Closing the loop

Redesigning the textile (waste) cycle in Madrid through urban manufacturing

Research portfolio

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Research portfolio
Architectural Design Crossovers
MSc3/4 ADC Graduation Studio: *The Expanded City/Madrid*, 2023/2024
TU Delft Faculty of Architecture and the Built Environment

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1 Research Plan

Closing the loop

Rethinking the textile (waste) cycle in Madrid

Figure 1

[Photograph of textile waste in an abandoned warehouse in Madrid]. (n.d.). El Mundo. https://www.elmundo.es/madrid/2023/09/13/64f22441f-dddff2d398b45bc.html

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Research plan
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Prologue

Since the start of my architectural master's education, I have been interested in exploring the ideas of waste, invisible systems and bio world. My fascination with the networked infrastructures and wastescapes brought me to the topic I will explore in my graduation year. Having before dived into the mentioned topics, this year I wish to explore their interrelations and bridge some of the knowledge gaps which could be a base for development of more attentive encounters between humans, (unalive) matter and cities. Can architecture play an active role in changing the way we consume and think of textile goods?

keywords:

waste flows

textile goods

circularity

active agent

social awareness

urban manufacturing

Figure 2

Navarette, R. (n.d.). [El 'vertedero' de ropa usada localizado entre Humanes y Fuenlabrada, en Madrid]. El Español. https://www.elespanol.com/enclave-ods/historias/20230114/cementerio-ropa-madrid-acumulan-toneladas-nadie-proceden/733176867_0.html

Introduction

527 kg of municipal waste were generated per capita in 2021 in EU (Eurostat, 2023). That means, each person created on average 1.44 kg of waste daily. More than 50% of this waste ends up on **landfills** all over the world, which poses a serious threat to humans, animals and our environment; contributing greatly to air pollution, soil contamination and gas emission. The speed and the way we consume and dispose of things is changing rapidly, leaving us with little time to react to this global issue of rethinking **production** to **consumption** processes.
For hundreds of years, we have been the biggest influence on Earth and its ecosystems and processes happening in the near-surface layer (soil, groundwater, river, trees, swamps, glaciers...), which Latour classifies as critical zones (Latour, 2017). This is due to the fact that the **Anthropocene** era is the time of rapid population growth, economic growth and technological advancements, which leads to accelerated human activities that are connected with habitat destruction, pollution, climate change, and loss of biodiversity. Graham and Marvin (2002) argue that these transformations happening in the cities; including economic, social, geographical, environmental and cultural aspects are linked to evolving methods and possibilities of **networked infrastructures**.

Anthropocene

the current geological age, viewed as the period during which human activity has been the dominant influence on climate and the environment

Networked infrastructures

'The networked city is a city of global connections, where the flows of capital, labor, and culture are reshaping the urban economy.' (Graham & Marvin, 2002)

Having that in mind, one can say that the cities have become the centre of **flows** and **exchanges**; including material, informational, energy, ecological, human etc. How can architecture contribute to bettering of these networks in order to enable necessary economic, environmental and social transformations to happen? Due to **capitalist** practices that care greatly responsible for creation of consumerism society, most of the mentioned systems function linear, following the strict path of **production – consumption - waste**. On global level, there is a wish to shift to a more **circular** way of thinking, but for this to happen, we would have to rethink the deep-rooted way in which we produce, consume and dispose of. For now, objects that we dispose of (waste) are mostly still seen as a **matter** at the end of its life. One of the aims of this research is to rethink the linear flow of matter and notion of waste as a final product. Is it possible to create more **resilient** and **self-sustainable** cities with a shift to more **circular network flows**? This question will be explored by looking specifically into **textile (waste) flows**.

Around 92 million tonnes of textile waste ends on landfills every year. Specifically for Madrid, **128.74 tonnes** of textile waste was generated in 2021. and 90% of that ended up on the landfills (El Mundo, 2023). Majorly responsible for this is **fast fashion**, a business model in fashion industry that focuses on rapid production and distribution of affordable, trendy clothing that is in line with current fashion trends. Spain is a big contributor to this topic, since Inditex, one of the largest and most prominent retail groups, is a company of Spanish origin. In general, Spain has a rich **textile manufacturing** history which was focused mainly in the southern part of the country, Catalonia and Valencia, and is not that prominent any more. On the other hand, Madrid was never a big industrial or textile manufacturing city. However, it has a history of craftsmanship since the medieval ages, focusing mostly on carpentry, leatherworking and blacksmithing. The peak of Madrid's textile industry was in 18. century with the opening of The Royal Tapestry Factory, which focused on luxurious tapestry and carpet manufacturing. By the end of 20. century, the city's economy was diversified, relying mostly on service sectors, finance and technology. Still, Madrid is a city in which

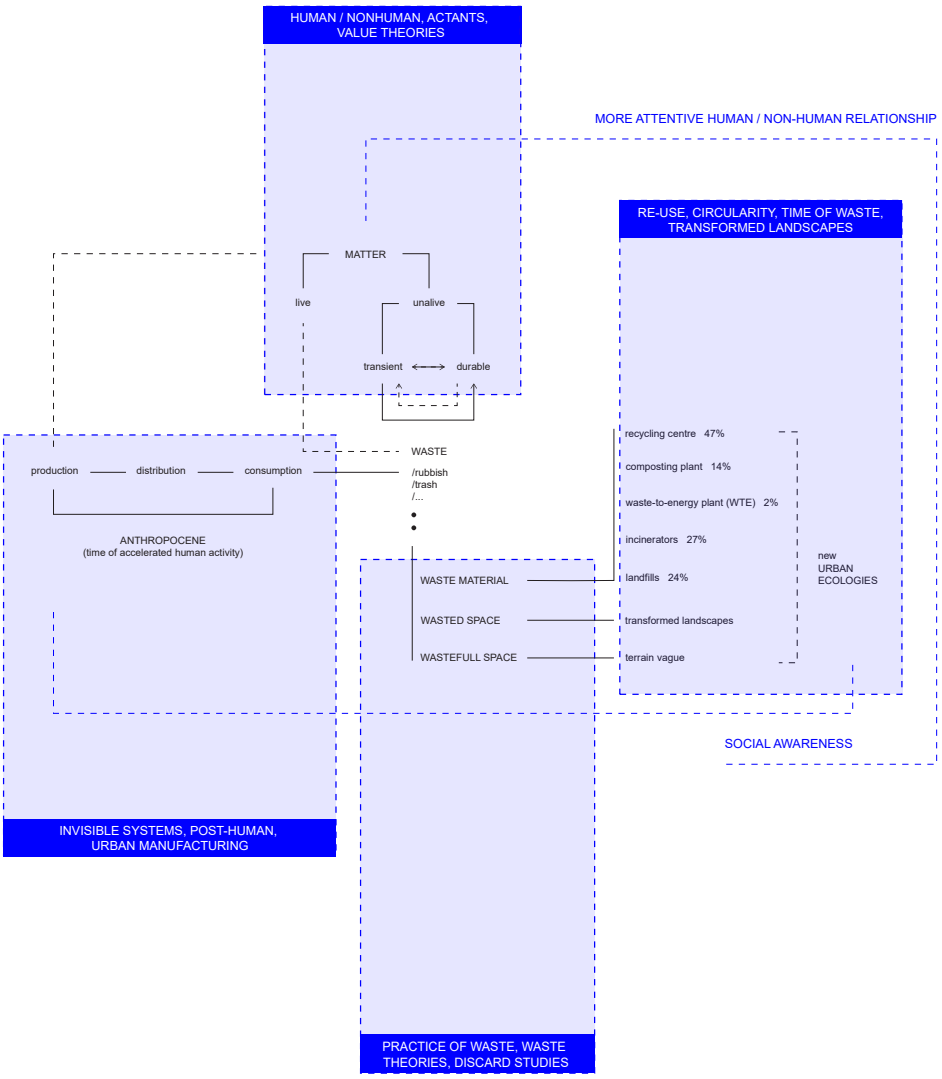
textile, the issue of textile waste especially is quite relevant topic, since the city still produces in small scale, hosts a biannual fashion week, where both local and international designers showcase their designs. It is also a city where numerous non-profit **second-hand organisations** are active and included in the textile waste management system. There is as well a lot of talk on governemnt level about improving the textile waste system in framework of sustainability.

The topic of textile material flows should be viewed both globally and locally to understand this **intricate network**. Crewe (2017) says fashion, which encompasses textile flows, is a complex phenomenon shaped by a variety of social, cultural and economic factors. For this reason, on global level, I will focus on understanding the process of production and transportation of goods, as well as textile waste management. On local level, I will focus on textile flows in the context of Madrid, looking into input and output of the city, presence and involvement in the network of fast-fashion and second-hand shops, as well as try to understand the public interest and stand on the topic.

Problem field diagram

Figure 3

Problem field diagram showing initial interests around the notion of waste



Within this research I wish to understand:

What is the role of architecture in creating more attentive relationships between humans and matter by rethinking the textile (waste) flows in Madrid?

Which poses some other queations:

What is the reality of production / distribution / consumption / disposal of textile goods in the global context and the context of Madrid?

How can architecture encourage the society to rethink the value system?

Who are the main actors in the network of textile production / distribution / consumption / disposal?

How do we act towards waste ecologies that are a product of old waste systems?

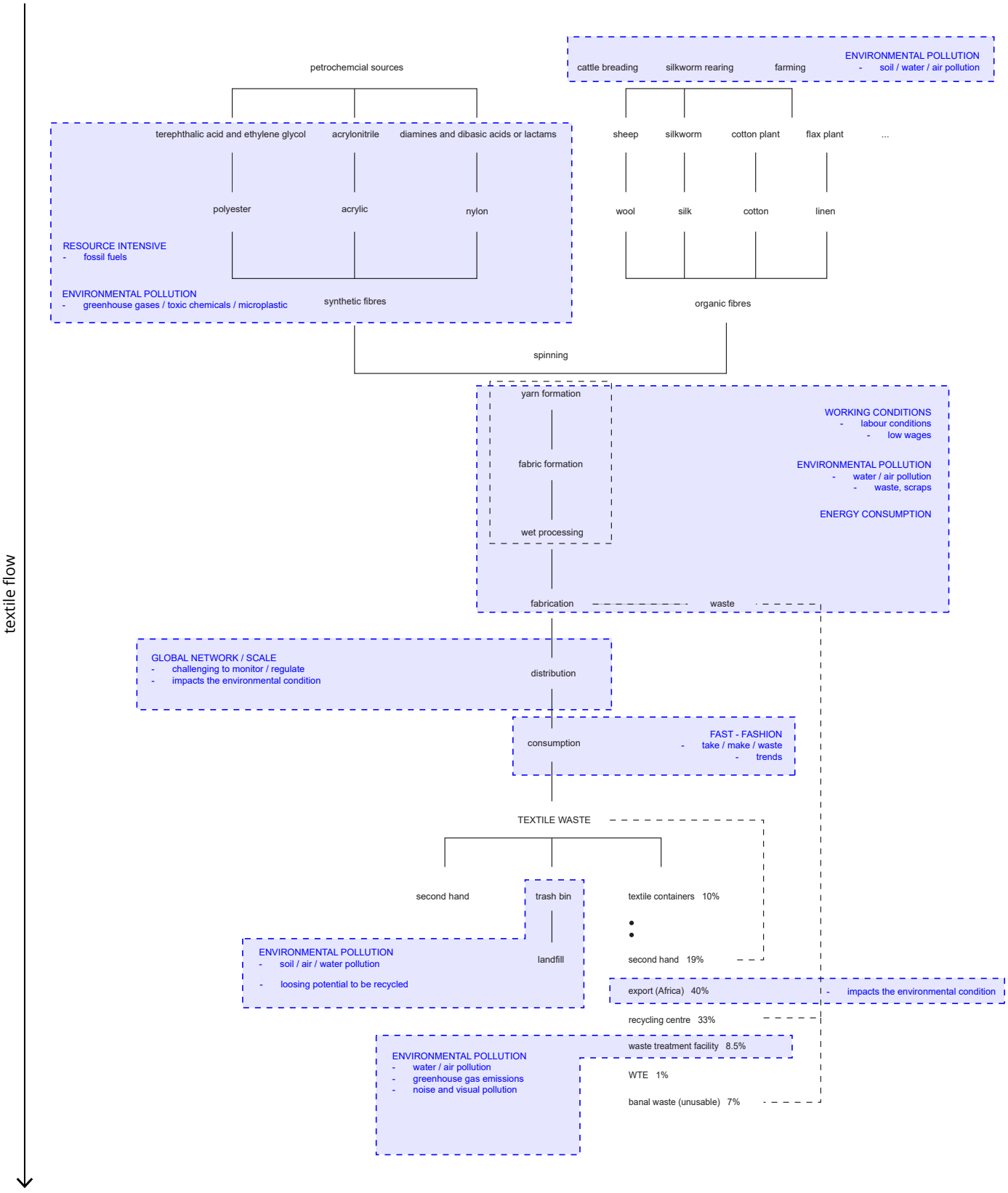
Can introducing urban manufacturing in the city based on service economy contribute to sustainability and self-sufficiency?

Problem statement diagram

The diagram on the right shows the flow of textile material from production to disposal and highlights the disruptions in the system that all together are responsible for the issue of unsustainable textile (waste) management and consumption. The diagram aims to show that not only the end product (textile waste) is the problem, but rather the whole system from the start until the end has issues that should be rethought. Right now, the system is contributing to environmental pollution, is resource and energy intensive and in some offers questionable working conditions.

Figure 4 (right)

Problem statement diagram showing the textile flow and pointing out the disruptions in the system


textile flow
petrochemcial sources
terephthalic acid and ethylene glycol
acrylonitrile
diamines and dibasic acids or lactams
polyester
acrylic
nylon
RESOURCE INTENSIVE
- fossil fuels
ENVIRONMENTAL POLLUTION
- greenhouse gases / toxic chemicals / microplastic
synthetic fibres
cattle breading
silkworm rearing
farming
ENVIRONMENTAL POLLUTION
- soil / water / air pollution
sheep
silkworm
cotton plant
flax plant
...
wool
silk
cotton
linen
organic fibres
spinning
yarn formation
fabric formation
wet processing
fabrication
waste
WORKING CONDITIONS
- labour conditions
- low wages
ENVIRONMENTAL POLLUTION
- water / air pollution
- waste, scraps
ENERGY CONSUMPTION
GLOBAL NETWORK / SCALE
- challenging to monitor / regulate
- impacts the environmental condition
distribution
consumption
FAST - FASHION
- take / make / waste
- trends
TEXTILE WASTE
second hand
trash bin
landfill
ENVIRONMENTAL POLLUTION
- soil / air / water pollution
- loosing potential to be recycled
textile containers 10%
second hand 19%
export (Africa) 40%
- impacts the environmental condition
recycling centre 33%
waste treatment facility 8.5%
WTE 1%
banal waste (unusable) 7%
ENVIRONMENTAL POLLUTION
- water / air pollution
- greenhouse gas emissions
- noise and visual pollution

Theoretical framework

How does one tackle such a complex global and local topic such as **waste**? It is a product of **dynamic conditions** and happenings, and can be seen through economic, political, environmental lenses and potentially many more. Crucial in dealing with this issue is trying to understand the mere notion of waste and the system of ecologies it operates within. To understand the role of architecture in contributing to the creation of more **sustainable textile waste system** by encouraging more attentive relationship between people and matter; in this research I will try to better understand the complexity of the meaning of waste and its system, and its relation to the urban environment and its processes.

For understanding waste at the smallest scale, which is that of matter, I will refer to Bennett's book: Vibrant Matter and an article Toward an ecology of materials by Ingold. Ingold talks about material culture, emphasizing that the nonhuman organisms should be viewed less though 'objectness' of things, but rather through material flows, which opens up a possibility to understanding better the relations between humans and environment. Furthermore, Bennett (2009) introduced a crucial theory for understanding the **agency** and complexity of **unalive matter**. She says that: "All forces and flows **(materialities)** are or can become lively, affective, and signaling." She as well talks about how an **actant** never really acts alone, this agency depends on collaboration of many bodies and forces; meaning that matter enhances its power when it becomes a **heterogeneous assemblage**. And what is waste and waste system than an assemblage of unalive matter, that is an active force affecting and being affected by economic, political and environmental forces of this world.

Actant

'Actants are not passive objects, but rather active participants in the world, capable of producing effects and influencing events.' (Bennett, 2010)

Heterogeneous assemblage

'Heterogeneous assemblages are composed of a variety of human and non-human actors, each with their own unique properties and capacities.' (Bennett, 2010)

Despite being an active agent in the society, waste is by the majority considered to be an unvaluable matter at its end state that is discarded and brought far from the eyes of society. Who is the composer of these **value systems** and how do they work? My basis for understanding this is Thompson's theory on **transient and durable matter**. He describes transient objects as ones that decrease in value over time and have finite life-spans. And durable objects as ones that increase in value over time and have infinite life-spans. Therefore, rubbish or waste can be interpreted as a third category that emerges from the transient one when the object completely loses the value. Thompson (2017) says: "Discards do not become 'rubbish' until social processes and practices conspire to remove them from circulation and consideration." One could say that waste is nothing, but a social construct that is product of various systems and that society is in charge of setting the value of things.

To understand the issue of waste in whole, one should not only look into the end product, that being waste and wastelands, but look deeper into the waste system and the production and consumption systems. However, it is important to keep in mind, what Gandy (2013) says that we should keep in mind urban wastelands and acknowledge their potential as sites of ecological and aesthetic exploration. Furthermore, Liboiron & Lepawsky (2022) say that since more and more attention is being paid to waste and value by different actors, it is important to contextualize the problems, materialities and systems of discard so we can address the wider problems and their origins rather than dealing with symptoms. He talks about how waste and pollution are not just simply

by-products of industrial systems, but rather their characteristic. And if waste is necessary for the system to work, then we should not work towards eliminating it, but altering the waste. Having said that, to successfully tackle a problem, I believe it is crucial to understand not only the global system, but as well to examine closely the specific operational system of interest in order to fully grasp its complexity and potential of change.

Being one of the most relevant topics when it comes to sustainability, both worldwide and in Madrid, I decided to look deeper into textile waste and systems. The fact is that the capitalist development of economy has given rise to exploitative fast-fashion systems. The amount of textile we consume and dispose of is exponentially growing, Corrigan (1997) says that clothing is one of the key areas of consumption. He stresses that, we as consumers have much power to change the system by choosing carefully what we buy. On the other hand, Brooks (2021) says that individual consumer adjustments, such as **consuming ethically**, will not lead to a big change. It is definitely not insignificant, but in order to actually make a change, we should look beyond consumption, into producing / transporting / **consuming** differently and **reflectively with awareness**. This thought goes with hand with what Blühdorn (2017) says about post-consumerism, that it is not just about reducing consumption, but changing the way we think about it and rethinking the role consuming plays in our lives, he calls for focusing more on relationships, community and natural world. How can architecture contribute and spark this shift in the way we consume?

One of the relevant notions as a continuation of the topic is the one of **urban manufacturing**. Since around the middle of the 20th century, western cities shifted from making things to providing services and importing goods. There is a gap now between those that consider **manufacturing** vital for the future development and ones who think the opposite. Hill (2020) says that while cities once produced great amounts of goods, very little was known about the vast network of other activities that come with manufacturing; such as training, logistics, material suppliers, research, design and engineering, etc. These networks and systems should be the ones we need to look into if we want to make a **fundamental change** in the way we consume. Currently, the whole system is damaging the environment and not letting the society to flourish long term. Hill (2020) says those **systems** need to be replaced with **regenerative** ones that promote circular economy and innovation, rather than the current linear system going by **'take, make, waste'**. Having said that, manufacturing should be viewed as a key component of circular economy infrastructure.

Urban manufacturing

'Urban manufacturing is not just about producing goods, but also about creating new forms of value through the integration of material and immaterial production processes.' (Hill, 2020)

Theoretical framework diagram

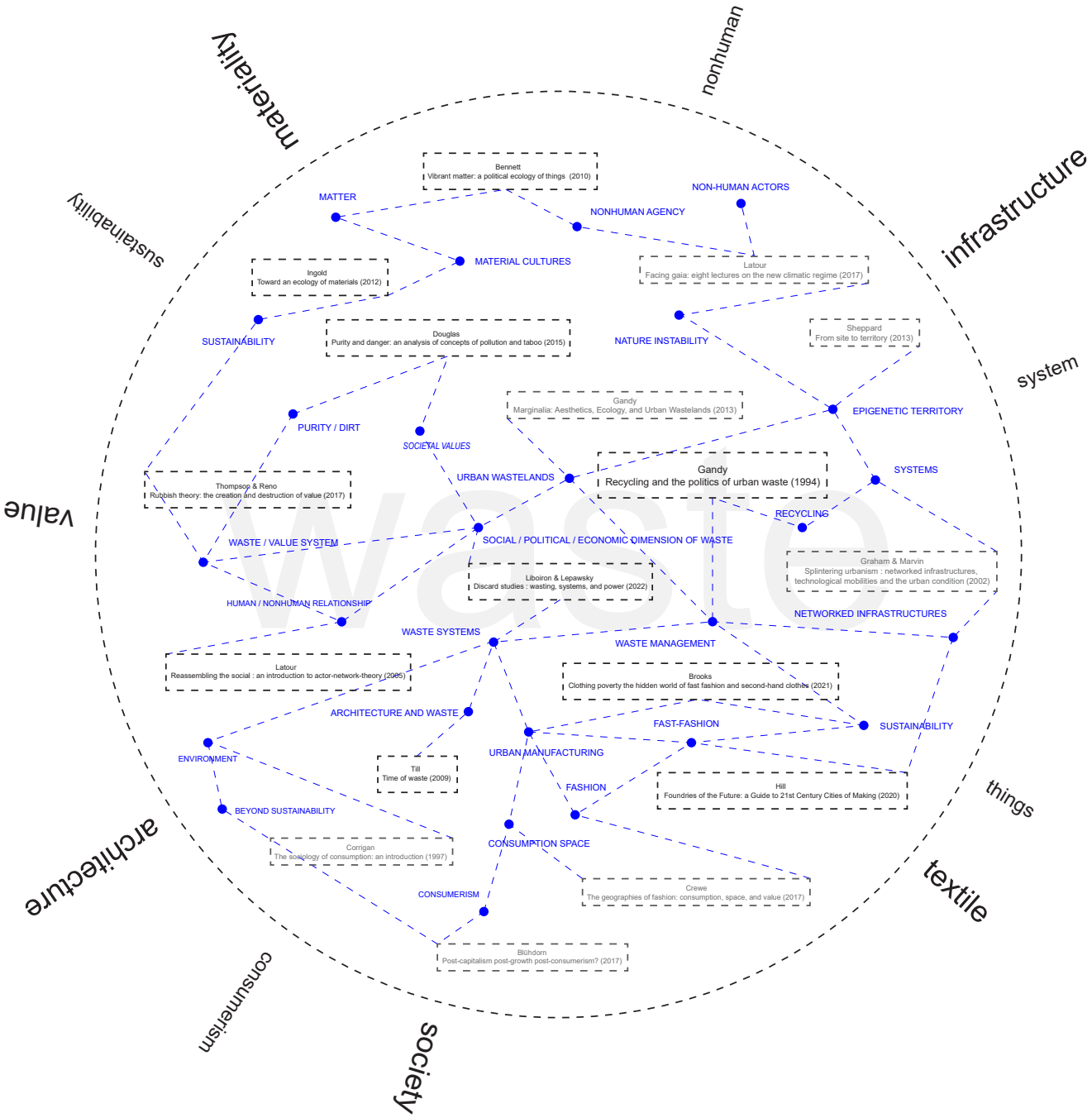


Figure 5

Theoretical framework diagram showing the interrealtions of various topics within the research field

Methodological framework

Shifting to more **sustainable textile (waste) flows** is a relevant global topic, discussed widely by ecological activists, economists and entrepreneurs. To understand the issue and its influencers and influences, which would bring me to more objective understanding of the topic and understanding the role that architecture plays within it, I will conduct the research in two scales (**micro** and **macro**) levels which will bring different findings complementary to each other. Macro level will encompass global to regional questions, and micro reginal to local.

On a macro scale, I plan to analyse **data** and **policies** relevant for textile industry material flows in relation to Madrid. Gathered information will be shown in **diagrams** and **charts** and will contribute to my understanding of past and current **trends** in textile material flows, and maybe help to think about the future ones. I will not only analyse the material component of the flows, but also **actors** and **locations** included in the process, which might possibly require reaching out to certain organisations and companies to share their available data. To showcase these relations, I will refer to Bruno Latour's **Actor-Network Theory**, where he emphasizes the role of both human and non-human entities in shaping **social phenomena** (Latour, 2005). Relevant information will be shown on selective maps where individual components will reveal its interrelations and possibly give a clearer overview of usually invisible system of operations. The forementioned data / policy analysis and **selective mapping** will hopefully shed some light on the complex systems network within textile production / distribution / consumption. All of that will be supported by findings gathered through analysis of relevant literature touching upon theory of matter, discard studies, waste practices, fast – fashion and manufacturing practices. When researching and mapping, especially on the macro scale, I will be aware of the theory of **epigenetic territory** that Lola Sheppard introduces in an article From Site to Territory, meaning that every site must be understood as the **'palimpsest of forces'.** She says that while some systems such as ecology and technology are visible, some such as economic and political forces operate remotely (Sheppard, 2013). Therefore, I will make an effort to take into account all affected and affecting systems, be they visible or invisible.

Actor - Network Theory

'ANT is a way of exploring the complex networks of relationships that exist between human and non-human actors, and the ways in which these actors shape and are shaped by their environments.' (Latour, 2005)

Epigenetic territory

'The "epigenetic territory" is one in which forces, data and information are continuously scripting its performance.' (Sheppard, 2013)

On a micro scale, I will focus on tracking the **network of textile flows** and actors on reginal and local level, which I will show through **maps** and **diagrams**. As a theoretical basis for this, I will as well as in macro scale refer to actor-network theory, focusing on relationships and networks created between **human and non-human actants**. With the goal of trying to deeper understand the influences different parties of interest have on each other and the material flows, I intend to look into **future city development plans** and urbanistic plans, where I will try to analyse sustainability and self-sufficiency goals. This could possibly reveal some new areas of interest. Moreover, in order to better understand the relationship between humans and matter in the context of Madrid, during the field trip I will **interview** the people included in different stages of the network, from production to consumption. This will give me an insight into subjective perspectives and stories that will potentially be helpful in understanding the **local perspective** and opportunities. On the field trip, I will also photograph the physical representations of the textile networks I discover during the research process. With this **photo diary**, I aim to represent the current relation-

ship between people and matter (textile in this case), which can be seen as a reflection on the current system and inspiration for rethinking it.

The methodology described above should result in an in-depth understanding and analysis of the textile (waste) networks and its areas of influence. With it, I am hoping to further expose **disruptions** in the system that require attention and will lead to areas of interest and special areas that could be the possible future intervention spaces.

Methodological framework diagram

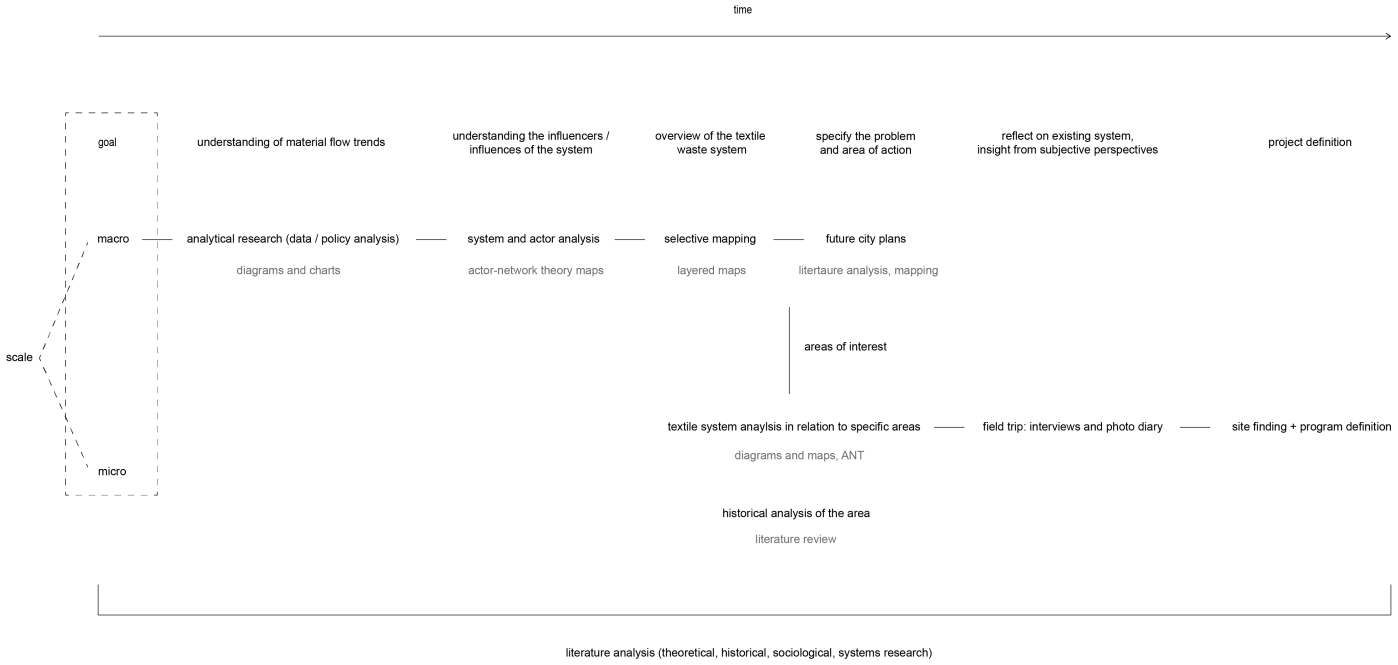


Figure 5

Methodological framework diagram showing research methodology and methods

Relevance

The reality is that we are a part of **consumer society**, we are producing and consuming more than ever, which leaves us with an unimaginable amount of byproducts as consequences of such lifestyle. The issue of **waste management** (be it municipal, industrial, construction..), is a relevant global topic in every corner of the world.

With this research and eventually design project, my aim is to look **beyond sustainability** in tackling the challenge of rethinking textile waste systems. Nowadays, 'sustainability' is a part of every agenda of all private and public organisations in every aspect of our society. However, thinking of sustainability in terms of recycling and re-using is not enough, one can say it is an outdated, almost archaic principle, certainly not elaborate enough to deal with such a vast issue in our hands. The goal of this research is to surpass the understanding of the current meaning of the notion of 'sustainability', by not look only at the end product, that being waste, but focusing on the system and seeing where the possibilities for introducing a relevant change are.

By researching waste flows, my focus being textile waste flows, I aim to understand the global and local intricate **network of matter flow** and transformation. This will enable me to discover the disruptions in the system, which will lead to understanding where the possibilities for introducing new ideas and changes are, to work towards the end goal of introducing a concept beyond sustainability and closing the loop.

Madrid promotes reusing and recycling of textiles through the framework of Sustainable Management Strategy for waste from the Community of Madrid 2017-2024. Within the city there is quite a large amount of textile containers, and on the outskirts of the city a few recycling plants. To the eyes of the public, or the ones that are disposing of textile in those containers, it might seem as if the problem is solved. However, there is much more to it than that, the containers are just a starting point of the textile waste management system, not to mention the textile that ends together with municipal waste. There are many organisational, technological and working downfalls of the system. The article in El Mundo (2023) talks about the severity of textile waste problem of Madrid, stating the problems within the collection, transportation and management of this waste. There is as well a government sustainability plan for the future called Madrid 360, which aims to fight climate change in the city. Within this document, that offers current analysis and future sustainability plans, there is a passage about waste management which promotes prevention of waste, improving selective collection, increasing recycling rates, improving treatment technologies and reducing overall emissions.

By striving beyond sustainability, through rethinking textile waste systems of Madrid and further, there is a possibility of creating more progressive and future resilient cities. Although Madrid is a service economy-based city that has never had a big industrial background, the city and some neighbourhoods especially, are in recent years becoming places of innovation and change. By redefining the old waste flow model, taking into account new technologies, new manufacturing and disposal possibilities, this project is a potential for introducing new models of producing, consuming and disposing in the cities, hopefully bringing a more attentive relationship between humans and matter.

Annotated bibliography

key concepts for research

Primary bibliography

1. Bennett J. (2010). The force of things. In Bennett J., *Vibrant matter : a political ecology of things*. Duke University Press.

nonhuman agency

This chapter of the book highlights the importance of nonhuman materials in public life and serves as a basis of understanding their agency.

2. Bennett J. (2010). The agency of assemblages. In Bennett J., V*ibrant matter : a political ecology of things*. Duke University Press.

thing-power, assemblage

This chapter of the book introduces the notion of thing-power and talks about agency's dependency on collaboration. It offers an understanding into how bodies enhance power as a heterogeneous assemblage.

3. Brooks A. (2021). Fast-fashion systems. In Brooks A., *Clothing poverty the hidden world of fast fashion and second-hand clothes*. Zed Books. https://doi.org/10.5040/9781350219243

fast-fashion, sustainability

This chapter of the book talks about the fast-fashion systems and its impact of society and environment. It highlights the importance of awareness of hidden systems in world of clothes as an opportunity to rethink the way we consume.

4. Douglas M. (2015). *Purity and danger : an analysis of concepts of pollution and taboo* with a new preface by the author. Routledge.

concepts of purity/dirt, societal values

This book is an anthropological work od exploring the concepts of human relation to purity and danger. Douglas argues that societies are the ones that establish the rules deciding what is considered clean and pure; and what dirty and polluted: According to her, this perception of value stays deeply rooted in society.

5. Gandy, M. (1994). Recycling in perspective. In Gandy M., *Recycling and the politics of urban waste*. Earthscan Publications.

municipal waste management

This book explores municipal waste management and recycling in three major cities. It suggests that to achieve a more sustainable system of waste management and recycling policy, there needs to be a fundamental change in public and rethinking the role of environmental protection.

6. Hill, Adrian V (ed.). (2020) *Foundries of the Future: a Guide to 21st Century Cities of Making*. With contributions by: Ben Croxford, Teresa Domenech, Birgit Hausleitner, Adrian Vickery Hill, Han Meyer, Alexandre Orban, Víctor Muñoz Sanz, Fabio Vanin and Josie Warden. Delft. TU Delft Open, 2020.

This book talks about the challenges of globalization, climate change and technological innovation that the cities nowadays face. It emphasized the importance of understanding interactions between the cities and environments and talks about the idea of re-introducing urban manufacturing into the cities.

21st century cities, urban manufacturing

7. Ingold T. (2012). T*oward an ecology of materials**. Annual Review of Anthropology 427–442. https://doi.org/10.1146/annurev-anthro-081309-145920

material culture, sustainability

This article talks about the material culture and a new approach that should emphasize the interconnection of humans and environment, which can lead to development of more sustainable resource use.

8. Latour, B. (2005). *Reassembling the social : an introduction to actor-network-theory* (Ser. Clarendon lectures in management studies). Oxford University Press. Retrieved October 16, 2023.

human and non-human interactions, actor-network theory

This book proposes a new understanding of society. It introduces actor-network theory, which emphasizes the importance of understanding complex non-human and human interactions and potential of understanding the network.

9. Liboiron, M., & Lepawsky, J. (2022). *Discard studies : wasting, systems, and power*. MIT Press. Retrieved October 11, 2023.

social, political and economic dimension of waste

This book provides a perspective on social, political and economic dimensions of waste, not just environmental. It calls for a concept of 'discard studies' and a new way of understanding the complex waste structures and systems.

10. Thompson, M., & Reno, J. (2017). *Rubbish theory: the creation and destruction of value* (New). Pluto Press. Retrieved October 30, 2023, from INSERT-MISSING-URL.

waste and value system

In this book, Thompson explores the social and cultural dimension of waste. Connecting it with systems of power and inequality. He proposes rubbish theory as a new way of understanding the systems of waste in relation to value.

11. Till, J. (2009). Time of waste. In Till,J., *Architecture depends*. MIT.

architecture and waste

In this essay, Till explores the relationship between architecture and waste, discussing social and political dimensions of it. He calls for a new approach that takes into account the challenges posed by waste.

key concepts for research

Secondary bibliography

1. Blühdorn I. (2017). *Post-capitalism post-growth post-consumerism? eco-political hopes beyond sustainability*. Global Discourse 42–61. https://doi.org/10.1080/23269995.2017.1300415

consumerism, beyond sustainability

In this article, Blühdorn writes about the ideas of post-capitalism, post-growth and post-consumerism; ideas that aim to transform the consumer society. He talks about ideas that go beyond the traditional idea of sustainability, which he says is losing its effectiveness.

2. Corrigan P. (1997). *The sociology of consumption : an introduction* ed. 1. SAGE Publications. Retrieved October 29 2023 from https://static2.cyberlibris.com/books_upload/300pix/9780857021854.jpg.

consumption, environment

This book gives insight in social and cultural aspects of consumption. He argues that consumption is a social practice that is shaped by norms, values and institutions. He also explores the impact consumption has on the environment.

3. Crewe, L. (2017). Figuring out the geographies of fashion. In Crewe, L., *The geographies of fashion : consumption, space, and value* (Ser. Dress, body, culture). Bloomsbury Academic, an imprint of Bloomsbury Publishing Plc. Retrieved October 29, 2023, from INSERT-MISSING-URL.

consumption space, fashion

This chapter of the book provides an overview of the complex relationship between fashion and geography, emphasizing the importance of understanding the conditions and spaces of fashion production, consumption and circulation.

4. Gandy, M. (2013). "*Marginalia: Aesthetics, Ecology, and Urban Wastelands.*" Annals of the Association of American Geographers 103, no. 6 (2013): 1301–16.

urban wastelands potential

In this article, Gandy introduces the idea of urban wastelands, sites that are often overlooked and ignored, as valuable spaces of ecological and aesthetic exploration. He emphasizes the importance of recognizing the value in them and incorporating them in the planning and design processes.

5. Sheppard, Lola. (2013). From site to territory. In Bhatia N. Sheppard L. Archinectcom (Firm) & InfraNet Lab (Firm). (2012). *Goes soft*. Actar ; Distributed by ActarD.

epigenetic territory

This article explores the relationship between site and territory, calling for a broader understanding of territory to fully grasp the complex environmental relations. It introduces the notion of epigenetic territory, which offers an understanding of the territory by taking into account the changing nature of the environment and the dynamic processes.

6. Graham S. & Marvin S. (2002). Introduction. In Graham S. & Marvin S., *Splintering urbanism : networked infrastructures technological mobilities and the urban condition* (1st ed.). Taylor and Francis. Retrieved October 29 2023 from http://public.eblib.com/choice/publicfullrecord.aspx?p=170145.

networked infrastructure, systems

This chapter of the book offers an understanding of the relationship between infrastructure and urban space and how one influences the other. It touches upon technological change and calls for taking into account changing conditions of the urban world.

7. Latour, B. (2017). First Lecture: On the instability of the (notion of) nature. In Latour B., *Facing gaia: eight lectures on the new climatic regime.* (C. Porter, Trans.). Polity Press.

instability of nature, non-human actors

In this chapter of the book, Latour argues that traditional conception of nature is no longer viable. He suggests understanding of nature that takes into account complex human-environment interactions. He brings into picture topics of non-human actors, technology and politics.

2 Graduation Plan

Studio:

Architectural Design Crossovers MSc3/4: The Expanded City/Madrid

first mentor: Alper Alkan
second mentor: Florian Eckardt
third mentor: Roberto Cavallo

Argumentation of choice of the studio

The reason for choosing Architectural Design Crossovers Graduation Studio is that I wanted to engage in a more interdisciplinary approach to architecture which would allow me to expand my research into various fields of interest and therefore explore how architecture operates within them. The studio topic Expanded City: Madrid offered an intriguing lens to examine the city. It enabled me to look at the city as a composition of various layers of complex relationships and flows intertwined within the city's system.

Graduation project

Title of the graduation project:

Closing the loop
Rethinking the textile (waste) cycle in Madrid

Goal

Location: Madrid, Spain

The posed problem:

We live in a time of accelerated human activity, which is characterized by rapid population growth, economic growth and technological advancements; which also translates into increased wasteful consumerist processes.
One can say that the cities have become the center of flows and exchanges; including material, informational, energy, ecological, human etc. How can architecture contribute to bettering of these networks and consuming more consciously in order to enable necessary economic, environmental and social transformations to happen?
Most of the mentioned systems function linear, following the strict path of production – consumption – waste; which is a characteristic of our consumer society produced by the capitalist practices. On a global level, there is a wish to shift to a more circular way of thinking, but for this to happen, we would have to rethink the deep-rooted way in which we produce, consume and dispose of.
To explore the notions of material /construction, system / program and social / cultural sustainability within the city, this project is focusing on textile (waste) flows. The textile and apparel industry is one of the leading sectors in the production of pollutants at global scale. It contributes greatly to the processes of chemical pollution (coming from chemicals for dyeing, bleaching, and processing fabrics), water consumption and

pollution (the production is water intensive and waste waters are often discharged into rivers and streams), energy consumption and greenhouse gas emissions (the industry is energy intensive, especially during processes like dyeing and finishing) and waste production. According to data analysis, the textile industry is responsible for 10% of global carbon emissions and it is estimated that it discharges around 20% of global wastewater. Furthermore, around 92 million tons of textile waste ends up on landfills every year. Specifically for Madrid, 128.74 tons of textile waste was generated in 2021. and 90% of that ended up on the landfills (El Mundo, 2023). Therefore, due to textile industry's widespread presence and direct physical impact, exploring concepts of sustainability through the framework of textile offers relevant findings.

Research question

How can architecture act as an incubator of the idea of creating more attentive relationship between humans and matter by rethinking the textile (fiber) and waste flow and their material ecologies?

design assignment in which it results:

Extensive mapping of the textile (waste) flow in the city of Madrid, including relevant network of actors, brought me to understanding the disruptions within the system and possible areas of intervention. Considering the flow is a part of a broader system, it should not be treated as an isolated case, but as part of a multilayered system. Being aware of the fact that architecture cannot change waste policies that are in effect, this project acts as an incubator of the idea of waste as a resource. It questions the idea of consuming and disposing habits within the context of the former industrial district of Arganzuela. The building does not only question the material flow, but tries to think in a concept 'beyond sustainability', considering material/construction, system/program and social/cultural sustainability. This is done by using durable and/or recyclable materials, focusing on design that can evolve over time to meet the changing needs of the system and reflecting on the site's context. It reimagines material cycles by including the community in the process of disposing. The idea is to highlight the importance of community and professional involvement and introduce the idea of bringing manufacturing back in the city.

Process

Method description:

In order to better understand the complexity of waste flow system, its areas of influence and the role that architecture plays within it, the research is conducted in two scales (macro and micro).
On a macro scale, I analyze data and policies relevant for textile material flows in relation to Madrid. These relations are selectively mapped, referring to Bruno Latour's actor-network theory, where he emphasizes the role of both human and non-human entities in shaping social phenomena (Latour, 2005); as well as theory of epigenetic territory, meaning that every site is understood as a 'palimpsest of forces' (Sheppard, 2013), considering forces operating remotely. The selective mapping helps understand the complex systems network within textile produc-

tion / distribution / consumption. These findings are supported by information gathered through relevant literature analysis touching upon theory of matter, discard studies, waste practices, fast – fashion and manufacturing practices.
On a micro scale, I focus on tracking the network of textile flows and actors, referring to actor-network theory. To deeper understand the influences different parties of interest have on each other and the material flows, I refer to future city development and urbanistic plans and existing ones, which leads to potential areas of interest and finally a site. Moreover, I make a photo diary on a field trip to Madrid documenting relationships between people and matter (textile), which can be seen as a reflection on the current system and inspiration for rethinking the future of it.
The methodology described above leads to an in-depth understanding and analysis of the textile (waste) networks and their areas of influence. With it, I am able to notice disruptions in the system that require attention and possible intervention areas. It also opened up a path to new opportunities for discussing different takes on sustainability.

Literature and general practical references

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Reflection

What is the relation between your graduation (project) topic, the studio topic (if applicable), your master track (A,U,BT,LA,MBE), and your master programme (MSc AUBS)?

Architectural Design Crossovers MSc3/4: The Expanded City/Madrid is a studio addressing the urban commons and ever-growing network systems of the city of Madrid. I responded to this by researching one of the most urgent topics, both global and local, that being the topic of waste (flows) and sustainability concepts, with emphasis on materiality. Because of time limitations, I take textile waste as my lens of exploration; which came as a conclusion of deep city data analysis, looking into current problems and consumption and disposal trends. However, this project can be seen as a starting point of rethinking various types of waste flows and sustainability concepts which is potentially a way to more resilient and sustainable cities. Having said that, research through various lenses of politics, economics, environment that is being conducted and the rethinking of the concept of sustainability is in line with the agenda of MSc Architecture track of TU Delft.

What is the relevance of your graduation work in the larger social, professional and scientific framework?

With this research and design project, my aim is to look beyond sustainability in addressing the complex challenge of rethinking textile waste systems. Nowadays, the term 'sustainability' has become a common feature in the agendas of both private and public organisations across various sectors. However, thinking of sustainability in terms of recycling and re-using is becoming almost outdated for tackling the vastness of this issue. The goal of this research is to surpass the limited understanding of the notion of 'sustainability', going beyond the consideration of waste as an end product, instead focusing on the system and exposing the possibilities for introducing a relevant change. This research and project will hopefully offer a relevant insight in rethinking textile waste on a global, not just Madrid scale, and highlight the importance of changing our relationship with matter.
In realms of architecture and science, there is extensive research on the concepts on waste management and sustainability. However, there is a noticeable gap in how architecture engages with this topics. By focusing on textile, I aim to bridge this gap by introducing greater architectural involvement and bring professional awareness on the issues.

3 Research Paper

Closing the loop

Rethinking the textile (waste) cycle in Madrid

Figure 1

[Photograph of textile waste in an abandoned warehouse in Madrid]. (n.d.). El Mundo. https://www.elmundo.es/madrid/2023/09/13/64f22441f-dddff2d398b45bc.html

Mia Vrgoč

Research paper
Architectural Design Crossovers
MSc3/4 ADC Graduation Studio: *The Expanded City/Madrid*

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keywords:

material flow

textile

'textility'

circularity

urban manufacturing

Figure 2

Navarette, R. (n.d.). [El 'vertedero' de ropa usada localizado entre Humanes y Fuenlabrada, en Madrid]. El Español. https://www.elespanol.com/enclave-ods/historias/20230114/cementerio-ropa-madrid-acumulan-toneladas-nadie-proceden/733176867_0.html

INTRODUCTION

From linear to circular

Liboiron & Lepawsky (2022) state that "... waste and pollution are not unfortunate accidental by-products of industrial systems of production but are rather characteristic of all industrial systems...". The truth is that for hundreds of years, humans have been the biggest influence on Earth and its ecosystems and processes happening in the near surface layer; including habitat destruction, pollution, climate change, and loss of biodiversity. This is due to accelerated human activities of the Anthropocene era we live in, often characterized as a time of rapid population growth, economic growth and technological advancements, which also translates into increased wasteful consumerist processes. Furthermore, the speed of the mentioned processes is changing rapidly, leaving us with little time to react to this global issue of rethinking production to consumption processes and waste they produce.

One can say that the cities have become the centre of flows and exchanges; including material, informational, energy, ecological, human etc. How can architecture contribute to bettering of these networks that would lead to consuming more consciously, to enable necessary economic, environmental and social transformations to happen?

Most of the mentioned systems function linear, following the strict path of production – consumption – waste; which is a characteristic of our consumer society produced by the capitalist practices. On a global level, there is a wish to shift to a more circular way of thinking, but for this to happen, we would have to rethink our deep-rooted production, consumption and disposal practices.

To explore the notions of sustainability (material, construction, system, program, social, cultural, etc.) within the city, this project is focusing on textile (waste) flows. The textile and apparel industry are one of the leading sectors in the production of pollutants at global scale. Textile waste makes for 5% of the waste generated globally and its waste stream is one of the fastest growing in the world. It contributes greatly to the processes of chemical pollution (coming from chemicals for dyeing, bleaching, and processing fabrics), water consumption and pollution (the production is water intensive and waste waters are often discharged into rivers and streams), energy consumption and greenhouse gas emissions (the industry is energy intensive, especially during processes like dyeing and finishing) and waste production. According to data analysis, the textile industry is responsible for 10% of global carbon emissions and it is estimated that it discharges around 20% of global wastewater. Furthermore, around 92 million tons of textile waste ends up on landfills every year. Specifically for Madrid, 128.74 tons of textile waste was generated in 2021. and 90% of that ended up on the landfills (El Mundo, 2023). Therefore, due to textile industry's widespread presence and direct physical impact, exploring concepts of sustainability through the framework of textile offers relevant findings.

Although architecture cannot overwrite waste stream policies and disposal practices, can it help incubate the idea of more sustainable material flows in the cities?

Methodological framework

In order to better understand the complexity of waste flow system, its areas of influence and the role that architecture plays within it, the research is conducted in two scales (macro and micro).

On a macro scale, I analyse data and policies relevant for textile material flows in relation to Madrid. These relations are selectively mapped, referring to Bruno Latour's actor-network theory, where he emphasizes the role of both human and non-human entities in shaping social phenomena (Latour, 2005); as well as theory of epigenetic territory, meaning that every site is understood as a 'palimpsest of forces' (Sheppard, 2013), considering forces operating remotely. The selective mapping helps understand the complex systems network within textile production / distribution / consumption. These findings are supported by information gathered through relevant literature analysis touching upon theory of matter, discard studies, waste practices, fast – fashion and manufacturing practices.

On a micro scale, I focus on tracking the network of textile flows and actors, referring to actor-network theory. To deeper understand the influences different parties of interest have on each other and the material flows, I refer to future city development and urbanistic plans and existing ones, which leads to potential areas of interest. Moreover, I make a photo diary on a field trip to Madrid documenting relationships between people and matter (textile), which can be seen as a reflection on the current system and inspiration for rethinking the future of it.

The methodology described above leads to an in-depth understanding and analysis of the textile (waste) networks and its areas of influence. With it, I can notice disruptions in the system that require attention and possible intervention areas. It also opened up a path to new opportunities for discussing different takes on sustainability.

Overview

This essay is a part a of graduation studio, and it serves as a basis for the following design phase of the project. The aim of this essay and research is to understand (by selective mapping, matrix analysis and literature studies) textile material (waste) flows and disruptions in the system; which are a first step towards imagining the alternative. Can architecture act as an incubator of change, embodying the idea of creating more attentive relationship between humans and matter by rethinking the textile waste flow?

The essay is further organised into three sections. The first one introduces the main topics that motivate my research and is titled 'material (waste) flow'. Here I dive into the consuming culture and waste practices in general and explain the methodology applied in research. In the last paragraph I focus on Madrid situated research. The text is

supported by systems approach based selective mapping of material flows. The next chapter discusses the most important topics in the idea of 'closing the loop' and emphasizes its position within design realm. First, I focus on expanding on the idea of urban manufacturing, which is a backbone of the project. Furthermore, the topic of sustainability is discussed through notions of material, system and culture; further explored through the notion of 'textility' and its translation into architecture, supported by precedents analysis. The essay ends with conclusion where I reflect on the discussion and highlight the insights that are relevant for the further design process.

MATERIAL (WASTE) FLOW

The notion of waste

Waste, as a byproduct of dynamic processes and conditions, can be analysed through diverse lenses like economic, political, environmental, and potentially many more. Crucial in addressing the waste issue is grasping not only the notion of waste, but also the system of ecologies it operates within. Thompson (2017) says: "Discards do not become 'rubbish' until social processes and practices conspire to remove them from circulation and consideration." Following this observation, one could say that waste is nothing, but a social construct produced by various systems that assign value and power of things. In line with Mary Douglas's statement, that waste is not an inherent quality of an object, rather it is merely a product of social classification systems. "Where there is dirt, there is system," she says (Till, 2009).

Furthermore, Liboiron & Lepawsky (2022) highlight a crucial point in the environmental movement on how 'waste' has become synonymous with 'household waste', therefore directing the action towards the consumers and their behaviour. While this perspective is significant, it is important not to lose the broader scope of waste system, its generation and management. Looking specifically into textile, its consumption rate is growing rapidly. Corrigan (1997) states that clothing is one of the key areas of consumption and that consumers choice can have a vast impact on the system. However, Brooks (2021) argues that solely individual consumer adjustments, such as consuming ethically, will not lead to a desired change. This approach is definitely not insignificant, but in order to actually make a change, we should look beyond consumption, into producing / transporting / consuming patterns. We should consume differently and reflectively with awareness; which presents a challenge since disposability, usually not an innate human practice, has become so familiar that it seems natural. Furthermore, it is not just about reducing consumption, but rethinking the role consuming plays in our lives and making a shift in our consumption mentality.

Understanding waste and its ecology requires an understanding of the intricate systems it is part of as well, which will be discussed in the following paragraph.

Waste system

Liboiron & Lepawsky (2022) emphasize the growing focus on waste and value by various actors, highlighting the importance of contextualizing the problems, materialities and systems of discard, so we can address the broader context of problems and their origins rather than just deal with symptoms. They suggest that if waste is an integral part of the working system, then we should not work towards eliminating it, but altering the waste. Having said that, to successfully tackle a problem, I believe it is crucial to comprehend not only the global system, but as well to examine closely the specific operational system to fully grasp its complexity and potential of change. It makes it hard, the

fact that waste networks and infrastructure have traditionally been designed to operate invisibly, without or with as little public presence as possible, also being beyond the scope of architectural and environmental designers (Ghosn & Jazairy, 2015). In addition, most solid waste systems rely on hinterland to keep the centre clean (Liboiron & Lepawsky, 2022), this division then creates centre and periphery, and supports the thought 'out of sight, out of mind'.

The current industrial infrastructure is linear, as McDonough & Braungart (2009) point out, it prioritizes efficient production and rapid distribution to consumers. One can say that there has been no space in industrial design agenda for the health and awareness of natural systems. Such existing economic and industrial systems have led to environmental and societal damages, says Hill (2020). Is it possible to transition to regenerative ones that enhance well-being, lead to more resilient and sustainable cities?

Manufacturing can be viewed as one of the critical components of circular economy infrastructure, along with related activities of production and care system, such as repair, recycle and reuse. Hill (2020) also draws attention to vast network of other activities that come with manufacturing, but little is known of them; such as training, logistics, design and engineering, etc. These are the vital areas to explore if we want to make a fundamental change in the way we consume. He advocates for replacing those systems with innovative, circular energy promoting, regenerative ones, rather than the current 'take, make, waste' linear system.

Furthermore, Bélanger & Williams (2016) argue that this shift in perspective towards circular thinking has stimulated numbers of developments in the post-industrial economy, focusing on waste dematerialization, brownfields utilization, and urban ecologies generation; as a result of merging of economic and ecological needs toward closing the material loop.

Liboiron & Lepawsky (2022) propose reevaluating and altering discarding by asking, "How do you discard well given specific contexts, materialities, and power relations?" To explore this, the next chapter will delve into actor-network relations and mapping the flow of textile waste in Madrid, aiming to identify systemic disruptions and potential interventions in the system, which leads to potential site and agenda.

Waste practices in Madrid / mapping the textile waste flow

To better my comprehension of waste practices and flows within the urban context of Madrid, next to relevant literature and data analysis, I incorporate what Furlan (2020) would refer to as Material Flow Analysis. This methodology involves evaluating flows of materials within specific geographical boundaries, considering both quantitative and qualitative values of material. By conceptualizing city as a living organism, this part of the research links activities, actors and locations within the urban framework, carefully considering possible influences on material flow, such as environment, politics, and society.

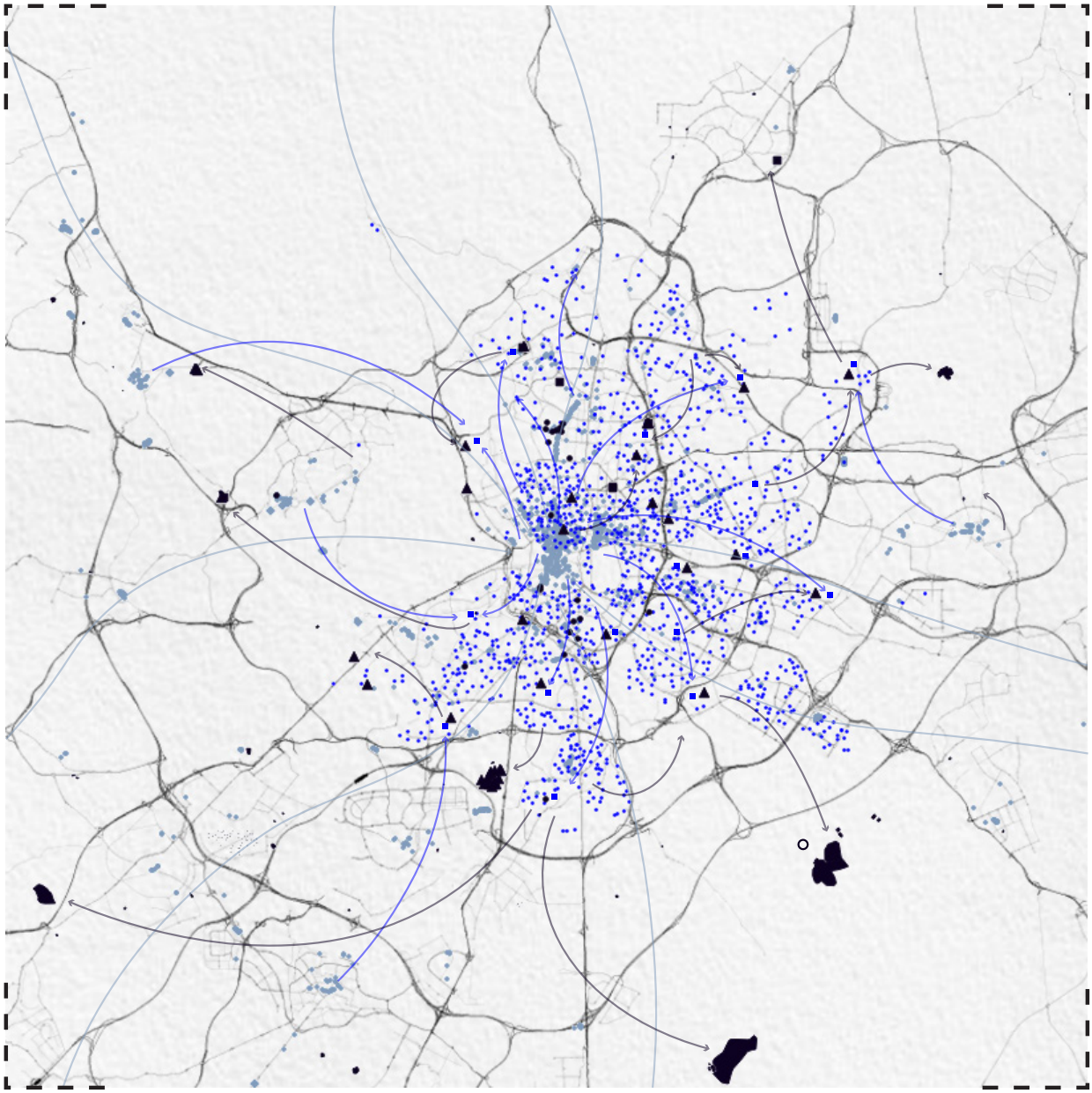
Currently, Madrid actively promotes reusing and recycling of textiles,

among other waste types, through the framework of Sustainable Management Strategy for Waste (2017 - 2024) from the Community of Madrid. Additionally, the city's 'Madrid 360' sustainability plan is an initiative aiming to combat climate change in the city. The mentioned document, which offers current analysis and outlines future sustainability strategies, includes a section on waste management. It promotes waste prevention, improving selective collection, increasing recycling rates, improving treatment technologies and reducing overall emissions. However, a 2023 article in El Mundo highlights the complexities of textile waste issue in Madrid, suggesting that the problem is more severe than people comprehend. The article points out the problems within the collection, transportation and management of textile waste, which with further analysis and mapping turns out to be the case.

Despite city's considerable number of textile waste containers, with the plan of introducing even more, along with recycling facilities on the outskirts of the city processing this type of waste; the growing issue of textile waste is still present. One can view textile containers as a 'last resort' in waste handling; and even then, it is just the initial point of the textile waste management system. Beyond the textile container, the system faces many organisational, technological, and working downfalls. First, while the city of Madrid is responsible for the management of most waste types, it holds competitions for non-governmental organisations to get a share in textile waste management. This approach leads to discrepancies in the organisational framework, as various entities participate in different stages of waste management, often not having the same values and interests. As a result, the system sometimes lacks transparency and consistency. Mentioned and safety issues can cause public mistrust regarding the disposal of textile in a 'sustainable' way, because one can never be sure where the disposed textile is going to end up.

The map and diagram on the next page illustrate the intricate network and main actors involved in textile waste management. The city of Madrid mostly depends on imported textile goods expanding the network to global level. One can see that according to data analysis, most of the textile is imported from countries such as China, Turkey, Bangladesh, Marocco and Italy. Prior to arriving to retail clothing or tailor shops, these goods are typically stored in warehouses located on the outskirts of the city, to where they are probably transported by trucks, after they arrive to the country by boat or a train. Once these goods are distributed and used and no longer needed by their consumers, the truth is that they are most likely to be discarded in the regular trash bins and eventually end up on landfills. According to data from Humana, one of the leading organisations in textile waste management sector in the community of Madrid, only around 10% of textile is deposited in designated textile containers to be further sorted.

Currently, Madrid has more than 1200 textile containers all over the city, as well as 16 recycling yards, offering residents accessible options for textile disposing. Following the collection from the containers, these textiles are then transported to the sorting facility. After sorting, approximately 19% is sent to second-hand stores, 33% is shipped to the recycling centres, 9% is processed at waste treatment facilities, 8.5% is sent to waste-to-energy plants and 8% is categorized as banal waste, that is further dispatched to the landfills around the city or further. Remarkably, 40% is exported, mostly to markets in Africa.



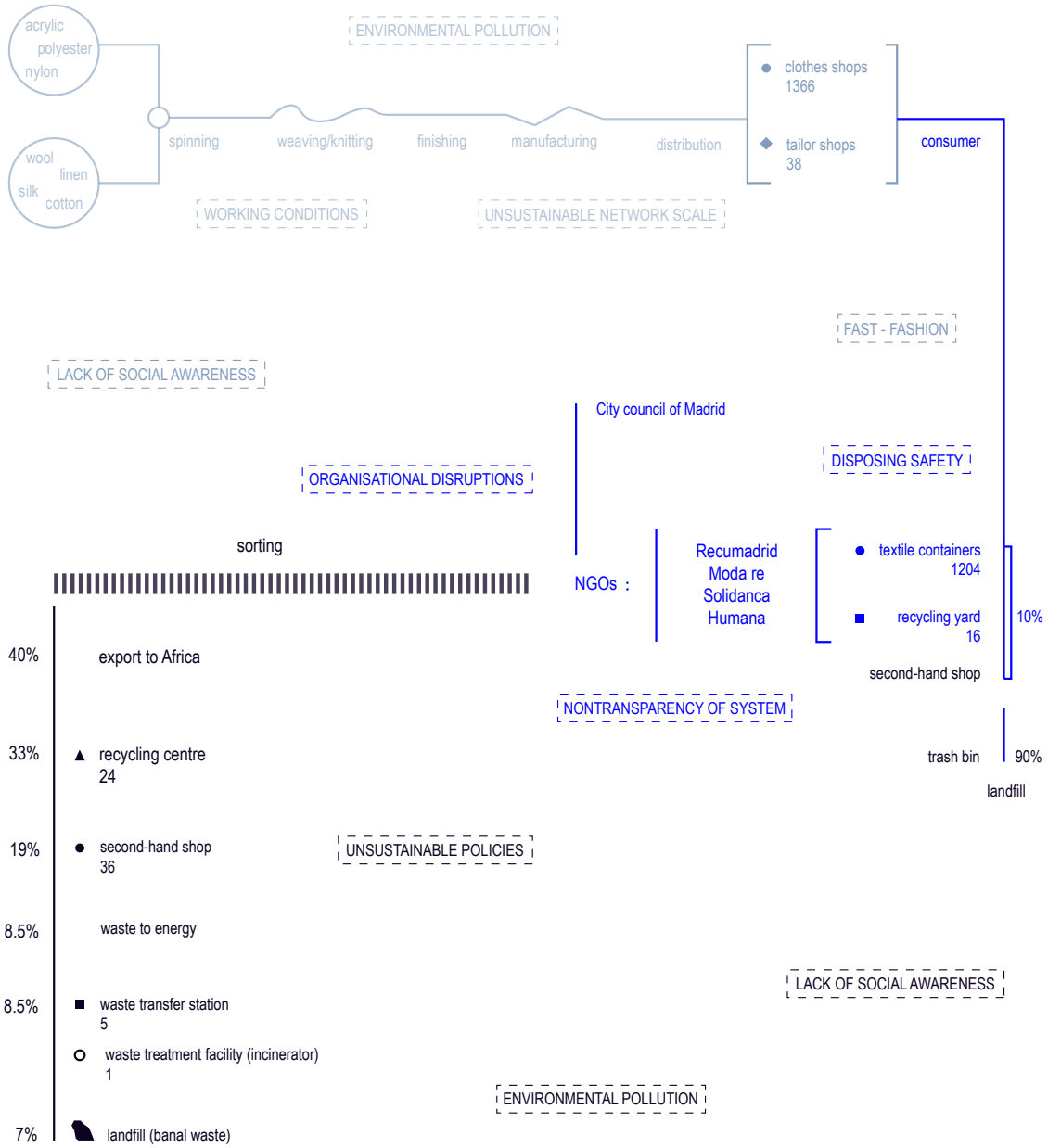


Figure 3

Madrid textile (waste) material flow map and diagram

Figure 4 (left)

Promotion of 'Madrid 360' sustainability plan

Figure 5 (right)

Textile disposal containers within the city

Figure 6 (left)

Humana warehouse

Figure 7 (right)

Textile disposal containers within second-hand shops

The conclusion of mapping the textile (waste) flow and analysing the processes and actors involved, is that there are numerous issues throughout the stages of production / transportation / disposal that compromise the sustainability of the system. These issues significantly affect the amount and severity of waste produced. Some of the key issues include environmental pollution, bad working conditions, unsustainable network scale, fast fashion, disposing safety, nontransparency of the system, organisational disruption, unsustainable policies and lack of social awareness. Upon a thorough research of the practices adopted by textile recycling entities in Madrid, such as Moda re, Recumadrid, and Humana, followed by a visit to the Humana headquarters, it is evident that textiles collected in designated bins are being dealt with. A fraction of these textiles is recycled, while the rest undergoes alternative disposal methods, which may not fully be in line with sustainable practices. Additionally, the popularity of second-hand stores, particularly among young people in Madrid, is noteworthy. However, it is crucial to acknowledge that strategies focusing solely on the recycling or end-of-life management of textiles fail to address the broader environmental implications of the issue. While architecture cannot directly

influence waste management strategies and policies that are in effect, it has a potential to act as an incubator of a certain idea. In this case, to make a systemic change and disrupt the system, after a thorough analysis, the conclusion is that we should focus not solely on the end waste product, but on the initial stages of the system. Focusing solely on sustainable waste management and efficiency will not have the needed effect on our making and consuming habits, which are crucial in the process of making a change. For this reason, this project seeks to explore new ways of making and (re)introducing urban manufacturing into the city, including experts, researchers and the community in the process. It also dives into exploring sustainability through various lenses; material, program and cultural; as a basis for further design research. These aspects will be further elaborated in the next chapter.

Overview

In order to make a change, we should look beyond the byproducts of the system, into the system itself, in this case textile manufacturing. Improving how we manage material (waste) flows is important, but the path towards a sustainable and resilient future is emphasizing the integration, not the dichotomy of industry and environment; by reimagining the role that manufacturing plays within the city. This approach calls for a collaboration of policymakers, industry leaders and communities that would participate in building this manufacturing ecosystem that becomes innovative, inclusive and sustainable. As we step into the era of urban manufacturing, city of Madrid has potential to integrate such approach into the city fabric. Integration of urban manufacturing is not just about altering production processes, but also redefining our relationship with the goods we consume and the space we inhabit. For this reason, it is important to create spaces in the city for researchers, professionals, craftsman and community to come together and benefit from the shared and newly produced knowledge. Such spaces should be easily approachable and transparent within the existing social context that it could benefit from. While architecture cannot directly influence the policies or processes, it can serve as the breeding ground of the idea of sustainable production and research that allows for new knowledge generation.

CLOSING THE LOOP

Urban manufacturing reimagined

We commonly view industry and the environment as conflicting, due to traditional industrial practices of extraction, production and disposal being destructive to natural ecosystems. On the other hand, industry often views environmentalism as an obstacle to its operations and expansion (McDonough & Braungart, 2009). Due to 'cradle-to-grave' principle that dominates modern manufacturing, it seems that these two systems (industry and environment) cannot thrive simultaneously. According to Hill (2020), most of the European cities experienced remarkable development in the late 19th and early 20th century, largely benefiting from manufacturing. However, by the second half of 20th century, the paradigm shifted. The manufacturing industry did not fit in the urban city plan within the global economy anymore. Majority of cities shifted to service-oriented economies, while importing the goods from all over the world. Madrid followed this trend as well. Even though it was never a big industrial city, by the end of 20th century, the city's economy was diversified, relying mostly on service sectors, finance and technology.

This transition presented a significant shift in urban dynamics. Although cities once produced huge amount of goods, little was known about the intricate relationship and dependency of urban manufacturing and the city, as well as the interaction and network of makers, designers, retailers, and researchers. McDonough & Braungart (2009) criticize the intentions behind such system, which is solely to make an affordable product that performs and lasts long enough that it would meet the regulations. Even though such products sometimes fulfil the expectations, they are not designed for human and ecological benefit and health, which is crucial aspect in contemporary society.
Re(introducing) urban manufacturing into the cities would be a great way to address these challenges and a great step in systematically tackling the textile waste flow issue. The idea is to transition from the mass production of goods characterized by low wages and poor working conditions, great environmental pollution contribution and unsustainable scale, to local production benefiting and supporting the community and thriving economy that has a regenerative relationship with the environment.

Hill (2020) argues that reintroducing urban manufacturing could fulfil following four needs. Firstly, it would generate local work and products development, which is a base of thriving economy. Secondly, embracing hight tech small scale manufacturing is a basis for stimulating environment which promotes innovation. Thirdly, adopting more efficient technology that can be repaired or improved would address the sustainable ways of making. And lastly, manufacturing would provide diversity of work conditions and accessible opportunities. Such innovative manufacturing model, combining product design and service leads to minimizing low value resource consumption and waste.

The Textiel Museum in Tilburg serves as a pivotal case study for my project, illustrating the successful reintegration of manufacturing into the urban fabric. Located in a repurposed textile factory, this dynamic space brings together exhibitions in design and art with educational

programs, ateliers, textile labs, a library, and material collections. Part of the museum, the TextielLab, operates as a specialized workshop and open studio dedicated to the production of experimental knits and woven fabrics. This lab facilitates a collaborative environment where designers, architects, artists, and students interact with technical experts and product developers, deepening their understanding of fabrics, computer-controlled techniques, and fabric production. Furthermore, the museum's extensive library, its collection, and the rotating exhibitions serve as resource for research and inspiration. This museum is a great example of the potential of urban manufacturing to stimulate a vibrant community of experts, researchers, craftsmen, and artists, while also engaging the wider community. This engagement creates a fertile ground for research, innovation, and development. The project emphasizes the importance of not only focusing on technology and manufacturing but also arts, crafts, and community involvement for sustainable production and innovation.

Key factors contributing to the success of this project that should be considered in reintroducing manufacturing projects include:

- The careful consideration of the historical and urban context in reclamation of abandoned and underused space.
- Its proximity to existing social infrastructure, enhancing community engagement.
- Accessibility via various modes of transport.
- The implementation of a variety of programs that attract different groups of people, fostering unique opportunities for collaboration.

This approach in design demonstrates how manufacturing can be successfully reintegrated into the urban life, highlighting the importance of interdisciplinary collaboration in driving sustainable innovation.

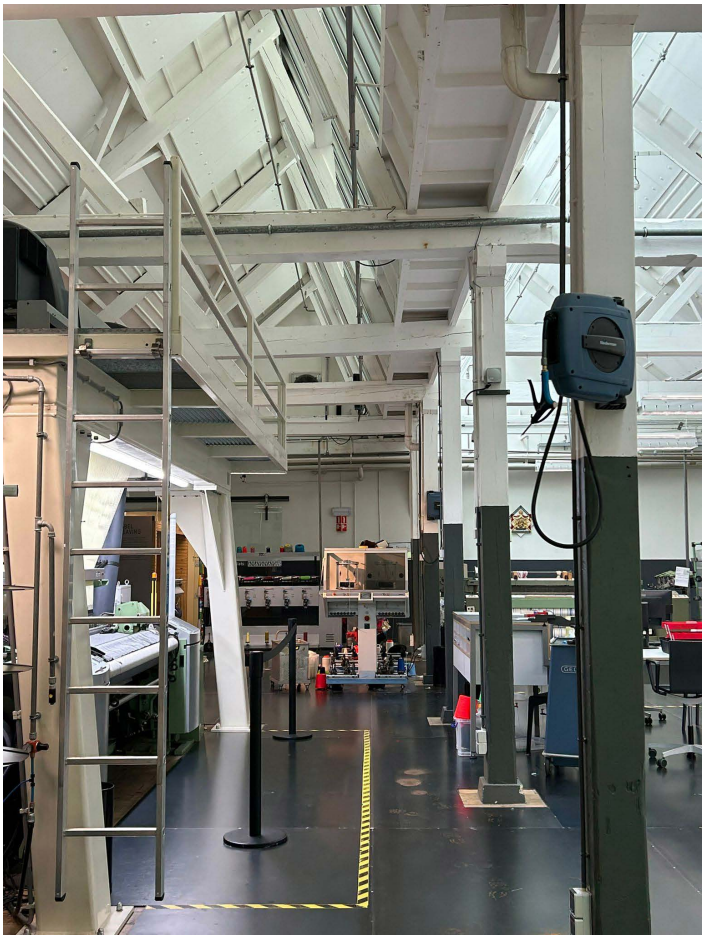


Figure 8

Textile Lab in Textile Museum Tilburg

Introducing urban manufacturing back into Madrid, starting with the textile industry, represents a starting point towards a more resilient and sustainable future. This approach could naturally extend into other sectors, such as furniture textiles, medical textiles, and even textile-based building materials; potentially even beyond the topic of textiles in the future. My research gravitated towards textiles due to their tangible presence in daily life, making this medium an ideal starting point for reintegrating manufacturing processes within the city. Considering textiles do not only have a functional, but also cultural and social significance; it becomes an area where except from professionals and researcher, makers and community could be involved through various events, workshops and knowledge exchange, making it easier to integrate within the existing urban fabric. Furthermore, this integration could also act as a catalyst for cross-industry synergies, including the waste management one, renewable energy (sustainable water and power networks), and tech startups. There is even a possibility to collaborate with existing institutions and networks such as The Royal Tapestry Factory, the Garment Museum and the existing vibrant ecosystem of second-hand shops and tailors in the area. In this way, urban textile manufacturing could act as a starting point for a wide range of manufacturing initiatives, which would enrich the community and pave a way for a more sustainable future.

Figure 9 (left)

Design lab in Textile Museum Tilburg

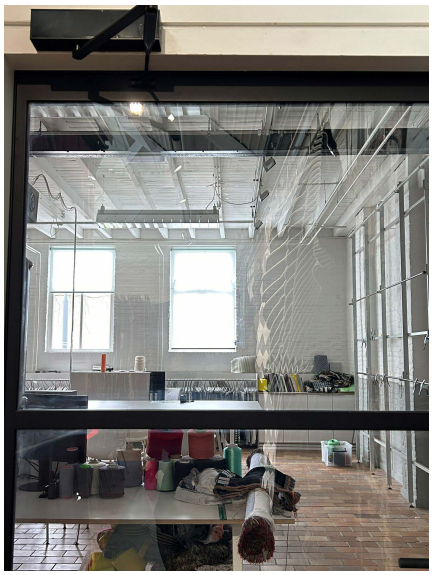


Figure 10 (right)

Textile lab in Textile Museum Tilburg

Figure 11 (left)

Sample studio in Textile Museum Tilburg

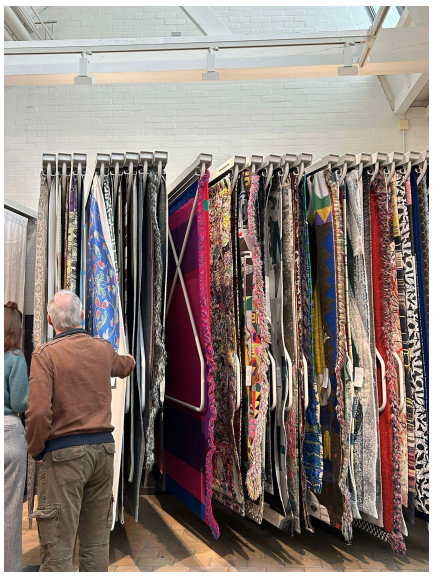
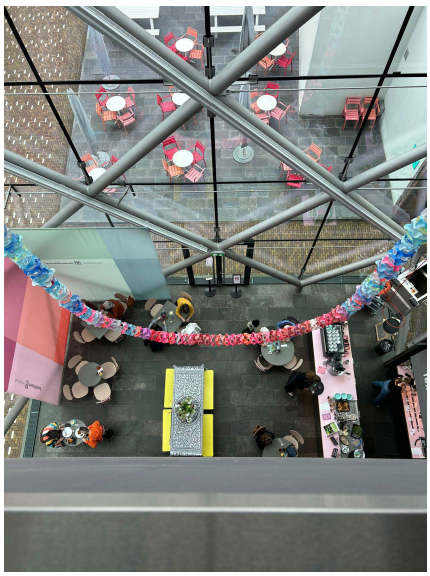


Figure 12 (right)

Cafeteria in Textile Museum Tilburg



Beyond sustainability

When tackling topics such as textile waste and urban manufacturing, one must also reflect on the omnipresent idea of sustainability. Within this project, my aim is to look beyond sustainability in addressing the complex challenge of rethinking textile material production and flows. Nowadays, the term 'sustainability' has become a common feature of many organisations agendas across various sectors. However, thinking of sustainability in terms of recycling and re-using is becoming an almost outdated principle for tackling the vastness of this issue. The goal of this research is to surpass the limited understanding of the notion of 'sustainability', going beyond the consideration of waste as an end product, instead focusing on the production system which enables grasping the possibilities for introducing a relevant change.

Sustainability can be expressed through various parameters. Considering the topic and scope of my research, I thought it would be important to understand what kind of sustainability there is, on which I should reflect in my design process. I broadly divided these sustainability notions into: material / construction, system / program and cultural / historical, but keeping in mind they cannot be viewed separately and they always influence each other. I describe them as following:

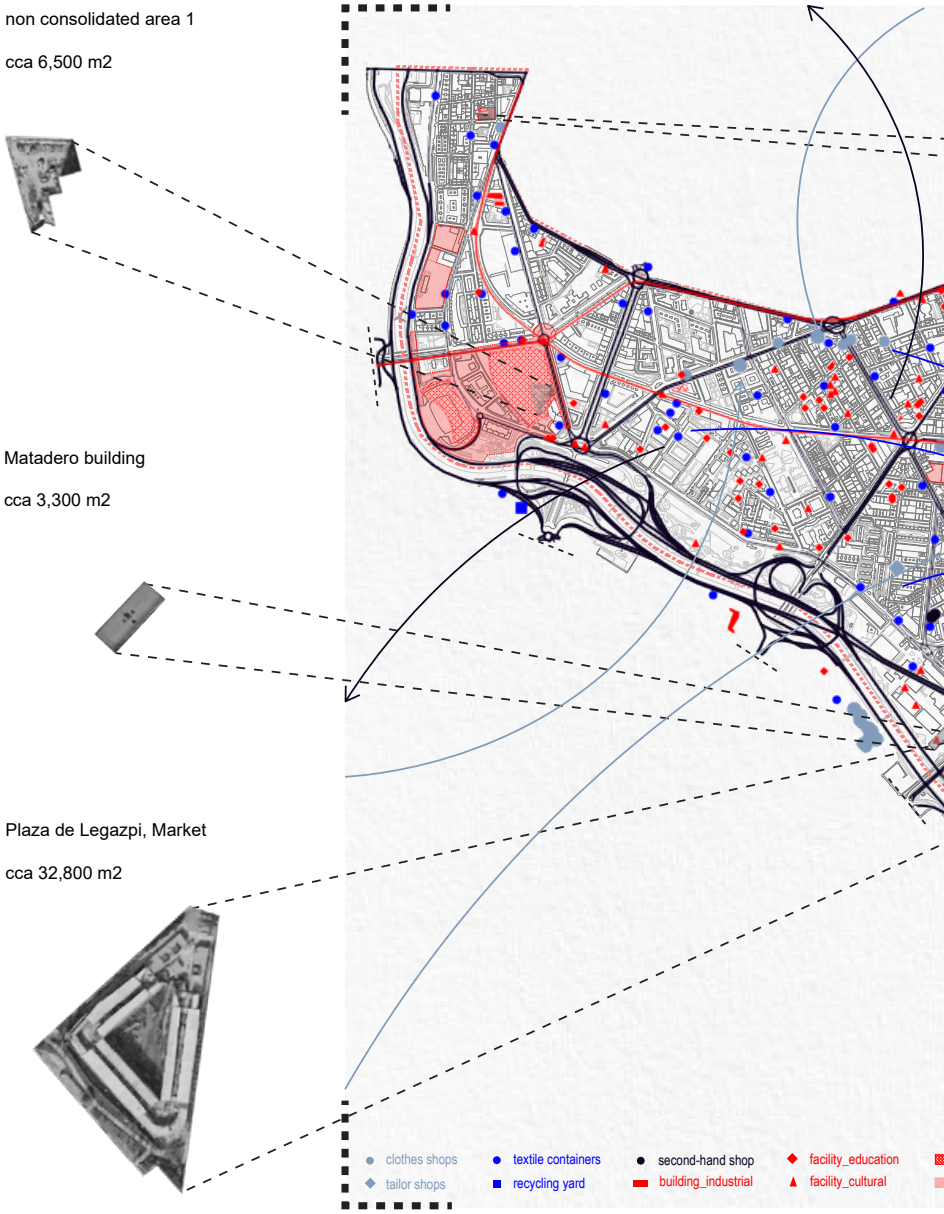
- Material / construction sustainability means using logical materials (durable and/or recyclable); considering energy that is used in the production, transportation, and construction process of the materials. It should also focus on using construction technologies that minimize waste, pollution and energy consumption.
- System / program sustainability focuses on creating energy-efficient buildings that incorporate sustainable systems reflecting the context. Moreover, great focus is also sustainable planning and designing of spaces that can evolve over time to meet changing needs, which either extends building's lifecycle or allows for flexibility.
- Social / cultural sustainability focuses on considering the building's impact on community and environment. The building should improve the quality of life for its occupants and surrounding community, by reflecting on cultural and historical context of the location.

Because of the nature of the project, focus of my research and design is within material / construction sustainability framework. And this notion is explored through the concept of 'textility' on a spatial and material scale, by analysing various architectural precedents. 'Textility' is thought of as a main conceptual thread of the project and in a more abstract sense, it could refer to the interconnectedness of various elements within a system, representing the metaphorical idea of weaving threads to create a fabric. This concept could be applied to describe the complexity within ecosystems, communities, programs, spaces or any system where different elements come together to form a whole. It is important to note not to understand the notion of 'textility' in its literal translation, but a metaphorical one.

In his article The Textility of Making, Ingold (2010) argues that making is a practice of weaving, shaped by dynamic force fields and material flows, allowing practitioners to tie their own lines of material flows that make up the material world. He critiques the separation of design and fabrication, saying it leads to environment devoid of natural flow. Furthermore, Bennett (2010) talks about liveliness of matter, challenging

the conventional division between inert matter and vibrant life. Emphasizing that this leads us to ignoring inherent vitality of matter and lively powers of the material forms. Given the focus on my research on textile waste and its flows, the concept of 'textility' and exploring materiality becomes crucial. Ingold said: 'As practitioners, the builder, the gardener, the cook, the alchemist and the painter are not so much imposing form on matter as bringing together diverse materials and combining or redirecting their flow in the anticipation of what might emerge.'

The concept of 'textility' is explored through various scales as mentioned, one of them being the scale of the former industrial district of Arganzuela where the chosen site is located. This district, comprised of



7 neighbourhoods, lies south of Madrid's historic city centre and north of the Manzanares river. It went through significant expansion during the industrial revolution, fostered by its proximity of the river and former Delicias train station, which ended up being the project's site location. This historically facilitated the integration of manufacturing into the city's fabric. Today, this is an area characterized by the remains of industry and diverse community; yet it has great potential to become an area that fosters sustainable change, considering it is already starting to transform into a more vibrant community, focusing on introducing the startup ecosystem and bettering the social infrastructure. Given its near central location and suitability for manufacturing activities, it has a great potential for the reintroduction of urban manufacturing.

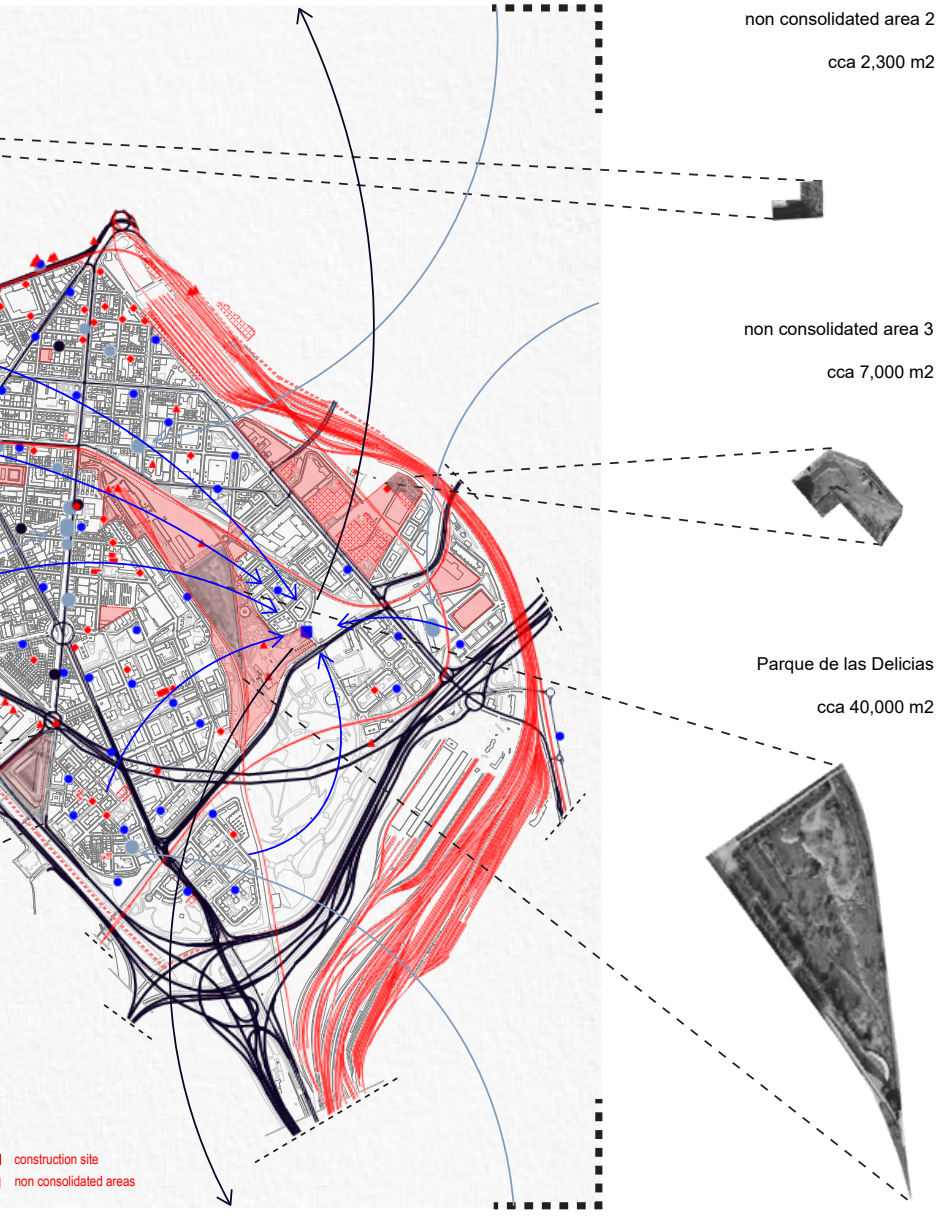


Figure 13

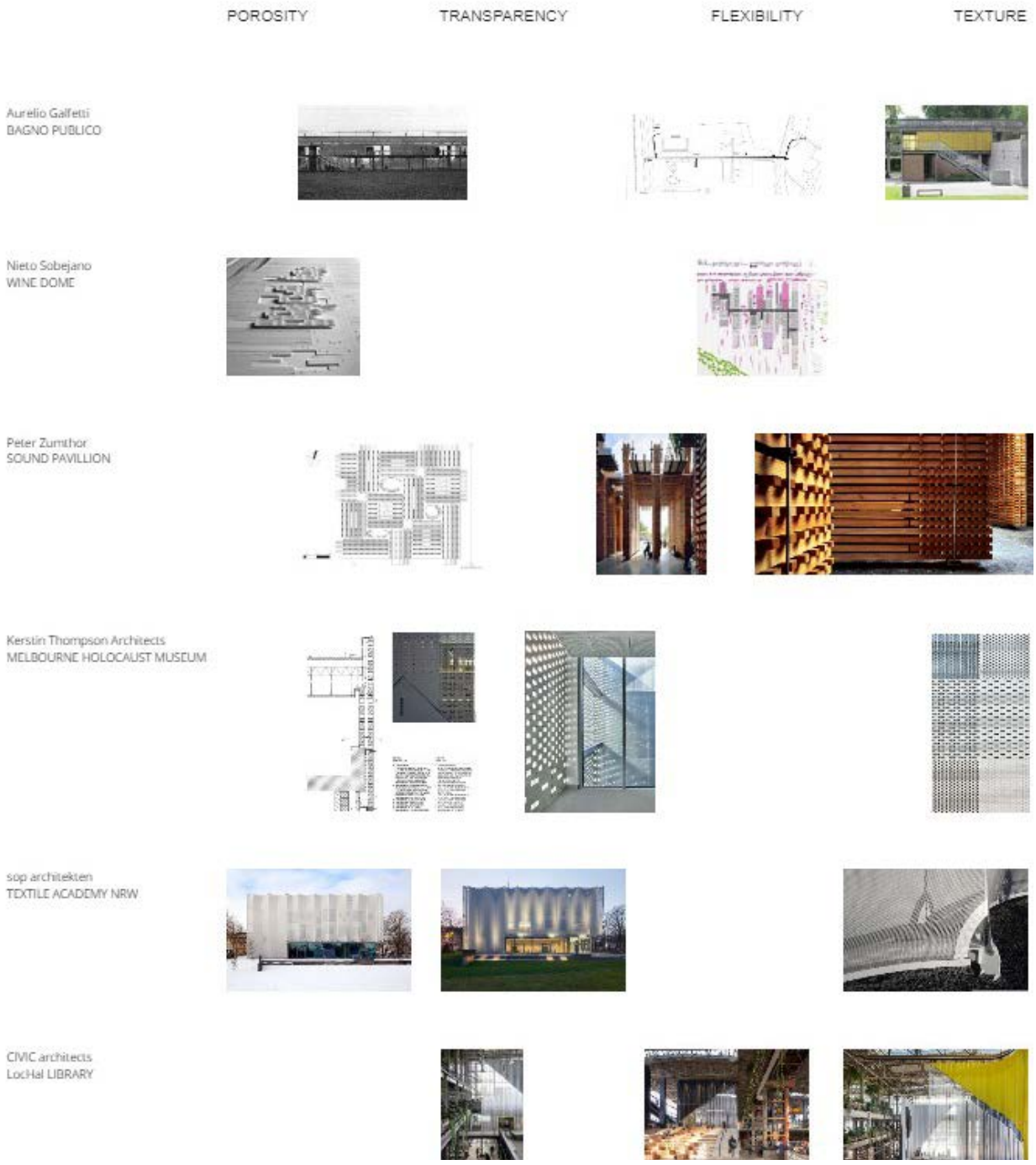
Arganzuela textile flow map

Figure 13 illustrates the textile (waste) flow within that area, further investigating the feasibility of integrating manufacturing processes. The area is currently characterized by many construction sites and non-consolidated areas, which were mapped together with the existing infrastructure of textile shops, disposal areas, recycling yards and existing cultural and educational facilities, to reveal potential areas of intervention that offer conditions where manufacturing could be weaved in the existing conditions. The Delicias station site was chosen, reflecting on the key factors of successful integration of manufacturing in Tilbrug, due to the infrastructure connections, proximity of existing social infrastructure and site conditions.

Figure 14

Precedents matrix

Furthermore, the following matrix of precedents explores the concept of 'textility' through notions of porosity, transparency, flexibility and porosity; all qualities of 'textility'.



The matrix in Figure 14 explores the notion of 'textility' in various architectural precedents which further inform the design project. It focuses on qualities such as porosity, transparency, flexibility and texture, which are all characteristics of literal or metaphorical concept of 'textility', to explore the notion of sustainability. While many projects were looked into, above ones are chosen to represent the qualities the project strives for.

Aurelio Galfetti's public swimming pool emerges as a concrete structure that not only shapes the landscape, but also organizes the surrounding area, connecting the town Bellinzona to the adjacent river. This concrete structure serves as a pathway, with an underlying metal structure that hosts different public functions. The metal structure allows for adaptability of the program, almost functioning as an add on system to the permanent concrete pathway. The lightness of the public structure, the metal, brick and glass, opposes to the heaviness of the permanent concrete structure. This juxtaposition of light and heavy materials, integration of public space, almost waving of this space into the landscape, serves as inspiration for the project.

On that note, Nieto Sobejano's wine dome is interesting and inspiring for its linear program development. The lines of program are in its core anchored by the main pedestrian pathway which fosters both visual and physical connection from one end to the other. This layout conceptually supports potential expansion, adapting to evolving needs. The building's dynamic interaction with the terrain, introduces a playful dialogue with the environment.

Going to the scale of the structure, Peter Zumthor's sound pavilion creates almost a labyrinth of different spaces by manipulating wooden wall elements and placing it in different relations. This project exemplifies the concept of 'textility' even on a small scale, from the wooden fibrous composition to beam connections, and then wall assembly. It highlights wood's tactile nature and the capacity to manipulate atmosphere, light and movement.

Another project, Kerstin Thompson Archtiects's Melbourne Holocaust Museum, stands out with its innovative brick façade, which not only facilitates natural ventilation, crucial in such a hot climate, but also transitions from a perception of heaviness to lightness of brick, by employing different patterns. It is interesting how a heavy and tactile material such as brick can in moments become light, porous and almost transparent.

Sop architekten also play with the notion of transparency in their project for textile academy NRW, where they implement a tensile textile façade system by adding a dynamic layer around the building. This allows for better climate regulation of the building, but also plays with the perception of building during the day and night, allowing us to perceive the building differently at times. Here, the notion of 'textility' is taken quite literally, exploring new ways of using textiles in architecture.

LocHal library in Tilburg is another example of innovative use of textiles. This building is a reinterpretation of an old building within its existing structure. The use of large textile curtains, developed in collaboration with the Textiel Museum Tilburg, allows for flexible partitioning of spaces to meet library's diverse needs. This highlights the potential of textiles to redefine space within architectural design.

In summary, these project illustrate parts of the concept of 'textility' in architecture, how materiality, structure and design can come together to create sustainable spaces and are an inspiration in my design process.

Overview

In conclusion, there is an existing complex relationship between manufacturing and sustainability that challenges traditional perceptions on the topic and calls for a harmonious integration of industry within the cities. By rethinking historical shifts from manufacturing to service-based economy, there is a potential for cities to reclaim their productive roles, by creating environment where industry and sustainability can thrive together. The Textiel Museum in Tilburg is a great example of such synergy, showing how manufacturing can stimulate innovation and community engagement. Conducted research on material flows and sustainability concepts, illustrates the potential for integrating manufacturing processes within the city fabric. It is important also to highlight the necessity of emphasizing sustainability that goes beyond mere recycling, to embrace an approach that encompasses material, systemic and cultural dimensions. Looking through the lens od 'textility', this chapter advocates for manufacturing as a basis of sustainable development, weaving the threads of innovation, community and environment to create a resilient urban future.

In the context of the city of Madrid, as mentioned, special area of interest for such an intervention is a former industrial district of Arganzuela. With its diversified economy and remains of industry, it is a perfect location for experiment of trying to implement manufacturing back into the city. It is an area of diverse community, existing social infrastructure and thriving startup ecosystem, close to the city centre, but also close to all major infrastructures. Located within the district is a chosen site for the project, on basis of parameters such as existing infrastructure, social infrastructure and size. The site is located on a former railway station Delicias, divided in half by the pedestrian ramp connecting the two sides of the railway. The northern side of the site is mostly in use, the former railway buildings were transformed into a railway museum and sports facilities. The southern side of the site is not in use, fenced space with some remains of industrial activities such as railway tracks traces and two old water towers. This project is a great opportunity for reintegrating and 'recycling' this space into the community by weaving in the program to the north and south part of the site and opening up to neighbourhood, allowing spaces for innovation, but also for the existing community.

Figure 15

Site picture from the south

Figure 16

Site picture from the north

CONCLUSION

Instead of trying to eliminate textile (waste) production, we should work on trying to alter the production process. In this research, I have tried to unravel the intricate dynamics of material (waste) flows, urban manufacturing and the overarching theme of sustainability within architectural realm. This exploration led me to question and challenge the conventional relationship between manufacturing processes and sustainability, recognizing that the issue of textile (waste) flows surpasses mere material disposal and touches upon material, social and infrastructural dimensions. Through comprehensive exploration of textile waste flows and sustainability frameworks, this research concludes with the potential of urban cities, like Madrid, to reclaim their production practices, working towards transforming traditional material cycles and closing the material loop.

This approach calls for more than just waste mitigation, it requires a fundamental revaluation of our interaction with materials, production and the built environment, transitioning from linear waste systems to regenerative cycles. Although altering waste policies and practices is a gradual process, architecture can serve as a potential catalyst of the change, an incubator of such an idea, embodying the principles of sustainable production. By rethinking the flows of material and embracing the interconnectedness of systems, communities and environment, architecture can pave the way for a more resilient and sustainable future.

Through the lens of 'textility' this research explores integration of manufacturing within the city, architecture fabric within site and 'weaving' the program into the building design, by redefining the material usage and creating logical system flows. The aim is to create an environment that not only showcases sustainable practices, but also serves as a platform for textile professionals and researchers, craftsman and the community; creating a space of mutual learning and knowledge exchange, making the production processes transparent and integrated into community's fabric.

Considering the industrial history and context of the site, it offers the opportunity to reimagine the underutilized area, by transforming it into an innovation hub. By highlighting transparency and sustainability in production, the project aims to transform the space, by converting the neglected area into a vibrant and engaging environment, also contributing to neighbourhoods economy; which is a significant step towards a more resilient urban future. As Hill (2020) says: 'Through stimulating innovation, manufacturing can build on established industries to develop new products, take advantage of diverse networks of designers and makers and channel innovation into dealing with local problems.' This innovation hub as the outcome of research process becomes textile innovation lab that manages to integrate light to medium manufacturing within the city of Madrid; at the same time recycling the former industrial underused site, engaging the community in the textile recycling and production process by offering engaging programs and events. It becomes a space where researchers and makers from the city can explore, learn and exchange ideas on sustainable production; and the building supports this thought by using sustainable energy flows and materials. This could potentially encourage other manufacturers and makers to form similar clusters and work towards a more circular material flow.

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3 Reflection

Architectural Design Crossovers MSc3/4: The Expanded City/Madrid is a research studio addressing the urban commons and ever-growing network systems of the city of Madrid. When choosing the studio, I was looking forward to being involved in an interdisciplinary approach with the emphasis on simultaneously responding on multiple scales. This turned out to be a good challenge for me, especially in transition between research and design phase, considering I was never until now involved in such a comprehensive project. Initially, I responded to this task by researching one of the most urgent topics, both global and local, that being the topic of waste (flows) and sustainability concepts, with emphasis on materiality. Because of time limitations and initial findings, I took textile waste as my lens of exploration, which came as a conclusion of deep city data analysis, looking into current problems and consumption and disposal trends. However, one should keep in mind that this project can be seen as a starting point of rethinking waste flows and sustainability concepts in the context of urban manufacturing in general, which is potentially a way to more resilient and sustainable cities. Having said that, research through various lenses of economics, environment and politics that was conducted and the rethinking of the concept of sustainability; and trying to implement these findings into current design process is in line with the agenda of MSc Architecture track of TU Delft.

On approach / methodology and results

Reflecting on the beginning of research phase and coming up with a method, I would say that part of the graduation process was quite fruitful. Analysing the city and the processes on a macro and micro scale allowed me to understand the complex system network within textile production / distribution / consumption and different influences on material flows. This was done mostly by selective mapping and relevant literature analysis. I have concluded what the disruptions in the textile flow and systems were and where potential areas for interventions are; which led me to focus on the whole process of the material flow, not just the end and the end product (waste). This shifted the focus of my research towards textile production and reintroducing urban manufacturing into the city.

The time before P2 was a crucial step of determining the location of the project and setting the main aims and qualities of the design. At this time, I was struggling a bit with finding the location for the project, a bit overwhelmed by the scale of the city and the idea of finding the perfect site. For me, the trip to Madrid in November was a more general, informative and explorative trip which helped me approach my research from a smaller scale and develop a focus; but it was not crucial for determining the site yet at that time. However, it helped me to focus my research on exploring the industrial district of Arganzuela, where I eventually found the site. What helped me in this process was setting up a scale of parameters or values that I thought would be crucial for the project at that moment. This process of finding the site and setting up the core values happened a bit late in relation to the P2 date, so the week of P2 and week after were used for contextualizing the research and setting up those values.

The period between P2 and P3 was a challenging one, trying to translate the values from the research process to design. The methodology suggested by the mentors including deep precedents analysis and detail focused design was a big challenge in testing my abilities; considering my conventional architecture education background, how I was taught and am used to working (scale by scale). I acknowledge this new way (for me) of working simultaneously on multiple scales to give comprehensive results, however it was difficult for me to adapt, causing confusion and struggle with the design. In the end, the idea of gathering precedents for all aspects of the project was helpful and allowed me to explore the design concepts beyond the mere notion of program. With P4 date approaching now, I could say I found my pace of working in the meantime, trying to simultaneously operate on all the scales, and a way to explore further the concept of reintroducing urban manufacturing, focusing on the idea of 'textility' and weaving. Weaving on multiple scales; weaving the manufacturing into the city tissue, the program into the building and in the end materiality. The notion of 'textility' became quite an important aspect of the project; where I pay great attention to how the building relates to the surrounding context, the flow of people and material within the building and play with the idea of 'textility' on a scale of design; it becomes a play of various materials and conditions relating to the program.

Throughout the process, all mentors have been giving insightful comments, leading me to explore some new ideas and crystalize my design agenda. Looking back, the comments from P2 about contextualising the research / design and making clear the core values of the project really helped to form a more stable design narrative. And P3 was a crucial point where mentor's relevant questions led me to rethink and focus on important aspects of the project.

Furthermore, during the graduation process, we had many interesting discussions with both tutors and students. I became familiar with new approaches to research and design. Which made me rethink my beliefs and approach to design, which of course is a never-ending process.

Conclusion

With the P4 date approaching, I am working on finalising and further elaborating on the materiality and detail of the project. I am hoping, in the end, to bring all the ideas and values together into a cohesive whole that emphasizes the main ideas of the project; which is a challenge considering the complexity of the program and interrelatedness of various design concepts. It became clear in the process that I cannot address all the questions that arise, considering the time and knowledge limitations, but I think I manage to make relevant statements in the field of architecture.

With this research and design project, the aim was to look beyond sustainability in addressing the complex challenge of rethinking textile waste systems. The findings and the project hopefully offer a relevant insight in rethinking, not just textile waste, but waste in general and manufacturing, on a global, not just Madrid scale, and highlight the importance of changing our relationship with matter. In realms of architecture and science, there is extensive research on the concepts on

waste management and sustainability. However, there is a noticeable gap in how architecture engages with the topics of waste, production and urban manufacturing. By focusing on textile, I wanted to bridge this gap by introducing greater architectural involvement and bring professional awareness on the issues.

This approach calls for more than just waste mitigation, it requires a fundamental revaluation of our interaction with materials, production and the built environment, transitioning from linear waste systems to regenerative cycles. Architecture has a potential to serve as a catalyst of the change, by embodying the principles of sustainable production; rethinking the flows of material and embracing the interconnectedness of systems, communities and environment. Therefore, considering the industrial history and context of the site, the project offers the opportunity to reimagine the underutilized area, by transforming it into an innovation hub. By highlighting transparency and sustainability in production, it represents a significant step towards a more resilient urban future.