# FAB LABS AS INNOVATIVE PRODUCTION SPACES IN THE CITY: COMPARATIVE ANALYSIS OF İZMİR AND DORTMUND

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# ABSTRACT

## FAB LABS AS INNOVATIVE PRODUCTION SPACES IN THE CITY: COMPARATIVE ANALYSIS OF İZMİR AND DORTMUND

In this study, a comparative analysis of three fab labs has been investigated regarding innovative and creative spaces in cities. Therefore, the fab lab models in Germany and Turkey have been examined. Fab Lab model has been emerged in the cities related to maker spaces and the Maker Movement to enhance the maker culture in the community. Under the guidance of literature reviews, the Maker Movement, Maker cities, Fab Lab model relations has been mentioned. In the scope of the study, three fab labs İzmir Fabrika Lab, Dortmund Dezentrale Fab Lab and HRW Bottrop Fab Lab was examined under the determined subtitles.

Additionally, semi-structured interviews were conducted with fab lab managers and workers. Fab lab objectives shape related to establishment process, initiator and organisation model. Regarding the various objectives of fab labs, user profiles, impacts and network with other foundations differentiate. To this extent, it is crucial to answering how fab labs can spread in cities considering their relationship between maker community and public spaces in the urban design context. By developing citizen participation, considering the potentiality of transforming fab labs to third places and specialisation possibilities of fab labs can response urban and community issues or needs. Therefore, when the fab lab model considered as revitalisation and transformation strategy, it is possible to answer environmental problems and demands with innovative and creative methods.

# ÖZET

## ŞEHRİN YENİLİKÇİ ÜRETİM ALANLARI OLARAK ÜRETİM LABORATUVARLARI: İZMİR VE DORTMUND KARŞILAŞTIRMALI ANALİZİ

Bu çalışmada, şehirlerdeki yenilikçi ve yaratıcı mekanlar göz önünde bulundurularak ikisi Almanya'dan birisi Türkiye'den olmak üzere üç farklı üretim laboratuvarı modeli incelenmiştir. Üretici hareketin yaygınlaşması ile üretici kültürün benimsenmesi adına şehirlerde ortaya çıkan üretim laboratuvarlarının sayısı gün geçtikçe artmaktadır. Literatür araştırmaları sonucunda üretici hareket, üretici şehir modeli, üretim mekanlarının ilişkisi verilmiştir. Çalışmanın kapsamında, İzmir Fabrika Lab, Dortmund Dezentrale Üretim Laboratuvarı ve HRW Bottrop Üretim Laboratuvarları belirli başlıklarda incelenmiştir. İzmir, Dortmund ve Bottrop'ta üretim laboratuvarı yönetici ve çalışanları ile yarı yapılandırılmış mülakatlar gerçekleştirilmiştir. Üretim laboratuvarlarının hedefleri, işletme modeli, kuruluş süreci, kuruluş hikayesi ve teşvik eden kurucusuna bağlı olarak farklılıklar göstermektedir. Üretim laboratuvarlarının hedefleri ve odakları laboratuvar kullanıcı profili, ihtiyaç duyulan kuruluşlarla ile ağ ve bağlantılarını ve mekânsal etkisini şekillendirmektedir. Bu bağlamda, üretici toplum ve kamusal alan arasındaki ilişkileri göz önünde bulundurarak üretim laboratuvarlarının şehirlerde nasıl yaygınlaştırılabileceğini cevaplamak çok önemlidir. Üretim laboratuvarlarının kentlerde üçüncül mekanlara dönüşme potansiyeli ve üretim laboratuvarlarının ihtisaslaşmasına olanak sağlayarak kentsel ve toplumsal ihtiyaçlara cevap verilmesi mümkündür. Bu nedenle, üretim laboratuvarları, vatandaş katılımını destekleyerek kentsel tasarım ve yenileme alanlarında yenilikçi çözüm ve öneriler sunmaktadır.

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# CHAPTER 1

# INTRODUCTION

The age of great transformation society life is affected by industrial internet and advanced way of manufacturing. Today advanced and specialised technology changing the old way of production process and techniques also provide the possibility to reach and develop the customizable product. With this aspect, today's mass production spaces, factories becoming smart and connect themselves more digitally to their distributors or suppliers. They are adopting themselves more effective new conditions of the time. High productivity is being introduced to a low cost by the analysis of high quality and abundant data that advanced industrial companies produce by using a 3D printer with many materials and machines equipped with sensors communicate with each other. This new era is called '4.0 Industrial Revolution', and this term is used in Germany for the first time in 2011 at the Hannover Fair. From past to present, industrial revolution processes are divided into four. The method of Industry 1.0 is accrued in the 18th century with water and steam-powered mechanical systems. During the Industry 2.0 times, electric energy was started to use, and transition to serial production has completed. The current industry process is called as 3.0 Industry, and it started with an integration of electronic and information technologies. Finally, the new method of industrial revolution called as Industry 4.0, and it related to the inclusion of more objects in the field of production of every purpose linked to the internet. Using internet technologies in the area of manufacturing brings many innovations together. With these improvements production facilities transform their tools or machines to the global networks by building interaction with small technologies.

On the other hand, internet technologies that getting spread by personal computers enabled the passive or limited roles of the masses to turn into time. While the first steps of this transformation are taken by the free software movement which is shaped by the claim that masses are the right to reach technology; the availability of technology, the inadequacy of responding to social needs, and the lack of mass production made it possible to fill the vacant space with more widespread and participatory proposals. These developments shaped the open source movement to the extent that they responded to the masses. At the same time, the movement evolved into a mutual relationship, in which

innovative technologies inspired to develop in the direction to support it. All these developments are accompanied by the spread of the new style production to the base. The widespread use of the rapidly raising Maker Movement and the increased use of 3D printers has opened a door for everyone to do home production. Now it is easy for people to create their workshops and turn their precision designs into products.

This study will investigate the innovative and creative spaces increased with the maker movement and culture in cities by examining three fab labs from different cities.

## 1.1. Aim of the Study

This study aims to examine and understand the innovative and creative spaces in cities relation with the Maker Movement, and the maker community. The study contains two sample from Germany and the other one from Turkey. Innovative and creative spaces can emerge in different concepts in cities. Regarding the maker culture and spatial uses related maker activities can appear in cities as maker spaces, hackerspaces or fab labs. The study targeted three fab labs from different cities and examined in determined titles such as organisation model, foundation purposes or fab lab networks. It has been tried to analysis that how the determined titles accomplish the use and effect of fab lab in different cities.

## 1.2. Scope of the Study

## 1.2.1. Method

This study has been made to prepare base for analyses to understanding and comparing of fab lab use and its effect to cities in Turkey and Germany. In this respect three fab labs in three different cities has been examined in determined topics. During the case selection, there is an effort to understand how different organisation models and objectives direct the fab lab user profile, possible affection to the community, fab lab connections and network. That is why the selected three fab lab has different organisation model and objectives regarding the story behind foundation processes. The three cases differentiate in terms of the organisation model arising from a local authority, private company and educational institution background of the establishment. In this respect,

İzmir Fabrika Lab is the first fab lab that supported by local authority and the most recent and pioneer fab lab in the country with its infrastructure and organisation model. Dortmund Dezentrale Fab lab and Bottrop HRW fab lab are supported and organized relatively by a private company and a university.

Moreover, the cases selected from Germany share common history by its location in Ruhr area ("Ruhrgebiet", n.d.).  Ruhr Area, which has come to the fore as an industrial zone from the Industrial Revolution to the 1990s due to its coal deposits, has established its urban vision as a service and culture-oriented metropolis in the last 10 years. Therefore, both Dortmund and Bottrop have tendency to change the visions through high technology, innovations, energy activities.

The case study research process is followed the conceptual structure that set of requirements, shaping the interview questions, conceptualization and self-observations.

Additionally, unexpected themes were allowed to emerge during the interviews, researcher responses happened spontaneously and in response to the informant's answers. Before the case examinations, intellectual background of the study has endeavoured to given in order to provide extended understanding to readers. Following part of the study focused on the examination of selected cases and comparative results and discussions. Data collection for the cases has been provided by interviews, virtual platforms and fab lab documents obtained from fab lab managers or workers. Regarding the Maker Movement and Culture and its effects to both cities and citizens behaviours, it is been tried to cover all the research question enough flexibility for other themes to emerge.

## 1.2.2. Interviews

Interviews that has been made 'Dortmund Dezentrale', 'Die Urbanistan', 'HRW Bottrop Fab Lab' and 'İzmir Fabrika Lab'. Interview which made for data collection about the fab labs was done with managers of the fab labs, workers of the fab labs. Additionally, conversations with fab lab users also conducted after the interviews with managers or workers. Interview questions were answered by workers, managers and occasionally by users when they are presence. Since in some cases the managers and workers also participating in the fab lab community as users, the interview questions that are convenient for users could satiably answered. During the interview, simple, clear and short questions have been asked. In order to have sufficient information open-ended

questions are preferred, but simple questions are also included. Interview durations are approximately one hour, and content of the interviews consists of four part which is general information of fab lab, organisation models and establishment purposes, user profile and participation and impacts of the fab labs.

### 1.2.3. Self-Observation

Self-observation after or before the interview is about the physical environment of the fab labs and evaluation of the location and physical elements in the place. User behaviours in the space may show the needs of makers about physical environment. Additionally, related environment and the relationship between fab labs and other cooperated foundations also observed.

In order to understand that how the fab lab effects the neighbourhood with its consistence first data collection has been completed from both manager and user and to integrate this in an urban design dimension physical conditions are evaluated.

### 1.2.4. Case Examination

All three cases were examined within the frame that include clear and sufficient information of general information of the city (context, population, economy, education level) that fab lab located, establishment process, purpose, vision and organization models of fab labs, technical equipment and fab lab offers, related associations and fab lab network, user profile and participation, fab lab projects, and fab lab affection on its environment.

### 1.2.5. Structure of the Thesis

This study examines Fab Lab Models and their impacts in three different cities regarding their organisation model and establishment purposes in four Chapters.
In the first chapter overall information is given to provide readers understanding of the aim, research methodology, and case descriptions of İzmir Fabrika Lab, Dortmund Dezentrale Fab Lab and HRW Bottrop Fab Lab with their reason of selection.
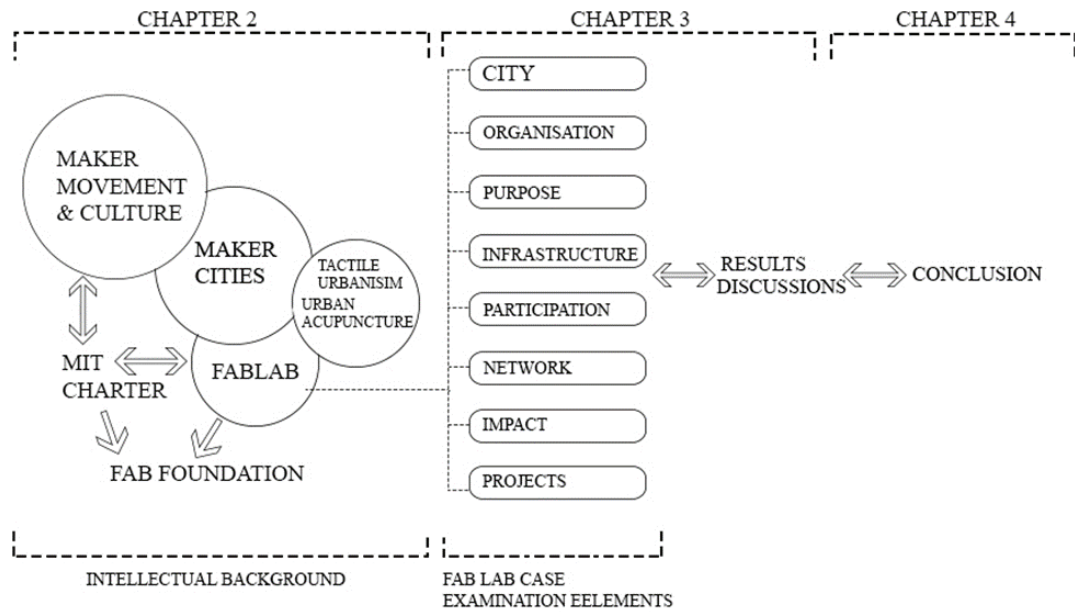
Figure 1.1. Structure of the Study

In the second chapter in order to expand the understanding of the readers, the intellectual background is given. The Maker Movement its relations with the maker cities and examinations in the frame of planning and design approaches and description of Fab Lab model considering its global networks are given.

The third chapter includes and shows the examinations, interview reflections, collected data and analysis of cases regarding the determined elements in order to understand and have the comparison ability of different fab labs. Result and discussion part of the chapter includes general interpretations and deductions considering the case analysis and intellectual background. Additionally, the following research questions of the study tried to be answered regarding the cases;

- How innovative and creative spaces can support the Maker Movement?
- How maker spaces (in general including Fab Labs, Hackerspaces etc.) can be spread and sustain in cities?
- How can be achieved the relationship between public spaces and Fab Labs in cities?

Finally, in the fourth chapter the study is presented as a summary and includes the general inferences regarding case comparisons.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1. Maker Movement & Culture

Makers, creators or innovative minded people always in the society and they have been producing or creating by their methods for considering both their own needs and others. The term 'Do it Yourself' is becoming popular in the cities to attract the attention of people through the making, creating something on their own or with others. However, the term DIY is not a new matter of fact since the makers, artists, craftsman or innovators were already in society (Kuznetsov & Paules, 2010; Anderson, 2012). The maker activity that comes from past and human nature has always been supporting sustainability in the cities and social life instead of consumerism (Anderson, 2012).

People who referred to as makers produce by using innovate the way of thinking and creativity in their actions and every product produced in that way can be considered as part of maker culture. Maker profile can vary from young people to adults or different education background or self-educated people who occupied with their project, and they can learn from each other by sharing the knowledge they have (Hirschberg et al., 2016). Since the maker minded people are aware of the value of co-working, they tend to share knowledge among different disciplines. This approach allows the response to the problems of society or initiations for citizens welfare. In this respect, maker spaces become the primary nodes in the city that allows makers to integrate by throwing them together and allow for people who wanted to develop their skills by learning with others. In the society, artists, designers, crafters, hobbyist, entrepreneurs, innovators, engineers, scientists or any others that engaged with a project creatively and innovatively are considered as a participant of the maker movement (Hirschberg et al., 2016).

Developing technologies, increasing innovative approaches and creative way of thinking in sectors, easiness to reach high technology compare with past and supported open design spaces in terms of tools and knowledge sharing, makers who have a similar set of values and purposes of the society has an opportunity come together (Hirschberg et

al., 2016). This action that contains the 'Do it Yourself' and 'Do it with Others' cultures spreading rapidly in the world and it prompted the fact that it is called 'Maker Movement'.

Especially after the announcement of 'National Making Day' by Obama in the USA (April 17th, 2015), encouraged the maker activities, meetings and festivals in the country and led to increasing the maker spaces in the cities in order to spread the maker culture through the society. Propagation of knowledge and information via makers or innovative spaces assets such as internet and physical tools is one of the values that comes with the maker movement (Van Holm, 2015). The central infrastructure that supports the movement accessibility of both hardware and software tools via maker spaces were not imagined before for individuals because those infrastructures used to mostly reachable for the experts (Paperts & Idit, 1990) and scientists (Blinkstein, 2013). Hopefully, this set of tools are reachable in maker spaces and the knowledge that individual needed to use the tools are given by the volunteer makers that take part in the movement. Thus, any individual capable of expressing their ideas, response their needs or realise their projects that can solve the problems within the maker community.

The Maker Movement Manifesto accentuates the significance of 'making' in human life and claims the 'making' as purview and inference of being human. Respectively, the manifesto reveals the creative philosophy of Maker Culture contains nine titles; these are 'make', 'share', 'give', 'learn', 'tool up, 'play', 'participate', 'support' and 'change' (Hatch, 2013). These nine characteristics of the maker culture have been summarised as;

- Aims at collecting individual creators at a centre
- Allows users to guide each other and transfer skills to each other
- Allows to design and share ideas
- Allows cooperation in projects
- Enabling individuals to discover by applying with the help of experiment and technology (Burke, 2015).

These criteria of maker culture of making philosophy support the individuals or participants in the maker community to have sharing culture rather than competition and give importance to enhance or enlarge the ability, capability of individuals rather than profit-making or money (Burke, 2015).

As has been emphasised above makers and innovators are the central dynamic of the maker movement. All followers of the maker movement or participants of the maker

community share a common set of values. Mark Freunfelder stated that there are characteristics similarities of makers through their motivation of making and those similarities show themselves as willing to learn new skills, curiosity, challenging oneself, sense of controlling or to personalise objects (Freunfelder, 2010). Additionally, those similarities of maker community participants, maker minded people willing to learn life long and tend to inform others with their knowledge and skills because as much as the maker culture or maker behaviour is awakening the city the maker movement can sustain. Moreover, learning and teaching together with the people who have similar purpose and values and meeting them or involving any project or activity is also an essential motivation for makers (Kuznetsov & Paules, 2010). The solidarity among makers that comes with the maker movement creates social, economic and educational values in the community.

In maker environments such as maker spaces, hackerspaces or fab labs becomes integration points of the maker community and in the frame of the maker culture knowledge sharing, learning-teaching skills, collaborative working helps to ascertain 'meaningful product' (Hirschberg et al., 2016). Most effectively the collaborative work of makers and 'meaningful products' can response the community needs or problems in the environment that they live. The integration and social circle where people have a chance to involve in maker spaces within this people have a similar way of thinking come together in order to enlarge their network by building new relationships with others, and this benefit of the maker culture allow to born social value in the community (Hirschberg et al., 2016). By learning and experiencing together in a social environment of a maker space, awaken the courage to self-discipline and problem-solving abilities of individuals (Van Holm, 2015). Since the maker spaces comprehend various people from different background of education and skills, social circle allows the integration of various ideas and sharing. Mainly, a pleasant social environment in maker spaces is a significant reason for makers committing to the maker movement and culture (Moilonen, 2012).

Besides, making together in informal collaboration brings educational value because the new way of learning, experiencing and information flow in maker spaces within the maker culture increases the self-awareness of individuals and contribute to spread education activities from schools or institutions through the public spaces (Hirschberg et al., 2016).

Additionally, the capability and ability to reach technological tools and equipment and rapid prototyping chances appeal artists, crafts, hobbyist or designers to initiate a

business since maker spaces offer to make possible this action with less funding (Hirschberg et al., 2016). Maker movement promoted individual entrepreneurs to start up their projects in maker spaces while the large companies start their creative incubator or R&D spaces. This creative and innovative spaces increased and attracted more attention to the culture of making together especially after understanding the significance of co-working, creating within the maker community. Naturally, with the supported both individual's and companies' initiations and start-up projects, maker movement leads to the emergence of business value in the society. The main factor that encourages the business value and attracts people to make initiations is the prototyping offers of maker spaces because with this offer maker, or designer can be involved in the process from the designing until the manufacturing, and this process contributes to producing 'customizable product' which may response more consumer needs and desires (Hirschberg et al., 2016).

Innovative and creative spaces such as maker spaces, fab labs, hackerspaces are the main cog of the maker movement and maker culture in terms of providing a physical environment, hardware and software technology offers and particularly enhancing and spreading the maker network (Van Holm, 2015). Changing the way of manufacturing habits in currents societies and desire for the customizable product are contributed to sustain and widen the maker culture.

Moreover, makers interested in values that they can offer for their cities both in the local and regional level. Makers also handle with the environmental problems, and they provide solutions in the frame of sustainability. The collaborative working context in maker spaces, value creation in terms of integration among makers and education, taking benefit from innovative and creative approaches to deal with the society's problems both in social and physical level and put forward meaningful outputs or products are involved the ideal concept of maker cities.

The way to make consumer-focused cities productive is through awakening citizen awareness and changing social thinking. Environmental and social problems within the cities can be addressed by revitalising the city' main producers as citizens and providing them with the necessary knowledge and spaces. More importantly, citizens participate and play a role during dealing with the cities' problems and future development decisions that needed to be taken.

## 2.2. Maker Cities

Maker City as a dynamic and living system requires to comprehend innovative and creative approaches through the development and growing of the cities (Hirschberg et al., 2016). Maker Movement brought the openness and sharer sense of making in the cities. As far as the needed infrastructures for the maker community provided by cities and citizen participation to the maker culture is increased cities will be shaping as maker city. A maker city involves the residents or citizens who work for similar values or interests because the mutual purposes of people create or encourage an impulse effect to move together (Hirschberg et al., 2016). Maker city must be shaped or designed to response the needs of the maker community and suppose to promote and encourage the capability of makers or citizens. Design of cities, quality of urban area should allow to residences, citizens to integrate and experience the maker culture in public areas together. That is why the main physical requirement of maker city is maker spaces that supported for people to engage with the act of making by themselves or with a group.

Corresponding with maker cities, at the end of 1980s creative city concept, has been emerged and reshaping or revitalisation of the cities were influenced by the creative city approach (Landry, 2012; Florida 2003). Following that examination of this new approach through the city design or reshape, some cities it has been agreed that some cities have more potential to become creative city than the others in terms of the knowledge base of citizens, urban regime or management (Landry, 2012). Namely, intelligence, motivations, creativity and desires of citizens and designers play a significant role while shaping the creative city. Respectively, for the maker cities, it is important to diffuse the culture of making since the cog of the maker city comes from the citizens who have interest making and manufacturing because as much as the innovative and creative spirit is awakening in the community, participation to the maker movement and culture will rise and diffuse. At the point of awakening the interest through making it is crucial to activate or motivate people by providing them with physical spaces and tools. The tendency through the making is increase when the accessibility of tools and equipment are enabled via maker spaces fab labs or public spaces so that people can experience the making activity (Hirschberg et al., 2016). Additionally, organising maker fairs, festivals and meetups or any event that throw makers together is also substantial for sustaining the maker culture in the cities. This kind of organisations have an essential role

in bringing the stakeholders and authorities can support the maker community and awareness of people who not involved maker culture can be raised.

As mentioned at the beginning since the maker city considered as a living system or ecosystem how the city supposed to shape or design and authorise the community in order to engage with making culture? At this point, Hirshberg, Kadanoff and Dougherty propose a maker city model and state that the strengthens of each maker city depend on their essential system about making following that the reinforced maker city is supported by maker related land uses from the centre, edges nodes (Hirschberg et al., 2016). According to their model, a maker city is supposed to surrounded by a physical environment, and land uses at the centre;

- Local and regional government (principal development offices, innovation offices)
- Corporations
- Real estate developers
- Philanthropic foundations
- Research universities or institutions
- Hospitals
- Non-profit organisations

At the edge;

- Makerspaces, fab labs and fabrications shops
- Makers as individual and groups
- Activist communities and industrial art centres
- Faith-based communities
- Manufactures
- Suppliers
- Tech Communities

At the nodes;

- Community colleges, universities
- Libraries and museums
- Recreation and community centres
- Community-based organisations
- Design and engineering companies (Hirschberg et al., 2016).
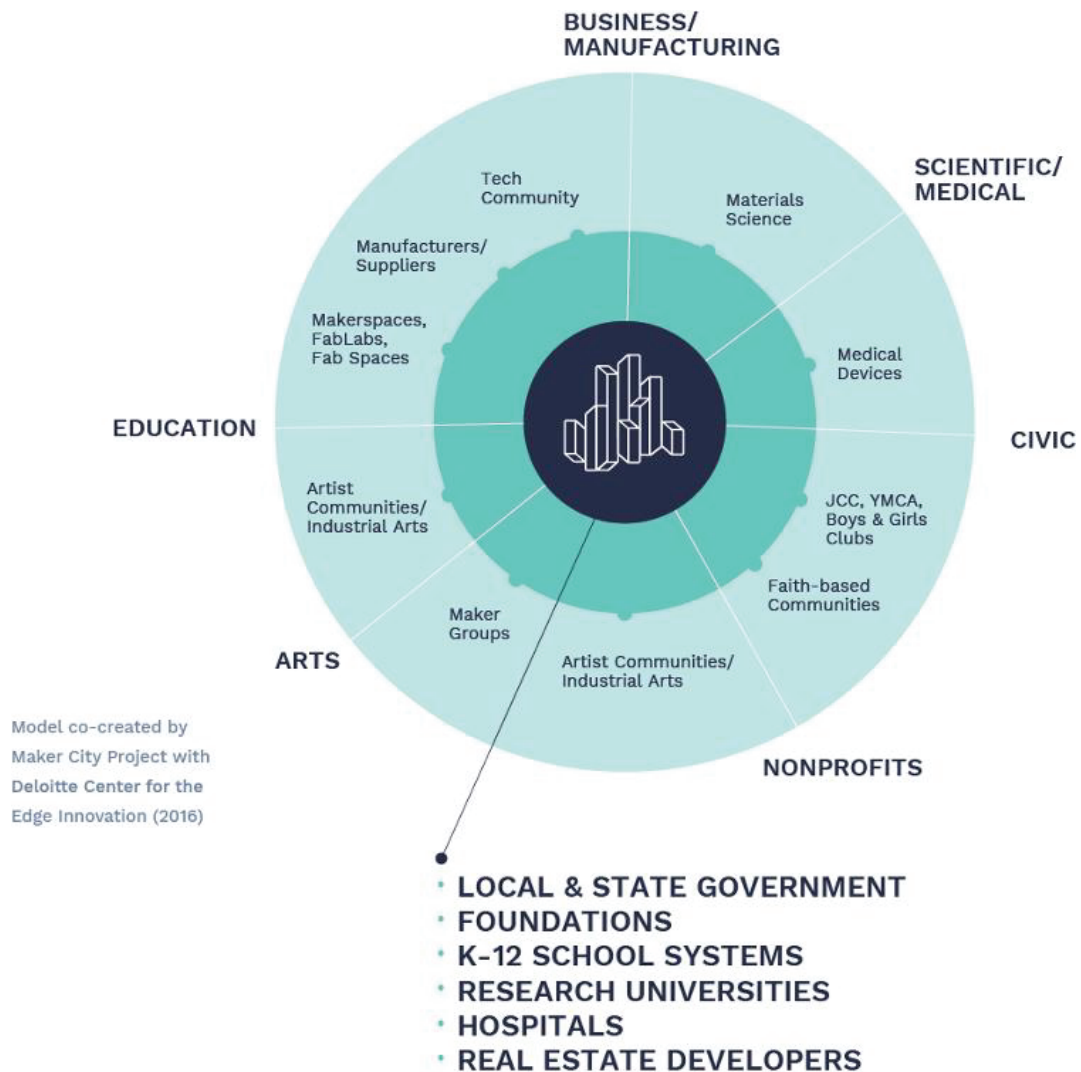
Figure 2.1. Maker City Model

(Source: Maker City Book, 2016)

It is possible to enhance the list of related land uses for maker city since the principal aim about strengthening the maker city is to provide engagement of human through the maker behaviour via maker related public or private spaces in the city.

Based on the observations of Moilnanen (2012), individual users mostly committed to one maker spaces additionally Moilanen states the reason of that those people use the maker space mainly for socialising and learning (Moilanen, 2012.)

Encouraging the participation of people to the maker movement and maker culture, contribute to both continuity and sustainability of the movement also innovative and creative citizen effect through the city's development and problems. Maker movement and spread maker culture in communities improves the involvement of residence to the

environmental problems or decision-making process for city development. Hippel states that democratisation of invention has been opened and become accessible with maker spaces in this way people had the chance to engage with the design and making things (Von Hippel, 2005). The ability to reach social and physical environment of making with rising diffusion of maker spaces in cities individuals react and response their environmental issues and needs (Van Holm, 2015). Apart from that, supporting citizen participation in environmental developments or issues, maker spaces also encourage individuals to join the local economy by supporting them entrepreneur level. The utility of prototyping in a maker space allows to experience the outputs rapidly and answer the needed adjustments also the maker or designer take in part the all manufacturing process from the idea to product (Van Holm, 2015). Thus, it is possible to mention that maker spaces contribute to the local economy by promoting entrepreneurship and can create an impulse effect to grow production or manufacturing spaces in urban areas.

## 2.3. Fab Lab as Innovative and Creative Space

The concept of innovation is becoming widespread almost in every field and the term has been clarified by Joseph Alois Schumpeter (Schumpeter, 1942) related with the field of economic science. According to Schumpeter competitive capacity in the economy is based on the technological developments in 1930s. Perceived positive impacts of innovation in the field of economy such as increasing manufacture and productivity, revealed that innovation is independent variable supports development (Tekeli, 2018). Following that this perception of innovation, the term as scrutinized and in 2005 by OECD and Eurostat in Oslo Manual. Following that the definition of innovation has been clarified as; a new implemented practise of improved product, marketing method or organisational method in business (Oslo Manual, 2005). These definitions and clarifications of innovation was delimited in the sense of marketing. However, Tekeli states that studies of innovation should be limited with the science of economy even though the first explanations and clarifications has been coming up regarding this field (Tekeli, 2018). He believes that the innovation must be discussed regarding culture, environment and the society that contributes to its development. On the other hand, Velibeyoğlu points out the details regarding those definitions of innovation, firstly it is necessary to understand the differentiation between innovation and invention. According

to him innovation affect the whole system or environment by improving the process of things while invention remains singular (Velibeyoğlu, 2018).

In societies some people adopted easily to the innovations and related with that Everett Rogers developed a theory and called 'diffusion of innovations' in order to explain phenomenon. According to Rogers, in any society individuals fall in to five groups regarding their adoption through innovations. These groups are innovators, early adopters, early majority, late majority and Laggards. Rogers has been analysed these groups with and S-curve (Rogers, 1962).
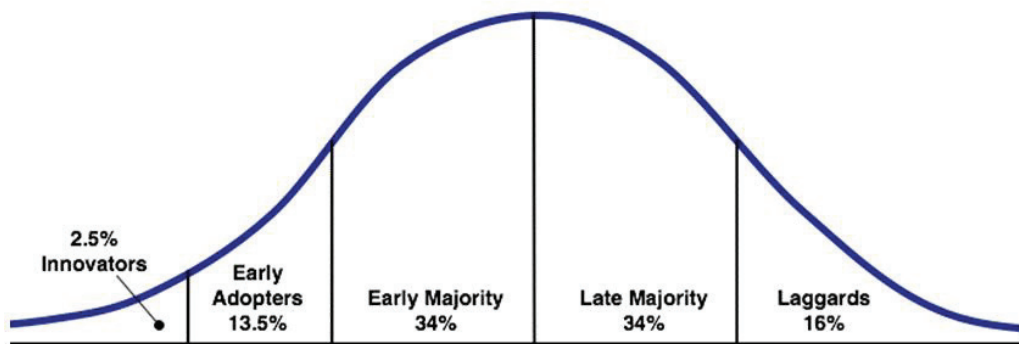


Figure 2.2. Adoption / Innovation Curve
(Source: Rogers, 1962)

Regarding the S-curve, innovators are small but important group since they are the first ones learn about and adopt. Additionally, innovators introduce innovations to larger groups because they share their experiences with their friends and community. Early adopters are also a small group and they are forward-thinking group and respected as opinion leaders. Early majority adopt the innovations significantly longer than innovators and early adopters. They have contact with early adopters and they rarely hold a position in the system. Late majority adopt an innovation after the average participant since this group of society are sceptical and have below average social status. The last adopters are Laggards, they are highly resistant to change since they are bounded with traditions and they have lowest social status. They usually wait to adopt any innovation until it gets mainstream or in some cases they never adopted (Rogers, 1962).

The development innovation as a term and conceptual in Turkey and in the world has been examined in three generation (Velibeyoğlu, 2018). In the first generation, innovation identified with 'creative destruction' (Schumpeter, 1939) that comes with technological developments. From 1960s to 1980s, accessibility of technology and knowledge spread through larger groups in the society following that in 90s information technologies and internet enabled the rapid transformation of communication between individuals and organisations. In the second-generation, innovations as shaped by foresighted leaders and authorities in order to respond the city needs and necessities. In this generation innovations or innovative approached served to city sustainability and the quality of life in cities. Third generation innovations become infrastructure and social network in cites and innovation based on sharing economy, maker movement etc. Innovation spaces appeared in cities as living laboratory (living lab), design laboratory (design lab) and fabrication laboratory (fab lab). These open innovation space approaches became widespread and effort to contribute citizen participation ad engagement to innovation processes (Velibeyoğlu, 2018).

The maker movement has developed as a special form of sharing economy and maker who involved this movement and culture express themselves by making. As a reflection of this movement and culture fab labs are getting increase in the cities. Today Barcelona even identifies itself as a fab city since it has more than ten fab labs in different themes. The fab lab concept was implemented in Turkey first time under the auspices of Kadir Has University in 2014. In the country today there is five fab labs supported by different organizations. 'İzmir Fabrika Lab' is the most recent and pioneer in the country since supported by local and governmental authorities and its activities. Conceptual of a fab lab can be defined as an open workshop that shared and collaborative space where people have accessibility to specific tools and equipment to design or invent. This place also provides the ability to individuals experimenting, research and prototype. User profile of a fab lab is quite comprehensive since space is appealing for researches, students, entrepreneurs, designers, artists, craftsperson.

The changing conception of innovation through openness contributed to new mechanisms to spread up to the outside world in that way digital tools and Internet-based equipment lead to the emergence of creative and innovative platforms for people who willing to pursue knowledge, information (Liotard & Revest, 2017). Fab labs, maker spaces or hackerspaces are some examples that can be given as those platforms where people engage with innovative, creative activities and pursues. Especially, fab labs are

spreading rapidly to offer people the accessibility of digital tools and capable them to create their personal fabrication also diffuse the maker culture. Formerly, graduated engineers and designers suffered from the lack of technical experiences (Sheppard & Jenison, 1997), hence in the beginnings of 2000s reducing in the price of 3D printers, laser cuts and open source hardware laboratory contribute to establish the laboratory in MIT by Professor Gershenfeld and it leaded today's Fab labs (Blickstein, 2013). According to list of fab lab in December 2017, there are 1205 fab labs over the world (Fab Foundation, 2017) follows the criteria that determined by the Fab Foundation.



Figure 2.3. Distribution of Fab Labs over the World

(Source: "Fablabs", n.d.)



Figure 2.4. Distribution of Fab Labs in Europe

(Source: "Fablabs", n.d.)

## 2.4. Background of the First Fab Lab and The MIT Charter

The first emergence of fab lab derives from MIT laboratory led by Professor Neil Gerhenfeld in 2001 and the purpose behind is to set up a laboratory where engineering students able to learn how to use digital equipment, tools and craft machinery to manufacturing things. The professor realised that not only engineering students but also architecture, design students and artist have also interest to the laboratory (Menichinelli et al., 2015; Liotard, 2017). The spreading idea of fab lab beyond the USA, affect especially developing countries and after that MIT's fab lab founders established the Fab Foundation and Fab Academy4 in order to lead, organize the idea and most importantly to create the network of fab labs (Liotard, 2017) since the sustaining the fab lab movement through the world requires well-organized network among fab labs. Founders of the first Fab lab (MIT Fab Lab), determined two anchor point to achieve their goals through widening the Fab Lab network; the first is organizing projects and conferences in order to establish coordination among the spaces and second anchor point is to provide a training offers and guideline that people can share the same principles (Liotard, 2017).

Mostly fab labs sustain its consistency under the roof of research companies, universities. If a fab lab foundation has the features that determined by MIT charter, it can join the fab foundation. MIT charter requirements for a fab lab is;

- Open to public access
- Ratifying the Fab Lab Charter
- Have technology, equipment accessible for anyone
- Sharing tools and knowledge
- Being part of the global community of fab labs (The Fab Foundation, 2019).

To sum up, it is possible to say MIT plays a substantial role of diffusion of fab labs all over the world and the contributions to widen and spread the network of the fab lab are non-negligible.

## 2.4.1. Fab Foundation

The Fab foundation was established by the MIT's Fab Lab Program in 2009 to reinforce the connection of the fab lab network at international level. The mission they follow is to make accessible the digital tools, knowledge to offer people the chance or

opportunity of making (almost) anything. The foundation supports the creation of Fab Labs, training offers for lab users, enhancing the network of fab labs in regional an international level and development of international projects. Training and educational support are provided via the platform called Fab Academy, and it gives the instructions and monitors through the research of digital fabrication or mechanisms (Fab Foundation, 2019).

Fab Foundation clarifies the Fab Lab as a platform of digital fabrication and computation also where people prototype, invent, create with this contribute to local development with an entrepreneur spirit. Additionally, in terms of the social values brought by the Fab lab concept to the society such as learning together by sharing and experiencing it also defines the platform as the connection point of learners, trainers, researchers, craftsperson or technologists. Recently, the network supported by the Fab Foundation reaches 30 countries and having the common tools, procedures and program bring together all fab labs under the same roof they can reinforce the connection and spread more over the world (Fab Foundation, 2019).

The fab lab concept appeared to ease prototyping activities for local development and local entrepreneurship; hence the concept has been embraced increasingly by the universities or schools to develop the STEM projects (Fab Foundation, 2019). Regarding the essential purpose or aim of the maker movement, the fab labs are an essential pillar of spreading maker culture through the cities and societies. Adoption of these spaces especially by the high educational institutions or early education foundations such as primary, secondary, or high schools provides and contribute the awaken the maker behaviour among people at young ages which promotes sustainability and continuity of the maker culture. Since digital fabrication can be considered as self-expression of individuals and gaining this experience in schools by supporting the construction tools engages people with technology and manufacturing so prevent the future generations being the only consumer in the society (Blickstein, 2013).

Mandatory characteristics of a fab lab that determined by MIT Charter and mentioned before and analytical approach of these required characteristics in the Fab Foundation Official Website emphasises the importance of public accessibility in the first place because this is essential for the democratisation of innovation. Following it was underlined that the only physical equipment or common set of tools is not enough to be a fab lab under the roof of Fab Foundation because the fundamental point behind enables the shared knowledge, information, designs, projects or documentation among other fab

labs in order to reach behind international borders. Moreover, fab lab supposed engaged and connected itself with the global maker community and because the isolated or being separated from related connections do not allow permanent and enduring existence of a Fab lab. Lastly, for fab labs wanted to join the Fab Foundations it is mandatory to accept and be committed the Fab Charter (Figure 2.5.) (Fab Foundation, 2019).



**The Fab Charter**

*What is a fab lab?*
*Fab labs are a global network of local labs, enabling invention by providing access to tools for digital fabrication*

*What's in a fab lab?*
*Fab labs share an evolving inventory of core capabilities to make (almost) anything, allowing people and projects to be shared*

*What does the fab lab network provide?*
*Operational, educational, technical, financial, and logistical assistance beyond what's available within one lab*

*Who can use a fab lab?*
*Fab labs are available as a community resource, offering open access for individuals as well as scheduled access for programs*

*What are your responsibilities?*
*safety: not hurting people or machines*
*operations: assisting with cleaning, maintaining, and improving the lab*
*knowledge: contributing to documentation and instruction*

*Who owns fab lab inventions?*
*Designs and processes developed in fab labs can be protected and sold however an inventor chooses, but should remain available for individuals to use and learn from*

*How can businesses use a fab lab?*
*Commercial activities can be prototyped and incubated in a fab lab, but they must not conflict with other uses, they should grow beyond rather than within the lab, and they are expected to benefit the inventors, labs, and networks that contribute to their success*

*draft: October 20, 2012*

Figure 2.5. The Fab Charter
(Source: "Fab Central", n.d.)

## 2.4.2. Fab Lab Conceptual Model

Fab labs, open high-tech workshops and physical space where people engaged with DIY (Do it yourself) and DIWO (Do it with others) activities usually contains the tools such as 3D scanners and printers for design and modelling studies; CNC machines, laser cutters for fabrication, computation and prototyping activities (Gadjanski, 2015).

The conceptual frame of a Fab Lab relies on opinions and purposes that come with collaboration, co-working, civic engagement of people so that they can contribute to STEM fields, entrepreneurship and local development (Gershenfeld, 2007). Regarding the fab Foundation principles, foremost essential of a fab lab is openness and being reachable by every people and they all supported by the international fab lab community because the purpose of fab labs is enabling people to make and create by supporting them both with tools and knowledge.

Fab labs offer the hardware and software technology usually in a stable environment; hence there are also mobile fab labs visits public spaces or neighbourhoods so that people engage with fab lab culture and join the community. Mobile Fab labs established inside a truck with the tools and machines as offered in the settled fab lab. According to Fab Foundation first mobile fab lab was constructed by MIT students in 2007 and the first mobile fab lab outside of the MIT was constructed in 2009 by Lorain County Community, and today the idea of the mobile fab lab is also spreading in countries (Fab Foundation, 2019). Widen the public network for fab lab community, enhancing or improving the spatial relationship city and fab lab, advertising fab lab culture by rising the recognizability with being mobile in public spaces can be considered as benefits of mobile fab labs.

Fab Labs one of the main physical cog of the Maker Movement, even though it is spreading over the world for 20 years, the effect of this innovative and creative spaces is not absolute and presentable yet. Foundation purposes, funding types or economic models, special target groups of each fab lab can differ, and these factors affect the impact of each fab lab through the local development, environment and society. According to the Menichelli (2015), potential effects of Fab labs can appear as;

- Fab labs can be considered as a physical space that people can fight with the current production system
- A space that allows an informal way of learning by experiencing with others
- Fab labs can be interpreted as a consolidation of engineering and art activities
- Lastly, these spaces can be seen as the emergence of 'new industrial revolution' across to mass production system (Anderson, 2012; Rifkin, 2011).

Before reaching these effects, Fab labs also should be interpreted as a social movement. It may already relate with the maker movement; however, as a particular innovation and creative space with its conceptual frame and supportive globalised

platforms behind Fab Labs can be considered as a movement too. All social movements in the history assemble under the roof of three common characteristics, and these are wrestling with targeted authorities, organising meeting or media, public presentations and exemplify or present the value of the eventualized possible impacts or effects (Tilly, 2004).

Based on these characteristics since the essentials and objectives of fab labs have been clarified by the Fab Foundation and Fab Charter, the first characteristic mentioned by Tilly (2004) is performed. Furthermore, organised international and local maker festivals, fairs, fab lab workshops, also maker magazines as media demonstrations support the fab labs in the way of seeing as a social movement by performing the stated second principle above (Tilly, 2004). Finally, the values of sharing knowledge, learning in a group, civic engagement and bringing or emerging the meaningful products come with Fab Lab concept is also showing the consequences, and all these allows to fab labs to be considered as a social movement (Walter-Herrman, 2013). Fab labs emphasise their essence as 'self-making' and users of these places mostly has conflicts inside, and they express that via making in the fab lab (Walter-Herrman, 2013). This shows the people who follow the fab lab movement has a shared sense of instinct to create something to respond to problems by using their capabilities. When the users have that purpose, fab lab becomes a space where anybody become maker, builder or manufacturer of something and then the essence of fab lab movement can be evaluated as making, creating or innovating (Tilly, 2004).

Today fab lab concept is already adopted by the educational foundations, large companies, local authorities. Additionally, supportive and developer implementations for rising the recognizability of fab labs are performed in cities via workshops, festivals or mobile constructions. These are efficient and required steps to widen the movement but for the eventual consistency of fab labs young generations are supposed to target. Paulo Blickstein (2013) emphasize the design principle of fab labs regarding the importance of digital fabrication and involvement of the young generation to the culture of making; firstly, even though the digital fabrication tools allows to have quick, satisfying products by student, they supposed to encourage for complex initiatives or trials so that the fab lab not only being used for hobby purposes of students (Blickstein, 2013). Secondly, fab labs must provide an experience space that students feel different than school. By mean that they could follow their instinct by designing or trying to work on a project. Thirdly, a fab lab must be the space where different disciplines are linked and experienced in an

intellectual environment so that any initiative project or idea can enrich. Fourthly, sharing knowledge especially in STEM fields in fab labs broaden the horizons through the materialise the ideas and projects, and then the meaningful products emerge. The final principle of fab lab individuals must allow bringing their projects or practices in the fields of art and crafts which can be re-invention projects or development of an existing project. Thus, encouraging or inspiring individuals in such practices allow to fab labs become spaces of a different way of working and experiencing (Blickstein, 2013). Relatively to principles of Blickstein (2013), Bart Bakker underlined the importance of congeniality of fab labs and states from his experiences from Dutch Fab Lab Society in Utrecht, technology offered by fab labs should not be only providing courses but also make easy accessibility of machines and make them user friendly or amiable to have the attention and inspire individuals (Bakker, 2014).

Fab labs are categorised in three regarding their funding system, target group, foundation purposes or workshops by Eychenne (2012) as Educational, private business or general public (Eychenne, 2012). These categories are clarified in the table below;

Table 2.1. Categorisation of Fab Labs

| Educational | Private-Business | Public (pro-amateur) |
|---|---|---|
| • Related with Universities<br>• Target users mostly students (but also young or retired people)<br>• Have MIT charter references<br>• Mostly open and free slot in a week | • Mostly self-employed entrepreneurs<br>• Starts up well-established firms<br>• Cultivate employee's collective intelligence and innovations<br>• These fab labs contribute to the development of knowledge management and knowledge transfer between employees | • Backed by government<br>• Provide development of local authorities and private financers<br>• Open to the local area for various users and usually set up in the middle of the city<br>• Offers services free or fee-paying<br>• Follows Hybrid Economic model |

According to the Fab Charter, fab labs may have business usage if the commercial activities do not conflict with other users or keep fab lab essentials, networks in the

background (Fab Charter, 2012). Relatively, four different business model explained by Fab Lab Iceland;

- The Enabler Business Model: Starts up new fab labs to widen the network of existing fab labs

- The Education Business Model: This model derived from the Fab Academy Education and most distributed one regarding other models. Training is obtained from local Fab labs, universities or business via the Fab Lab network.

- The Incubator Business Model: Entrepreneurs or designers are supported with the infrastructures so that they can start up their own sustainable business within the fab lab.

- The Replicated /Network Business Model: In this model, a product is ascertained by using the facilities from the fab lab, and the product can be replicated for marketing purposes or lead a brand (Business Models for Fab Labs, 2011).

# CHAPTER 3

# CASE STUDY: İZMİR AND DORTMUND

In this chapter, İzmir Fabrika Lab, Dortmund Dezentrale Fab Lab and HRW Bottrop Fab Lab will relatively be examined. Firstly, general information of the cities, İzmir, Dortmund and Bottrop were given. Demographic features, location of fab labs was tried to be described considering the contexts of cities, and the following titles were focused on more fab labs social and physical features. Therefore, the establishment stories and processes, organisation models with purposes and visions, physical and social infrastructure offers, related associations and networks, user profiles and user participation behaviour, fab lab projects and its possible and current effects were tried to represent.

Interviews have been conducted in fab lab buildings, which are Dezentrale Fab Lab (Dortmund, Germany), HRW Bottrop Fab Lab (Bottrop, Germany) and İzmir Fabrika Lab (İzmir, Turkey). Interviews have been done -within the following order- with Patrick Jaruschowitz (Manager of Dezentrale Fab Lab) in the 20th of June, Robert Reicher (worker in HRW Bottrop) in the 18th of December and Aslı Topal (Design Coordinator of İzmir Fabrika Lab) the 24th of December in 2018. In the 26th of April, another meeting has been done in İzmir Fabrika Lab with Aslı Topal and Sonay Perçin (Project Coordinator of İzmir Fabrika Lab).

Each of these interviews had approximately took one hour to be completed, and the interview questions were then categorised and analysed in four main parts; general information of the fab lab, organisation models and establishment process objectives and fab lab network, user profile and participation, current and possible impacts of the fab labs (Appendix A).

Regarding these examination and analysis titles at the result and discussion part, the comparative comments were attempting to interpret. Cases involve different organisation models with various purposes and objectives. In the figure below the location of three fab labs was illustrated.

Figure 3.1. Location of Fab Labs that included Case Study

(Source: Google Maps)



Figure 3.2. Location of Bottrop and Dortmund in Ruhr Area

(Source: Google Maps)

## 3.1. İzmir Fabrika Lab

### 3.1.1. General Information of the City

İzmir Fabrika Lab located on Konak District (Alsancak Neighbourhood) where is placed south-east of the İzmir Gulf. The establishment of the Factory Lab is supported by

the İzmir Development Agency (IZKA), and fab lab has opened its doors to visitors and users in the very beginning of 2018. İzmir is the third biggest province in the country with its over 4.2 million population (TUİK, 2018). The city has the largest population in its region, and it illustrates itself as the city of Fairs it is famous Izmir International Fair that held every year in September. Another main characteristic of the city is being a coastal town and its harbour also locates in Konak District. Especially this distinctive characteristic of the city is separated İzmir from the other Anatolian cities. Thus, the identity of the city consists of three concepts which have interwind and complete with each other as 'the town, the sea and the port'.
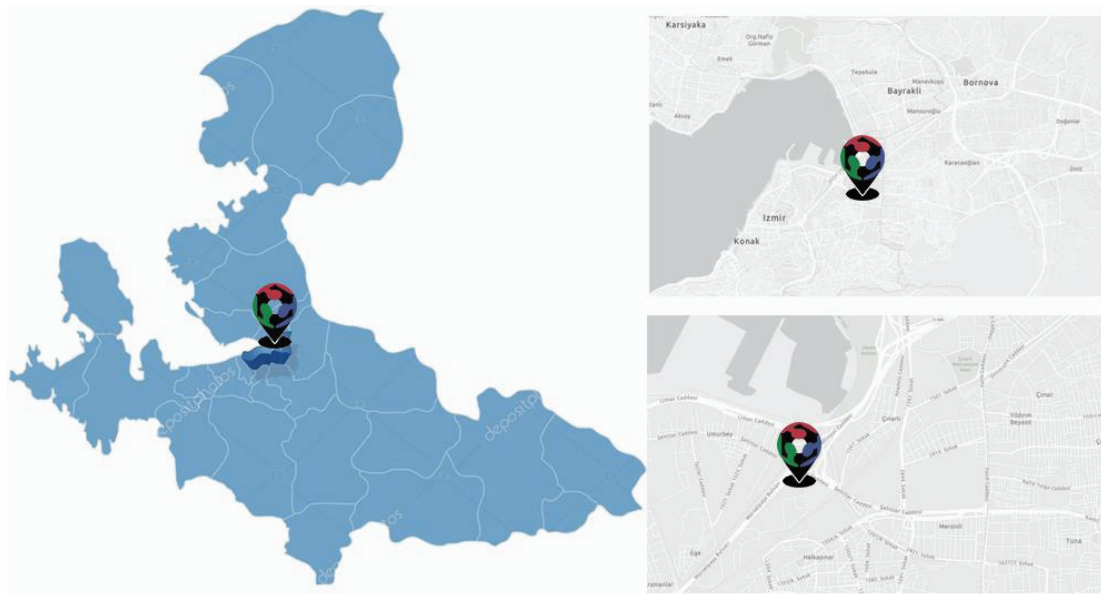


Figure 3.3. Location of İzmir Fabrika Lab

(Source: Google Maps)

Within its long history, the city was under the hegemony of many authorities such as Lydians, Persians, Hittites. Since it was a prosperous city in terms of geography and trade power, the city has been destroyed and re-established by these and other authorities in the past. Today archaeological studies that were done in Kadifekale show the city had grid planning system with its long vertical-cross streets. Moreover, the reputation of the city was related to the existence of the port because of the first settlements located between Kadifekale and old natural harbour. Therefore, the city will mainly be a place of

this natural harbour and its future will also be shaped according to the viability of the harbour (History of İzmir, İZTO).

İzmir is one of the cities that investors prefer qualified young people with a high-quality education. The city is also appealing for young people with its universities and high-quality education offers. Considering the educational background of the city, the literacy rate is %98.5, and the college and faculty graduate is %18.4 following that, %36.9 of the population graduated from universities and %19.1 is male while %17.8 is female (İzmir Governorship, 2019). Additionally, in the city, there are nine universities, 35 institutes, 79 faculties, 136 research and application centres, four techno parks, 41 R&D centres (EGIAD, 2017).

According to İzmir Chamber of the Commerce; trade, tourism and industry sectors are lively in the central districts of the city. The agricultural sector and animal husbandry are most common in the areas away from the centre. Sectoral distribution percentage in the city is; %10 agriculture, %31.1 industry, %58.9 service (TUİK, 2017). Also, the unemployment rate is %14 according to data of İCC dated 2017. Additionally, according to data of Turkey Statistical Institute, the unemployment rate between 15-24 age is 21.4 %, while the unemployment rate between 15-65 age is %12 (TUİK, 2018).



Figure 3.4. Sectoral Distribution
(Source: TUİK, 2017)

### 3.1.2. Establishment Story

İzmir Fabrika Lab is innovative and implemented a part of a project supported by İzmir Metropolitan Municipality and İzmir Development Agency. The project named as

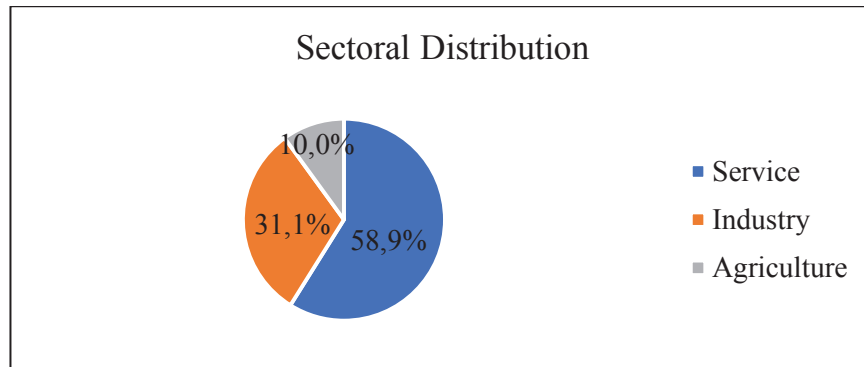City College Guided Project (Kent Koleji Güdümlü Proje) and in 2014 both the metropolitan municipality and the development agency has signed the project agreement. Every year Annual Activity Report that prepared by İzmir Development Agency gives information about the process of City College Guided Project and its implemented stages. According to these reports, after the authorities sign the project agreement in 2014; in the first quarter of the project the creation of a project Office, determination of the project team, creating a governance structure for project management, ensuring visibility and recognition and the preparation of the tender documents' studies were carried out. The first project monitoring has occurred, and for the reporting period, 931.791,06 TL was paid for the project (IZKA Annual Report, 2015). Following year, implementation of foreseen project activities and acquisitions activities were carried out also monitoring visits were held in June and October 2016 (IZKA Annual Report, 2016). While the early stages of the project were intense studies such as literature review, strategy development, action plan preparation focused; reporting period has oriented the establishment of the fab lab and the implementation of training programs in the priority occupations determined by the participatory studies. The project implementation phase completed end of December 2017. Within the final payment made in 2018 June, a total of 1,7 million TL was paid on a project basis (IZKA Annual Report, 2018).

After four years the project agreement was signed, İzmir Fabrika Lab offers citizens high technology tools and education services in order to produce and become productive all together since January 2018. Today the Factory Lab İzmir continues to work under the İzmir Metropolitan Municipality Vocational Factory Directorate. The Factory Lab is the first Fab lab in the country priorities social benefit and support also open to citizens without payment require and established by the local government.

### 3.1.3. Fab Lab Purpose, Vision and Organization Model

İzmir Profession Factory incorporates vocational and technical oriented courses for citizens in order to reach the purpose of creating sustainable employment model in the city. Following this purpose, economic development, employment and competitiveness is attempted to be increased by offering various courses ("Meslek Fabrikası", n.d. ). İzmir Profession Factory is presented as 'Craft Factory' or 'Vocational Factory'.

Figure 3.5. İzmir Fabrika Lab
(Source: "Meslek Fabrikası", n.d.)

Therefore, İzmir Profession Factory aims to contribute vocational skills of citizens and craftsmanship. Considering the sectors that already need labour force and the labour that will be needed in the city caused by rapid changes in technology or new lifestyles' needs that prompt new fields of work, the Profession Factory offers the courses that elected in that respect. Thus, particularly unemployed women and young people and following that the whole unemployed people in the city, also individuals who willing to improve their skills and learn new technologies to contribute their projects or ideas or university students can participate the courses and after they can develop their skills or ideas in the workshops held in the İzmir Fabrika Lab.

İzmir Profession Factory has identified as its main objectives as,

- Responsive to the unemployment issues in the city
- Provides individuals to produce their prototype and allow them to take part in both the learning and design process of a project
- Immingle innovation, creativity with education process and provide implementation-oriented learning
- Supports technological tools to entrepreneurs for their projects

- Tries to awaken of productive spirit in the society ("Meslek Fabrikası", n.d.).

In respect of these purposes, the Factor Lab was established in order to contribute individual's productivity with an innovator and maker environment where can share knowledge and develop ideas. Thus, the Factory Lab supports citizens with hardware and software infrastructure, 300 m² workshop area and network providing for entrepreneurship.

In Factory Laboratory Organization Support Service Application Documents clarified that to run the fab lab mainly needs a managing director, a fab lab coordinator and a technical expert.

Fab Lab Organization model is illustrated in Figure 3.6., and all responsibilities and appropriate profile of managing team are explained in Table 3.1. and Table 3.2. below.
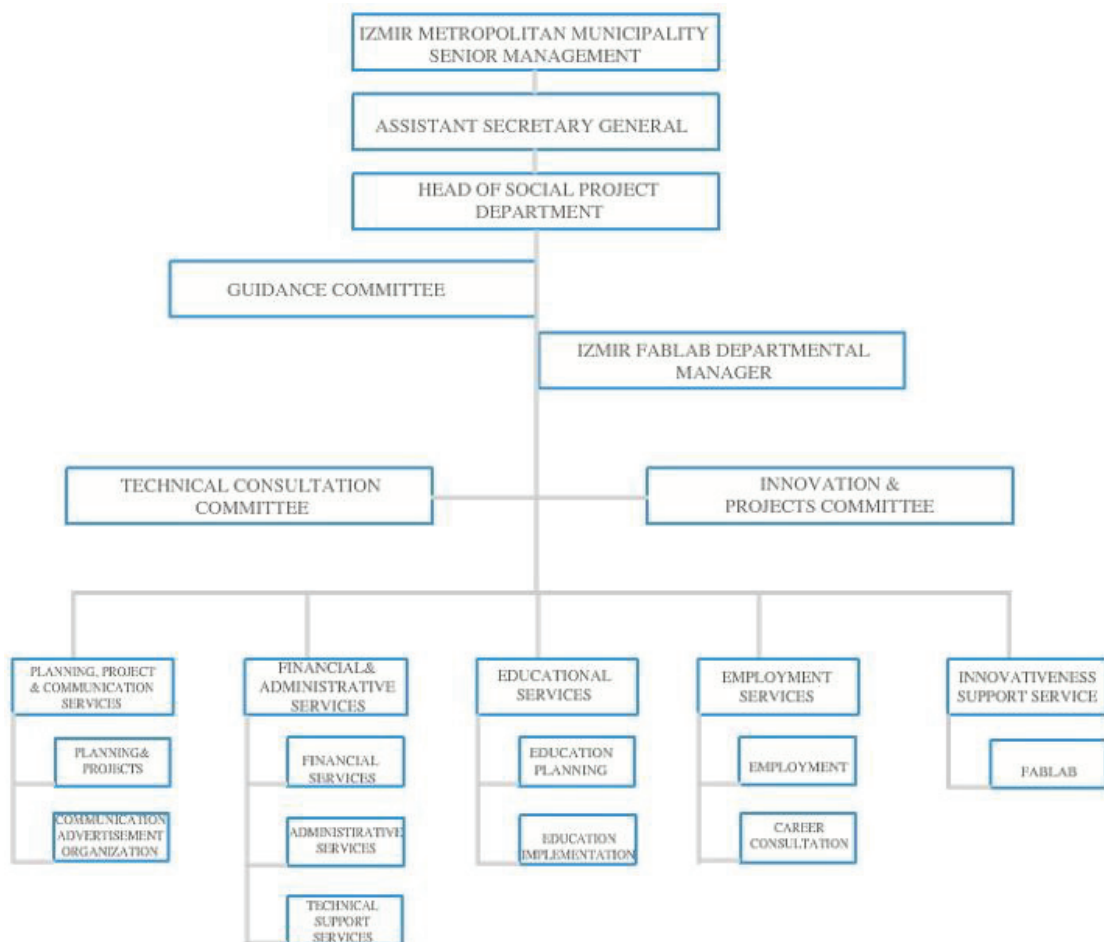


Figure 3.6. Organizational Model

(Source: "Meslek Fabrikası", n.d.)

Table 3.1. Role Distribution in the fab lab

(Source: Fabrikasyon Lab. Kuruluş Destek Hizmeti Uygulama Dökümanı, 2017)

| Managing Director | Fab lab Coordinator | Technical Expert |
|---|---|---|
| • Advertisement of fab lab<br>• Stakeholder Relations<br>• Activity, Education plans and Workshops Scheduling<br>• Human resources management<br>• User- Visitor Relations<br>• Providing new collaborators<br>• Management of user applications process<br>• Evaluation of activity, workshop, education process | • Developing and managing educational context<br>• Supplementation of innovative technologies to fab lab<br>• Producing activity content<br>• Planning and follow up an audit of producing a process of users<br>• Maintenance and control of tools and equipment<br>• Generate demands for the purchasing process | • Care of fab lab equipment and tools<br>• Stock controlling<br>• Support for the production process of users<br>• Interfere in fault condition of tools<br>• Ensure the fab lab order<br>• Keep equipment in enable state<br>• Controlling the use of equipment follow chart |

Table 3.2. Appropriate profile for fab lab Team

(Source: Fabrikasyon Lab. Kuruluş Destek Hizmeti Uygulama Dökümanı, 2017)

| Managing Director | Fab lab Coordinator | Technical Expert |
|---|---|---|
| • Graduated from bachelor and having a background of Engineering, Design or Architecture<br>• Good Turkish and English writing and speaking skills<br>• Having at least three years of project management experience<br>• Experience of social media management and public relations<br>• Experience or interests of fab lab, co-production, co-working | • Graduated from electronic, computer science or mechanical engineering (or architect, designers with technical experiences)<br>• Experience of d modelling and fab lab equipment interface software<br>• Well use of fab lab tools and equipment<br>• Interested in creative mechanic electronic software projects<br>• Well presentation and communication skills<br>• Following the new technological developments | • Graduated from related technical schools or bachelor programs<br>• Experience with CNC, laser cut, 3D printers, electronic cards and software<br>• Knowledge of Arduino or Raspberry Pi<br>• Knowledge of repairing the lab equipment<br>• CAD knowledge, Solidworks, Autodesk Fusion<br>• Basic knowledge of using drill, solder etc. |

Activity program in the fab lab begins with the learning process of high technology tools and software. Firstly, users must learn how to use the technology offered by the fab lab. After, creative and innovative workshops will be held in order to appeal to

different user groups. In the process of workshop organisations, fab lab Coordinator is responsible for determining education, context and general implementation while Managing Director is caring for advertisement, collection and evaluation of user applications and feedbacks (Fabrikasyon Laboratuvarı Kuruluş Destek Hizmeti Uygulama Dökümanları, 2017).

Additionally, to increase the recognizability of the fab lab, various themes and activities such as maker fair, maker meet up must be held. Thus, the network between people interested in creativity and innovation will spread. Moreover, fab lab employees must meet up to evaluate past activities and to arrange the upcoming ones. The whole team determines the monthly activity theme and purpose. İzmir Fabrika Lab team is consists of Mechanic Workshop Coordinator, Robotic Workshop Coordinator, Design and Activity Coordinator, Project Coordinator and Technical Expert (Fabrikasyon Laboratuvarı Kuruluş Destek Hizmeti Uygulama Dökümanları, 2017).

## 3.1.4. Fab Lab Offers and Technical Infrastructure

Available technological tools and equipment are in the fab lab; 3D printers and scanners, CNC Router, Laser cut, robot arm, computer aided sewing machine and robot design &training kits. Important and considered facts about determining the right equipment for the fab lab and users are;

➢ Not difficult to learn to use,
➢ Convenient and easy to use,
➢ No risk of severe bodily harm,
➢ Consumption material is affordable (Fabrikasyon Laboratuvarı Kuruluş Destek Hizmeti Uygulama Dökümanları, 2017).

Within these considerations today İzmir Fabrika Lab has FDM 3D printers which one of the easiest to use also these machines provide the adequate level of printing quality and allows to print with raw material such as nylon, lay brick, wood fill PLA. Besides, SLA 3D printing which is proper for more detailed works such as jewellery and dental prosthesis accessible in the lab. The raw material for SLA 3D printers is resin and products are producing by freezing resin with a laser. Training scheme of the fab lab mainly based on fab lab's personal training and fab lab users' training. Thus, various workshops and training courses are in different themes were held in the fab lab since its

establishment. Firstly, personally oriented training which focuses on providing ability and practice to lab personals also create the awareness and interaction between fab lab users and personals are prepared and held in the lab. In this respect lab personals are trained in the workshops that are;

- Digital Fabrication Principles Applications and Prototyping: Training content is to introduce digital fabrication which is a new way of producing and developing with computer-supported technologies. Besides, the training includes comprehensive fab lab Philosophy in order to awaken the maker behaviour.

- Digital Fabrication and Project Development: In this training, personals inform about either product developing for solving any problem within the fab lab or organising activity and work as teams. Project developing follows four initial steps, planning, process and closing.

- Computer Support Design and Modelling: Aim of the workshop is to provide the capability of 2D and 3D design for personals in order to produce with the equipment that offered by fab lab and for this training, Autodesk Fusion 360 program is used.

- Fab lab User Login Training: Within this training, lab personals are informed how to introduce the fab lab to its' users about the process of the projects by showing how to reach the equipment or materials and recognising the operation of the fab lab.

- Fab lab Visitor Trip Planning Training: This training includes topics about welcoming the users and visitors, informing about the foundation of the fab lab and its purpose, introducing the fab lab culture and tools usage and presenting fab lab projects.

- 3D Printing Training: Personals are intended to make their printers with the printer kits. In this training, the electronic and mechanical parts of a working 3D printer are first introduced (Fabrikasyon Lab. Kuruluş Destek Hizmeti Uygulama Dökümanları, 2017).

İzmir Fabrika Lab held activities for participants and visitors in various themes such as 3D Modelling, 3D Printing and Scanning, Electronic Prototyping with Arduino, Design Oriented Thinking Workshop, Arduino Day, Producing Workshop (3D Printer Making, Drone Making and Internet of Things).

Figure 3.7. Ardukit Applications Workshop with children aged 10-16
(Source: İzmir Meslek Fabrikası Müdürlüğü, Fabrikalab, 2019)



Figure 3.8. 3D Printing Workshop for INARfest
(Source: İzmir Meslek Fabrikası Müdürlüğü, Fabrikalab, 2019)

### 3.1.5. Related Associations and Fab Lab Network

İzmir Fabrika Lab is the only proper place that offers digital production and necessary or vital educations about digital productions. There are other institutions like techno parks, hackerspaces in the city as well but in terms of the equipment, tools and space İzmir Fabrika Lab has distinguished itself from other innovative spaces. The fab lab also has a unique feature with being the first fab lab that supported by the local authorities in the country. Hence, in order to be a good example for the future fab labs, it needs to widen and increase the recognizability, and this can be realised with providing connections and networks with the other innovative and creative spaces. Thus, co-operation and co-working with the universities, colleges, high schools, incubator centres, techno parks, hackerspaces, technology transfer offices will help to awaken innovation and creation behaviour of the citizen.
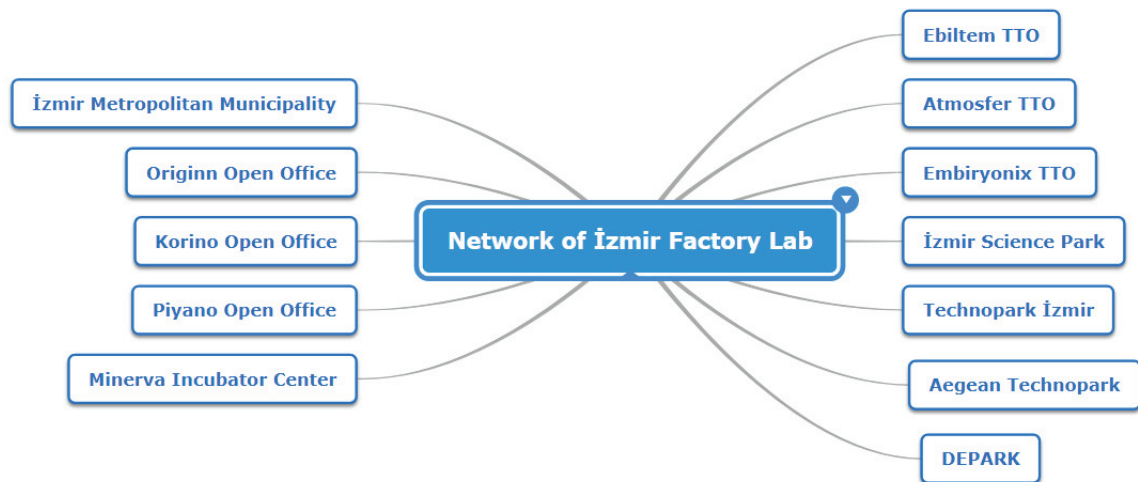


Figure 3.9. Network of İzmir Fabrika Lab

There are entrepreneurship centres like Originn, Korino, Piyano can relate with the fab lab. These centres are serving with the new sense of office life with its offering and design for freelancers, designers, entrepreneurs. Mainly, these places help to bring together the people into innovation and creativity. Open offices enable information sharing and co-working among people with different knowledge background. For instance, in Originn there is a Food lab activity area that an output of coworking of people

who share the working office. Piyano is another boutique office that offers people who want to set up their business but in the idealisation process or people who need an office occasionally. The other is Korino, and this co-working space has been established with the support and co-operation of 9 Eylül University Technopark and 9 Eylül Entrepreneurship Academy. In this office, people can work, socialise or gain knowledge. Entrepreneurs, designers, freelancers have a chance to work together and create a network within this place. Additionally, techno parks in the city like İzmir Science Park, Technopark İzmir, DEPARK (Dokuz Eylül University Technopark) or Aegean Technopark are other places in contact with the fab lab. Technopark İzmir was established in the campus area of İzmir Institute of technology in 2004. That is the 4th established techno park in the country and currently has 150 both local and foreign company, and it is adopted as Technopark under the Innovation Centre Project. Technopark İzmir provides incubator space for innovative ideas and connects advance technology with industry ("Teknopark İzmir", n.d.). The other one is İzmir Science Park was established in 2013 under the guidance of İzmir Economy University and İzmir Chamber of Commerce. Research and developing innovation projects have been realised here, and the Science park provides services for students and young entrepreneurs. The technology developing area aims at creating an entrepreneur-investor-industry network. Also, easy and simplify the production process of technological products and software ideas, and the science park provides consultancy and investment support for advanced technology. Thus, it contributes to the number of patent and copyright in the country ("İzmir Ekonomi Üniversitesi, İzmir Bilimpark", n.d.) Another techno park in the city is DEPARK, and it also aims at supporting entrepreneurs with creating a common space for them. Ideas, projects especially related to renewable energy, transportation, health, environment or advanced technology tools are supported by the technology development area. Currently, it has 120 firms and 28 patent and led more than 60 start-up projects. For the people who interest the Technopark is providing legislation information, pre-incubation and incubation services and technical services ("Dokuz Eylül Teknoloji Geliştirme Bölgesi, DEPARK", n.d.). The last techno park is that the fab lab related to is Aegean Technopark and it has two campus area that technological studies are continued. It is foreseen to create an environment for research and developing studies aimed at producing high value-added products in different sectors especially life science and health ("Ege Teknopark, IdeEGE ", n.d.). Other places that the fab lab is related in the city is technology transfer offices such as Ebiltem TTO, Atmosfer TTO and Embiyonix. These places are contained within

universities in orderly Aegean University, İzmir Institute of Technology and İzmir Economy University. Technology transfer offices empower research and development projects and university-industry collaboration. Ebiltem TTO was established in 2013 and oriented to be responsive for the local-regional problems and needs. It encourages the projects that help, contribute regional development by organising project market researches for investors. Additionally, it provides linkage between European Projects and regional industries and increase the scientific activities within universities and empower the relation among universities and industry ("E. Bilim Teknoloji Uygulama ve Araştırma Merkezi", n.d.). The other technology transfer office is Atmosfer that established in İZTECH campus area. The main objective is the commercialisation of the advanced technology that comes from academical researches and studies under the cooperation of university and industry. Atmoster TTO provides consultancy about support programs for entrepreneurs, academic researchers and take an active role in research and developing operation process. Also has supports people with entrepreneurship training and determine the start-up candidates, prepares symposiums, advertisement activities ("Atmosfer TTO", n.d.). The last one is Embiryonix TTO, which allows students to start up their projects. It is a centre that develops technology, design process and let students grow their innovative and creative ideas or projects.  Also support them with mentoring, expert opinions and provide a space for meeting with investors ("İzmir Ekonomi Üniversitesi", n.d.) . Furthermore, incubator centres are also innovative spaces that the Izmir fab lab is allied. Minerva Incubator Center is operating within the Yaşar University in the city since 2015. Purpose of this incubator centre is to support young entrepreneurs by providing pay-free offices and infrastructure services for twelve months. Developing ideas and training about creating business models, drawing together entrepreneurs and innovators, mentor supporting, finding funding sources for projects are the advantages that Minerva Incubator Center provides ("Minerva Kuluçka Merkezi", n.d.). Following all connections, the Project Coordinator stated the Fab Lab is a member of CoderDojo International Network. Coderdojo is based on Dublin and provides a free network for children to teach and enhance their capability of digital computing and programming. Today Coderdojo has more than 600 connections over 60 countries and these networks provide spatial support for children, and spatial support connections called as Dojo ("CoderDojo", n.d.). Thus, every Saturdays İzmir Fabrika Lab opens its doors for children to offer this service as a Dojo.

### 3.1.6. Fab Lab Participation and User Profile

According to interviews and received data from the İzmir Fabrika Lab, activity participation between 2018 March and 2019 March period is below. Gender distribution of the applicants reveals the gender imbalance of the participators. Additionally, more than half of the participations are consist of students.
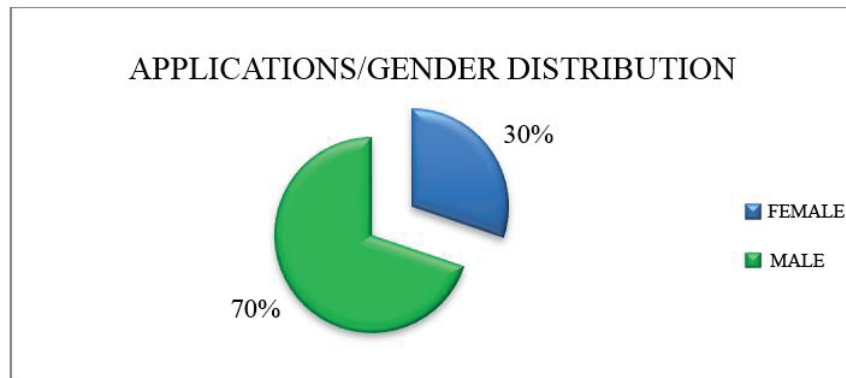


Figure 3.10. Fab Lab Applicant Gender Distribution

(Source: İzmir Meslek Fabrikası Müdürlüğü, Fabrikalab, 2019)
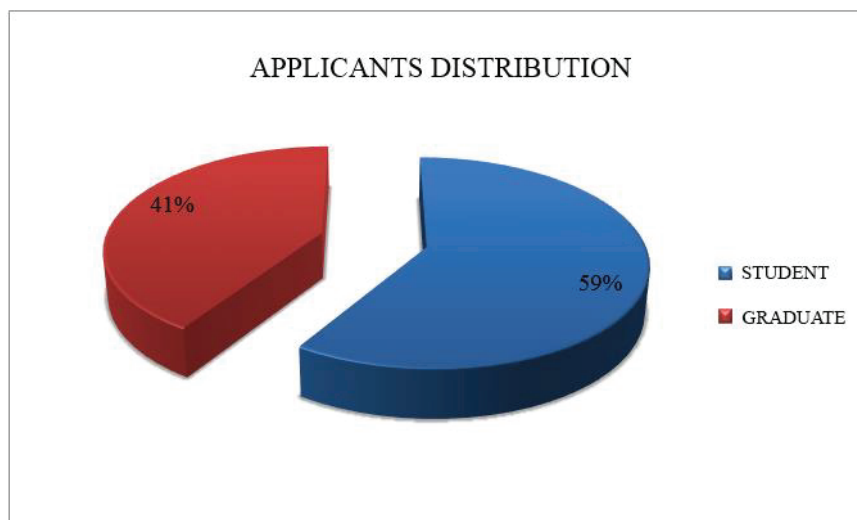


Figure 3.11. Fab Lab Applicant Distribution

(Source: İzmir Meslek Fabrikası Müdürlüğü, Fabrikalab, 2019)
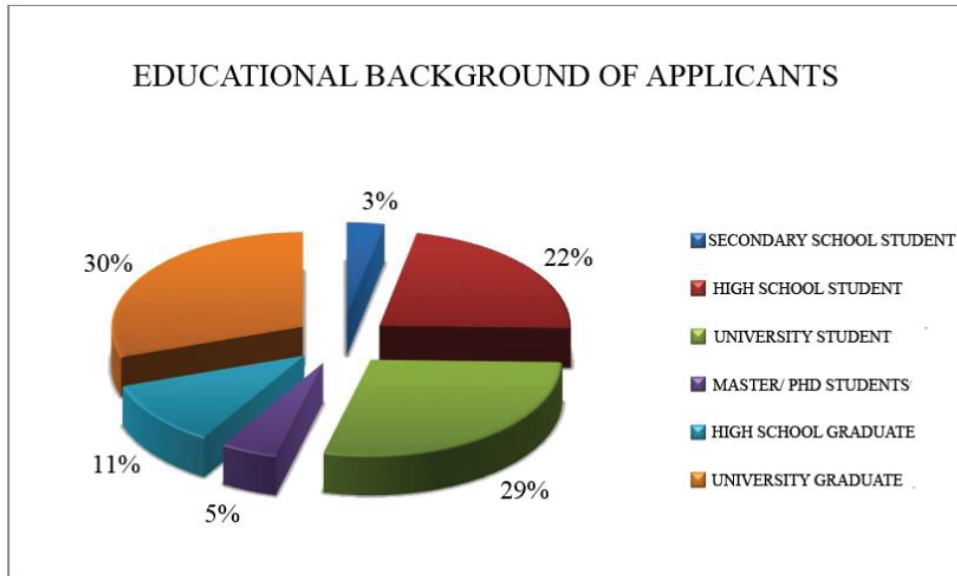
Figure 3.12. Educational Background of the Fab Lab

(Source: İzmir Meslek Fabrikası Müdürlüğü, Fabrikalab, 2019)

Regarding the educational background of the applicants, it has been revealed that the current university students and users with a bachelor degree are the main participants with high school students.
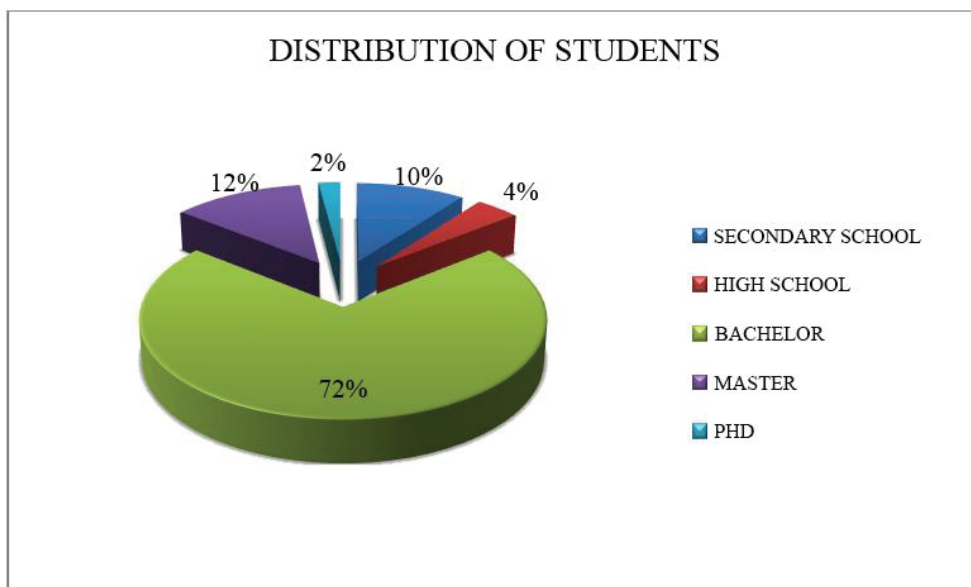


Figure 3.13. Distribution of Students

(Source: İzmir Meslek Fabrikası Müdürlüğü, Fabrikalab, 2019)

More than half of the students who take benefit from fab lab offers and participate workshops are bachelor students. Following, the less participatory group of students are consist of PhD students.

Vocational courses that hold by municipality contributed to the awareness of the fab lab because it has been noticed that most of the graduated people that joined to fab lab activities are comes from those courses. Therefore, it is possible to say that vocational courses in the city provide recognizability about fab lab and people from different groups with different knowledge background come together and have a chance to work or join activities within the fab lab.
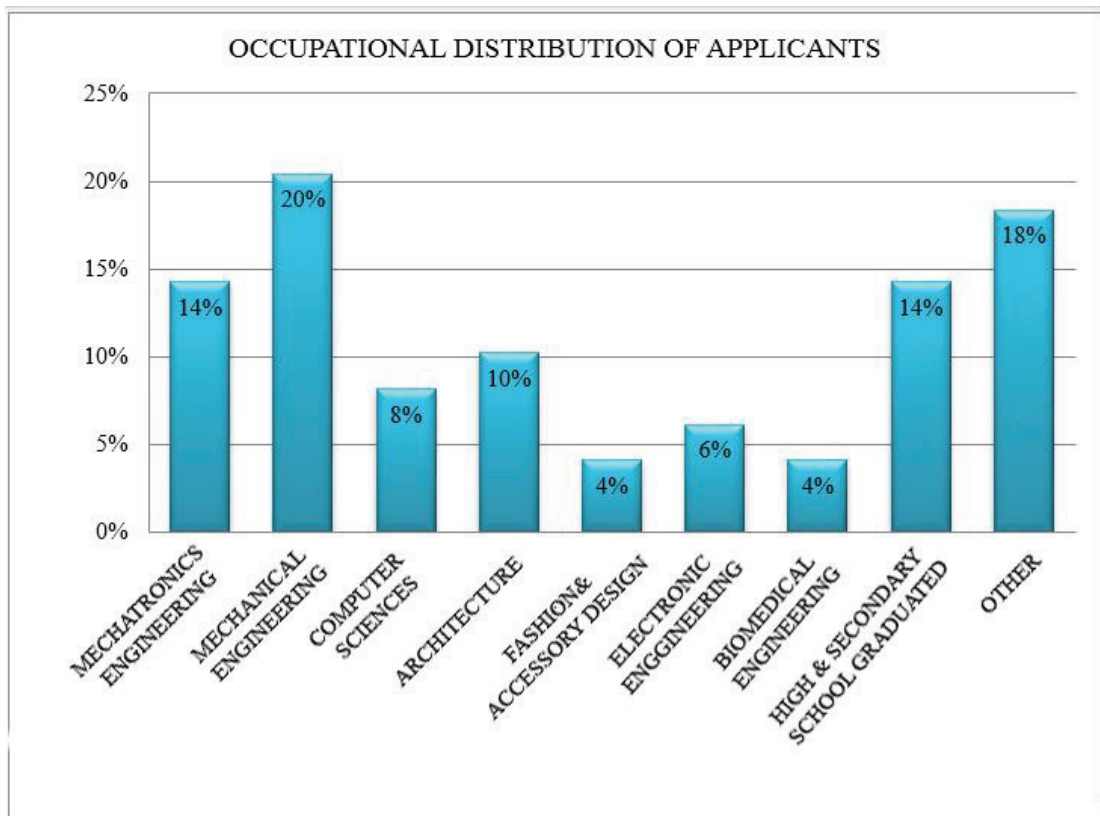


Figure 3.14. Occupational Distribution of Participations
(Source: İzmir Meslek Fabrikası Müdürlüğü, Fabrikalab, 2019)

Occupational Distribution of the Fab Lab participations relatively consists of engineering backgrounded people. However, it should be considered 18 percent (other) of participants is consists of physicians, agriculture and philosophy backgrounded people.
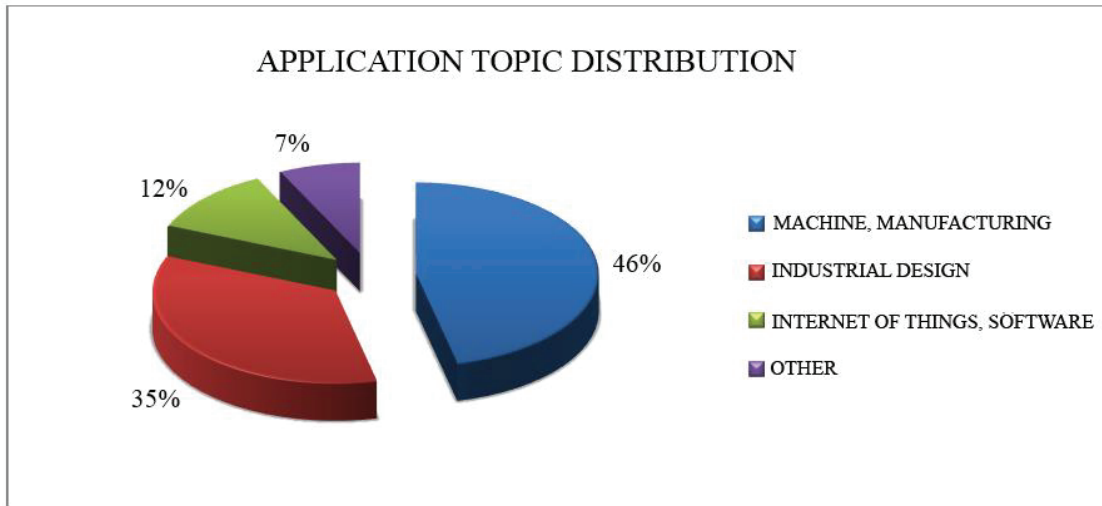
Figure 3.15. Application Topic Distribution

(Source: İzmir Meslek Fabrikası Müdürlüğü, Fabrikalab, 2019)

According to applications, participatory groups or individual purpose to use the fab lab environment and infrastructure includes highly manufacturing activities and design activities. Based on the interviews the fab lab coordinators revealed that the participation from universities and high schools increases before the 'Teknofest Istanbul'. During the preparation process of this kind of festivals increases the demand of infrastructure use offered by the fab lab. Additionally, other hackerspace or maker space users demands to use Factory Lab infrastructure when their hardware infrastructures are broken or out of use. Factory Lab coordinators added that there are fab lab users commute from İstanbul in because access to the fab lab technical infrastructures is free.

However, project coordinator of the fab lab mentioned that there are some applicants come with ideas but not willing to do it themselves, besides, the manager adds '…This is the indicator of unsettled maker culture in the society.' The Fab Lab team consider the confidentiality of project information and detail, also mentioned that the participants find İzmir Fabrika Lab reliable in term of privacy since it is a foundation under the roof of a local authority.

## 3.1.7. Recognizability of the Fab Lab

In order to increase the awareness of the three-step based promotion plans were prepared. The Process consists of short-term, medium-term and long-term strategies.

During the short-term period, fab lab holds activities, training programs for personals and workshops for users and visitors. This period also includes advertising via social media and organisations, activity sharing with related associations and introducing fab lab culture and infrastructure to citizens. In the medium-term, project recalls, and university collaborations have been made. Additionally, to the workshops that started previous term fairs, and maker meetings were organised. Maker and innovator network are widened with various workshop themes and mentoring. For the long-term period, it has been planned that co-workings with incubator centres, universities' RE&DE centres and international connections are empowered. Since the entrepreneurs are important participants of the fab lab, for the long-term period also aimed at entrepreneurship activities and training supports. The process of the production developing and prototyping of the entrepreneurs and freelancers are supported by the fab lab. Another activity in this term is calling students to prepare both international and national competitions in various fields such as renewable energy. Thus, these groups are provided to produce their projects in the fab lab. Additionally, İzmir Maker Fair that holds in İzmir Architecture Center and other fairs are the activities that throw together the makers, innovators and creative people so these activities can be organised and hosted by the fab lab to increase the awareness and recognizability of the lab (Fabrikasyon Lab. Kuruluş Destek Hizmeti Eğitim İçerikleri ve Pilot Uygulamaları, 2017).

### 3.1.8. Projects

Interviews revealed that the İzmir Fabrika Lab has applications from individuals and groups through the component production of Projects. Regarding that, project applications represented below;

- GençBizz Entrepreneurship Program for High schools; Headphone cable collector (completed), Training kit aims to create awareness on recycling (ongoing), a necklace to raise awareness for minimising the harm of acid rains to humans and nature (completed), soap production from ash and olive oil without using any additives and lamp with electricity generation from magnetic field (completed).
- In the scope of First Lego League (FLL), the space station model was printed upon the use of a public school in the project presentation in the theme of 'space dumpster 2' (completed).

- Applications made within the scope of TUBITAK Science Awards Competition; Design of a system to be activated automatically in case the passenger aircraft crashes due to a breakdown (ongoing), train system design to make visualisation of the mathematics subjects which more difficult to understand (ongoing).

- Within the scope of Erasmus+ Youth Programs, the fab lab is the official partner of ' Future 4.0 Do it Yourself' which includes the activities to widen maker culture and consciousness-raising of maker movement among young people. The project acceptance process is in progress.

- Under the Technology and Art Festival, 2018; bionic hand, 3D-printing manufacturing, CNC Router manufacturing and Drone manufacturing has been completed. Moreover, for the Teknofest 2019; Life Capsule for homeless people and Unmanned Aerial Vehicles in different specifications are the ongoing projects that the fab lab cooperated.

- Currently, İzmir Fabrika Lab is leading the 'Drone for Children' project.

- The fab lab supporting the capstone projects of students such as furniture design, 3D modelling and print with walker and prosthesis for animals with or without limb deficiency, two degrees of freedom manipulator design, resting unit and capsule design for airports, a machine system that makes easier to lode from pick-up style vehicles, automatic cover system designed to protect vineyards from natural events, PID controlled portable quick clothes dryer hanger bracket and hand tools suitcase.

## 3.1.9. Current Impact – Potential Impact

The first Factory lab in the country that supported by local public authorities has already started to contribute the employment in the city with skill-building workshops and courses. Although it has been one year that fab lab is serving citizens forty-two activities in thirty-two various themes have carried out. The lab also become a member of Fab Foundation in its opening year. Lab workshops and activities aim to be appealing for different groups in the society also effort to awaken the producing together and improving innovative behaviour of citizens. Workshops held in the fab lab with mentors and co-operation with the related associations are also contributing social life by including disabled people and Z generation. According to İzmir Fabrika Lab Official

Website, 55.000 people have benefited from the vocational courses that supported by the municipality. Considering employee-needed sectors and fields both courses and workshops that hold by the fab lab brought people with different knowledge background together and provided a space to share that.

## 3.2. Dortmund Dezentrale Fab Lab

### 3.2.1. General Information of the City

Dortmund Dezentrale fab lab is in the western part of the city in 'Unionsviertel' since 2013. The city of Dortmund is the 8th largest city in Germany with 601.780 thousand inhabits according to population data of Dortmund City Statistic Book in 2017. The city is the largest city by population and area in the Ruhr Area which also known as 'Ruhrgebiet'. In its history, two notable periods have experienced by the city which is Hanseatic League in the 14th century and as a centre of industrialisation in the Ruhr in 19th and 20th century. The city was adapted steel, mining and beer industries. Irrespectively, the city's new vision more focused high technology, robotics, biomedical technology, tourism, finance and education services. Thus, Dortmund was classified as a Node City in the Innovation Cities Index published by 2thinknow in 2009. The Dortmund Technology Center 'Technologie Zentrum Dortmund' is established is the only one of its kind in the city in 1985 and has a significant effect between scientific studies and economic executions. The main purpose of this foundation is originating and giving rise to new future-oriented technological developments for the city's economy ("Stadt Dortmund", 2014).

According to the educational background of the city, there are more than 85.000 students overall the schools. The primary education system is duration is four years. After, students continue to college preparation schools. Besides, there is two higher education institution which is Technical University of Dortmund and Dortmund University of Applied Science and Arts. Both institutions host over than 42.000 students. Therefore, it is possible to say the city has a dynamic population with its young people because of having universities. Additionally, %45,3 percent of the inhabitants has high school diploma and %14,9 has academic degree (Kommunal Daten- Qualifikation Dortmund, 2014).

Inhabitants of the city Around 30 percentage of Inhabitants of the city has an immigration background which means more than 170.000 people (Dortmunder Statistiks Jahrebericht 2018). More than 20 percent of immigration in overall Germany is inhabiting in Dortmund. According to statistics in 2018 made by the municipality of Dortmund; Prominent nations in the immigrant background of Dortmund are Turkish people (over 20.000), Polish people (roughly 10.000) and Syrian People (roughly 9.000) (Dortmunder Statistiks Jahrebericht 2018). Hans Böckler Foundation in 2012 showed that the poverty rate in overall Germany is increased between 2005 and 2011. Although the unemployment rate is low in the country, the poverty rate is low in urban areas. Moreover, 5,25 percentage of the country population is living under the poverty line, and those people live in 6 cities which are Leipzig, Dortmund, Duisburg, Bremen, Hanover and Berlin. The situation for Dortmund is also not promising because the same study shows that between 2005 and 2011 poverty percentage is continuously increased from %18.6 to %24,2 (Spiegel Zeitung, 2012). Additionally, based on data from Federal Employment Agency the unemployment rate in Dortmund is %9,9 (Bundesagentur für Arbeit-Statistik, 2019). Dortmund Yearly Statistic Book (2014) shows that the employment in the city is divided into three sectors which are primary, secondary and tertiary sector and people who work in the primary sector is less than 135 people. As a percentage, %13 of employers in the city are works for the secondary sector, and %10 percent of secondary sector workers have a foreign background. %87 of worker population in the city are work in the tertiary sector which means retail, service, health, education. Additionally, %11 of workers in the tertiary sector are foreigners (Dortmund-Statistisches Jahresbuch, 2014).
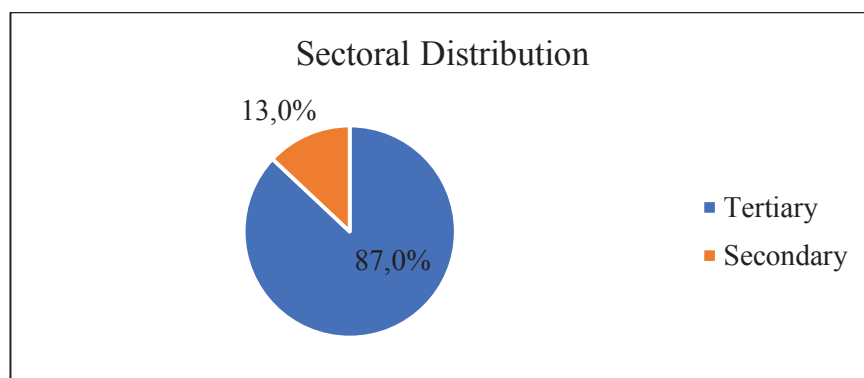


Figure 3.16. Sectoral Distribution

(Source: Dortmund-Statistisches Jahresbuch, 2014)

### 3.2.2. Establishment Story

Dortmund Dezentrale fab lab foundation purpose was oriented to provide active and participatory citizens in research studies, practices and projects. Patrick Jaruschowitz who is the manager of the fab lab was already an employee in Fraunhofer UMSICHT which is a research company that mostly focuses on sustainable economies, environmentally friendly technologies and innovative approaches. The Manager initiates the establishment of the lab by asking for funding from the research company. Thus, with the positive approach of the company first tools and necessary equipment in the fab lab was provided. Afterwards, the manager prepared a conception for the fab lab which clarify that the lab would promote projects, researches and innovations but, besides that the lab would also enable for digital and biological fabrications. Although, the high-tech machines supported by Fraunhofer UMSICHER, financing the fab lab was an obstacle for Manager during the foundation process. First, the Manager tried to find public financings. By the help of having a connection with Folkwang Art University and collaboration with students and researches there the fab lab made its advertisement and spread out its name. Moreover, the head of Biolab (Julia Krayer) in Dezentrale was a research assistant at the Folkwang Art University, and she met with the manager during the financing seeking times. After, these two innovative and promoter persons discovered that their mutual interests and 'Dezentrale' have appeared and opened for citizens interest with its biolab and fab lab.

With the opening of the fab lab to the public use every Wednesday, first workshops were to inform users about the high-tech machines like 3D printing, laser cut and to teach them how to use. Therefore, Dezentrale held workshops like 'Introduction to 3D print' and 'Cryptoparties' and these workshops were required payment around 20 euros, there was also other workshops which required participation fee more than 20 euros, but these workshops have not achieved expected engagement from participant or citizens. Fortunately, the fab lab has increased the participants by revealing itself with its digital fabrication and high electronic technology in 2014 Innovative Citizen Fair which is held for the first time in the city of Dortmund.

It is possible to say that the first big announcement of Dezentrale fab lab was accrued here. Afterwards, many workshops of themes took in part in Dortmund Dezentrale fab lab; thus, participation in labs has enlarged and increased. Today,

Dortmund Dezentrale is one of the members of cooperation of Innovative Citizen Maker Fair with Fraunhofer UMSICHT, Folkwang Art University, Dortmunder U and Heimatdesign. Since 2014, every year Dortmund host the Maker Fair and provide an information sharing space with workshops and exhibitions to citizens. The fab lab and biolab, recently have an ongoing project from the head of biolab (Julia Krayer) which is about mushroom growing and there are other projects from the visitors or users, about material development from biological wastes, accommodation design for student dorms and experimental design of clothes by using laser cut.



Figure 3.17. Dezentrale fab lab
(Source: "Dezentrale Dortmund Fab Lab", n.d.)

### 3.2.3. Fab Lab Purpose, Vision and Organization Model

Dezentrale Fab Lab emphasise its purpose as providing a space where individuals gather knowledge and experience in a collaborative environment so that they can realise innovative initiatives. Moreover, the fab lab aims to support research projects and introduce the maker culture to citizens by giving a chance to involve the maker community. Manager of the Dezentrale was hired by the company Fraunhofer UMSICHT which is generated in Oberhausen. Fraunhofer UMSICHT was founded as a non-profit technical, scientific institution in 1990 ("Fraunhofer UMSICHT", n.d.). The Research company is a pioneer and focus in the fields of sustainable economies, innovative industry

and environmentally friendly technologies. The purpose of the research company is developing these foci and contribute to living standards by promoting the innovation level of the national economy. In order to encourage an exchange to improve technological innovations, Fraunhofer UMSICHT works within the network. Therefore, it establishes connections with universities and scientific institutions.

Moreover, UMSICHT actively engages in international project development and participate in the European project in order to fulfil sustainable success at the international level. Within the maker movement and 'do it yourself' culture network of physical devices, software, connectivity, data exchange enabled in the level of an individual. The maker culture shows itself in many activities which are related to creativity, entrepreneurship, technology and participation. Maker labs, fab labs, hackerspaces, design labs are several examples of the movement. Most importantly, the movement encourages innovative and creative industries and sustainability. With the current manager of the Dezentrale's initiation, Fraunhofer UMSICHT inaugurated the maker and fab lab in Unionsviertel area in Dortmund. Within the purpose of awakening and contributing to the culture of innovation and production in urban areas, UMSICHT established and funded the Dezentrale fab lab.

Beginning in the first place the manager of Dezentrale, and his colleagues running the both fab lab and biolab. Since the Dezentrale is an extension of Fraunhofer UMSICHT, it is not easy to become a business form. Dezentrale does not have a standard membership system. Nobody charges from the usage of tools and equipment in the fab lab or biolab. However, if somebody uses a considerable amount of the materials or a particular technology, the user will be asked to pay a contribution fee. Fraunhofer UMSICHT afford the funding system of the Dezentrale in the establishment process. After the fab lab and biolab established and offered itself to citizen use, it had to finance by itself. UMSICHT supplied the space for Dezentrale and the high technology equipment but after the needs of the Dezentrale such as maintenance or care of this equipment must be provided by its finance. Today the funding system is mainly based on the money which comes from the ongoing research projects that awarded and gained financial aid from research institutions.

Additionally, Julia Krayer who works as a research assistant in the Dezentrale's biolab holds workshops both free and with an entrance fee around 30-50 euros. Also, the money that comes from the workshops which required an entrance fee is another source for financing the Dezentrale. Besides the manager of the Dezentrale and the research

assistant there is also one more worker who is the manager's apprentice. As a worker, there are only these three people in the Dezentrale, and they are responsible for hosting people during the open-public days. There is not a clear separation between job and personal interest in the Dezentrale. For example, since both research assistant and manager's apprentice take responsibility of Dezentrale about space needs and showing or informing visitors or users about the tools and equipment also they both run their individual or group projects and researches under the roof of fab lab or biolab.

## 3.2.4. Fab Lab Offers & Technical Infrastructure

Dezentrale opens its doors to everyone on Wednesdays and Thursdays with its fab lab and biolab where people focus digital fabrication on Wednesday afternoons (between 14:00-20:00) and mushroom growing and bio fabrication on Thursday afternoons. Beside only offering space and high technology equipment, Dezentrale holds many workshops that require participation fee starting from 20 euros. Various workshops that are offered and themes are related both provide knowledge about exclusive technologies by using 3D printers and scanners also bio-design and bio fabrication. Within the scope of Dezentrale Fab Lab's, there are 3D printing and scanning technologies, laser cutters, and soldier equipment. These digital fabrication technologies are open to public or civic use ones in a week during the opening hours under the control of supervisors. It is also possible to have information from people who work or continuously use space as a maker. Since the both fab lab and biolab established and running by Fraunhofer UMSICHT Research Company, Dezentrale held workshops in these themes below;

- Digital Production (3D printing and scanning technologies)
- Mushroom Cultivation
- Bio Fabrication
- Bio Design
- Textile with Laser Cutting Technology
- Fermentation
- Small Housing Workshop with Children
- Cyrptoparty ("Dezentrale Dortmund Fab Lab", n.d.).

Based on the interviews, the manager stated that his idea is to connect fab lab with craftmanship activities and manual corporation. He believes that this bright and promising

idea create integration between the traditional and new way of making; however, it has not been fully implemented. According to the Manager, the problem about to reach his idea is that people who use the maker space are not active in desirable level, the maker space is used by people mostly hobby purposes and they not aware of what could be changed and created in the fab lab.

## 3.2.5. Related Associations and Fab Lab Network

Dortmund Dezentrale invites people to coordinative working to improve its value and effects within the city. Even during the establishment process of the LAB mostly was achieved with Fraunhofer UMSICHT and naturally with innovative individuals. Therefore, after its establishment, the fab lab sustain the collaboration working with other foundations in the city. Allied with the Dezentrale fab lab, there are leading active players Dortmund Municipality, Die Urbanisten, Heimat Design, Die Materialisten, Dortmunder U, DASA, Maker Fair Ruhr and Innovative Citizen Maker Fair. Having Connection with them provide strengthens for these all foundation.



Figure 3.18. Network of Dezentrale Fab Lab

Dezentrale has connections with Dortmund Municipality accordingly Art and Creative Centrum (Kunst und Kreativezentrum) in Unionviertel. Dortmund Municipality's one of the projects is about the transformation of old factories in Unionviertel- Reinischestrasse and developing innovative and creative movements in the area is directly related with location of today's design and creative spaces in the city.

Because of the structural change and the retreatment of the industry, the neighbourhood has lost its charm and quality of life then become a problem in Dortmund. With the compilation of Dortmunder U (The U Tower) and impulses of major cultural projects in Ruhr Area create increasing demand of young creative economists for affordable space in the extended environment of The U Tower for individual and related foundations. Mainly the U Tower was an old brewery building in the city, but today it is an iconic art, innovation and creative centre of the city. The Unionviertel area offers locations that are in good condition for the establishment of a creative-economy based business. By mentioning that, there are already existing creative entrepreneurial focus as well as public services and infrastructures. Further, there are still vacancies that are available in the area. For this reason, Unionviertel area was included in the project of 'Creative Quarter (Kretivquartier)' of the Ministry and Economic Development of Ruhr (Wirthschaftsförderung Metropole Ruhr) and European Centre for Creative Economy (ECCE) ("Stadt Dortmund").
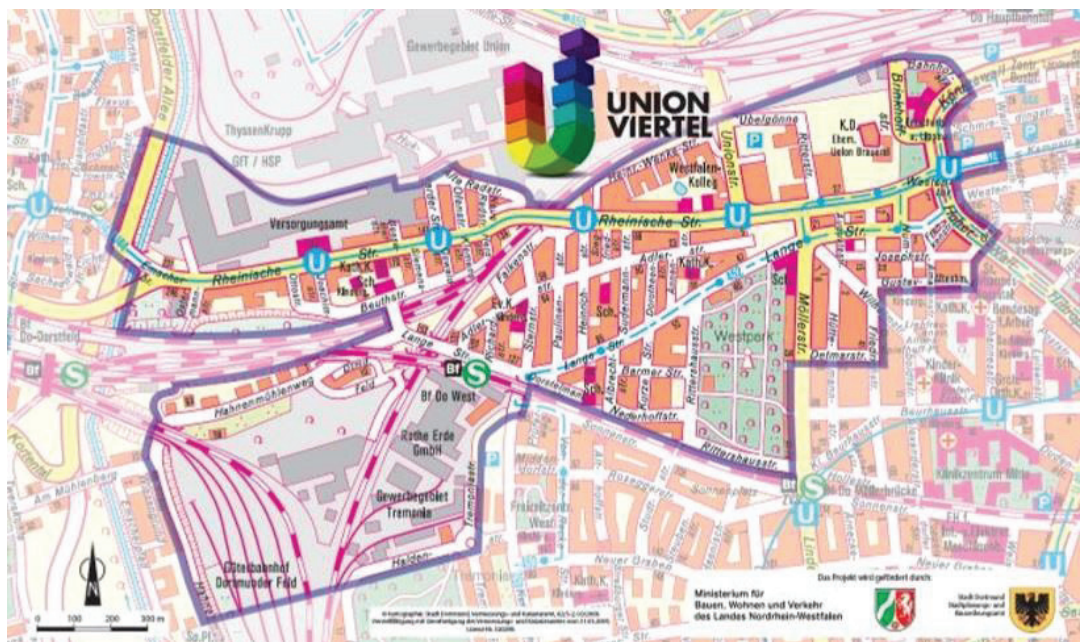


Figure 3.19. Creative Quartier in Dortmund
(Source: "Stadt Dortmund", n.d.)

'The Creative Dortmund Master Plan' takes the development into account and in addition to general goals, formulates the implementation of a creative incubator as an

impulse project for the district. According to the researches of the project, there are two main locations with a different focus. One of them is Union-Gewerbehof on Hurdakerstrasse and the second is Heimat Design in Hoher Wall. The characteristic feature of both locations is to offer attractive premises especially for founders and established companies. Additionally, to the location's attractiveness, over the past few years around forty studios, galleries and offices have been established in the district which has both cultural and creative economic priorities. Moreover, The Master Plan Program includes space development and management, foundation support on both qualification and communication, communication and creative impulse projects. By the implementation of the project Union Trade and Heimat Design companies from the Unionviertel area are joined and forced to accompany and support the actual development process and developed new offers and services for the district.

'Die Urbanisten' is other related local foundation which creates innovative approaches in the perspective of urban living, and it is a participatory platform for citizens and urban unity. This non-profit oriented foundation is mainly focused on public space and its uses and local urban culture. The vision behind these focuses is about to reshape urban spaces with local sources and awaken the citizens being creative, innovative, participatory and lively.



Figure 3.20. Workshop area of Die Urbanistan

(Source: Hazal Bingöl O)

Figure 3.21. Workshop area of Die Urbanistan 2

(Source: Hazal Bingöl O)

Die Urbanisten has activity researches which are about art activities in public spaces, urban gardening, urban development and recycling approaches. The Foundation has its design workshop and invites people to improve their ideas within the open workshop.  Moreover, it also offers people handcraft workshops (required payment around 50 €-70€) ("Die Urbanisten", n.d).

Dezentrale fab lab makes available the high technology that it has for Die Urbanisten participants and the management team. Especially, for handcraft design workshops people can use the equipment in the fab lab and additionally people in the fab lab will be willing to show how to use the tools to others. Die Urbanisten has 'Do it Yourself' workshops which are including handmade production activities and knowledge of recycling the materials. Die Urbanisten held the first urban production festival in its are in February 2018 for four days. During the festival people from the city and all Ruhr area become together to produce, work and design. Festival mainly emphasised the importance of local production in art, craftsmanship and agriculture for the environment. Festival also offers visitors to have the knowledge of producing their vegetable and fruits in the urban area. Small visitor workshops had the opportunity to exhibit their projects. Dezentrale Biolab took in part with its mushroom growing project and had the opportunity to participate exhibition. Both Die Urbanisten and Dortmund Dezentrale are innovation

and information spaces for the City of Dortmund. They offer people from any gender or age workshops which they can create or improve their ideas, projects or initiative. While Die Urbanisten provides and encourages art, craft and urban gardening workshop activities for people Dezentrale offer chance to use the high technology it has. Especially sharing knowledge and information among users is one of the most notable features of these places.

Heimat Design is another network of Dezentrale Fab Lab which is under the management of Mark Röbecke. Design studies are mostly focused on fashion, object, graphics and photography in the last years. Heimat Design is a young foundation in design industry. Currently, the design platform carries on in Dortmund with its rural and regional roots in North Rhine-Westphalia (NRW) Area since 2004 ("Unionviertel", n.d.). Most of business development agencies in Ruhr Area works successfully in the creative industry with the Heimat Design. The platform publishes a magazine about design issues, culture and daily life articles twice in a year. Moreover, The Design Platform offers exhibitions, trade fairs, collaborations for young designers who would like to define themselves in a place of creative design ideas. After fourteen years from the establishment, 'Heimat Design' has become feature-rich design platform as magazine, exhibition area, shop, workplace, organiser, communication agency for creative people and all above this it became a design network. The exhibitions and fairs that offered by Heimat Design are also involved comprehensive Maker and Design Fairs in NRW area. Especially during the Innovative Citizen Festival and Maker Fair Ruhr both Dezentrale and Heimat Design have worked in collaboration. Heimat Design is the main figure of Graphic Design Studies during the festivals and fairs. Indeed, the Heimat Design is one of the important and creative nodes in 'Unionviertel' area with its works and initiations such as 'Pop Design Festival' and 'Design Flea Market'.

Die Materialisten (the Materialists) is a small business administration be rooted from Dezentrale, and currently, this company offers people workshops within the Dezentrale, Fairs and Festivals in the city. Founders of the company have known each other from the Dezentrale's workshop activities, and they developed their project under the roof of Dezentrale and then established their own company. The goal of Die Materialisten is to actively participate in the realisation of local and sustainable production culture, from their point of view business model based on regionalisation, cooperation, do it yourself (DIY), repair and common benefit are better suited to the social and environmental problems of today's systems (https://diematerialisten.de). Thus, they

provide materials, technology services for this change. Customer profile of Die Materialisten is a small business that makes it easy to enter new manufacturing techniques, craftsman, creative people and producers. The combinations of 3D printing and innovations in biotechnology and the most prevailing techniques are the fronted. Most importantly for Die Materialisten to have a critical view of ecological and social consequences of their products and entrepreneurial strategies. Cooperation works of Die Materialisten and Dezentrale involved in Urban Development Day (Tages der Staedtebauförderung) in Dortmund Hörde in May 2018. Both these creative establishments hold a workshop about the edible mushroom growing. Total of participants discussed it multifaced situation with enough basic facts about mushroom cultivation by the end of the workshop.

Dezentrale Fab Lab also connected with The Dortmunder U in terms of exhibition, festival activities. The Dortmunder U is serving for innovation, art design and creativity activities since 2010 after its renovation process for two years. This former brewery building is today's landmark for the city, and it holds many events, festivals, fairs and organisations for citizens. Dortmunder U develops innovative concepts, initiates a partnership between art and science and cooperates different players in the field of creative industries. Therefore, it can be considered as node of art, science, innovation, culture, education and economy. The Dortmunder U based on a cooperation of diverse users of the U Building, the Museum Ostwall, The Cultural Office of Dortmund Municipality, The Hardware Medienkunstverein, The Dortmund University of Applied Science and Arts, TU Dortmund, the European Center for Creative Economy (ECCE) ("Dortmunder U", n.d.). The U Tower represented by the transformation of the Gerber Architecture for the city and the whole Ruhr Area. Moreover, it symbolises the structural change of the Ruhr Area's heavy industry towards a division into the most critical resources of science, creativity and culture ("Dortmunder U", n.d.).

Above all, Dortmunder U hosts Innovative Citizen Festival since 2015, and this year for the 4th time, the Dortmunder U in cooperation with Fraunhofer UMSICHT opens its doors to all technology enthusiasts who would like to think locally and independently of a manufacturing culture. Large Scale urban agglomerations are decoupled from the cities, and everyone sits alone in the home with the acquired blessing of civilisation and does not know how to deal with it. This position to the increasingly sophisticated technology is often characterised by isolation, helplessness and lack of communication with each other. Innovative Citizen Festival wants to contribute to this human attitude to

high technology use by examining how techniques can be acquired in the high technology sector. Dortmunder U began event series about teaching. Technology does not necessarily have to be alienly, frightening or something out of the control of an individual. Therefore, the Innovation Citizen Festival offers fresh ideas about making their own, also provide possibilities and opportunities in dealing with modern technologies and their use at the local level. Interconnectedly, networked people, bring manufacturing culture back to the cities which has been lost. The Festival consciously sets itself apart between two different approaches to dealing with high technology products and called as maker shows which are an exhibition of innovative and creative projects. On the other hand, participatory workshops hold by innovative foundations which are taking place in the festival. The second approach is providing information sharing for people and helps citizen to understand the high technology tools. Effectively use of techniques has a local level key transformation of the city. Every year since Innovative Citizen Festival is held in the city, Dezentrale took part in and offered many workshops like it was explained above to the citizens. During the Festival, there is a multi-stakeholders dialogue about the potential of Makerspaces and Fab labs. In the last Festival, this dialogue was followed by workshops where more democratic future of technology is designed, produced. An interactive experience is a right atmosphere for the exchange of knowledge ("Innovative Citizen", n.d.).

The relationship between human, work and technology are shown and interpreted in every new way by the DASA exhibition. It is primarily about the question of securing central human values in the workplace. The DASA focuses on people with their psychical, mental and cultural concerns ("DASA", n.d.). It shows changing temporary exhibitions and organises theme-related regular events for its target groups. DASA holds the Scenography Colloquium for museum scientists, architects, exhibition designers as well as interested people from the educational and cultural sector or creative industries. DASA also offers symposium of the series 'Constructing the Future of Work' which is a future-oriented topic for human work ("DASA", n.d.). DASA defines itself as a place of discovering, thinking or asking. Most importantly this year for the 3$^{rd}$ times Maker Fair Ruhr was held in DASA in March. In the Maker Fair draw together more than 50 makers in Dortmund. The Maker Fair is started in the USA for the first time as both science an entertainment festival, and at the same time, it is entirely new. This Fair is an inspiration for innovation and creativity. Many producers, hobbyists, hackers and artists are present in the Maker Fair of Dortmund's results of discovers and experiment that cover the entire

spectrum of science technology, crafts, art, performance, experimenting, learning, recycling, inspirations and entertainment. Additionally, many interesting interactive stations on exiting learning programs and workshops and experiments complete the exhibitions of the Dortmund Maker Fair. Dezentrale has been involved in Maker Fair Ruhr in DASA. Both fab lab and biolab and visitor projects in Dezentrale were exhibited during the Maker Fair. Mushrooms growing, e-textile, laser cut clothes and more about biotechnological waste projects were demonstrated.

### 3.2.6. Fab Lab Participation and User Profile

Today, in the Dezentrale both fab lab and biolab offer different thematic working fields for citizens. The community in the Dezentrale divided as the ones who interested in digital fabrication and the others which focuses mushroom grooving and experimenting and all these people sharing the same space.
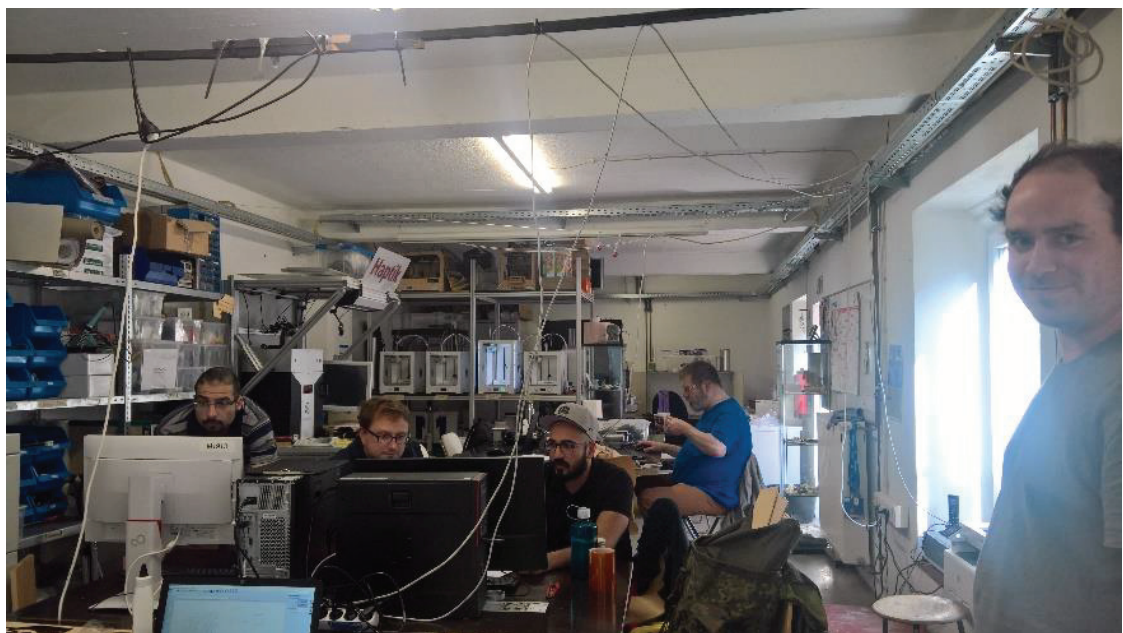


Figure 3.22. Dezentrale Fab Lab, Digital Fabrication Area
(Source: Hazal Bingöl O)

Since the Dezentrale's awareness and reputation is not in the desired level, visitors and makers in the both fab lab and biolab join the Dezentrale's social environment or

maker community as by way of having personal connections. Moreover, the current situation of user profile reveals that in the maker space 3D printing systems, laser cutting, and other high technology equipment are appealing mostly by men while mushroom grooving, bio fabrication or workshops that are offering new methods of the textile field are attracted by women. Within these observations and facts, the manager of the Dezentrale added that it is a considerable effect that the biolab take attention on women and help to keep the gender balance in the Dezentrale. According to the manager, today Dezentale's gender balance is better than other Fab Labs. Additionally, Julia Krayer who is a research assistant and a worker in the Dezentrale has many contributions to having the attention of women. Workshops related to fashion and textile products and having a female worker in the maker space who able to teach how to use equipment and tools is giving useful expressions to the female makers and visitors. According to interviews, some of the users of the space and maker needs to commute from another city or more than one hour. They come to use the technology and interact with the social environment of Dezentrale's, and they admit that the bounded with Dezentrale even they use other maker spaces too. The main effect about that active users also satisfied by the social community of the maker space. Even some active makers holding workshops in other maker spaces, they use the Dezentrale as the leading working, researching or experimenting space. Although Dezentrale has social group, space is delaminated only for laboratory activities and not used for another interactive entertainment area for visitors. Moreover, about the user or visitor profile of Dezentrale is mostly consist of males that over 25 years old.

### 3.2.7. Recognizability of the Fab Lab

Aim of Dezentrale is to introduce people both innovation and creativity, also make society, citizen aware of how they can contribute their city, living and culture. By offering free usage of both biolab's and fab lab's tools, equipment and providing a space for information change; Dezentrale wants to improve innovation and creation level of society. Therefore, all creative and innovate festival that held in the city or region (Ruhr Area), they involve with their projects and visitor projects in order to have the attention of people through maker spaces. Manager of the Dezentrale is aware that to improve the intelligent in the cities, intelligent and active society or citizen are needed. This desired

citizen type can be provided by the required infrastructure and creative platforms by changing the society or citizen role from consumer to producer of the cities. However, before changing this role of citizen, necessary knowledge must be given or shared. In this aspect, maker or design spaces, fab labs have significant value because potential visitors or users of these spaces supposed to learn 'how to use' the tools offered from maker spaces.

Dezentrale's location in the city has benefits, but the physical condition of the space is not at the desirable level. Since the Dezentrale located in Unionviertel area which is new 'Creative and Innovation Improvement Area in the city. Therefore, Dezentrale has physical connections with other maker or design spaces, festival or fair areas as well as workshops in the Unionviertel area. As a physical space Dezentrale is using a courtyard of housing area where the entrance provided by Richardstrasse. Thus, both the fab lab and biolab are not visible from outside. Dezentrale shows up in many fair or maker festivals to aware people about their existence and tries to take attention of citizen through the Dezentrale. Unfortunately, its awareness in the city is not at the desired level for now.

## 3.2.8. Projects

Interviews showed that visitors of Dezentrale divided into two groups. Dezentrale's fab lab and biolab have different focus and projects. One group of visitors most interested in mushroom grooving and experimenting and the other group are involved in digital fabrication techniques. Users of fab lab and biolab have revealed that space is only used for studies or researches that related to fab lab and biolab. Dezentrale's projects have separated in two; the first one is the projects that are from Dezentrale's researches and conducted by both the manager and permanent and continuous users, other projects which are from visitors. Dezentrale has two important projects. One is 'Senior Design LAB', and the other one is 'Creating own rheumatisms aids with 3D printing'. The European Regional Development Fund finances senior Design LAB project until 2020. Within this project Dezentrale focus on two thesis work that is 'The design outputs of transdisciplinary and mixed age teams are more creative and sustainable to shape democratic change' and 'By combining design and fab lab, entirely, new products become possible against the backdrop of decentralised production capabilities'. Since the Dezentrale has project funded running system, it is currently involved four significant

projects that support financial aid to the establishment. Firstly, COWERK60 is providing a variety of open workshops about urban farming, repair cafes and focuses on how collaborative economy takes in par production processes ("Cowerk", n.d.). Secondly, E: Lab is oriented on researches about sustainable solutions for urban living problems in citizen districts by involving citizen participatory and their ideas. Thirdly, Senior Design Lab is about providing a laboratory which targeting seniors and involve personal production. Lastly, with SLSASSIST project, they producing low budget required aid devices for people who suffer from rheumatism disease by using specialised technology tools ("Dezentrale Dortmund Fab Lab", n.d.). Within this project, an aid device was produced for rheumatisms patients. People who suffer from rheumatism often have struggles about limited mobility or joint pain especially when the hand are affected. Therefore, rheumatoid patients need tailor-made devices that cannot be purchased in the required shape, fit or size.



Figure 3.23. Aid device for Rheumatism Disease
(Source: Hazal Bingöl O)

### 3.2.9. Current Impact – Potential Impact

The studies and researches in Dezentrale are involved in the idea of Sustainable Development. In this respect, the activities of makers and researchers focused maintenance of living. Thus, fab lab and biolab become a space of emerging innovative and creative ideas by providing citizens with the ability to reach high technology and knowledge. Dezentrale courage to makers to start their entrepreneurship. Today there is only one business that has roots from Dezentrale, and it calls as 'Die Materialistan' (the Materialists), and it offers people specialised workshops and sells specialised filaments. Moreover, the idea of sustainability is involved in the daily life of many people. Even choosing the use of transportation in a sustainable way such as public transportation and bike using or changing eating habits by becoming vegetarian or vegan are under the roof of sustainability. Additionally, the precise way of assimilating that idea can be achieved with creating a new mindset for the societies. Maker spaces, hackerspaces, urban farming ideas, all contribute to sustainability but according to the manager of Dezentrale only way to having success about it is first changing the way of thinking society. Fortunately, this innovation and creation spaces in the city can be an impulse for awakening the desired mindset in the society.

### 3.3. Bottrop HRW Fab Lab

### 3.3.1. General Information of the City

HRW Fab Lab was founded in the city of Bottrop by a professor of Hochschule Ruhr West (HRW) University for Applied Sciences, and today the Fab Lab is located on the campus of the university, and it has continued its existence since 2010.The city of Bottrop located on Metropolitan Region Ruhr and the industrial identity of the region shows itself in the city's economic activities. In the recent past, the country's economic power was relying on the Ruhr region in the rising times of heavy industry such as mining and steeling. Besides, chemicals, textiles and machinery were also leading production sectors. However, with the sustainable and environmental-friendly approaches through the city and economy and regarding this the closing of the factories in the area vision and future of the city was tended towards innovation and energy activities. In 1997 the first

Local Climate Concept was emerged in the city and later altered this Integrated Climate Protection Concept in 2011. With its environmental acts and measurements, the city was awarded European Energy Gold. The Project of Future Cities (Zukunftstads) of the municipality paves the way of re-evaluation and renovation of old industrial areas with new economic approaches and focuses on service, health, entertainment and creative industries. Additionally, Innovation City Ruhr Project also awakens the inhabitant behaviour through the energy-producing future buildings and thanks to this pilot project climate-friendly and energy-efficient social housing was created in the city. Thus, the changing future orientation of the city allows new working areas and creates the need for a qualified workforce.

Today, the city has three boroughs named as Bottrop-Mitte, Bottrop-Süd and Bottrop-Kirchhellen and according to 2017 Yearly Statistic Book of Bottrop the overall population in the city is 116.845, and approximately %10 percent of this population has an immigration background. The main percentage of this immigrated population is consisted of Turkish (%35) and following that with %11, and %8 percent are Syrians and Polishes. The unemployment rate in the city is %7.7, and approximately %25 of the unemployment rate is consists of immigrated people (Statisches Jahrbuch Bottrop, 2017).

Additionally, the educational background of the city is also showing that the 47 percent of inhabitant are graduated from high school and 9 percent have an academic degree in the city (Statisches Jahrbuch Bottrop, 2014). Considering the changing city vision and new working areas HRW Fab Lab is a space that supports people's capability both unemployed and employed who wants to improve their skills by teaching with its technical infrastructure.

## 3.3.2. Establishment Story

HRW Fab Lab foundation goes back to 2010 without knowing the Fab Lab context in general. Prof. Dr Schaefer who was appointed to the field of Technical Computer Science at the Bottrop University of Applied Sciences University Ruhr was the founder of this establishment and today he still has the responsibility of the Fab Lab as the manager. After providing necessary technical tools for the Fab Lab such as laser cuts and 3D printers with the budget of the university, Professor finds out the context of Fab Lab that defined by MIT Professor Neil A. Gershenfeld. Following the awareness of a Fab

Lab concept, Professor Schaefer began to create a connection with other Fab Labs in order to hold Fab Lab Related activities in the campus area. Thus, the awareness of the concept could be improved, spread through the people and innovators could have a chance to come together and share ideas. In 2013 HRW Fab Lab become a member of Fab Foundation and Fab Academy. In order to enhance the equipment in the Lab, Professor Schaefer is continuing the research applications and set up connections with entrepreneurs. Today there are fifteen employees in the lab from different specialisations both include graduated and students and the Lab offer people educational activities (Unterfrauner E., 2017).



Figure 3.24. HRW Fab Lab Area

(Source: Hazal Bingöl O)

### 3.3.3. Fab Lab Purpose, Vision and Organization Model

According to Fab Lab Manager, the primary purpose is to provide access to the developing technologies so that the pupils, students and researchers can empower and develop their studies with prototyping.

In the beginning, the primary beneficiary group was the students from HRW University of Applied Science, but today both all level of students (university, primary school, secondary school) and citizens have benefited from the HRW fab lab via technological infrastructure and educational workshops. Also, another object of the Lab is that support human capability in the city in terms of craft and art related innovative approaches. The organisation of the fab lab contains Fab Lab Manager Prof. Dr Schaefer as the head of the lab who has a background of Computer Engineering and Physics, research assistants and students.

Currently, there are ten employees, and five of them are research assistant, and the other five are students. All workers have a different background in terms of their study field such as Industrial Engineering, Mechanical Engineering, Applied Computer Science, Human-Technology Interaction, Energy Systems, Mechatronic. fab lab team members are mostly researchers and students from HRW University applied Science. Both students and research assistants also have their projects that they are advancing within the lab beside their responsibilities as a worker in there. For instance, Lukas Hellwig from the team has a degree from mechanical engineering and continue a master program Production Management within his master researches he focuses on mobile Fab Labs. In the lab he is responsible for the workshops and activities also informs the lab user about funding programs for their project.

Another example is Marcel Kellner from the team he is continuing his bachelor's degree in Energy systems and works in the lab as technical personnel also he leads the HRW Co-Lab which is an innovative& creative people network. Employees organise maker workshops and activities in the context of STEM-education. Funding system of the Lab is provided by sponsors that are Men Energy Solutions and Sparkasse Bottrop. Since the lab is part of the HRW University of Applied Science, there is also a separated budget for the Fab Lab. Additionally these, there are EU-funds, commercial funds, educational funds for STEM-projects and project-based funds.

### 3.3.4. Fab Lab Offers & Technical Infrastructure

Even though HRW Fab Lab was established for developing the ideas and projects of students from HRW University, today it opens its doors for every citizen who interested in innovation and creativity. Every tuesday and wednesday Fab Lab open for users and

use of the machines are free, does not require any membership regulations also citizens are supported by the fab lab team when they need any help about developing their projects or ideas. HRW Fab Lab has advanced technology tools and equipment. These are listed in Table 3.3. below in terms of their related field as mechanical, Electronical, Computer Science (Informatics) and other available options offered by the HRW University.

Table 3.3. Available Equipment and Tools in HRW Fab Lab
(Source: "Hochschule Ruhr West, Min4tu- Zdi Zentrum Bottrop.", n.d.)

| Mechanical | Electronical | Informatics | Other |
|---|---|---|---|
| • Various 3D Printers (for PLA/ABS), <br> • Laser CNC cutting machine, <br> • Band Saw, <br> • Circular Saw, <br> • Scroll Saw, <br> • Bench Drill, <br> • Small and Large Lathe, <br> • Drills and Stands, <br> • Tiller with X/Y table, <br> • Disc Sander, <br> • Standard Tools (hot glue guns etc.). | • Exposure Unit, <br> • Etcher, <br> • CNC Milling Platinum, <br> • 3D Light Microscope, <br> • Soldering Iron, <br> • Reflow Oven, <br> • Programming Adapter (for a microcontroller, EPROMs, GALs etc.), <br> • Components (including boards, resistors, capacitors, LEDs); <br> • Laboratory tables with power supplies, <br> • Measuring Instruments (multimeters, oscilloscopes). | • Arduino (Uno, Nano etc.), shields, sensors, actuators; <br> • MSP 430, PIC; <br> • Raspberry Pi, Panda Board, Beagle Bone; <br> • Android 7-inch tablets, <br> • FPGA boards. | • A0 plotter of the university can be used; Paper, Transparencies (backlight) etc.; <br> • Cutting; various films, <br> • Sewing Machine, <br> • Construction materials; Acrylic in different colours, plywood, aluminium. |

HRW Fab Lab has Open Evening activity that allows people to visit the Fab Lab space to learn how to use or experience the tools together and develop the individual and group projects. This activity is basically about the advertising or promotion of the Fab Lab and aimed to pull the attention of people by providing them with user experience. Therefore, during Open Evening Fab Lab team support people by their knowledge and creates a space for together learning and sharing to develop ideas and enterprise. People who want to join Open Evening must fill an enrolment form before and bring the fab lab to be active during the visit.

The Fab Lab personal and student courses themes are;

- Fast prototyping with laser cutters (Michael Schaefer)

- 3D Beginners Course, Sketch Creation and 3D Printing (Robert Reichert, Michael Schaefer)

- 3D Special Course, 3D Construction and Printing (Michael Schaefer)

- Microcontroller for Dummies: Arduino as Rapid Prototyping Environment (Michael Schaefer)

- Electronics Special Course: From the Idea to the Board (Tobias Poppe, Michael Schaefer)

Another activity within the Fab Lab is HRW Co-Lab that provides a collaboration network by throw together people with the same interest from different universities and organise regular meetings. This meeting aims to awaken the cooperation behaviour of different disciplines among the students, innovative production developing, encouraging start-ups based on student projects and finding additional funds for research studies. Therefore, the Lab offers people within this network production of prototypes, provide easiness and connection of marketing and sales, consulting of finance finding and feasibility and education of advanced technology products.
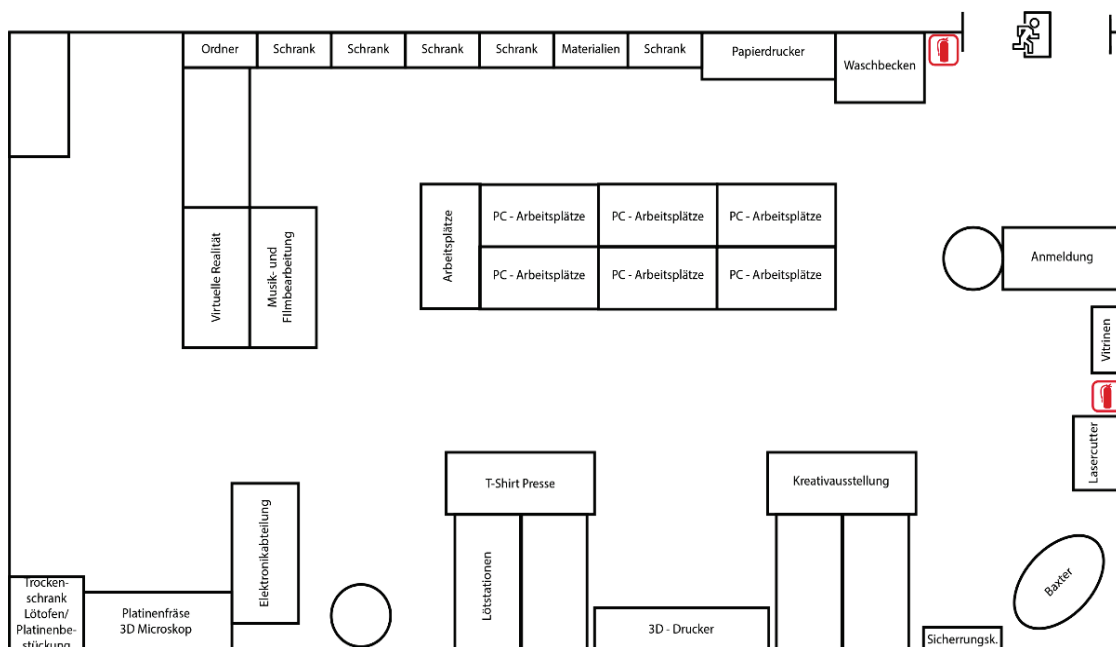


Figure 3.25. Plan of HRW Fab Lab

(Source: "Hochschule Ruhr West, Min4tu- Zdi Zentrum Bottrop.", n.d.)

Additionally, Fab Lab organises 'Time Machine for Dummies' to pull the attention of the HRW University of Applied Science students and produce clock together and introduce the equipment in the Lab. Fab Lab holding these activities and workshops in it 117 m² area and its plan is below. According to interview with the fab lab worker Robert Reicher the fab lab area is going to move since they need larger area for increasing number of fab lab users. The university will assign larger space for fab la activities in the campus.

## 3.3.5. Related Associations and Fab Lab Network

HRW Fab Lab cooperates with other fab labs, universities, local foundations and companies in order to enhance its connection through different social groups in terms of gender or age. However, it is possible to say regarding the establishment purpose of the Fab Lab, the activities, workshops are mostly student-oriented so the lab efforts to pull the attention of young people to direct their interest toward science studies and experiences. To achieve its purpose and sustain its existence like innovation initiation it needs network and connections local, national and international level. HRW University of Applied Sciences is the leading partner of the HRW Fab Lab not only the university has taken part in the establishment process and continuing funding the Lab but also the first users of the Fab Lab are HRW University's Students.

Additionally, The University provides connections and held organisations towards the Fab Lab activities.
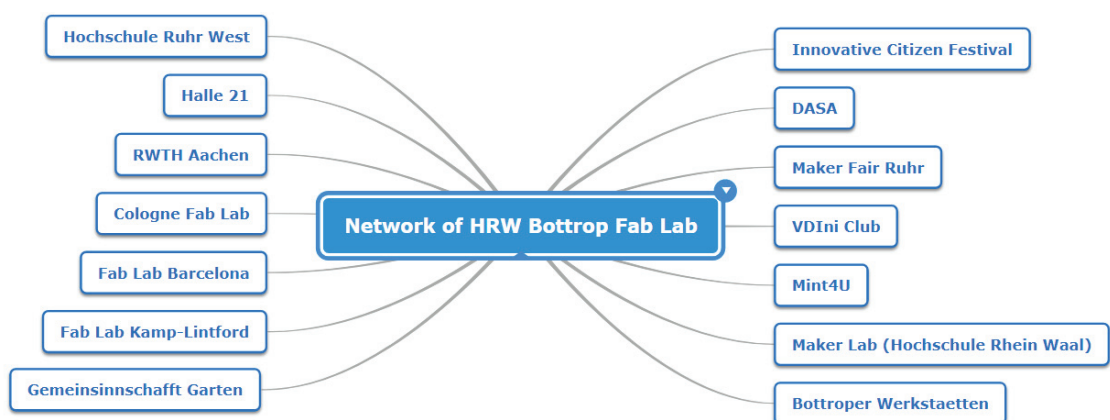


Figure 3.26. Network of HRW Fab Lab

Mint4U is a network that is aspiring the lack of skill shortages towards ZDI project which stands for Shaping the Future through Innovation (Zukunft durch Innovation). The project centre is one of the funders is HRW University, and objective of the ZDI project is informing the young people about STEM fields and increase the attraction of young people toward those fields regarding global and societal issues. Initiation of the project is started in 2004 and aimed to enhance the capability of the young generation in both natural and engineering sciences by providing study program opportunities. The project has 43 different networks in the North Rhine-Westphalia area, and Mint4U is one of the connections of the project. Mint4U tackles with the lack of knowledge in STEM fields by cooperating HRW University and business incubators. Since HRW Fab lab has the high technology to appeal the attraction of students and young people by also providing a space that they can experience the STEM studies within the fab lab technology it has a connection with the Mint4U.



Figure 3.27. Workshop within the Mint4U Project
(Source: "Hochschule Ruhr West, Min4tu- Zdi Zentrum Bottrop.", n.d.)

Moreover, both this association has activities together such as 3-day student courses in the theme of Cyanotype, Retro Computing, Stop-motion Film Production. These courses have been completed in the HRW fab lab area with the participation of the students via Mint4U centre ("Mint4U", n.d.). In 2017 August, Ferien4U Camp has been held in the campus of HRW University of Applied Sciences. This activity was a cooperation work of Mint4U, HRW University and HRW Fab Lab that aims at the have

the attention of students between 8<sup>th</sup> to 13<sup>th</sup> grade towards to STEM fields by providing them tools and making the activities enjoyable with teamwork also knowledge sharing. Namely, young generation interests are wanted to appeal through the Mathematics, Informatics, Natural Sciences by providing entertaining and social space with the experiences of advanced technology use. With this respect, Ferien4U Camp was offered to participants various workshops in the theme of VR-Glasses, Musical Instruments, Robotics, Machine-Electro subjects by using 3D Printers and Scanners for four days ("Mint4U", n.d.).

Moreover, the same cooperation or institutes have another collaboration work that was held in the HRW Campus area between 2011 November and 2012 January focusing similar purpose. In this work 10<sup>th</sup> to 13<sup>th</sup>-grade girl students were invited courses in the theme of Energy and Computer Science because the participation of girls in these fields wanted to be increased by introducing and informing with free of charge courses. Within the ZDI project, Mint4U informed schools about these courses and contributed to student flow through the courses. Students have a chance to obtain knowledge from a scientist from HRW University by working during the courses and the build wind tribunes together. Additionally, students informed about Energy Saving and joined laboratory experiences of sun and wind energy, later they analysed the energy consumption in their houses within the energy studies. The other course with girl students was aiming at creating own MP3 player, and the ideas that developed in the group could be realised with computers and outputs could bring to home (webpage of HRW University of Applied Sciences).

VDIni Club is a foundation that purposed to encourage children activities towards science and technology with its connected institutions since 2015. VDIni is standing for 'Verein Deutscher Ingenieure' and means 'Association of German Engineers', and the centre is in Düsseldorf. The Club organises visits to Research Companies, Airports or Institutions in order to keep children aware of the technology and science and raise awareness. Additionally, the club builds connections with primary and secondary schools to widen its participation network also provide activities, lab experiments and accessing to computer courses. Besides, cooperation with the research companies, radio club electronics and handicrafts workshops were held. The Club visited the HRW Fab Lab with 16 children and had a chance to experience the Fab Lab technologies. During this visit, children are introduced with the 3D printers and Scanners and nameplates have been

made from the plywood sheets. Professor Schaefer informed about modern production technologies, robots ("VDIni Club: Hier Ist Technik Im Spiel", n.d.)

In March 2018 HRW university held a workshop about how SMIs can be affected by the advanced technologies in the concept of Industry 4.0. The main collaborator was the manager of UMBAU21 Project, WiN Emscher-Lippe; also regional agencies such as MEO, Niederrhein, Niederrheinischen IHK and other 65 authorised consultant took part in the workshop. During the workshop, Professor Schaefer presented the advanced technology that may be used in SMIs and discussed together with the theoretical and practical sides considering the companies working speed. After presentations, visitors had a chance to discover the HRW Fab Lab area and experienced the technologies and so that they could be informed about the possible use of these technologies in SMIs.

HRW Fab Lab also in contact with the other Fab Labs and they organised workshops together. HRW Fab Lab Team visited Fab Lab Barcelona in 2016, and both fab Lab users are joined workshops together, and they had benefited from the widening their networks and knowledge sharing. Moreover, comments of Robert Reiceher (worker of HRW Fab Lab) Cologne Fab Lab, Fab Lab Kamp-Linford, RWTH Aachen Fab lab are also other connections of HRW Bottrop in terms of organising workshops and exhibitions. HRW Fab Lab has a cooperated work with Maker Lab of Rhine-Waal University of Applied Sciences. Maker Lab held a 3-day young people participation-oriented workshop in 2017 and aimed to introduce students toward advanced technology uses by awakening the entrepreneurship spirit among them. They encourage young people and students to discover and produce their project within the Fab Lab. Regarding the other connection with other fab labs, Halle 21 is a maker space derived from HRW Fab Lab and organising workshops and involving projects together. Founder of Halle 21 is a former worker of HRW Fab Lab and today he continues his projects and initiations under the roof of Halle 21 with other users.

Bottoper Werkstaetten is another ally of HRW Fab Lab, the organisation main objective is support entgegration of vulnerable groups such as physically, mentally or phscologically disabled people with the working life. Therefore, Bottoper Werkstaetten and HRW Fab Lab co-working about regain the vulnerable groups by supporting their capabilities in the Fab Lab.

To widen the awareness of Fab Lab concept and to reach the people HRW Fab Lab also in contact with the Congress, panels and maker festivals. For this reason, the Fab Lab joins West Visions Panel, Future City Congress, Innovative Citizen Festival. In

these organisations, Fab Labs has the opportunity to present their projects and activities. However, HRW Fab Lab differs itself when it widens its networks since it organises HRW Fab Talks and inviting the innovators, initiator of creative projects and entrepreneurship to Bottrop. For instance, in October 2018 speakers were invited from both Human Lab (France) and Opendot Lab (Italy) so that they can share their works, initiations, knowledge and experiences. The Fab Talk theme that held in November 2018 was about the integration of disabled people with the help of advanced technology in Fab labs. Another recent Fab talk was held in February 2019, the speaker was from 3D Competence Center Niederrhein, and the participants present their 'One Dollar Glasses (EindollarBrille) Project', and the content of the project focuses people's glasses needs.

## 3.3.6. Fab Lab Participation and User Profile

Participation in HRW Fab Lab in terms of gender dispersion is balanced and especially female users in the lab are encouraged by appealing workshops. Even though the Fab Lab tends to increase the capabilities and interests of pupils and young generation in STEM fields, The Lab workshops also appealing and for other social groups particularly in disadvantaged areas. Additionally, activities such as 'Open Evening' or HRW Co-Lab is open for everybody, and these activities always include peoples from Fab Lab Team so support or inform new users and visitors.

Based on the Fab Lab Interview there is 200 person who uses the Fab Lab facilities by joining workshops, as visitor. Additionally more than 30 person use the fab lab regularly (once in a week) to improve their projects. The Fab Lab organisational team members are also developing their both individual, and group projects and gender balance is also visible in the Fab Lab team. HRW Co-Lab was founded by a team member and is aimed at to provide users interactive, collaborative working activity by sharing the knowledge among users. Fab Lab workers has the certifacetes from Fab Academy and they help to other users to improve their projects and intitiations. Robert Reicher mentioned that the one of the most important thing about take the attention of people to the fab lab is being friendly and he believes that HRW fab lab team is achieving this by providing amiable social environment. According to him the students who works in the fab lab is quite open and friendly for new comers and visitor in terms of helping them about the tools they need for ideas or interests. Additionally it is so important to finding

the right tool for individuals which make them to work or maker anything regarding their interest. Participation to the fab lab is provided various activities such as a gardening project that one of the team members lead, the project involves local users from different ages and university students. Moreover the companies sends their works to HRW Fab Lab in order to develop workers' cabalities in terms of digitilazing and computing.

## 3.3.7. Projects

Currently, there are three ongoing projects that funds by The European Regional Development Fund (ERDF), grants from the State of North Rhine-Westphalia and "Investment in Growth and Employment". The projects are Go Labor - "Fast Protection for Tips Investors", Flex lab Plus Industry 4.0 and Digitization 4.0.

Go Labor Project is a mobile laboratory project that aims to inspire and provide capabilities to disadvantaged young people with 'Open Innovation Starter Kits'. Thus, the informative workshops could be brought to people such as in neighbourhood centres or both open and closed public spaces around residential areas. Basically, with the mobile fab lab, users or participants can experience rapid prototyping and CAD design. The project duration is three years, and The Fab Lab is working in cooperation with ZDI Centre.

Additionally, this mobile fab lab also targets to reach local operations and aware them about rapid prototyping because this technology will be important for SMIs shortly. The purpose of the Flex Lab Plus Industry 4.0 project is to develop decentralised, inter-target STEM offers on "new production methods" by empowering the network among ZDI centres, universities, vocational institutions. Moreover, the project aims to inspire students, teachers about involving the MINT Training Careers and introduce the 'Do It Yourself' and maker culture with the collaboration of ZDI, Bottrop City and companies. In this respect, the HRW Fab Lab is one of the technical supports of the ZDI Bottrop in the 3D scanning and printing, sustainable raw materials, electronic development, ultralight and programming topics. The duration of the project is three years and finishes in May 2019. The last project from HRW Fab Lab is Digitalizing 4.0, and the objective is the development of decentralised, inter-target STEM offers. The project allows students to have the knowledge and understand future technologies so that they can prepare themselves for the rapid changes and take part in the world of tomorrow. The project

includes 'digital production' and 'virtual reality' themes. New technologies are designed and experienced by students under the MINT. During the process of the project, the collaboration among companies, educational institutions and local citizens have importance ("HRW Fab Lab", n.d.).

## 3.3.8. Current Impact – Potential Impact

Innovative and creative development targets of HRW Fab Lab contributes and affects social values both local and regional level. The tendency of balancing gender dispersion in the fab lab team, organisations and activities held by; importance given local problems but particularly encouraging individuals towards exploring, experiencing and learning within the collective space is principal values and positive social effects that created by the HRW Fab Lab. Hearten female participation from young ages and assisting them in science and innovation by providing the use of advanced technology capabilities succour to break the traditional image of the female role in society. 'Girls Day' organisation that held by both support of HRW University and Fab Lab supports pupil young female participators with workshops and the fab lab's technical infrastructure in a corporate company. So that the participants can feel relaxed, encouraged during this huge organisation, assisting the team of the activity consists of mostly females, and this also helps students to see females as role models in such fields (Voigt et al., 2017).

What is more, the Fab Lab also takes steps for improving refugees' or disadvantaged people's capabilities in handicrafts fields by providing them knowledge and to invite people to fab lab manager and the team keeps open the doors for wider community once in a week for prototyping, improving their attempt or initiation and learning the fab lab culture. With the help of workshops in the Lab, people can gain capabilities for their future careers. Besides these effects, there is also a gardening initiation that one of the team members took an important role and carry HRW Fab Lab towards being an also Green Lab. This initiation had been started in 2015 cooperation of Dortmund Technical University and Bottrop City and today this initiation is supported and Fab Lab too.

The project called 'GemeinSinnschaftGarten' and means community garden. It promotes to spread community garden in city areas and tries to establish a network, harvesting, sharing and volunteering in urban gardens where people can experience,

produce and learn about nature. Today there is three gardens in the city established by GemeinSinnschaftGarten and the foundation is supported by HRW Fab Lab, Bottrop City, a bio-product selling market (Bio Bukes), construction company (Bauwerkstatt Raschke Bottrop), landscape and outdoor design company (Blanik GmbH and Gala-Bau Kaufmann).



Figure 3.28. Urban Gardening Project
(Source: "Gemeinsinnschafftgarten", 2018)

These partners promote the foundation by advising community gardens plans in terms of design, determining location; hiring the needed equipment, organising construction days, supporting the making process of garden boxes, collecting donations, advertising the activities via the internet. Additionally, organizing the education forums with gardeners and spreading the urban gardening ideas through Bottrop City by enhancing the network with other foundations and organising festivals (Gemeinsinnschafftgarten, 2018).

Moreover, the considering the sustainability, the fab lab worker Robert Reicher has projects with the ideas of building things differently and he produced a part of a bike

with using bamboo and carbon fiber to provide compressive force and tensile force (Figure 3.29).



Figure 3.29. Project of Robert Reicher

(Source: Hazal Bingöl O)

### 3.3.9. Results and Discussion

All the case examinations an interview revealed that the principal purpose of the fab labs is spread the maker culture by empowering individuals with the hardware and software reinforcement. Additionally, all fab labs agree to contribute the local development and sustainability by making. This purpose already lies behind the philosophy of fab lab culture. However, the establishment process and organisation models reveal the different foci of fab labs that effects their activities, networks and user profiles.

Different organisation models of fab labs effect the user profile and social circle of the fab lab. From the cases it is possible to say that private company organised fab labs focuses more research studies and work as incubator center even though they open for

citizen participation, they have not concern about widening its social circle and maker culture through the society compare with the other fab labs which organised by educational institutions or local authorities In this respect, concerns about spreading maker culture in cities,  local authority based fab labs are more successful since their target groups are various. University or educational based fab labs naturally involves more participant from students and researches, but it is seen that citizen participation or user profiles of educational based fab labs is tried to enhance with the appealing different workshop themes.

Moreover, from the cases it can be said that the physical environment and the location of the fab labs are also important to citizen awareness and engagement of individual with fab labs. In this case Dortmund Dezentrale Fab Lab inadequate in terms of providing satisfying spatial environment. Therefore, among the cases İzmir Fabrika Lab has opportunity to serve citizens with its spatial offers also related establishments like vocational course areas supported by the municipality are working together with the Fab lab area. Thus, the importance of the related establishments around fab labs reveals itself. This effort tried to in the case of Dortmund Dezentrale since the location of the Dezentrale is in the creative center but event tough the design offices fab lab, exhibition areas and festival areas are in the same neighbourhood it is possible to say that the fab lab isolated by its physical environment and less concern of  involve the network of creative and innovative spaces in the area.

Concerns about stablishing networks with other related institutions are significant to sustain fab labs. In this respect cases reveals that HRW Bottrop has an effort to widen its network at the local, regional and also international level. That effects the recognisability of fab labs and HRW Bottrop Fab lab trying to strength its network since its establishment and this contributes the widening user profile and social circle in the fab lab. In this respect İzmir Fabrika Lab has efforts to widen its network and trying to enhance its participants with related organizations in the city since the fab lab is new the connections and participations satisfying. Currently, İzmir Factor Lab connected with open offices to have the attention of freelancers and entrepreneurs and the techno parks or technology transfer offices that derived from universities. Compare with Dezentrale Fab lab and HRW Bottrop Fab Lab, İzmir Fabrika Lab has more options to widen its network inside the city. Considering populations of the cities where the fab labs located is also arguably in terms of effect area and sufficiency of fab lab offers.

The targeted group of the fab lab specify network and relations with other foundations. Thus, the HRW Fab Lab has connections with student competence networks and technology clubs for children. Workers of HRW Fab Lab includes bachelor and master students, and they are also leading their projects related to widening Maker Culture, Mobile Fab labs. Assistants students contribute to enhancing lab participation among students by advertising their projects and other users' projects. Additionally, research assistants' projects regarding discriminated parts society also provide the enlarge user profile by introducing them the lab infrastructures and encouraging fab lab activities. Among the cases when the user profile is compared, it is seen that the since the Dortmund Dezentrale widen its social circle mostly by the current users' network. Even though they hold workshop themed targeting specific groups in the society the Skelton user profile consists of the manager and researchers social circle.

For all cases it is indispensable to introduce individuals with maker culture and involve them to the innovation processes. However, regarding the cases other objectives of fab labs and supports they have from different organizations and foundations effects the level of concern of widening the maker culture. Governmental and Education backgrounded fab labs have more influence to widen the maker culture among citizens.

Lastly, continuity and sustainability of the fab labs require meaningful relations and connection with other foundations. Additionally, involving festivals and maker fairs both local and regional level is also essential. Since the fab labs are used by innovator, maker and creative minded people in order to survive these spaces, the maker behaviour supposes to awaken and widen. This could be achieved with enlarging the maker community by increasing recognisability of fab labs. The cases reveal that the network strength of the fab labs contributes their purposes even though they share different objectives.

# CHAPTER 4

# CONCLUSION

Evolving the emerge of the Maker Movement and purpose of spreading maker culture first in the USA after other countries allowed to increase the attention of individuals, companies and educational institutions to creative and innovative spaces. The tendency of diffuse the maker culture and empowering the capability of individuals in terms of manufacturing and fabrication activities; appeared as a different land uses in cities such as maker spaces, hackerspaces, fab labs. All these innovative and creative spaces follow the purpose of widening maker culture and awaken maker behaviour as sustainable respond to consumerism. They perform to achieve this in an environment where they able to access advanced technology and the social circle they can integrate and learn, experience together.

In this study, mainly focused on the fab lab uses and implications in cities by examining three selected case. After the emergence of the first Fab Lab in MIT, led by Professor Neil Gershenfeld was attracted by not only the engineering group but also artist and designers. The realisation of the contributions of advanced technology to human capabilities for any making activity led to the rising of Fab Foundation and related with Fab Academy. Because those innovative spaces can sustain and ensure continuity by connecting each other or gathering under the same roof.

Maker behaviour was already in society, people making and producing things with different purposes with the help of tools and equipment they can reach or access. The contribution of the innovative and creative spaces to individual makers or the maker community is ensuring an environment they these like-minded people come together and work or make together. This contribution is essential for maker-minded people accessibility to needed tools, technology to expand their capabilities also procure more people by showing them what they able to do with innovative and creative spaces. Thus, the follower and participant of the Maker Movement will enhance. Fab labs, maker spaces will guide and encourage individuals by finding the perfect tool, the technology that make them work and produce regarding their interests and needs. Existence and endurance of those spaces in cities will change the individual's behaviour through manufacturing and

allow them to participate in the producing process. However, the diffusion of innovative and creative spaces over the world is also substantial and to achieve that they should act together, stay connected and enhance their network so that they can increase the awareness and recognisability of maker culture and spaces. In term of fab labs, the Fab Foundation is the roof they can relate and stay connected each other, but it is also essential to stay connected with different types of innovative spaces such as hackerspaces, incubator centres.

More connection will contribute both maker community and consistency of innovative and creative spaces. At this point, urban development and regeneration strategies are also crucial for widening the innovative spaces in cities. Regarding that, supporting maker spaces, fab labs in the cities can be considered as a strategy in the frame of tactical urbanism approach and urban acupuncture. Tactical urbanism puts the people integration and participation in the centre to respond to the urban problems so strategies or incremental interventions regarding innovative and creative spaces will contribute citizen participation to urban development. This is the intersection point of innovative spaces and tactical urbanism. As much as tactical urbanism strategies include the innovative interventions in urban areas such as open lab, fab lab or maker spaces where individuals develop their capabilities in this way citizens will engage more with environmental decisions.

The examined cases reveal that fab labs are also integrated with community activities such as urban gardening or sustainability in terms of environmentally friendly re-production of things. Even though the root purpose behind the fab lab model is to allow people to create and contribute to individual fabrication, fab labs can specialise or focus more one direction.

Lastly, since the fab lab model's closes the conditions of being third place (Oldenburg, 1989) by offering a comfy social environment and reinforce the civic engagement where people share and learn fab labs might be transform the third place in cities.

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# APPENDIX A

# INTERVIEW QUESTIONS

Table A.1. Interview questions for fab lab employees

| General Information | 1. Who is the initiator of the Fab Lab? When the Fab Lab is founded? |
|---|---|
| | 2. Do you offer any membership? If yes how much the payment? |
| | 3. What is the number of employees? Background of the employees? |
| | 4. Could you represent the Fab lab? What kind of infrastructures or tools are offered? |
| | 5. What is the number of participants/makers/users? |
| Fab lab Organization, Establishment And Network | 6. Could you shortly tell the establishment process of the Fab Lab? |
| | 7. Could you explain the organisation model of the Fab lab? |
| | 8. What kind of funding system has the Fab Lab? |
| | 9. What is the vision, purposes and objectives of the Fab Lab? |
| | 10. Do you have formal or informal rules, agreements in the Fab Lab? |
| | 11. Does the Fab lab have connections with other foundations, makerspaces or Fab Labs? (schools, companies etc.) |
| | 12. Does the fab lab have any tendency to specialization in area? |
| | 13. What kind of projects you have within the Fab Lab? (Completed, Ongoing) |
| User Profile & Participation | 14. What is the background of the participants? (education, age, gender) |
| | 15. Do you think there is gender-balance in terms of users and fab lab workers? If not do you promote anything to keep the gender balance? |

| | |
|---|---|
| | 16. Do you usually experience the knowledge sharing among participants? Have you experienced any conflict? |
| | 17. How you motivate makers or people to user the Fab Lab? |
| | 18. Do you offer any courses or engagement activities? |
| | 19. What are the main motivations, purposes of users to use the Fab Lab? |
| | 20. Do you have participants from vulnerable groups? (disabled people, immigrants) |
| Impact of the fab lab | 21. Do you think the Fab Lab effects local economy? How? |
| | 22. Do you think the Fab Lab effects the environment? How? |
| | 23. Do you wanted to add any other values that comes with the Fab Lab and its culture? |