs. The robots will work alongside with humans and human trainers will help the robots to learn and understand doing complex tasks.

- **Sensor System Integrator**
  As every product that is built will have a sensor and must talk to each other and the main hub, integrating the entire sensor and building a dynamic and organic communication like systems thinking will be a challenge and an opportunity

- **Generative Designer**
  A more optimized solution can be made by using the artificial intelligence based generative design software. The designer will take the help of artificial intelligence based generative design software that suggests tens of thousands of design options based on defined criteria.

- **3D Print Specialist**

  Today 3D printers have reached the capabilities to handle metals, composites, and other materials. With more advancements in hardware and software, the 3D printing or additive manufacturing will be widely available. This will bring the opportunity for the 3D print specialists.

- **Augmented reality/Virtual reality Experience Curator**

  Already Pokemon-go has moved the people out of the couch. The possibility of augmented reality and virtual reality are beyond games and studios. The building design, automotive design, training simulators and education are few of the design and engineering applications of augmented reality and virtual reality.

- **Synthetic Biologist**

  Unlike today, where this domain is restricted to scientists, in future it will be more promising as synthesizing DNA (Deoxyribonucleic acid) is becoming less expensive. The bold thinkers and engineers will leverage this profession's expertise to build microscopic things.

Futurist Thomas Frey argues that the higher education is inclined more towards educating the students on current jobs. As per his thumb rule on future jobs, 60% of the jobs that will be in 10 years from now are not yet invented (Frey, 2011). A study by Fast future, *The shape of jobs to come* gives more elaborate arguments on what kind of jobs are expected to present by 2030. The study has mapped in total 110 future jobs with respect to the various fields of studies. The following are future job titles mapped by the cited sources. (Talwar and Hancock, 2010) (Sodexo, 2014)

- Body part maker
- Nano medic
- Farmer of genetically engineered crops and livestock
- Old age wellness manager
- Memory augmentation surgeon
- New Science ethicist
- Space pilots, architects and tour guides
- Vertical farmers
- Climate change reversal specialist
- Quarantine enforcer
- Weather modification police
- Virtual lawyer
- Avatar manager
- Alternative vehicle developers
- Waste data handler
- Virtual clutter organizer
- Time broker/ time bank trader
- Social networking worker
- Personal brander
- Urban agriculturalists
- Business colony managers
- Competition producers
- 3D Food-printer engineers
- Book-to-app converters
- Social education specialists
- Privacy managers
- Wind Turbine repair technicians
- Data hostage specialists
- Smart dust programmers
- Personality services
- Smart contact developers
- Tube transport engineers
- Drone dispatchers
- Mass energy storage developers
- Nostalgist
- Telesurgeon
- Rewilder
- Garbage designer
- Simplicity expert
- Healthcare navigator
- End of life therapist
- Gamification designer
- Robot Counsellor
- Corporate disorganizer
- Un-schooling counselor
- The urban shepherd
- Space pilots, tour guides
- Transhumanist consultant

3.2.3 Trends in future skills

One question, which got me an unexpected answer from various people in my interviews is about the future skills that industry expects to have for the graduates. Most of the answers stated the need for the graduate to have the basic skills that have not changed from decades.

As per report, *Future Work Skills 2020* by Institute for the Future, there are six drivers for future skills. They are extreme longevity, rise of smart machine and systems, computational world, new media ecology, superstructure organizations, global connected world. Based on these drivers the report suggests the following 10 skills people should have in future. (Davies et al., 2011)

Sense making ability to determine the deeper meaning or significance of what is being expressed.
Social intelligence: ability to connect to others in a deep and direct way, to sense and stimulate reactions and desired interactions.
Novel and Adaptive thinking: proficiency at thinking and coming up with solutions and responses beyond that which is rote or rule-based.
Cross cultural competency: ability to operate in different cultural settings.
Computational thinking: ability to translate vast amounts of data into abstract concepts and to understand data-based reasoning.
New media literacy: ability to critically assess and develop content that uses new media forms, and to leverage these media for persuasive communication.
Trans-disciplinarity: literacy in and ability to understand concepts across multiple disciplines.
Design mindset: ability to represent and develop tasks and work processes for desired outcomes.
Cognitive load management: ability to discriminate and filter information for importance, and to understand how to maximize cognitive functioning using a variety of tools and techniques.
Virtual collaboration: ability to work productively, drive engagement, and demonstrate presence as a member of a virtual team.

Table 3.1: 10 skills people should have in future, Adapted from report Future Work Skills 2020.

3.2.4 Trends in future food

No wonder why Britain have top spot for chicken tikka masala in their top food favorite list. How did an Indian Recipe ended there ?. Last century trends influencing our food were because of globalization, fast food, and diversity. A report *Eating IN* 2030 by Barilla center for food and nutrition foundation argues that the following evolving trends will be influencing the food we eat in future. *Taste, caring for health, orientation to the past, orientation to the future, technology, naturalness, globalization of flavors, local and regional food, luxury food, low cost food, speed, individualism, sustainability* (Barilla, 2012). Following are the some of the major trends for future food:

- **Non-GMOs**: As the public demand for organic and genuine is taking momentum, the food will be more clearly labelled of their family and type. (Paulas, 2014)
- **Insect based Food**: Eating insects is common in some of the cultures; because farming insects is sustainable, there will more restaurants and retailers selling insect based food.
- **Plant-based meat like foods**: The start-ups like *Beyond meat* and *Impossible Foods* are reinventing the meat and dairy by replacing the meat with so called plant based meat (Robinson, 2016).
- **Drinking Meals**: Gone are the days of meal pills, the drinks like *Soylent* are tasted by more than 1 million and the start-ups like *Ambronite* are taking them to the mainstream (Robinson, 2016).
- **Lab grown food**: It is a half century old idea, but recent advances in the research and many companies like *Memphis Meats* are aiming to bring to mainstream in next few years (Belan, 2015).
- **Digital and Data driven experience** in Bars and restaurants: The technology will give access to the data about personal preferences of customer and businesses will use this to offer more data driven services apart from food or drinks (Belan, 2015).
- **3D printed Food**: 3D printing has already found a place on the shop floor in many of the manufacturing companies, the recent attempts to 3d print the food will go mainstream in future disrupting the food ecosystem (Belan, 2015).
- **Robots and Big Data** will be making your personalized burger or pizza: Robots are helping everywhere to make the job easy or to save extra money; it is more common to see future robots serving and taking some jobs in smart kitchen. With companies like *Zume Pizza* who are already experimenting with using robots to make pizza, this will be mainstream in future (Robinson, 2016).

3.2.5 Trends in science

In his study, Roger Highfield has asked various experts about the vision of tomorrow's science. Following are visions from his report. (Highfield, 2007)

- **Back to nature** - Plants make their food by directly using sunlight, Dr Andreas Mershin at Massachusetts Institute of Technology has the goal to find the alternative to silicon based solar panels and develop paint like material that can be applied to any surface, and when exposed to light, produces electricity.
- Nano technologies are not only assisting in reducing the size factor but also bringing more wider applications. Dr John Alexander says that on battlefield, nanorobots are going to do lot of things from seeking and destroying targets to repairing clogged blood vessels.

- Biology, in 2016 CRISPR(clustered regularly interspaced short palindromic repeats) - gene-editing tools are used on to treat human. Ray Kurzweil argues that in next 10 - 15 years we will have the method to reprogram our biology towards disease free world.
- Beyond GMO(genetically modified organism) - the synths. Can we build an organism? Seems possible. The recent advancements in synthetic biotechnology are giving a way to build synthetic organisms. These modified organisms could help in various field such as to manufacture better biochemicals, bio-fuels and bio electronics.
- The search for Holy Grail of human longevity goes back to ancient times. Prof Leonard Hayflick argues about how one must think seriously about altering the aging process and where it leads us.
- Virtual reality, 2017 will be the year when virtual reality is expected to be a reality, and we are ready to enter in to virtual world. Jaron Lanier says the simplicity and possibility to integrate virtual reality into human body are raising questions about our identity, social networks, and family relations.
- Robot with human feelings, human with robotic power -Advancements in prosthetics is giving new power to disabled people and it has become widespread making humans more machine like. In addition, the robots have been powered with muscle and other biological components. Prof Rodney Brooks argues that in next 40 years, robots with more biological components and humans with electronic components will be common.

3.2.6 Trends in artificial intelligence

> Finland wants to be world's number one in artificial intelligence
>
> (Samuel Kaski, Aalto news)

Human from the age of caveman is trying to automate the repetitive jobs that they perform. In the 18th century, he has automated the jobs using steam power, in 19th century using modern machinery and in 21st Artificial intelligence is taking the role. Artificial Intelligence is expected to do the same thing what the machines has done in the last century, replacing the repetitive jobs, or doing the job efficiently than humans.

The origin of the term AI - Artificial Intelligence goes back to 1956 when the future leaders of Artificial intelligence research have met for a conference. The Artificial intelligence is defined as the science with computational approach based on human intelligence to sense, master, and justify the decision making. Due to advances in computing power and academic research, Artificial intelligence is expected to have high impact on society and human life. By 2017, Artificial intelligence has found applications in various fields such as app that turn picture into art, self-driving cars, health-care diagnostics, forecasting the heart failure, designing structural nodes, editing the movies and as an Assistant to us in our digital world.(Stone et al., 2016)

Due to recent advances in Artificial intelligence, companies and computer scientists are now keener on the three laws of robotics that were defined by Isaac Asimov. Microsoft chief executive officer, Satya Nadella believes that the following principles or the goals will help the Artificial Intelligence research to be ethical to society (Vincent, 2016).

- Artificial Intelligence must be designed to assist humanity.
- Artificial Intelligence must be transparent.
- Artificial Intelligence must be designed for intelligent privacy.
- Artificial Intelligence must maximize efficiencies without destroying the dignity of people.
- Artificial Intelligence must have algorithmic accountability.
- Artificial Intelligence must guard against bias.

According to the report *Artificial Intelligence and life in 2030*, the following are few fields that have been chosen which already have and expected to have high impact on human living and society.

Self-driving power: In 2016, most of the automotive makers had at least few concept self-driving cars, which are anticipated to hit the road by 2021 (Muoio, 2016). Market researcher Berg Insight believes that by 2030 there will be 71 million self-driving cars on the roads. This are expected to expand other fields such as trucks, delivery vehicles, flying drones and more.

Transportation planning / city planning: The availability of large data and machine learning applications are paving the path to develop dynamic strategies for optimized and effective services for the cities. Already start-up *Starship* has been testing the delivery robots on London streets and Amazon has been testing the drone delivery in UK, this could be more common in future. The increase of connected vehicles, and connected infrastructure in future will help to reach high level of safety and offer more reliable transportation services by cities.

Making automotive systems smarter: The cars compared to decade ago have been safer, more robust, and more dependable. From the introduction of Global Positioning System to current more advanced real time sensing for collision detection, traction, and cruise control, have been and will continue to be supported by deep learning Artificial Intelligence.

Talk to me: Already today, cars have the assistance systems that alert when the drivers gets distracted and smart phones and household devices have assistance systems built-in. In future, this interaction will be more organic. The advanced algorithms will sense and learn directly from human interaction. For example, through the concept car NeuV, Honda believes to give the cars more intractive with feel human emotions (Debord, 2016). This will further expand to other fields like home and service robotics, personal robots, virtual avatars and more.

Health-care: The report considers that Artificial Intelligence influence on health care is most favorable and optimistic compared to other seven domains. Artificial Intelligence powered applications will help in yielding better health results and living

conditions for millions of people. For example, United Kingdom Medical council team has used Artificial intelligence system to forecast the death of the patient with heart disorder (Gallagher, 2017). The Artificial Intelligence powered clinician's assistants, health-care analytics, health-care robotics, mobile health services, and elderly care will support us in physical, mental, emotional well-being in future.

3.2.7 Trends in education and learning

Sugata Mitra believes that the current education system is based on methodology from medieval age of empires, where platoons of people in a military style are trained to get to know what they must do and how they must to do. He believes education trends can be compared to that of mobility. For example. how a *horse* couch with couch man changed to a *car* where passenger is the driver and how there is no need of driver in future *driver-less cars*. To support his argument, he throws light on how learning and teaching are not anymore, the trendiest words on google search. He anticipates that a teacher should never teach the kid, they would be only a facilitator in unstructured and self-organized environments. The main challenge according to him is hesitation of parents to adapt to and believe in the new education system. (Mitra, 2015) The following are the insights gathered from various cited sources.

- Moving from teacher centric classroom to student centric, and the dominance of technology will help to develop customize and personalize learning for each student. It is challenging to have active human resources all the time to provide quality education. But due to advance technology use such as Artificial Intelligence assisted learning tools, it will be possible to facilitate high quality student centric personalized education. (Stone et al., 2016)

- Higher Education institutions are *go to* spaces for knowledge creation and solving global or local issues (Taylor, 2015). Wide access to online education platforms such as Moodle, MOOC, Coursera, edX are now reaching the masses. Most of the top universities now support these platforms by offering courses and recognizing them in student curriculum. This helps in finding a balance between online courses and academic in universities strategy (Lukanic, 2015).

- In 2016, the workforce with skills required to support self-driving cars was not widely available. This has led to formation of collaborative ventures like Udacity, and more university like programs by industry. Udacity, which promotes itself as university by industry offers *nanodegrees* for upcoming and demanding skills while collaborating with industry partners. (Udacity, 2017)

3.2.8 Future user

Half of the workforce by year 2020 will be from millennial's, generation Y or Z and by 2030, it will be generation alpha (PricewaterhouseCoopers, 2011) (McCrindle, 2009). However, how does these people are differ from other human generations?

Futurist Mark McCrindle's research group has coined the word generation alpha for anyone born after 2010 until 2030. Born to the age of touchscreen, YouTube and Instagram will grow up with smart-phone and will be sharing their thoughts to the world in seconds. They will be work on multi-screen, multi task and glass will be the their medium for interaction unlike paper. McCrindle believes that generation alpha will be the most metamorphic generation due to technological change. (McCrindle, 2009)

There are also many speculations made about the alpha generation characteristics, and following are the insights: (Berkowitz, 2016) (Schawbel, 2014)

- **Mine and it's all Mine**: Generation alpha are most likely want to own for themselves. They are not a prone to sharing things.
- **I Sit or I Rush**: They are believed to be very active when they are not stationary and vice-versa.
- **You know me all**: They do not mind to share their information and do not bother about privacy.
- **I'm not the Same**: These people are assumed to change their behavior all the time.
- **More ambitious**: As access to information, people, and resources, generation Alpha are expected to be more entrepreneurial successful.
- **Shop Online, less human contact**: Generation alpha as expected will be most connected generation, which spends more time online, and less time talking to humans in person.
- **Self-sufficient, better education and ready for big challenges**: The access to more information regarding challenges in the world will make them to be ready for facing big problems. They would prefer cheap or free online learning rather than expensive higher education.
- **Social media**: It hard for Generation alpha to believe the world without social media. To him or her, every word and information will come social media.

3.2.9 Trends in future creative ways of working

Maurice Contie in his talk on the incredible inventions of intuitive Artificial intelligence on how creative ways of working will change argues that in the next 20 years *we will radically change our ways of working compare to the way we worked in last 2000 years.* With respect to our ways of working going back to caveman/hunter age which lasted for couple of million years, the agriculture age which lasted for thousands of years, the industrial age which lasted for centuries, the information age which lasted few decade, the next is argument age. He believes that in this argument age, the natural human capabilities will be amplified by computational systems, robots support in making digital nervous system that bridges human to the world above the natural senses. He classifies the design ways of working into following.

Passive design: design systems did what we have directed them to do. For example, the chisel scarves where it is pointed to.

Generative design: these design systems takes the goals and uses computational power and algorithms to synthesis forming a shape with new design by themselves. He further explains on how the algorithms are designed based on evolution in nature to develop a new design.

Intuitive design: these design systems develop their intuition using deep learning systems by learning from the scratch and use reasoning rather than logic to take decision. These systems can be used to design things, which are beyond the reach of human power.
Further ahead, he argues that in this augmented age we will be moving from manufacturing things to farming, from being constructed to grown, from being isolated to being connected, from extraction to embrace aggregation and from being obedient to valuing autonomy. (Conti, 2017) (Duckworth, 2017)

Yury Vetrov, shares his insights about how these algorithm driven design or artificial intelligence systems will have impact on creative process of digital, product, industrial designers. Already major content publishing platforms such as Medium, Readymag, and Squarespace have introduced simple systems which help user to pick from various templates. The website constructors Wix and the Grid have algorithm driven features which helps to suggest the style, layout and templates. In this age of augmentation of human abilities, Roelof Pieters and Samim Winiger have suggested the following will be the advancements of design systems.

First generation: Design systems will imitate the digital shape of the correspondent analogue systems. **Second generation**: Assisted creation systems: Design systems will assist the creation process. For example, in creative process, the machine and humans will debate and have a closed feedback loop. **Third generation**: Assisted creation systems 3.0: While learning the skills to become expert from beginner, design systems will optimize detailed conversations using argumentative capabilities.

1. Gathering the valuable problem for the company or business and users to solve while exploring the problem boundaries.(Analysis).

2. Choosing the best solution to resolve the problem and exploring the solution boundaries (Analysis).

3. Develop a product that addresses this problem and launch in to the market.(Synthesis).

4. Evaluate on how the product works and how the real user adopts the product and refine the product. (Analysis and synthesis).

5. Combine and consolidate the solution with other solutions of the business.(Synthesis).

Further ahead Yury suggests on how designers and design systems can collaborate, and he envisions the working process of digital product designers as analysis and synthesis steps.

Analysis

Trained algorithms analyze the essential expressed information. The human (analysts) first start training the algorithms with defining (from the designer) the limitations and variables. With close loop feedback, the users are used to test and refine the outcomes.

Synthesis

Generative design which is defined as a process that mimics the evolution in nature by taking the design goals and finding the best solution by exploring all the possible solution (Fischer, 2001). It has already been used in some industries such as performance, industrial design, fashion and architecture. In 2016, Autodesk Dreamcatcher which is widely used by industrial designers has attracted attention due it is capability to support generative design principles. As designer defines the limitation, variable and guidelines in overall generative process, the following could be the possible working process to synthesis the solutions using algorithm driven design systems.

1. Considering pre-determined guidelines and variables, the algorithm generates variations of solutions.

2. Based on the requirements and design quality, the variations are filtered.

3. Most compelling and suitable variations are picked and refined by designers and managers.

4. The picked variations are tested in different conditions using design system and then the human choose the most promising solution.

(Vetrov, 2017) (Roelof Pieters, 2016)

Chapter 4

Past and present innovation ecosystems

Chapter preview: The previous chapter outlines various trends and megatrends. This chapter introduces the concept of innovation ecosystems. Section 4.1 define the concept of innovation ecosystem and describes the 500-year-old innovation ecosystem and explains the arguments behind the success. Section 4.2 presents case for the study, the Design Factory.

4.1 Innovation ecosystem

In nature, an ecosystem is an atmosphere involving all the living things and non- living components such as sunlight, soil, water, and air with which the living things interact. Today, an innovation ecosystem in terms of economic value contains economic decision makers such as government, businesses (producers) and consumers, as well as non-economic factors such as culture, knowledge, organizations, and social interaction. These non-economic factors play important role in aiding and fostering idea creation, and in initiating and distributing innovation among all the actors. An active and advanced innovation ecosystem facilitates members to cooperate beyond traditional limitations and enables knowledge into innovation. (Mercan and Goktas, 2011) For example, today active members in most of the ecosystems are venture capitalist, scientists, engineers, technology integrators, visionaries, entrepreneurs, etc. These members are spread around a research institution, with their skills and activities, an ethical series of capital formation and redistribution aids in a symbiotic existence and development.

4.1.1 500-year-old innovation ecosystem

Design Factory being an experimental ecosystem, strives for empirical changes and educating the change makers. In this research, Design Factory is taken as case study to anticipate futures for future innovative experimental ecosystems with the focus on educating and supporting the students. These innovation ecosystems are not new; learning from the history, Renaissance Florence was a comparative model for innovation and is a good example to take inspiration to build next generation Innovation Hubs. The Renaissance, the cultural movement was considered as the link between medieval and

modern period. It has influenced European intellectual life to frame and modernize understanding of humanity, art, science, music, religion, self- awareness (Brotton, 2006). The origins of renaissance go back to 13th century Florence, which then spread to Italy and later to rest of Europe. However, what triggered this movement?.

Eric Weiner argues that compare to silicon valley, renaissance Florence was a better model for Innovation and is a better example to take inspiration to build next generation innovation hubs. He believes that following are few lessons we can learn today that are relevant and valuable.

- **Guardianship of Talent** / Backing talent / Aiding talent: The Italian Baking family, the House of Medici were instrumental in locating talent. Eric explains how Lorenzo Medici has took a talented boy from the streets and invited him to his residence, supported him. This boy later became Michelangelo. The Medici's were not always generous, before investing on any talent, they have considered and calculated risks and then aided. Similarly, unlike charity, cities, organization, and wealthy individuals must consider in aiding the new talent with some expectations for common benefit.

- **Mentor and Mentees**: The relationship between mentor and mentees were long term and more meaningful compare to now. Eric elaborates how Leonardo da Vinci was an apprentice in Florentine bottega, or workshop run by Andrea Del Verrocchio an artist and businessperson. Leonardo spend more than a decade, starting from cleaning the floors and raised to paint portions of Verrocchio artwork. Leonardo could easily found another job rather than spending time in murky workshop but he saw value in learning there.

- **Potential Wins over Experience**: When it comes to solve or achieve mysterious and incredible talent and potential are important compare to experience. Eric explains how Pope Julius II was right in believing in Michelangelo who was then a sculptor in Rome but had no experience in painting was assigned to paint the ceiling of the Sistine Chapel.

- **Catastrophe generates new possibilities**: Rather than restoring the old fame, it is required to take advantage of the disaster to build perfectly new from the scratch. At the time when Black Death had wiped out the city Florence, the innovators had chance to think about where to find opportunity among pain and what did yield from this. After these kind of efforts, the city's Renaissance had bloomed after few decades from the happening of Black Death, according to Eric.

- **Cradling and accepting the competition**: Valuing both the winners and losers so that they will learn from it. Florentines acknowledged the importance of having an active competition. The two legend's of the age, Leonardo, and Michelangelo, could not digest each other but the competition and appreciation from the city has pushed them to yield exceptional work.

- **Exploring and Blending Ideas**: Importance of introducing new ideas and fresh talents and figures on regular basis. Eric talks about how the Florentines were keen on investing in exploring different cultures and history for inspiration to nurture and synthesize new ideas. Also, then board committee was keen on

> replacing the leadership regularly as they believed that creative attempt to find and implement new ideas won't be extirpate as fast as compared to pride or satisfaction or laziness. They recognized that innovation involves a synthesis of ideas, some new, some borrowed, and there is nothing wrong with that. (Weiner, 2016)

4.1.2 *Bottega*, innovative co-working spaces

There were barely 14 co-working spaces that have existed in 2007. By 2016, there are 11,100 co-working spaces around the world and are forecasted to rise to 26,078 by 2020 being used by 3.8 million members. (Steve, 2016)

The previous topic has described how the whole ecosystem was striving for innovation. As Design Factory shares the principles of a co-working physical space, this topic will give the insights on how the co- working spaces or bottega's, the Renaissance workshops where supporting the ecosystem with their innovative practices.

The function of shared spaces goes back to 500 years old idea of the Renaissance *bottega* or workshop in Florence where the master (capobottega) is the underwriter to client and take the responsibility of quality and consistency of the work. New artists, new talents, new techniques, and new artistic styles have origin while working together and by challenging among themselves. The workshops that belongs to the artists, craftsmen, businessman where the physical spaces that were responsible for shaping the Renaissance and to place knowledge at the heart of value creation.

The Renaissance communities were defined and given shape in these workshops as these workshops were meeting and working space for all the contributors or stakeholders such as painters, sculptors, other artists, architects, mathematicians, engineers, anatomists, scientists, and rich merchants (sponsors). The outcome resulted in creating entirely new ways of working, designing, and developing new products and services and new breed of entrepreneurship. Piero believes that to build innovative and collaborative workplaces we can learn from the bottega's of the Renaissance. He suggests that the following are the principles that made bottega's successful.(Formica, 2016)

- Ideas to Action: Bottega's were the hotbed for generating new ideas and further building and nurturing them to become into economic values.
- Promoting the communication between the talents: Existence and clashing of different talents in one space have resulted the workshops to be places that are more active and yielded the disagreements to more productive and practical.
- Aiding to bridge the gap between art and science: Bottega's could have holistic vision to creativity and innovation. This was because rather than only artistic they were trans-disciplinary.

4.2 Design Factory

The story of Aalto Design Factory originates from an interdisciplinary course called Product Development Project offered to students by Laboratory of Machine Design at the Helsinki University of Technology (HUT) in 1997. To prototype the vision of future interdisciplinary cooperation and education, a research project Future Lab of Product Design (FLPD) was launched in 2006. FLPD was a physical platform for interdisciplinary co-operation, and "Educate the world's best product designers". By 2008, it was scaled-up and named as Design Factory, one of the spearhead projects of the forthcoming Aalto University, which was formed in 2010. By 2016, Design Factory has grown to be an influential ecosystem in Aalto University and wider society by being a passion based co-creation platform. Through its passion and problem-based learning approach, it is flourishing not only as an ideal place to experiment and develop ideas and, bring people together, but also uniting people internationally through building a global network, giving freedom to explore and building ideas and redefining the way we work. (Bjorklund et al., 2011)

In 2015 - 2016, Aalto Design Factory supported 42+ courses, 1500+ students and 35+ teachers and has grown to Design Factory Global Network with 21 Design Factories in 2017. acting as innovation hubs in universities and research organizations around the world. The ecosystem is supporting various stakeholders such as, students, industry partners, research community, startup enthusiasts, city, and many more. The aim of Aalto Design Factory is to act as an experimenting platform for all stakeholders in the community. The main community members in Aalto Design Factory are Aalto University teachers, students, researchers, and external company/organization representatives.

Teachers consider Design Factory as facility which inspires and encourages teachers to teach students with more hands-on group works and interactive based teaching methods while solving real life problems. Student joins the Aalto Design Factory while taking multi-disciplinary courses that are organized and offered at Design Factory. Students enjoy the relaxed working culture which gives them freedom to explore while learning to solve real life problem in a team. Researchers in-house make use of the dynamic community and activities to perform applied research and make possible collaborations. The company/organization representatives consider Design Factory as a place of inspiration and they are also source for the projects and real-life problem briefs for student projects and assignments. The following are the 10 observations about Aalto Design Factory's ways of working with respect to Design Factory community(Bjorklund et al., 2011). These are also considered as basic principles or building blocks when designing any new Design Factories (Tuulos, 2015).

- Be inspired by example.
- Attract people with helpful and proactive attitudes.
- Ensure open knowledge sharing and keeping the community tight.
- Low hierarchies and bureaucracy and keeping things informal.
- Providing encouragement and practical support doe development.

- Rapidly making ideas into actions.
- Being Proactive and taking initiatives.
- Freedom in work.
- Provide a physical home base.
- Encourage showcase and avoid showrooms.

I believe these principles are valid when considering the nature of this study, it should is important to consider this principles for planning future activities.

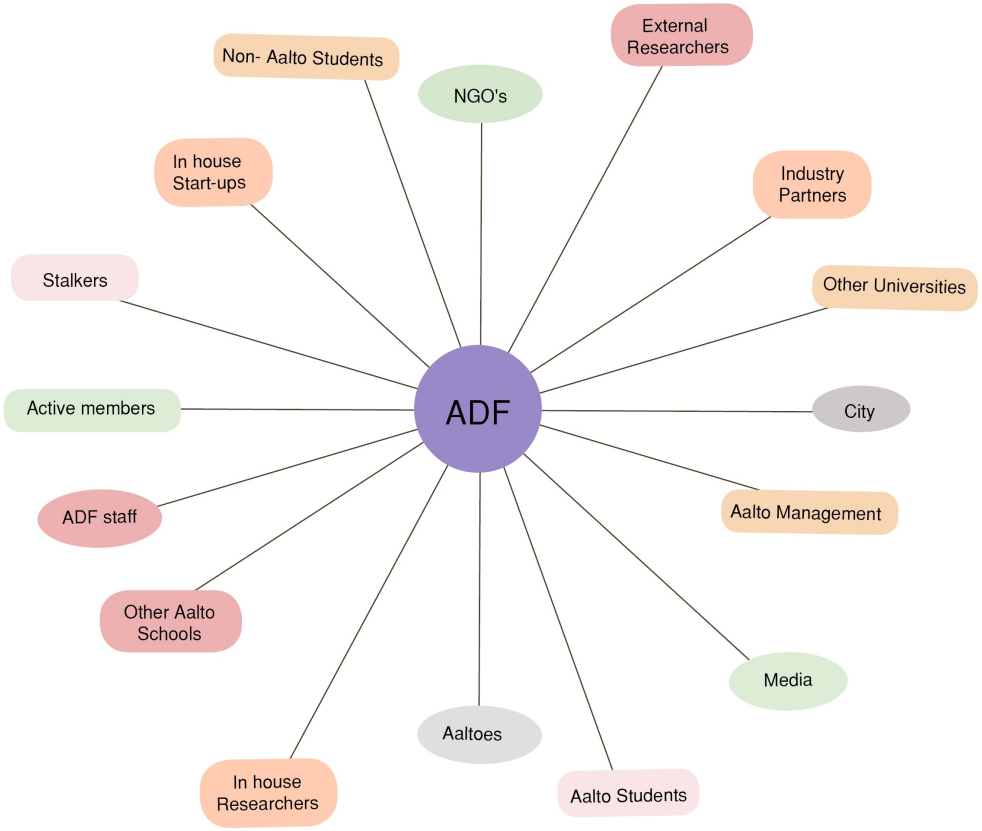


Figure 4.1: Stakeholders in Aalto university ecosystem

Chapter 5

Drivers

Chapter Preview: The previous chapter introduced the present and past innovation ecosystem models. This chapter discusses and summarizes insights from pilot interviews and secondary research from chapter 3, *Hello Future*. Section 5.1 explains the pilot interview process and summarizes the insights into facts, challenges, and assumptions. Section 5.2 proposes drivers that are identified from the insights from section 5.1, section 3.1, and section 3.2. Section 5.3 defines various areas of change for the Design Factory and the drivers are further categorized with respect to areas of change. Section 5.4 will discuss about primary and secondary evaluation approach for the drivers. Section 5.5 will describes the survey results and its the evaluation.

5.1 Pilot interviews

To gather insights from the Design Factory ecosystem, 10 people representing various stakeholder groups of Design Factory are interviewed. The interviews were semi-structured with open ended questions, occasionally re-framing the questions during the interview if the participant found it difficult to relate the question to the topic. As the questions were deliberately left broad, it was difficult for few of the participants to answer them. The interview questions can be found in appendix (see A.1) As insisted by many experts that care must be taken while selecting the experts panel, as usual time and resources played a significant role in the selection process. And snowballing approach was used to get diverse experts for the study (Rowe and Wright, 2011).

The responses from the participants have been documented and the insights were summarized into three categories facts, challenges, and assumptions. These insights can be found in appendix (see A.2).

5.2 Drivers

The drivers are the trends that will affect the future occurring of an event. A total 36 drivers are identified from insights that are gathered from secondary research on trends and mega-trends as well as interviews.

- **Virtual World**: Virtual reality, Augmented reality, working and leading a digital identity, working globally and virtually.

- **Online education (MOOC)**: more access to free and online courses, and able to include them in university learning.
- **Industry and university inter-dependency**: Industry will be more like university and university will be more like industry.
- **Moving to new Place**: As Design Factory is moving to new place physically it is challenging to flourish the same energy.
- **Change in Management**: The founding management will retire in few years.
- **Elderly population**: How to involve elderly population in the activities actively and use their capability
- **New methods in teaching vs old method**: Next 10 years this school will be splitting into two, we have to find out how to communicate together,
- **Finding Good students**: Hard to get good students, and influence the on how the young school children are making up their thoughts.
- **Interdisciplinary and T-shaped people**: People with broader and specialized skills.
- **Teacher role**: From being a teacher to being a facilitator.
- **Connected people**: Connected planet, the 5G is standardized and the connectivity has been reached to more remote areas - connected lifestyle, connected business, connected intelligence.
- **3D printed world**: widely available 3D printers at home.
- **Artificial intelligence and human interaction**: Interaction with artificial intelligence will be more organic and transparent.
- **Artificial intelligence assisted services**: Using artificial intelligence in enhancing human capabilities, artificial intelligence is widely used in various services such as, insurance, health, medicine, banking, engineering, designing etc., artificial intelligence powered teaching assistants and education services.
- **Health and well-being services**: Health well-being continues at workplace.
- **Automated world**: Automated super markets, kiosks, cafes.
- **Connected devices**: 100 billion devices connected to web, internet of things.
- **Mobility**: Electric and autonomous driven mobility.
- **Personalized and customized services**: Personalized medicine, growth in demand for personalized and customized services, products using personalized education, learning for such student.
- **New job titles and future job skills**: Thumb rule 80% of the jobs will expire in 10 years, need for more creative approach/ knowledge, As the robots and artificial intelligence tools will be taking over the routine jobs

- **Collaboration with robots, trans-humanism**: How humans collaborate with artificial intelligence driven services, robots, and others to be more productive.
- **Co-working spaces**: Traditional offices to community co-working spaces, as Freelancing websites will be the new labor unions.
- **Modular and integrated labs**: To support the product teams and to not lose the momentum to innovate the labs will be more compact, modular and flexible and integrated with larger work-space.
- **New disciplines**: New disciplines such as Nano-technology, synthetic biology, having a direct impact on developing new products.
- **Degree structure**: How does the new degree structure will be Nano-degree.
- **Future user**: Needs of generation alpha, and next.
- **Community based living**: People will be moving towards community based lifestyle (co housing) to be more sustainable, but still prefers their personal life.
- **New education models**: Education as service, new service based ownership models.
- **Big data and data gathering**: Using big data method and data gathering for developing the services.
- **Design Approach**: From passive towards generative, intuitive new generation creative generation process.
- **New breed of entrepreneurship**: Start-ups, how start-up sauna, altoes etc. will impact.
- **City & neighborhood**: Collaboration the city co-working places and new policies will affect.
- **Sustainable use of resources**: Due to materials scarcity, importance is given to local recycling and materials sustainable use and measuring of carbon footprint.
- **Student centric**: Education moving from teacher centric to student centric education.
- **Physical spaces**: The new role of physical spaces.
- **Social media**: Social media driven information gathering and consumption.

5.3 Categorizing of drivers

The drivers are categorized per areas of change. The most common origin of drivers is pointed to the general areas of change which are Political, Economic, social, technological, legal (PESTEL) (Witcher and Chau, 2010). For the purposes of this study to align the insights with the context of Design Factory, the following areas of change are used.

1. **New methodologies**:This area is about supporting the learning of the student; technology or requirements can drive these methods.
    - Virtual World
    - Online education (MOOC)
    - New methods in teaching vs old method
    - Interdisciplinary and T-shaped people
    - Teacher role
    - Artificial intelligence and human interaction
    - Artificial intelligence assisted services
    - New job titles future job skills
    - Collaboration with robots
    - Future user needs
    - Design approach
    - Student centric education
2. **New Connected world**: This area is about the new participants in the network, new collaborations, and new emerging disciplines.
    - Connected people
    - Co-working spaces
    - Modular and integrated labs
    - Big data and data gathering
    - Physical spaces
    - New disciplines
    - Connected devices
    - Mobility
3. **New operating model**: This area is about new operating models with new and old partners.
    - New education models
    - Degree structure
    - New breed of entrepreneurship, start-ups
    - Industry and university inter-dependency
4. **Societal and demography**: This area is about societal drivers that can impact the activates of Design Factory.
    - Personalized and mass customized services
    - Elderly population
    - Finding good students

- 3D printed world
- Health/ well-being services
- Automated world
- City & neighborhood collaboration
- Sustainable use of resources
- Community based living
- Social media

5. **Organizational**:This area is about Design Factory management, Aalto university management, active members in community and Design Factory Global Network.

   - Moving to new place
   - Change in management

5.4 Testing and evaluating the drivers

The testing and evaluating of the drivers is carried in two parts, first through a primary workshop with a core Design Factory team to sort and prioritize the drivers and then through an online survey with 25+ participants.

5.4.1 Primary evaluation

The first part of identifying critical drivers is addressed by using the primary model which is a graph with impact and certainty on the axes (Lindgren and Bandhold, 2003). A workshop was organized with four participants representing Design Factory research, teaching, management, and strategy. The members discussed each the driver and placed them on the graph while categorizing the driver with respect to their impact on Design Factory and possibility of it to happen in the next 20 years (see figure 5.1). The drivers, which are in the top right corner (highlighted in ellipse, 5.1) where selected for further evaluation along with a few drivers from outside the cluster.

The challenge in using this method for shortlisting the drivers being that, it allows only to choose the drivers from the top right cluster and there is a potential risk of ignoring few potential drivers. To overcome this challenge, few of the drivers (highlighted in box, 5.1) which are outside the top right cluster but are expected to have potential impact on the case are included in the shortlisted drivers. This suggestion of divers from outside cluster are based research analysis done during the scouting phase. In total the following 19 drivers were selected with through this exercise.

1. Teacher role & new methods in teaching
2. Interdisciplinary and T shaped people
3. Student centric education
4. Design approach

5. Virtual world
6. Elderly population
7. Connected people
8. Artificial intelligence assisted services
9. Big data and data gathering
10. New disciplines
11. Industry university inter-dependency
12. Degree structure
13. New education models
14. Future user needs
15. New job titles and future job Skills
16. Physical spaces
17. Modular and integrated labs
18. City & neighbourhood collaboration
19. Moving to new place

5.4.2 Secondary testing

The second part of evaluating the drivers is addressed through an online survey with selected experts panel. Commonly, when following Delphi method, the survey has multiple rounds giving the participants an opportunity to iterate their options. However, due to time restrictions, the scope of the study and the satisfactory results primary analysis of results after the first round already provided the necessary information that was aiding to continue with the next phase of the study, only one round of the online survey was conducted.

The three elements of the survey, which are questions, data collection and selecting expert panel, were based on Delphi requirements. Each driver is framed into a question; except two drivers were found more useful when combined to form one question. The survey questionnaire contained 19 questions. A panel of experts were asked to evaluate the question with respect to three scales, which are:

- Desirability to Design Factory
- Feasibility to happen in next 20 years
- Respondent's experience with the drivers

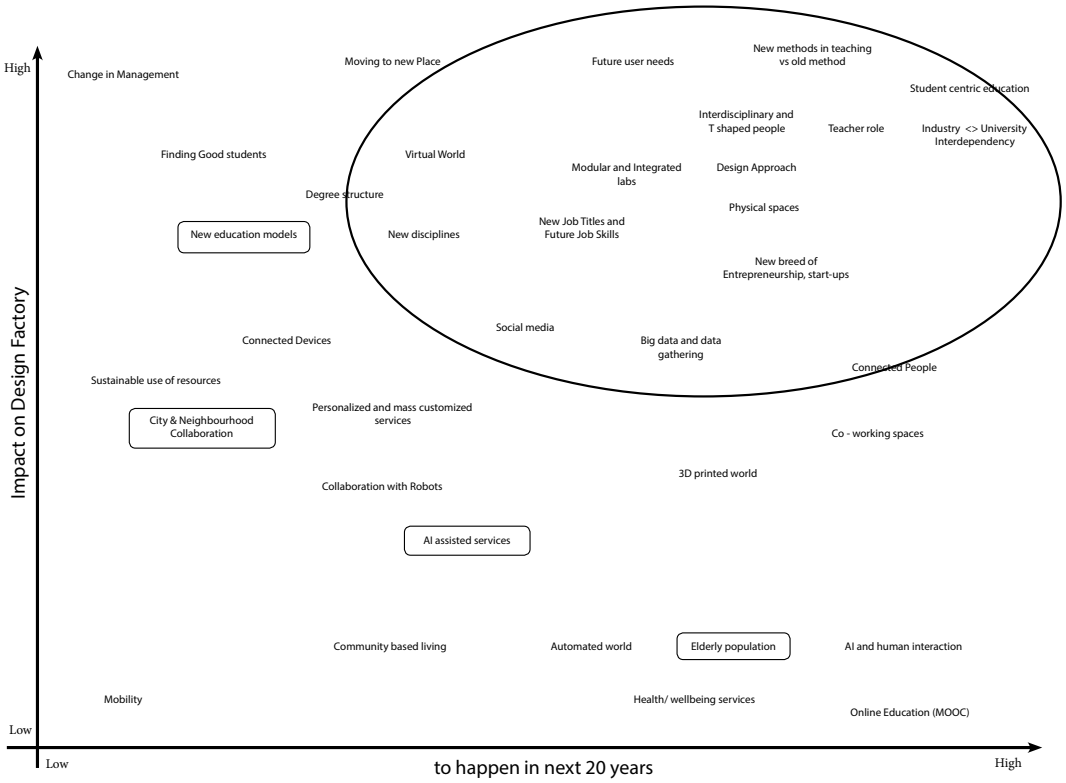


Figure 5.1: Graph based sorting of drivers

There was also a provision to give open comments

The expert's opinions were recorded through providing four options per scale. For example, for the scale of Desirability, the expert can choose the opinion of very undesirable which has score of 1, undesirable which has score of 2, desirable which has score of 3 and very desirable which has score of 4, so that quantitative data can be captured (Murray, 1970), (Linstone et al., 1975). For usability purpose, a visual aid (smiley faces) was embedded in the scale option (Stange et al., 2016). The survey questions and their format can be found in the appendix (see A.3).

The questionnaire was tested with three people who have similar backgrounds with the members of the expert panel and was iterated with the feedback. The final questionnaire was sent to with the deadline of two weeks to attempt the questionnaire.

Based on the score given by the participants in the survey, the mean is calculated for feasibility and desirability. Based on the score each driver received, a graph is plotted (see figure 5.2) to summarize all the drivers together. From the graph in figure 5.2, the drivers can be grouped into two major clusters. These clusters are based on the driver's position with respect to their scale of feasibility and desirability (Von der Gracht, 2008).

The cluster of drivers, which have low feasibility and low desirability are named as *Potential Jolts* and the cluster of drivers, which have high feasibility and high desirability are named as *Significant Impactors*.

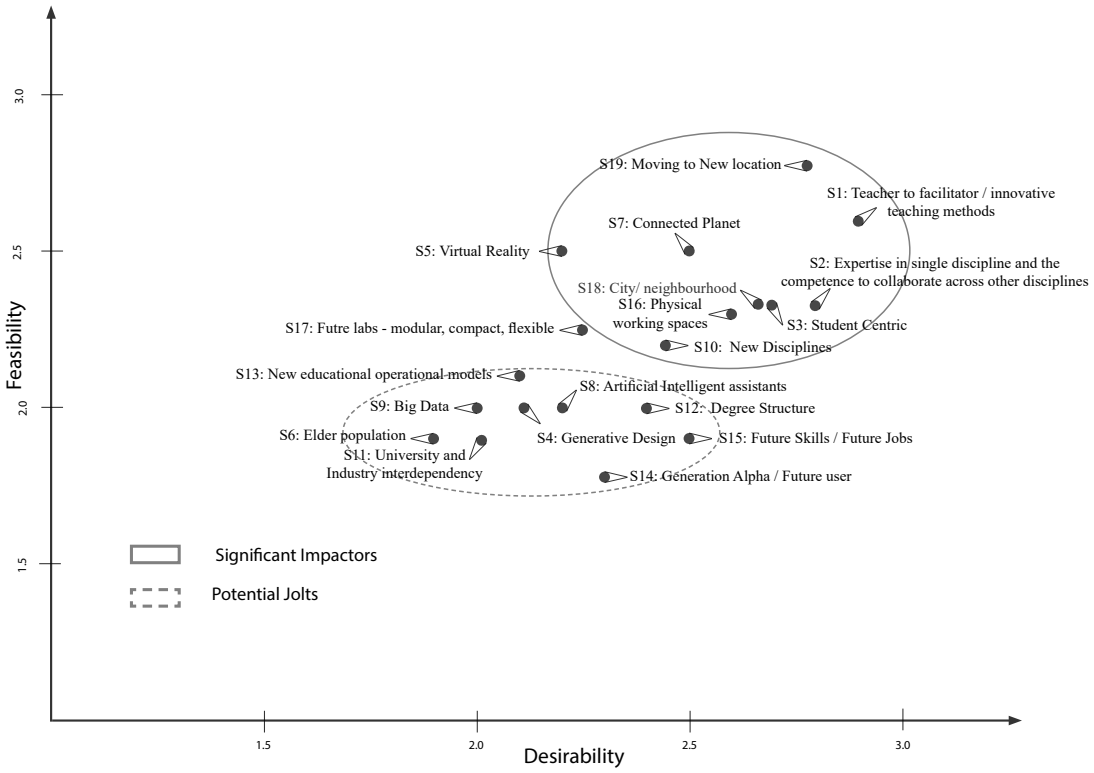
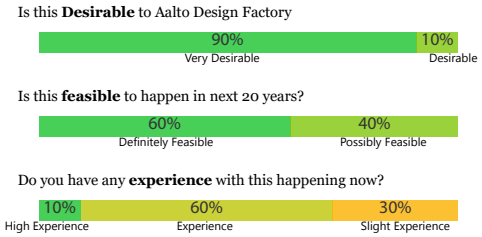


Figure 5.2: Graph with survey results and identified driver's clusters

Additionally, detailed assessment for each question with comments can be found following:

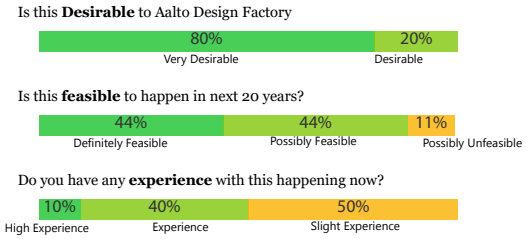
Statement 1. As the students can gain knowledge and access information from various sources, the role of the teacher will evolve from being a teacher to facilitator. In next 20 years, teachers will be comfortable in being a facilitator while using innovative teaching methods to educate the students. Design Factory will act as a safe environment for researchers to experiment and teachers to foster these new teaching methods.



Comments:

- I think the main point is that in the future education and curriculum is **built with staff, students, researchers and corporate partners together.**
- In the future, the question is not whether or not teachers will be comfortable with this is or not. There is no option. **This should be a basic assumption for anyone considering being a university teacher.**
- Experimentation most definitely. Experimenting with and developing innovative methods are part of the question, but there's already a lot of great stuff out there, so it's also about connecting info.

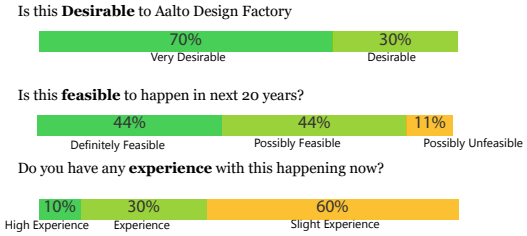
Statement 2. In next 20 years, the abilities to have expertise in single discipline and the competence to collaborate across other disciplines will be important for successful student education and in their professional career. Design Factory will support the student to acquire the abilities to collaborate across new and emerging disciplines.



Comments:

- Something that is and should remain in the very **core of DF**.
- In a way this is what we're currently doing in IDBM, and it will most certainly become even more important in the future.
- The real question is what are the professional roles of graduates in 2030 - are they **"jacks of all trades - masters of none" - or should we really think about enhancing deep professional competencies** ?
- Design factory type environments that bring people from different disciplines together, will become more and more important in the future. Also bringing in parties from outside university circles is crucial.

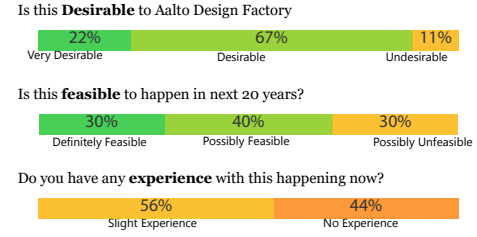
Statement 3. The current teaching methods which are based on teacher centric classroom style will change to student centric learning in next 20 years. Design Factory will support this student centric learning by providing personalized and customized learning options to the students.



Comments:

- **Students centric isn't only about individualisation/ personalization**, but yes we are doing it I believe.
- **If we personalize too much, we might lose the community aspect.** So I'd say community-driven learning will become important: it's not only about the student herself, but more about the community. But yes, teacher-centric learning won't be as useful as it might have been some years ago.
- In order for this to happen **new digital means of teaching will need to be utilised more and more.**

Statement 4. Current creative process involved in Design approach while working with the design tools is passive, that is "we get what we need". For example a chisel will carve where we want to or a software does what we want. By 2036, tools with machine learning and artificial intelligence will enhance our creative process towards generative and intuitive design. Design factory will support the students in using these new generative and intuitive design tools to enhance students creativity and productivity.



Comments:

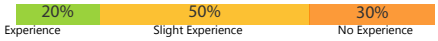
- I'm not sure I believe that tools will have major generative properties, but **I think DF does aim to support whatever tools/trends do emerge.**
- This is a crucial point! **This whole human-machine interface is really important an issue, and it will definitely influence the way we as teachers interact with our students**.
- This is something should be developed together with other facilities and resource pools across Aalto

Statement 5: By 2036, Virtual Reality will be widely used in day to day work, communications. Also interaction and collaboration between colleagues, students are actively done through Virtual Environment. Design Factory will provide an active virtual environment to experiment with new innovative and experimental methods that support students learning.

Is this **Desirable** to Aalto Design Factory

Is this **feasible** to happen in next 20 years?

Do you have any **experience** with this happening now?

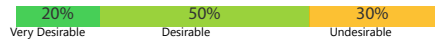


Comments:

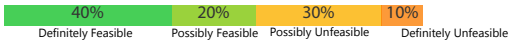
- A nice addition, but by **no means a priority.**
- This will certainly influence teaching and learning. VR might not be popular in 2036, but something that seamlessly blends **VR with Reality**.
- It is merely a medium.
- We should provide **tools and possibilities for people to experiment** with new technologies.

Statement 6: By 2036, there will be prominent percentage of elderly population that leads active lifestyle. This population will have their own needs and may require some assistance to integrate with the virtual world and the new generation. In Design Factory, elderly population will play active role in passing their knowledge, supporting the students learning and community activities.

Is this **Desirable** to Aalto Design Factory



Is this **feasible** to happen in next 20 years?



Do you have any **experience** with this happening now?

Comments:

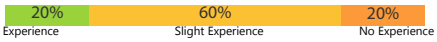
- Elderly are **one stakeholder group amongst many possible** community involvement groups.
- **At least in Finland we used to have this kind of mentality in the past, so hopefully we can resurrect it**. Older generations can serve as mentors (even reverse mentoring included), while students can inspire future generations in finding their own path.

Statement 7: By 2036, we will be part of 100+ billion Internet of Things (devices) that are connected to the web. As 5G is standardized, the connectivity will reach to remote places and people will lead a more connected lifestyle. There will be more connected business with connected intelligence building towards Connected planet. Design factory will use the highly active connected environment to support students, researchers, teachers and all stakeholders.

Is this **Desirable** to Aalto Design Factory

Is this **feasible** to happen in next 20 years?

Do you have any **experience** with this happening now?



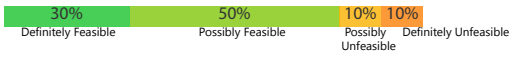
Comments:

- Important design topic that needs a lot of attention.
- DF has a unique profile, it's role is to generate and support new ways of learning and teaching - stick to the competencies - there will be a million other providers for the "Internet of Things" - don't try to compete.

Statement 8: By 2036, Human will know-how to collaborate with AI driven systems, robots and other advanced systems to be more productive. Human capabilities will be enhanced by using Artificial Intelligent assistants. Design Factory will support the students to learn on collaborating with these AI driven systems, robots and other advanced systems.

Is this **Desirable** to Aalto Design Factory

Is this **feasible** to happen in next 20 years?

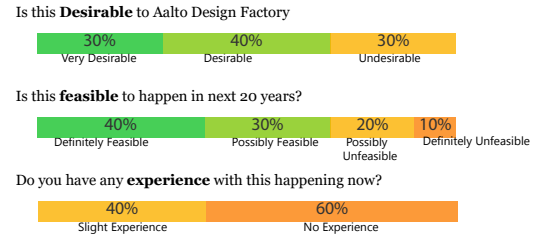


Do you have any **experience** with this happening now?

Comments:

- **The core of design factory is in human centric design; people and communication.** Some of the identity will be lost,
- Important would be to envision a future one step ahead of this. **Crucial to imagine, what will exist beyond AI.**
- The specific technologies listed so far, I personally find AI as most intriguing as a technology.

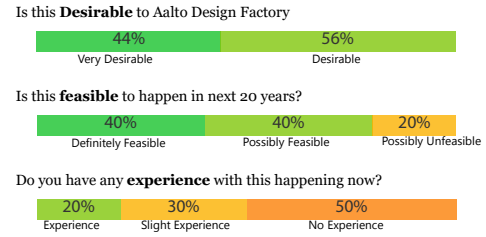
Statement 9: By 2036, the real-time data is gathered through various gadgets and other information related to user behaviour and requirements. This data can be used to develop new and customized services to the user. The courses, teaching and services offered at Design Factory will be customized based on students data.



Comments:

- Everything revolves around co-creation, not individual development efforts. Individualization can be taken too far. Some uncomfortability may be needed for learning.

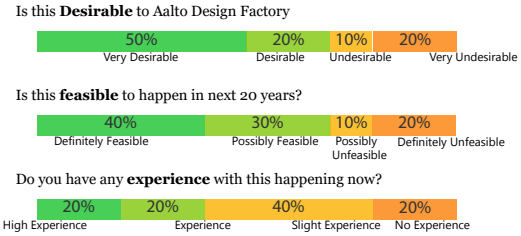
Statement 10: By 2036, New disciplines such as Nanotechnology, synthetic biology, cognitive science will having an direct impact on the traditional disciplines for developing new solutions. The students at Design Factory will be taught methods involving these new disciplines to solve problems.



Comments:

- The point is to bring different disciplines together and co-create also within these disciplinary studies.
- **New disciplines are emerging constantly,** and I think it's crucial that teachers and higher education institutions are actively seeking ways to inspire collaboration between disciplines.
- Design factory should aim to cater the students and faculty new methods that they would not encounter otherwise, so this is very much what design factory should be doing.

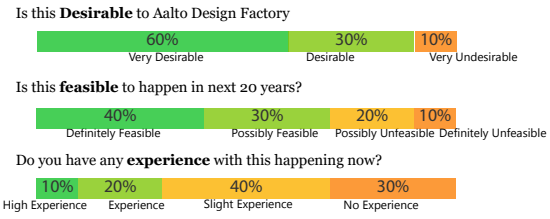
Statement 11: By 2036, the quest for innovation will lead the industry to act as an university. In order to teach practical skills while solving real life problems university will become more like industry. Design Factory will play an active role in these interactions between industry and university to support the learning of the student in solving real life problem.



Comments:

- **We want to offer something that the industry cannot** - the sum is greater than the parts.
- I'd envision universities to become more bold in their visions.
- Universities are the sounding boards for the development of society, they must be autonomous and independent.

Statement 12: As updating skills has become quite essential to support the new needs in professional career, the demanding skills will be offered through segregated courses or nanodegree programs. These nano degrees will be widely offered by industry or organization or university. In next 20 years this will have an impact on current Degree structure offered by university. Design Factory will offer segregated courses in collaborating with other organisations in demanding skills and students will also have freedom to build their degree with respect to these courses.



Comments:

- I'd say executive education should definitely collaborate more with entities like Design Factory.
- **School becomes a service,** you never graduate.

Statement 13: By 2036, the New educational operational models will bring new actors to current operations and ownership in the Education. For reference, Recent examples for New operational models are uber and AirBnb. Design Factory will take initiatives in bringing new actors into current education models which would benefit the student learning.

Is this **Desirable** to Aalto Design Factory

Is this **feasible** to happen in next 20 years?

Do you have any **experience** with this happening now?

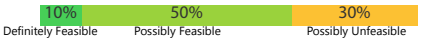
Comments:

- Sounds like a **good and flexible role for DF**.
- Educational startups are growing. DF should support these.

Statement 14: Born to the era of touch screen, YouTube, Instagram, generation alpha will be sharing their thoughts into the world in few seconds and will be the most metamorphic generation due to frequent technological changes. The needs of these future users will be driven by new principles. Design Factory will be a place where the needs of students in 2036 will be fulfilled and the students will find it as curious and intrigued as it is now.

Is this **Desirable** to Aalto Design Factory

Is this **feasible** to happen in next 20 years?



Do you have any **experience** with this happening now?

Comments:

- I don't believe the needs really change that much, we just might have new tools to help us meet the same needs or new contexts that change the requirements around meeting the same needs.
- **The users of DF should be actively involved in the development and activities of the DF**. In 2036 the needs of these users will be different than the users of today.

Statement 15: By 2036, most of the current job titles and roles will be absolete. Students are educated for the future jobs based on future skills and needs. Design Factory will play a dynamic role in supporting the students in learning the required skills and needs.

Is this **Desirable** to Aalto Design Factory

Is this **feasible** to happen in next 20 years?

Do you have any **experience** with this happening now?

Comments:

- **This is the whole point of co-creation** - learning to create the future, playing a proactive role in one's role/career/company/ community Educational startups are growing. DF should support these.
- This, involves risk taking and as such it is something universities aren't that familiar with. But **definitely a path worth pursuing!**

Statement 16: By year 2036, in the age of virtual world, physical working spaces will act as human outpost motivating and supporting different generations, cultures and diversities. Design Factory will be physical space which will bridge the gap between humanistic and virtual world while supporting different generations, cultures and diversities under one roof.

Is this **Desirable** to Aalto Design Factory

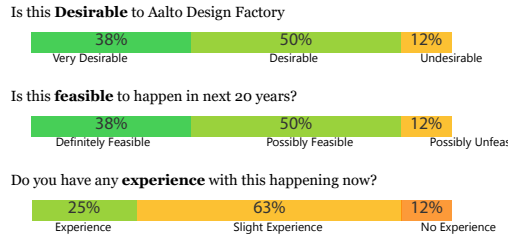
Is this **feasible** to happen in next 20 years?

Do you have any **experience** with this happening now?

Comments:

- Keeping the physical is definitely important, and acting as a physical hub too. Not sure how crucial the bridging between online and physical will be though.
- Design Factory cannot be only a virtual environment, even in 2036.

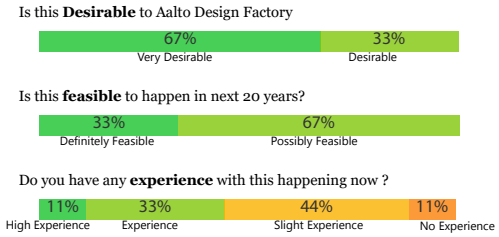
Statement 17: By 2036, to support the product teams and keep up the momentum to innovate, the future labs will be more compact, modular, flexible and integrated to larger co-working spaces. These modular, flexible and compact labs can are integrated to workplace in Design Factory to support the course project needs and requirements.



Comments:

- This more compact, integrated, etc. happens, but also shared (more users) pooled, bigger resources serving all university departments should happen, simultaneously. What disappears is the middle model of substantial dedicated resources for one program and school.

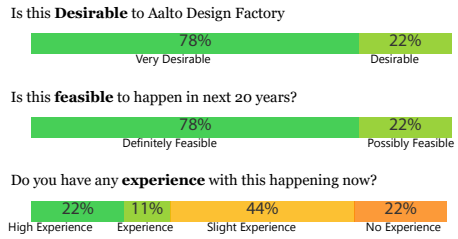
Statement 18: Currently City of Espoo supports Aalto Design factory ecosystem in initiatives. The new collaborations between City and Neighborhood will play an important role in next 20 years as well. Design factory will be more active in collaborating with the neighborhood, city and other organisations.



Comments:

- The 3 core areas of universities are research, teaching and societal impact - **so definitely will be a big role,** although I might not highlight Espoo/neighborhood over or beyond other community instances, such as non-profits, public organisations, citizens etc
- Design Factory cannot be only a virtual environment, even in 2036

Statement 19: In next few years Aalto Design Factory ecosystem will move to a new physical location in university campus. As the energy and spirit is so materialized in current building, it is challenging to carry the vision to new building but this will also be an opportunity to revamp the vision in supporting learning of students in future.



Comments:

- Having a physical location and the type of premises we create is important, but Design Factory is not tied to any specific address.
- A good opportunity to reflect on what has been achieved so far, and where do we want to be in 2036. And even before that!
- Relocating would be a good opportunity (and maybe the only possible way) to reassess what should we focus on. **We should involve current students more in this process.**

Chapter 6

Building scenarios

Chapter Preview: The previous chapter discussed about sorting the driver and assessing the results from online survey study. In this chapter, the scenarios are built from the identified drivers and the proposed scenarios are evaluated in a workshop.

6.1 Building primary scenarios

Scenarios are used to convey complex information that describes plausible future events. They are effective tools to visualize complex futures and assist in decision making.To build scenarios, one driver from each cluster (see figure 5.2) is used to maintain dynamics in the scenarios. As there is no defined method in selecting the driver combinations, trial and error method is used to find the combination of two drivers that make a sensible case, and later more drivers are added on top of the two primary drivers (Lindgren and Bandhold, 2003).

The method that is mention in the topic scenario planning, (refer: section 2.4, figure 2.4) is used to build primary scenarios. For example on primary scenario building, see figure 6.1. In this example, the drivers used are artificial intelligence assistance vs New methods, student centric. The artificial intelligence assistance is mapped on vertical axes while new teaching methods together with student centric education is mapped on horizontal. the quadrants represent different possibilities of the driver relations.

After putting together few similar combinations, eight primary scenarios were built. These scenarios were kept generic to have a with wider perspective on future education, ways of working and learning. The primary scenarios can be found in the appendix(see A.4).

6.2 Testing and evaluating scenarios

A workshop to test and evaluate these scenarios was organized with the various stakeholders and members of Design Factory. The aim of the workshop was to test the eight scenarios with participants through providing a framework with which they can discus in teams and test the assumptions made in the scenarios. An example of the framework used can be found in the appendix (see A.5). As the given scenarios did not contain Design Factory specific information, the participants were instructed to ideate with the following perspective:

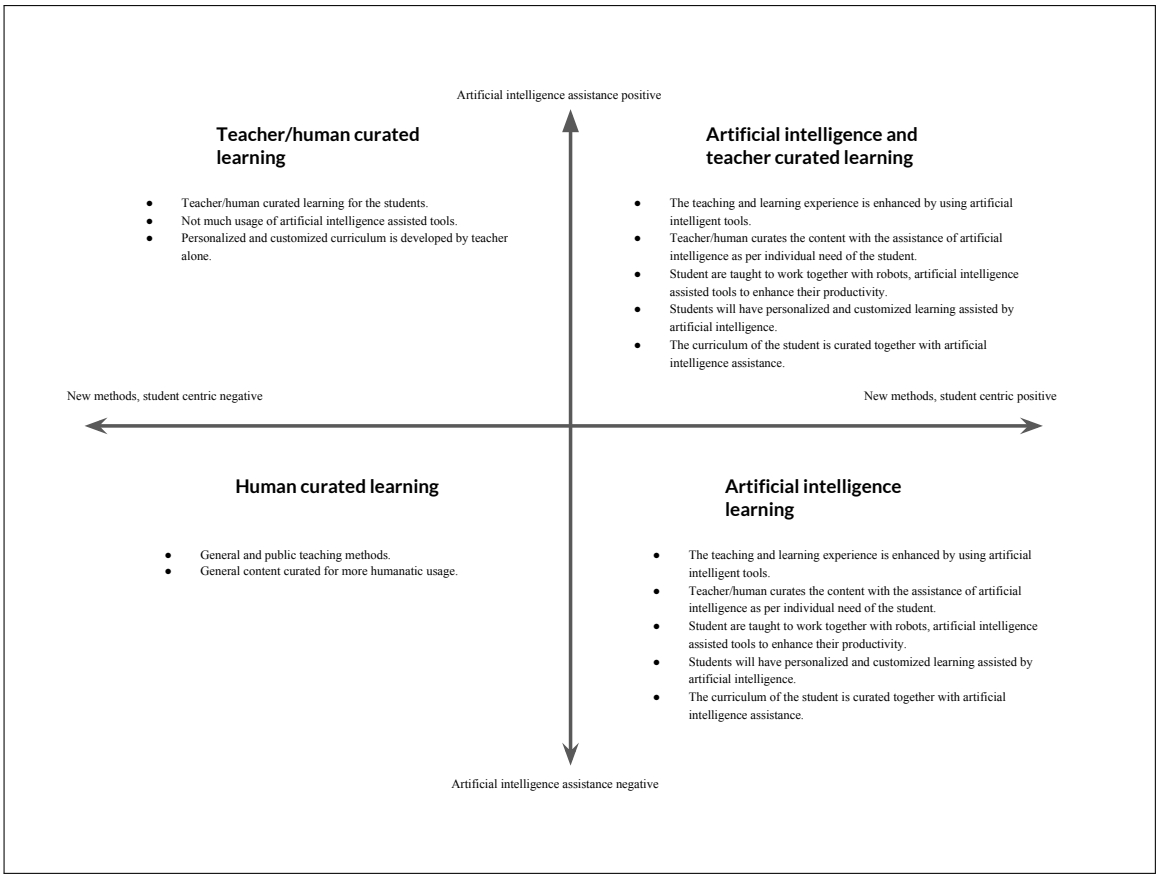


Figure 6.1: Example for building primary scenarios using drivers

- What could be the elements in Design Factory, which will support and enhance the student education?
- What could be the elements in Design Factory that will attract, engage, and motivate students/people?

The process of the workshop was, the participants are divided into four groups, for two different ideation sprints in each of the two-ideating session they were asked to work on the given scenario and make a story that can be presented to other participants, so the participants can vote for the top three scenarios. The participants for the workshop include various stakeholders of the Design Factory, master level students, representatives from other Design Factory's, and a high school student.

The teams were formed based on two factors: firstly, expertise with knowledge to the topic of scenario and second, the team represents all the stakeholders of Design Factory. Also, they were few participants from outside Design Factory invited to get an outsiders perspective and a high school student was also invited to bring the perspective of future Design Factory user.

A mock workshop with two people was carried out to test and streamline the workshop process. As it was challenging for participants to contemplate about future and keep their focus on future thinking, there were few activities such as a warm up exercise and providing some inspiration in between the ideation sessions. From the observation

as being a facilitator, these activates were helpful in challenging the mood and energy of the participants into thinking about future possibilities.

The scenarios were chosen based on two criteria:

- Based on participants voting, the scenarios were prioritized based on the votes received from participants. The scenarios with the score (number mention next to scenario) received are Symbiotic world (7), Hyper connected humans and devices (6), Co-Creating Education (4), We also Love you (6), Intuitive world (0), Data Driven Experience (8), unreal World (2), Synergy (1).

- The participants understanding and interpretation of the scenario about the Design Factory. This is assessed by going through the workshop materials that participants produced.

The final chosen scenarios are *Data driven experience, Symbiotic world, Hyper connected humans and devices, Co-creating education, We also Love you.*

6.3 Factors effecting the scenarios

By analyzing the boundaries that were defined for the driver and the content produced from scenario testing workshop and comments from online survey participants, the agility of the scenarios can be measured through two factors: technology enabled /driven and community enabled/ driven (see figure 6.2).

- *Technology driven*, this factor deals with usage of new and emerging technology will enable and drive the scenarios.

- *Community driven*, this factor deals with the initiative that the community will take will drive and enable the scenarios.

Based on the observations from the graph, it shows that all the scenarios have their agility in the positive extreme. To explore the other extreme, that is considering the negative extreme of the factors technology driven and community driven, a new scenario *lost in the crowd* is proposed. The final scenarios are updated with the content produced in the workshop. These scenarios are now explicit refer to the futures of Design Factory. In addition, few facilitators which are driving the scenario are also mentioned.

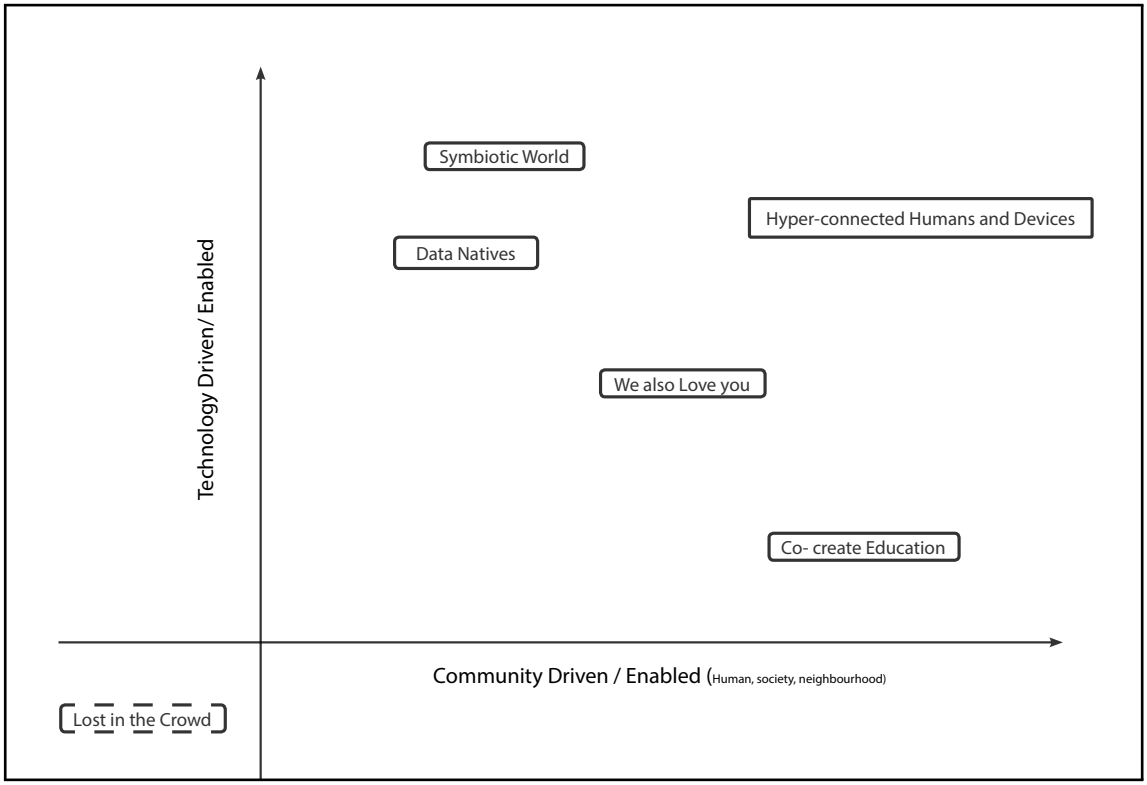


Figure 6.2: Factors effecting the scenarios.

Chapter 7

Plausible futures

Chapter preview: This chapter presents the final scenarios on plausible future based on the observations and results from previous chapter.

7.1 Final Scenarios

The final scenarios are updated with the content produced in the workshop. These scenarios are now explicitly referring to the futures of Design Factory. Each scenario is also assisted by a scenario visual. In addition, few facilitators which are driving the scenario are also mentioned.

7.1.1 We also Love you

This scenario is based on the current core principle of Design Factory, which is to bring disciplines together and teach problem- and passion-based learning. In this scenario, the Design Factory will be a place bringing together students from new and emerging disciplines, such as organic electronics, nanotechnology, cognitive economics, computational science, synthetic biology, wearables, exo-meteorology, quantum mechanics, genetics, artificial intelligence, and more, to teach students problem-based learning. The focused approach is on design thinking and human-centered, real-life problem solving.

These students can come from various disciplines and schools. A physical or virtual working medium is provided to support the interactions and teamwork. For example, Design Factory on Mars brings together students from new disciplines, such as new emerging space tech, and they join the day-to-day work actively through virtual media.

Design Factory acts as home-like, safe environment to all students from other disciplines to experiment and participate in problem-solving processes. The new teaching methods also consider the importance of finding a common language for student group work because it is challenging for students from different disciplines to understand each other's insights. With these new collaborations, new job titles are shaped, new breeds of skills are fostered, and new ways of developing products are taught to students. The master's program at Aalto University supports discipline fluidity, i.e., one may not have a major study but one may specialize in a field.

The teachers are supported with new methods for working with new disciplines. There is active collaboration with stakeholders to resolve other disciplines' problems.

There will be new compact and modular labs and facilities integrated with Design Factory to support these projects.

Facilitators:

- The strong foundation that Aalto University has laid to encourage interdisciplinary activities; the new wave of energy and interest that is visible on the University campus for interdisciplinary-related activities.
- The awareness of the people of the importance of involving various disciplines in solving problems; the growing dependency of one discipline on another.

Figure 7.1: We Also love you

7.1.2 Temple of co-creation

This scenario regards how new actors can play important roles in providing new education models, education as service, school as service in the sharing economy or life as service, unlike currently, when the government plays the main role in Finland. These new actors can spread around the globe, and students can pursue their educations while utilizing Design Factories globally. New actors, such as cities, NGOs, startups or industry, will play vital roles by supporting programs and courses in the university, where students can major or minor in their degree studies.

Instead of a pre-planned study path, it will be phenomenon-based learning, in which students will have options to choose from and freedom to explore.

Design Factory acts as a platform that collaborators/stakeholders can approach for projects and challenges that are more agile, and ad hoc, this platform helps to find the right match for collaborators. This platform acts more like a consultant to industry/society challenges, bringing outsider perspectives and using the latest technologies, such as virtual collaboration, to form new collaborations and to solve global problems by reaching remote locations.

Because students are qualified through co-creation to solve their domain-specific problems, the actor will directly support students. Support can be based on sponsorship or ownership. For example, a student wants to solve NGO problems, the student conducts his or her study together with an NGO, and the NGO adopts the student. Therefore, the student earns his or her degree with NGO problem-solving abilities. The education does not end after graduation; it continues in work life, so the person continues to learn the new skills required to for the job.

Facilitators:

- The disruptions that are now seen in terms of new service and business models, such as Uber and Airbnb, are also becoming popular in other industries. In addition, Design Factory can undertake active initiatives in this regard because it closely collaborates with the actors within the Design Factory global network.

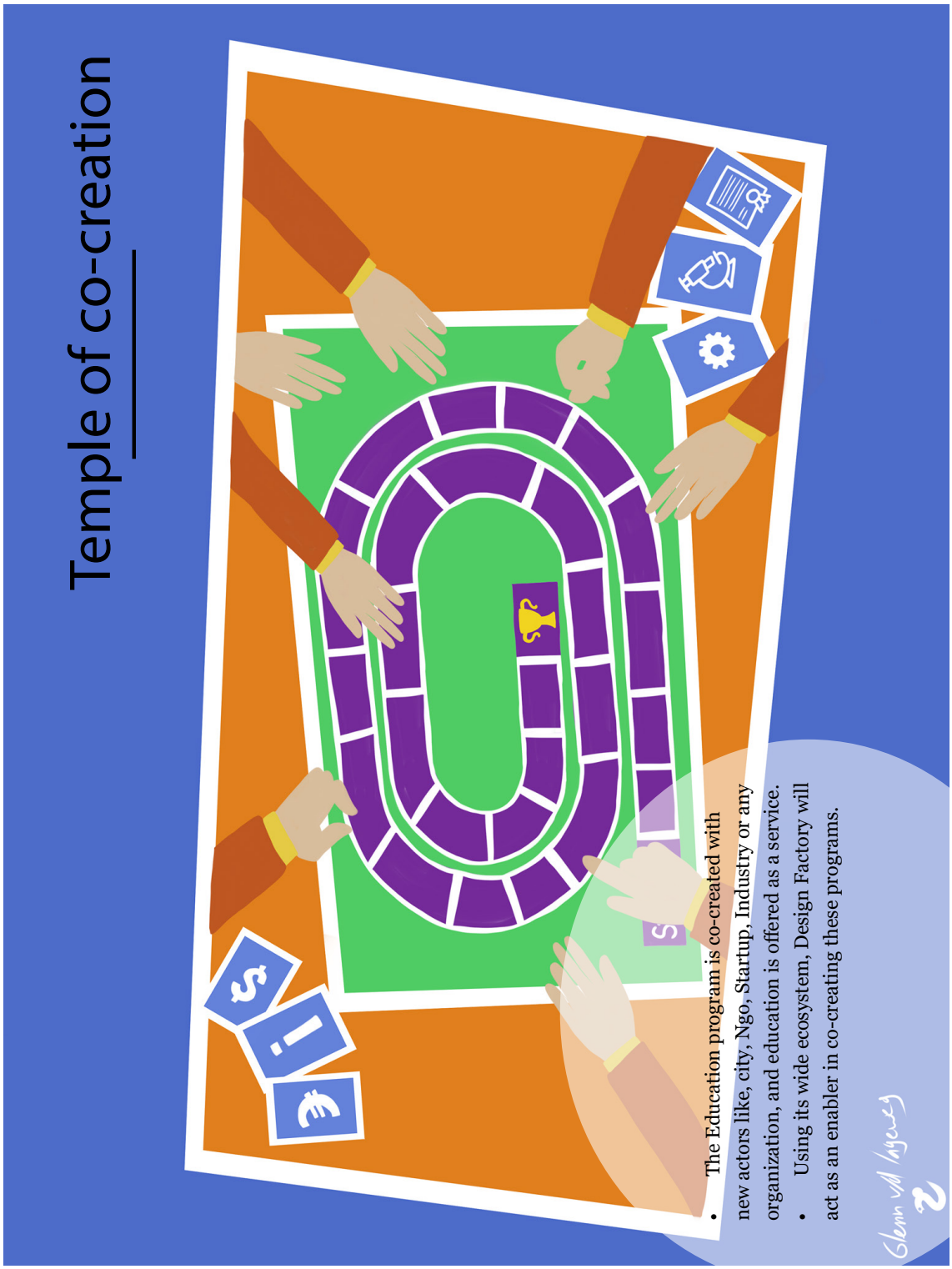


Figure 7.2: Temple of co-creation

7.1.3 Symbiotic world

Artificial Intelligence Enabling the new Renaissance

This scenario is based on using artificial intelligence(AI)-assisted virtual assistants and robots in day-to-day, labor-intensive activities, such as managing teaching-related activities and data-assisted services to personalize education to the student. The human can devote more time for human-to-human interactions and creative work. The humans learn from robots, and robots learn from the humans. Since there are active robots, i.e., artificial intelligence-assisted virtual assistants in Design Factory, and students are taught to work together with robots and virtual assistants to enhance their productivity and creativity.

Teachers can monitor the interactions of students and robots, and the robots help the teachers to gather data related to student interests and preferences, which can be used to refine the course content in real time. In addition, students' curricula are refined based on skillset needs, which are required for future jobs. Therefore, the teacher/human curates the content with the assistance of artificial intelligence per the individual need of the student.

Robots will be a part of artificial intelligence and virtual-assisted Design Factory community, and they will help in building trust among the community by gathering common insights, understanding, and intelligence. In addition, they will help in forming student groups, organizing group activities, encounters and collaboration with other groups with similar interests and needs, which will facilitate serendipity among the students, teachers, and community.

The experimental and agile nature of the Design Factory platform to innovate new methods in teaching and learning is strongly supported using artificial intelligence, virtual assistance and robots for day-to-day activities. The teaching and learning experience is enhanced using artificially intelligent tools.

Because it is challenging for teachers/humans to interact with students 24/7, this model is supplemented using virtual assistants and robots for study-related issues. It also provides access to relevant content beyond space and time. Students will have personalized and customized learning assisted by artificial intelligence.

Facilitators:

- Already, people today are spending more time interacting with virtual chat bots than in human-to-human interaction, and this trend will continue to increase in the future. Embedding a virtual assistant, which can help in having conversations about study-related issues will help in bringing back the focus to education in this virtually rich interaction and environment.

- Artificial intelligence-assisted tools are already used in many applications, such as health care, media, and automotive, and in the future, there will be more trust in using these tools for more dynamic applications.

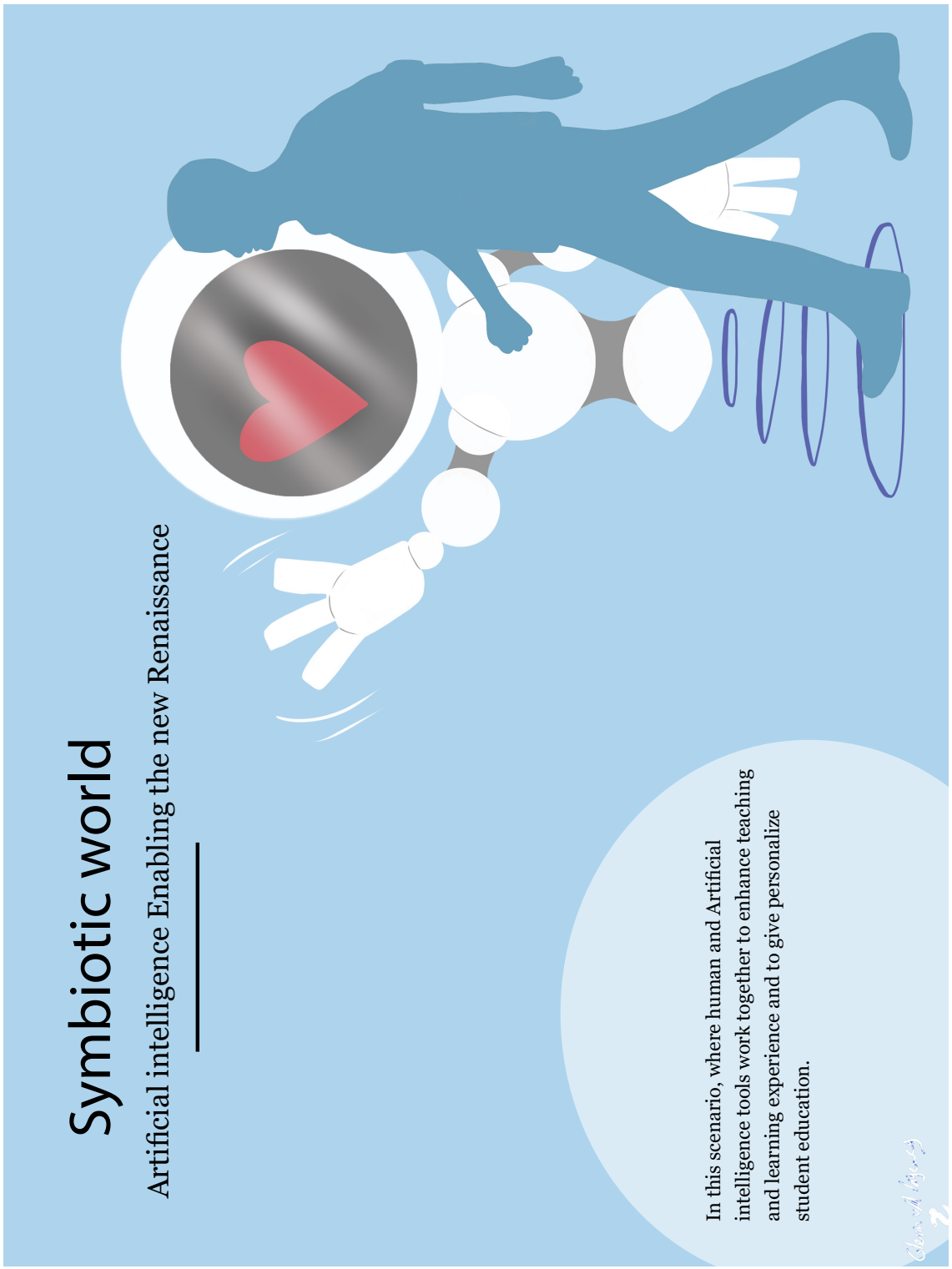


Figure 7.3: Symbiotic world

7.1.4 Hyper-connected humans and devices

Humans and devices are connected from very remote parts of the world. New digitally connected and collaborative teaching is offered to students across all of the Design Factories. This scenario is based on enhancing learning by utilizing connected humans, the Design Factory community and devices by an active platform. The hyper-connected humans in this scenario have two perspectives:

- With standardization of 5G, the information can be shared easily, virtual collaboration can be achieved with remote locations, and human-Device (internet of things) interactions will enhance team working.
- The growing Design Factory Global Network, in which Design Factories in other universities around the world with common visions are in a tightly connected community by engaging in various collaborations and projects.

Teaching and learning methods are curated while working in the hyper-connected philosophy and community. The information enhances the teaching and learning experiences available from the connected resources and devices. Connected thinking is used to experiment and develop new ways of working, learning, and teaching and to curate curricula.

There will be approximately 100 Design Factories around the world in next 20 years. There is the availability of consistent knowledge and people in the community. This knowledge can be shared with in the community actively. A student will have the option to choose elements from Design Factories and earn a degree. The working and interaction medium will evolve to digital and virtual formats. The new teaching methods support this new way of working, which are based on connected and virtual collaborations.

For example, a student can join the Design Factory Global Network and choose to study and gain knowledge from any Design Factory with a subscription model for a lifelong learning experience or even to earn a master's degree. Moreover, for other stakeholders, such as industry, there is another subscription model and an option in which billing is performed for an idea or knowledge.

Facilitators:

- The possibility to work and share information in real time with remote locations.
- The ability to integrate humans and machines more organically.

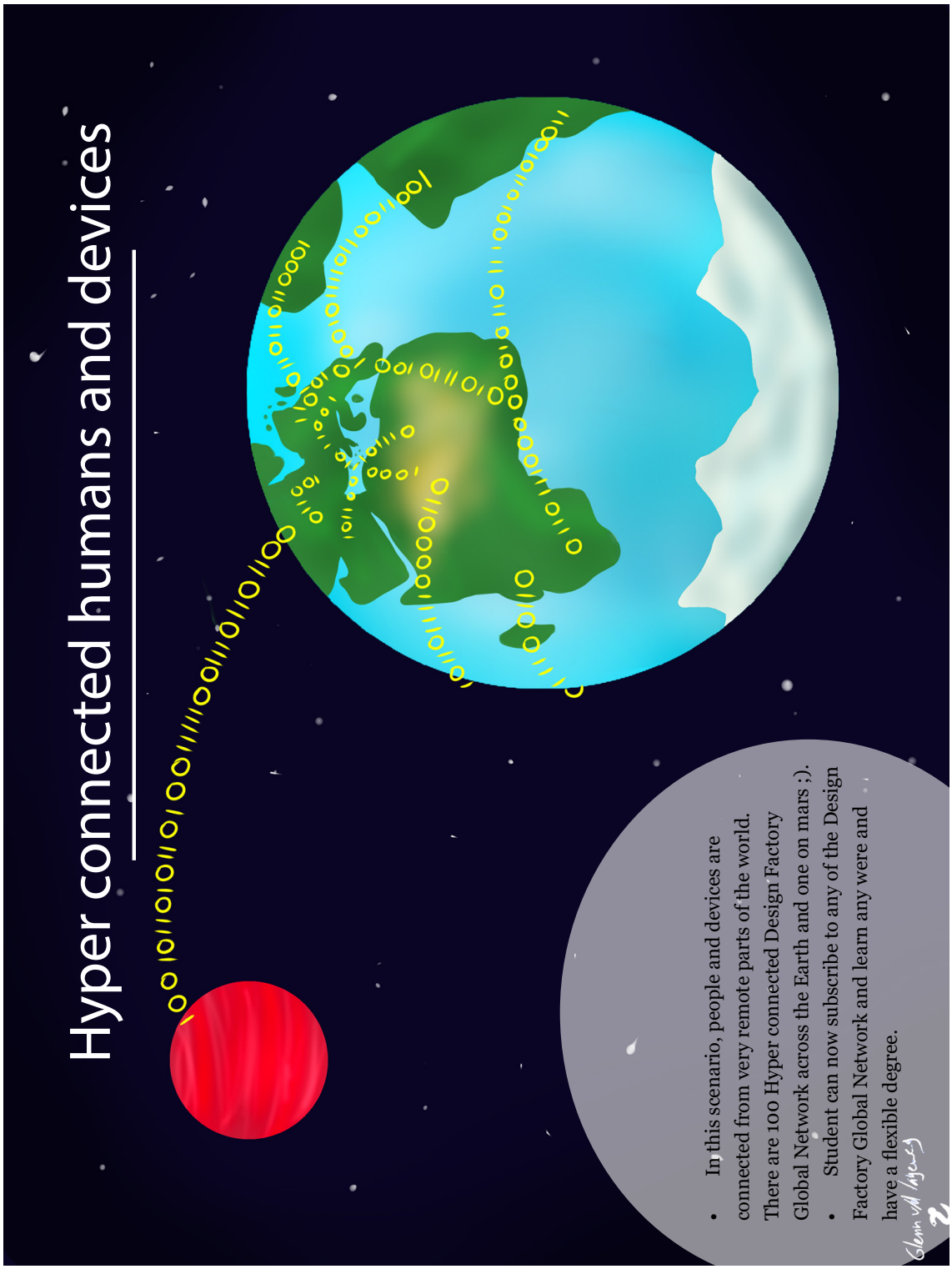


Figure 7.4: Hyper-connected humans and devices

7.1.5 Data natives

This scenario is about supporting student learning using data collected from students in addition to human support. The data are used to personalize study plans, and degree structures enhance the learning experience. Design Factory as a data-collecting environment provides an agile platform through which data are collected in real time from the student about behaviors, interests, gaps, and preferences to build and refine course content in real time. The new teaching and working methods in this agile environment provide freedom for teachers to teach and share their knowledge.

The data from the students are collected from the day they were born to enhance lifelong learning. Because the future student is now in his or her early childhood, in principle, the data about the person's preferences and interests can be collected from now. Based on the personal data, there is an option that the student is invited to the university based on his or her career preference. The education is designed based on the trends and new requirements that future jobs require. When student takes a break from education to work in industry or goes abroad as an exchange student, once he or she returns to his or her education, the study plan and degree structure are refined based on the student's new learning and experience gained at work.

The data from the community are used to find a demand-driven approach, which is important for building student teams and stronger community aspects. It is possible for students from various locations and disciplines to converge over common interests and relevant knowledge.

Working spaces are agile and intuitive to use based on user data. The data used to plan *coincide* virtually and physically to encourage encounters and open innovation. The physical environment/lecture rooms are modified based on real-time data collected from the users so that they act as a safe environment and inspiration to innovate and work. Generational and knowledge gaps between teachers and students are minimized using in-house data resources, which help the teachers and students to find synergies.

Facilitators:

- Currently, personal data facilitate mass customization; similar, data about student preferences, learning, and skills needs can facilitate personalized and tailor-made education for each student.
- Collecting meaningful data and making sense out of the data using sophisticated machine learning tools are reaching new applications.
- The culture of providing personal data for customizing and personalize services is gaining popularity.
- There is always a demand for personalized and tailor-made services. Because these services demand so many resources to be consumed and it is impractical to provide personalized education, it has not reached a mass scale. The use of data and machine learning tools can now facilitate the providing of mass customization and tailor-made education with respect to the needs of individual students.

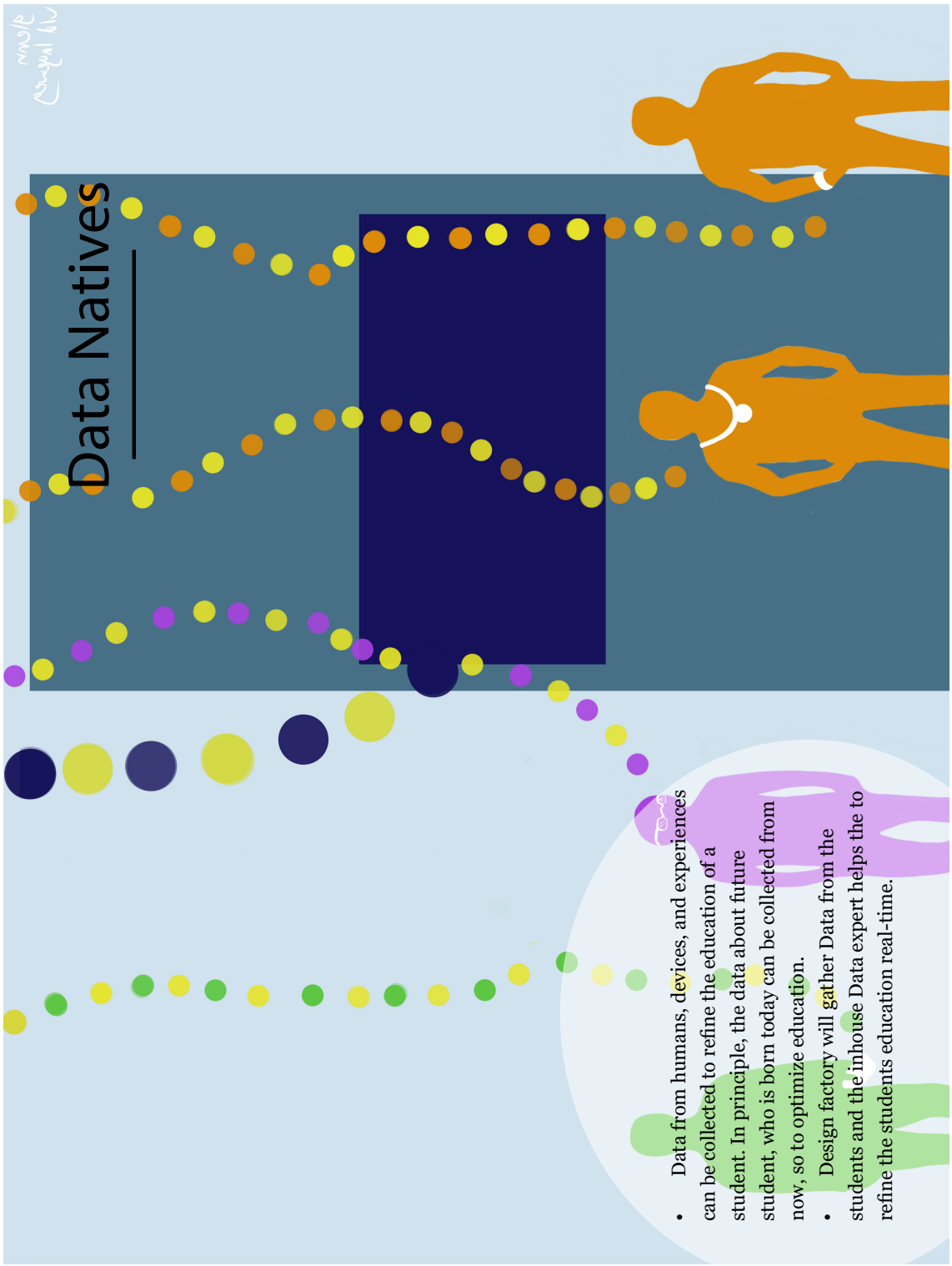


Figure 7.5: Data natives

7.1.6 Lost in the crowd

This scenario is about when technology-enabled and community-driven factors are at the negative extremes; that is, technology and community do not drive the Design Factory's experiential nature. Design Factory dissipates other actors inside Aalto University because other actors provide similar philosophies, facilities, and environments to Design Factory.

In this era, when interactions and collaborations are driven by digital and virtual environments, Design Factory has its own physical environment, which is solely driven by face-to-face and human-to-human interactions.The experimental nature of Design Factory is highly conservative. The teaching methods, communication, collaboration and co creation with other stakeholders are based on traditional methods.

Design Factory teaches students using the same methods used on campus. It is difficult for the students, researchers, teachers, and other stakeholders to find the differences between the Design Factory and other actors on the Aalto campus. The stakeholders lose sight of the community aspect and are scattered around the campus without a shared vision.

The collaborations with other disciplines will be limited. The current major disciplines with which Design Factory works are engineering, design and Business, the collaboration between these disciplines will be constrained and restricted. Few emerging disciplines are brought together. The aim of education and degree program is focused on field specific research rather than problem solving.

The curriculum and study plan of the student's degree program are not flexible and are based on traditional structures. The student does not have the freedom to create his or her study plan or to choose courses to his or her interest.

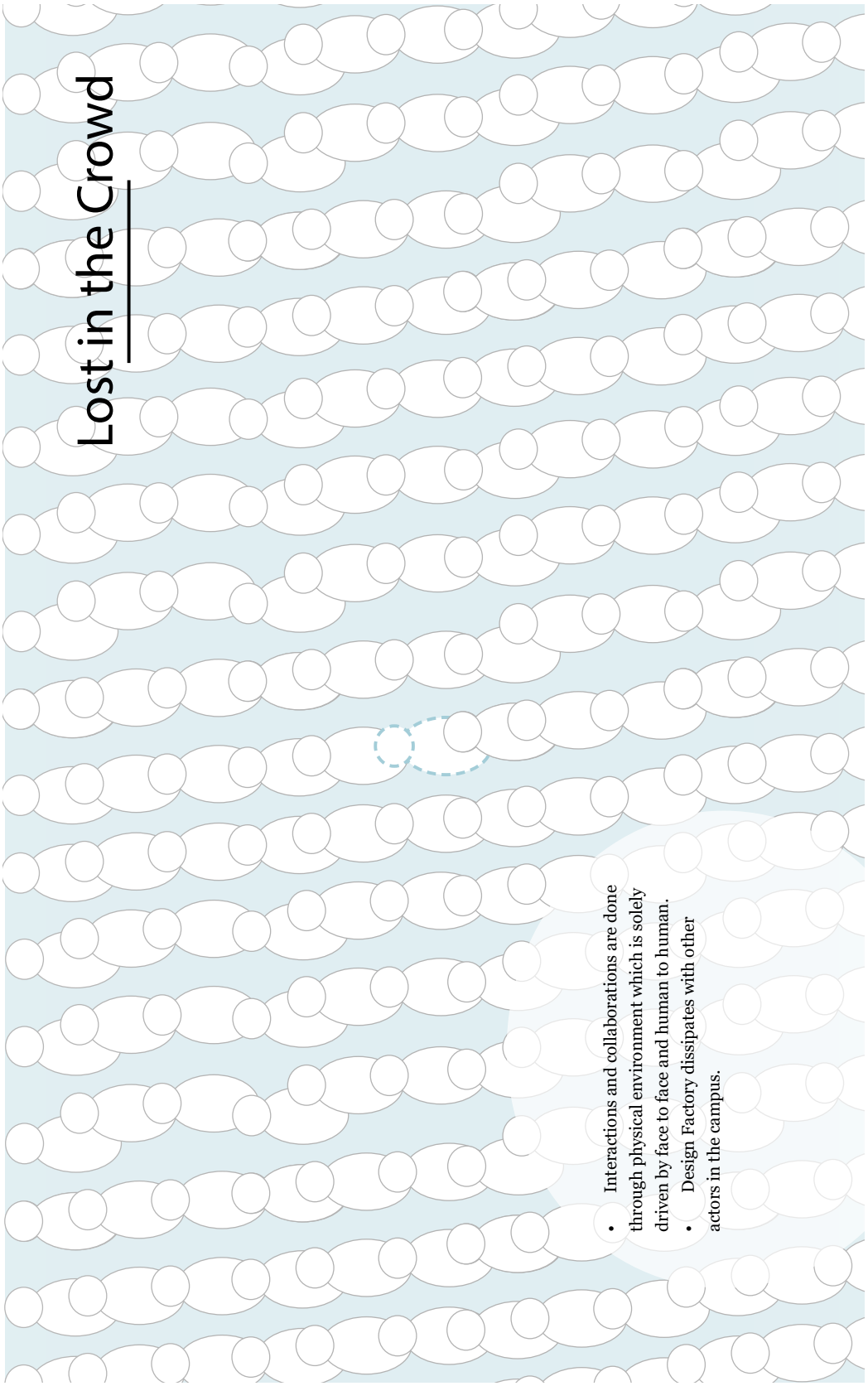


Figure 7.6: Lost in the crowd

Chapter 8

Final words

> "You need to be able to stand the critique", as your doing something very different
>
> (Participant from the interview)

This chapter throws the light on the observations, recommendations and discussion points which should support the Design Factory in keeping the experimental nature in future as well.

8.1 Discussion

The systematic method that is proposed and used in this study aims to apply foresight approach or futures studies in envisioning the plausible futures for innovation ecosystems that are spread around university and focus on student's education. This study method can act as an inspiration to similar foresight studies that aim to involve all the stakeholders, external experts and future drivers to anticipate futures visions that assist their organization in decision making and future preparedness.

However, the limitations of the study which are today's futures drivers, participants view on futures and the Aalto Design Factory centric study environment, have a significant impact on study outcomes. This could be also an interesting challenge for future prospects in terms to address the issue both in content wise and method wise. one option to overcome this issue could be to involve more external experts,and potential stakeholders in the study process.

8.2 Conclusions and observations

Based on the final scenarios and insights gathered in the study, the radical nature of education and experimental ecosystems in next 20 years could be impacted by:

- Personalization of learning experience or giving choices to the student on ways of learning and working, which will add value to the student's education. It is important to have a balance between the personal and the community aspects while defining the study plan or the teaching methods.
- Educating students with respect to confluence of various distant disciplines is vital in problem-based learning. Already today, few of the basic disciplines are brought together, but emerging disciplines like nanotechnology, artificial intelligence and, biotechnology will play an important role in the confluence in future.
- Taking inspiration from new business/service models which are redefining the current operating systems. The education system for example, with new actors, can be offered as a service rather than a product.
- Changing ways of interaction and communication, The communication and interactions will go beyond human to human and voice to voice. The virtual and brain to computer communications will bring new challenges and opportunities while defining and planning the interactions and encounters in the community and outside. For example, current innovation spaces, which have the purpose to encourage collaboration and encounters, may not serve the same purpose in future.
- *Design* based approach will reach a wider audience and industry, the key factor for creative process will be on how to use design principles along with generative tools to solve problems.
- In the gig economy, people will have multiple careers and, skills play a more critical role than a degree. There will be a need to offer a flexible degree structure, that supports the development of a wide skill-set.
- Low hierarchy in administration and management and less distance between student and teacher which are Design Factory's core principles, can be maintained by integrating them to virtual environment and virtual assistants.

Further, based on the research, the following observations are made:

- Four out of eight primary scenarios that were chosen are technology related. This shows that technology will drive societal change and will highly influence the next generation of experimental education.
- From the online survey results, it is observed that all the participants are aware of the proposed drivers and have some experience with them.
- As this study was aimed to trigger new research directions, there are many ideas which arose during the study that can be further explored into detail and experiment to find the limits. Some of the ideas can also be implement today and

few require some maturity in terms of technological advancements and societal changes.

> Design Factory is only a project, so we need to lead the way, we need to literally always be in front line. otherwise, if we start moving to the comfort zone, we won't exist anymore, it will fall flatten, it will end there, there is no other possibility
>
> (ADF staff member, Report)

8.3 Recommendations

Based on the study's outcomes, which are future scenarios, the following are the recommendation given to Design Factory.

- As the problem solving relies on more extreme disciplines, more disciplines from inside and outside of Aalto university should be brought together.
- With the changing dynamics in the university campus as other disciplines understand the value of inter disciplinary, new ways of teaching and working, Design Factory should come out of its bubble and should be more proactive in influencing Aalto's strategy.
- As technology will drive societal changes more rapidly, it is important to collaborate with new actors, because an experimental platform will highly depend on technical competencies and resources.
- Keep the Experimental nature up-to-date.
- As Design Factory has a vibrant community and global network, there is an opportunity to involve the community and stakeholders, together with new actors and reflect about what can be done and achieved together. This is vital in reviving the vision and strategy.

The following are points which I believe are a good start to integrate this work into Design Factor's strategy and decision making.

- It is important to focus on lifecycle of the methods. For example, taking inspiration from fashion industry about how there are new trends every season and how some trends will be outdated. As experimenting is in Design Factory's core philosophy, it should be aware about when the methods, or environment will be outdated. Teachers and researcher should be provided with required new tools to experiment.
- As the public organizations in Finland such as City of Espoo and Finnish Government are positive towards building interactive and creative workspaces, there can be new initiatives to involve these organizations directly and actively in the ecosystem.
- Like other schools in Aalto University, primary and high schools are aware of the importance of new ways of working, and teaching. They have already taken these new principles in their vision and plans. When Aalto University campus will be ready by 2020, the vibe and energy in the campus will be based on these new principles. It is important for Design Factory at this point to differentiate itself from other spaces in the Aalto university campus with bold and radical vision. It is vital that Design Factory still will be an experimental platform, nurturing and fostering next generation of new ways of working and teaching, so that it will still be a place of inspiration for the community in future activities as well.

- As there was restriction in time and resources for this study, there could be some ideation sessions based on this study to yield more tangible ideas within Aalto Design Factory ecosystem and Design Factory Global Network.

- The growing network of Design Factory not only helps in building the community but also to find the synergies to develop new things. As the next generation teaching methods, and problem solving are very much depended on global values, it is important to co-create a shared vision. The role of Aalto Design Factory could be to provide bold and ambitious guidelines to define the shared vision.

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Appendix A

First appendix

A.1 Interview questions

- What is your vision for Design Factory in 2030/40.
- What you believe will be the challenges Design Factory would face in future.
- What factors are more likely to influence your work or your role in future.
- What external factors and mega trends are likely to impact Design Factory objectives.
- What do you think about the needs of Product designer/ Change-maker- future user?. (as Generation Z (born in 1995) and alpha (born in 2010) will be in Design Factory)
- What will be the challenges in educating these change-makers/product designers?.
- What do you think about the Industry expectations from these change-makers in future.
- How would you define change makers at your time of education, how would you compare your education system with the current system.
- Do you think technology (high tech) will play a radical role in future. If so, how?.
- What could be the challenges in collaborating with partners?
- What makes you curious, when you hear the word Design Factory or when you're in Design Factory.
- Are there any important internal factors that might have high impact on Design Factory in future. Please specify few.
- Before 10 years, engineering, design, business were taught independently, but now they are together with inter-disciplinary activities or concept, what can supersede interdisciplinary in future.
- What would not change in future.

- How do you think the Design Factory is bringing value to the neighborhood, city?.
- Will there be any wild card in technology or research methodology, or the way we work, which would radically change in our daily practices at Design Factory.
- How do you think that we can co-create and bring more value to Design Factory while working with other Design Factoryâs.
- As every organization redefines its mission and vision at some time, when do you think it's the time for design factory to redefine itself, how would you vision it.

A.2 Interview insights

A.2.1 Facts

- Design Factory is a clear understanding of a mind-set, and it will be within the language across the university and industry. Because the boundary will not be distinguished as they are now.
- A globally spread network of Design Factory's, it will be still called as an experimental platform.
- Design Factory will be a forerunner and will keep the industry, companies, and universities awake.
- There will be fear among stakeholders that they going to lose something from their discipline. Making universities, industries, decision makers realize that being a specialist is important but on top of it, you need knowledge on how the other disciplines work.
- Have to Educate the facilitators to understand that by doing they will see completely new opportunities.
- The challenge at this point is to have enough funds to run the ecosystem.
- The style of teaching is not renewed as fast as changing generation.
- The slowest changes are happening in minds of people, and attitudes.
- Must explore the possibilities for tele-presence techniques and advanced video meeting.
- Involving self-supporting companies like start-ups.
- Urbanization is driving people to cities and that gives us new opportunities and challenges. In addition, the hugs speed of tech change and disruptions.
- Online possibilities and getting the online presence more. That will make team working in global.

- The people will be the same in future as today and hundreds of thousands of years back, we will go more towards nature.
- Students/change makers are expected to be responsible for guidance towards change.
- Increase human skills, as we more we forget where we came from, the less future change makers going to make change. They must do hard work to prove their point.
- Change makers must be brave, challenge, not to respect hierarchy, people to come with having own ideas, having own visions.
- Role of teacher has really changed to be a coach from role of actor who performs; this kind of coaching would evolve in future as well.
- Design Factory is one of the successful examples and role models what can be done and how can be done to maintain good partnership with industry it can be in the form of student projects or contract starts up partnerships and we will find out new ideas for that.
- Applying and testing quickly and focusing to the problem not the guilt's. We can develop methods and teaching cultures, which is also motivation for the boys; this is something, which would kind of grown into larger areas. Methods based on trust are more important.
- Everyone wants to live forever, like being well; being healthy and having the right to your own destiny, self-determined ecosystem can support other users and other opportunity.
- Industry is adapting and learning from Design Factory.
- It helps any of those parties to have dreams and interests in improving their educational activities. It's an everyday conference.
- Design Factory is a cannery; it is a dialogue between individual demand and need.
- Big company that changed many things, still culturally change, start-up sauna, entrepreneurship, education, aging of population the cost of the health service system, climate change and the sustainable, how about the elderly population or the contact for the youngsters or the potential students is also quite weak.

A.2.2 Challenges

- The spirit is not same as among the Design Factory network.
- School system is really fixed, has lot of friction for change to happen.
- Keeping this ecosystem flourishing as now.

- It is home for start-up and small companies; it means that limitation is on other hand, the size, operations that is also possibility because of very interdisciplinary.
- Listen to human needs, not accepting the virtual world for communication and involving more humanistic and diverse environment.
- Educating students on changing world.
- Because information is everywhere, how that is converted in to knowledge. It can be through collaboration and cross silos like normal boundaries, and cross boundaries.
- In next 10 years, school system will be splitting into two extremes and there needs to be a way of communicating between these extremes.
- it's hard to find good students.
- Trying to do the ideas are 100 years old, it is hard where the culture is very strong, the parents, the student, government do-not want to change.

A.2.3 Assumptions

- Design Factory and Start-up Sauna can be working together and cooperating using real money.
- In future, Design Factory network can still community based ecosystem and having a start-up sauna next to every other Design Factory.
- More common research initiatives and more common shared courses between different universities (Design Factory's) around the world.
- Silos must be interdependent to bring about new world.
- Industry expectations fundamental reminded the same and they will remain the same.
- Nothing has change, students are more sophisticated, Student luxury will be less in future, and you will be expected to utilize the information. They do not become attached to university, if you are in university, industry, or religion.
- University will be industry more and industry will be requiring being more university.
- Design Factory will be a forerunner and will keep the industry, companies, and universities awake.

A.3 Online Survey questions

1. As the students can gain knowledge and access information from various sources, the role of the teacher will evolve from being a **teacher** to **facilitator**. In next 20 years, teachers will be comfortable in being a facilitator while using **innovative teaching methods** to educate the students. Design Factory will act as a safe environment for researchers to experiment and teachers to foster these new teaching methods.

2. In next 20 years, the abilities to have expertise in single discipline and the competence to collaborate across other disciplines will be important for successful student education and in their professional career. Design factory will support the student to acquire the abilities to collaborate across new and emerging disciplines.

3. The current teaching methods which are based on **teacher centric** classroom style will change to **student centric** learning in next 20 years. And Design Factory will support this student centric learning by providing personalized and customized learning options to the students.

4. Current creative process involved in Design approach while working with the design tools is **passive**, that is âwe get what we needâ. For example a chisel will carve where we want to or a software does what we want. By 2036, tools with machine learning and artificial intelligence will enhance our creative process towards **generative** and **intuitive** design. Design factory will support the students in using these new generative and intuitive design tools to enhance students creativity and productivity.

5. By 2036, **virtual reality** will be widely used in day to day work, and communications. Also interaction and collaboration between colleagues, students will be actively done through Virtual Environment. Design Factory will provide an active virtual environment to experiment with new innovative and experimental methods that support students learning.

6. By 2036, there will be prominent percentage of **elderly population** that leads active lifestyle. This population will have their own needs and may require some assistance to integrate with the virtual world and the new generation. In Design Factory, elderly population will play active role in passing their knowledge, supporting the students learning and community activities.

7. By 2036, we will be part of 100+ billion **Internet of Things** (devices) that are connected to the web. As 5G is standardized, the connectivity will reach to remote places and people will lead a more connected lifestyle. There will be more **connected business** with **connected intelligence** building towards **Connected planet**. Design factory will use the highly active connected environment to support students, researchers, teachers and all stakeholders.

8. By 2036, Human will know-how to collaborate with Artificial Intelligent driven systems, robots and other advanced systems to be more productive. **Human**

capabilities will be enhanced by using **Artificial Intelligent** assistants. Design Factory will support the students to learn on collaborating with these Artificial Intelligence driven systems, robots and other advanced systems.

9. By 2036, the real-time data is gathered through various gadgets and other information's related to user behavior and requirements. This **data** can be used to develop new and customized services for the user. At design Factory, the courses, teaching and services offered will be customized based on students data.

10. By 2036, **New disciplines** such as Nanotechnology, synthetic biology, cognitive science will have a direct impact on the traditional disciplines for **developing new solutions**. The students at Design Factory will be taught methods involving these new disciplines to solve problems.

11. By 2036, the quest for innovation will lead the **industry to act as an university**. In order to teach practical skills while solving real life problems **university will become more like industry**. Design Factory will play an active role in these interactions between industry and university to support the learning of the student in solving real life problem.

12. As updating skills has become quite essential to support the new needs in professional career, the demanding skills will be offered through segregated courses or nano-degree programs. These nano-degrees will be widely offered by industry or organization or university. This will have impact on current **Degree structure** offered by university. Design Factory will offer segregated courses in collaborating with others organizations in demanding skills and students will also have freedom to build their degree with respect with these courses.

13. By 2036, the **New educational operational models** will bring new actors to current operations and ownership in the Education. For reference, Recent examples for New operational models are Uber and AirBnb. Design Factory will take initiatives in bringing new actors into current education models which would benefit the student learning.

14. Born in era of touch screen, YouTube, Instagram, **generation alpha** will be sharing their thoughts into the world in few seconds and will be the most metamorphic generation due to frequent technological changes. The needs of these future users will be driven by new principles. Design Factory will be a place where the needs of students in 2036 will be fulfilled and the student will find it as curious and intrigued as it is now.

15. By 2036, most of the current job titles and roles will be absolute. Students are educated for the future jobs based on **future skills** and needs. Design Factory will play a dynamic role in supporting the students in learning the required skills and needs

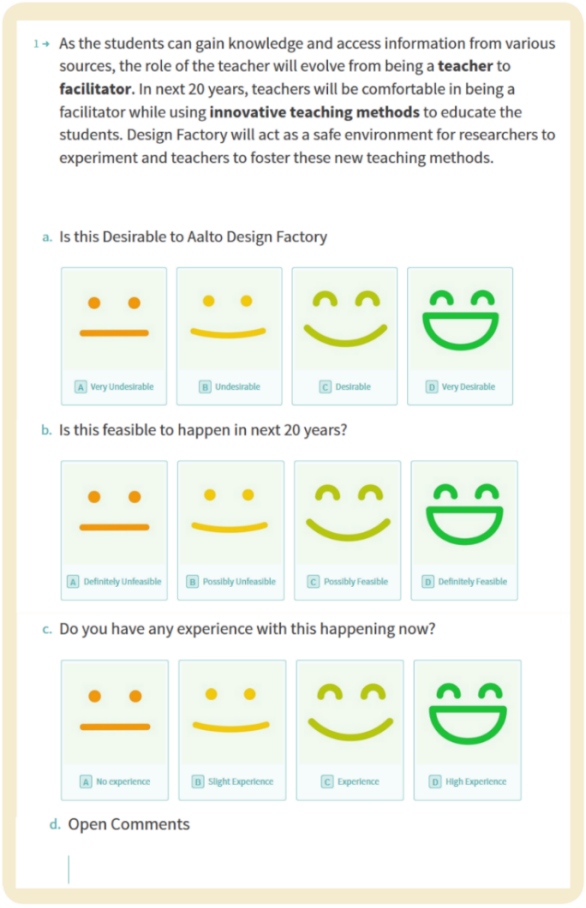
16. In year 2036, in the age of virtual world, **physical working spaces** will act as human outpost motivating and supporting different generations, cultures and diversities. Design Factory will be physical space which will bridge the gap between humanistic and virtual world while supporting different generations, cultures and diversities under one roof.

17. By 2036, to support the product teams and keep up the momentum to innovate, the **future labs** will be more compact, modular, flexible and integrated to larger co-working spaces. These **modular, flexible and compact** labs can are established in Design Factory to support the course project needs and requirements.

18. Currently City of Espoo supports Aalto Design factory ecosystem in initiatives. The new collaborations between **City** and Neighbourhood will play an important role in next 20 years as well. Design factory will be more active in collaborating with the neighborhood, city and other organizations.

19. In next few years Aalto Design Factory ecosystem will move to a **new physical location** in university campus. As the energy and spirit is so materialized in current building, it is challenging to carry the vision to new building but will also be an opportunity to revamp its vision in supporting learning of students in future.

A.3.1 Online survey format



A.4 Primary scenarios

The eight primary scenarios are:

A.4.1 Symbiotic World

- The teaching and learning experience is enhanced by using artificial intelligent tools.
- Student are taught to work together with Robots, artificial intelligence assisted tools to enhance their productivity.
- Students will have personalized and customized learning assisted by artificial intelligence. The curriculum of the student is curated together with artificial intelligence assistance.
- Scenario drivers: Artificial intelligence, teacher role and new teaching methods, student centric education.

A.4.2 Hyper-connected Humans and Devices

- People and Devices are connected from very remote parts of the world. There are 100 Connected Design Factories across the Earth and one on Mars.
- Teaching and learning methods are curated on working in the hyper connected philosophy and community.
- Teaching and learning experience is enhanced by with information available from the connect resources and devices.
- Scenario drivers: Connected people, new teaching methods, degree structure.

A.4.3 Unreal World

- The virtual environment is seamlessly blended into real environment.
- Virtual medium is enhancing day to day collaboration, group works, communication, interaction, teaching and ways of working
- Teaching methods are experimented and developed to support these virtual interactions.
- Scenario drivers: Virtual reality and argument reality, new teaching methods.

A.4.4 Synergy

- New teaching methods are developed and experimented with respect to close collaboration with industry and university.
- Teaching methods are based on Real Time and very dynamic collaboration and interaction with industry and university.

- The quest for innovation, industry strategically collaborates closely with university.
- Scenario drivers: Industry and university inter-dependency, new teaching methods, degree structure.

A.4.5 Co-Creating Education

- New actors like city, start up or industry will play vital role through supporting programs and courses in the university, where student can do major or minor their degree studies.
- The curriculum of the program will be developed with the actor, university, and students interests. In addition, student will have options to choose.
- As student is already trained through co-creation to solve their domain specific problems, the actor will directly support students. Support can be through sponsorship or ownership.
- Scenario drivers: New operating model, new teaching methods, degree structure, student centric.

A.4.6 We also Love you

- Students from emerging disciplines will be brought together and will be part of co creation to solve the problem.
- Actors from these disciplines can be from inside Aalto and from outside Aalto.
- The actors are bought together in order to cater the students and faculty new methods, that would not have encountered otherwise.
- With these new collaborations, new job titles are created, new breed of skills are fostered, and new ways of developing products are taught to the students.
- Scenario drivers: New Disciplines, new teaching methods, degree structure, student centric.

A.4.7 Intuitive World

- The creative approach/ process will be based generative and intuitive design tools with respect to studentâs needs.
- EX; a chisel will carve where we want to or a software does what we want. By 2036, tools with machine learning and artificial intelligence will enhance our creative process towards generative and intuitive design.
- To enhance creativity and productivity, new teaching methods that are experimented, developed and taught will be highly based on generative and intuitive design tools.
- Scenario drivers: Design approach, new teaching methods, student centric.

A.5 Workshop framework