AMS Mid City

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Research Book

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AMS Mid City

THE URBAN MANUFACTORY

CP

COMPLEX PROJECTS
DEPARTMENT OF ARCHITECTURE

2018

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RESEARCH BOOKLET | 2017

INTRODUCTION

Amsterdam has become a city predominantly focused on consumers. Makers and user are drifting away from each other, which results in environmental pressure, mental disconnection from the production process and loss of the potentialities provided by the urban environment. Recent trends allow for restoring the relationship between the production process and the city. Offshoring production is getting less favourable since production costs in developing countries are increasing. On the other hand, prices for robots replacing human labour are decreasing. Digital fabrication, such as additive manufacturing techniques and other CAD innovations bring back the essence of craftsmanship, namely, on-demand, personalized production , tailored of consumer goods with a 'batch-size-of-one', available for all. The Urban Manufactory embeds production program (again) in the urban context and enables interaction between consumer and producer. The building consists of a tower volume in which production program is stacked. Products leave the building, after assembly, packaging and storage, through air and over land. The production tower has a strong vertical layering starting from a public zone to a service core intended for the vertical circulation of goods and material. The tower sits in a base volume that contains program that has a supportive function. Here a research centre, for the development of material and machinery, an education – and knowledge centre that educates the public regarding digital fabrication, retail, and hospitaly, both used by public and employees, is situated.

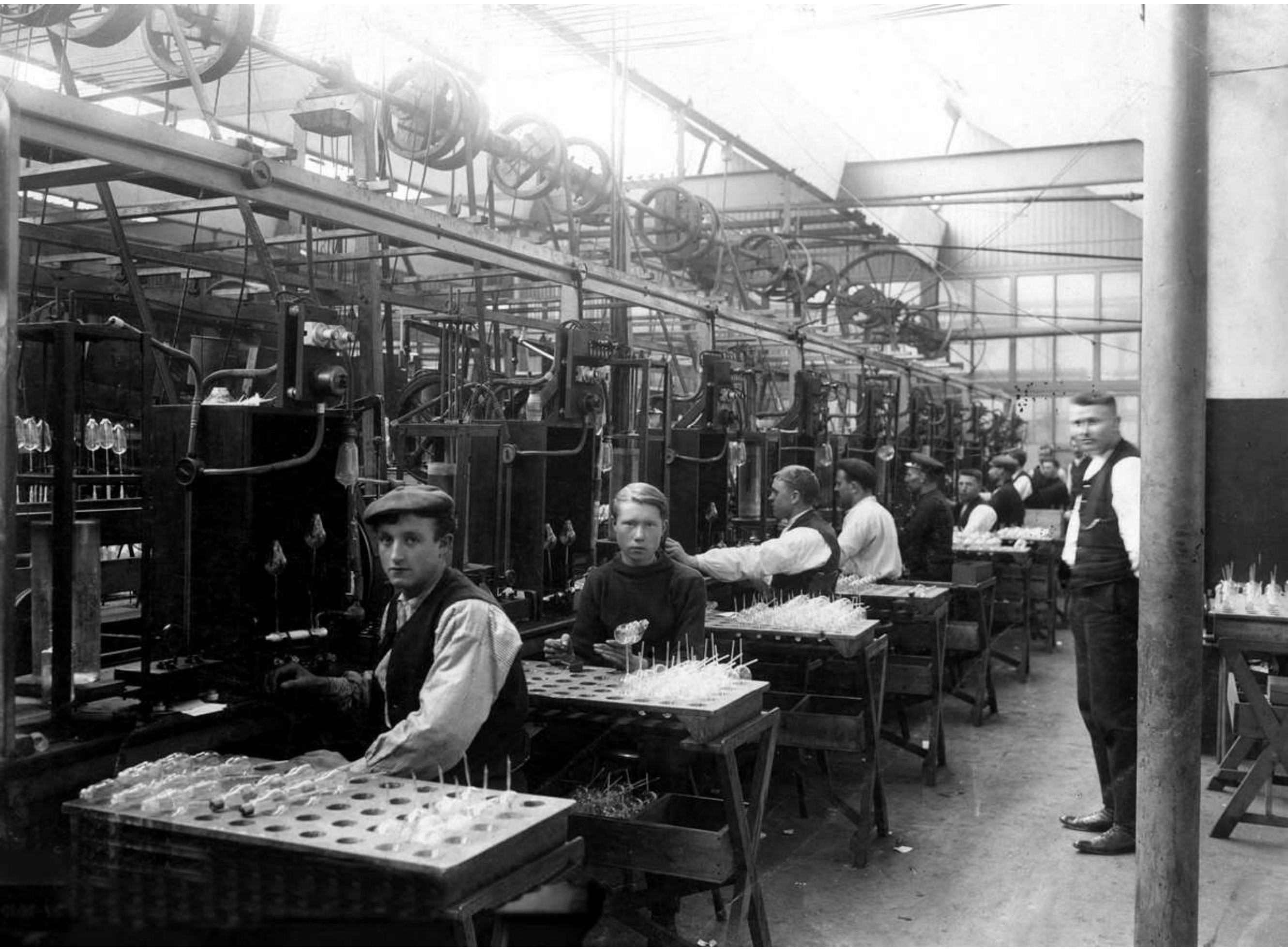
RESEARCH

RESEARCH

INTRODUCTION

Only few people feel connection with the production process of the goods they consume. Nowadays production takes places outside our view. Its consequences are mass production, standardization, alienation of manufacturing. But the production landscape is shifting. New manufacturing techniques are being developed. We are now in the areas of the so called fourth industrial revolution. From mass production and standardization we can produce efficiently a batch size of one. Products are related more specific to the consumer. On demand production and sutomization will replace large batch production. A great advantage but therefor a renewed relationship between producer and consumer needs to be formed. Interaction and proximity become essential. A renewed relationship with the city. The connetion to craftproduction in times before mechanisation when. We enter the era of the urban factory.

When producton was pushed outside the city our city became prdomincatly focused on consuming. Makers and users are drifting away from each others. Environmental pressure, alienation of the process and loss of potential as consequences. Trends such as advanced manufacturing allow for restoring the relationship between rpdouction and the city. This thesis is aiming to restore manufacturing within the city and make use of potentialities of the city such as available workforce, market.



The project needs to be seen in the bigger framework of the complex projects studio. The methodology of complex projects is based on working with different scales and cultural contexts which give the complexity to the assignment. The AMS Mid-City studio is dealing with a future vison of the city of Amsterdam. Therefor the studio is looking into the whole spectrum of the city, from the city centre (left) to the suburbs (right) And represented through the 3 locations: Amsterdam Centraal, Amsterdam Amstel and Amsterdam Zuidoost. he amsterdam 2050 vision is set up from the perspective of the three most important issues that the future city is dealing with, namely: Energy, health and mobility. All in the most broad sense of the word. I focused how the city in 2050 is dealing with energy and more in general resources. In general the city of 2050 is dealing with resources in a more local and decrentralized way. In 2050 Amsterdam has completed the energy transition from fossils to renewable energy. Energy is generated and stored locally thought natural resources such as wind and sun. Also goods will be produced more locally.

Researched districts


ERLANDSCHE VLIEGTUIGEN-FABRIE
FOKKER

Timeline of manufactoring

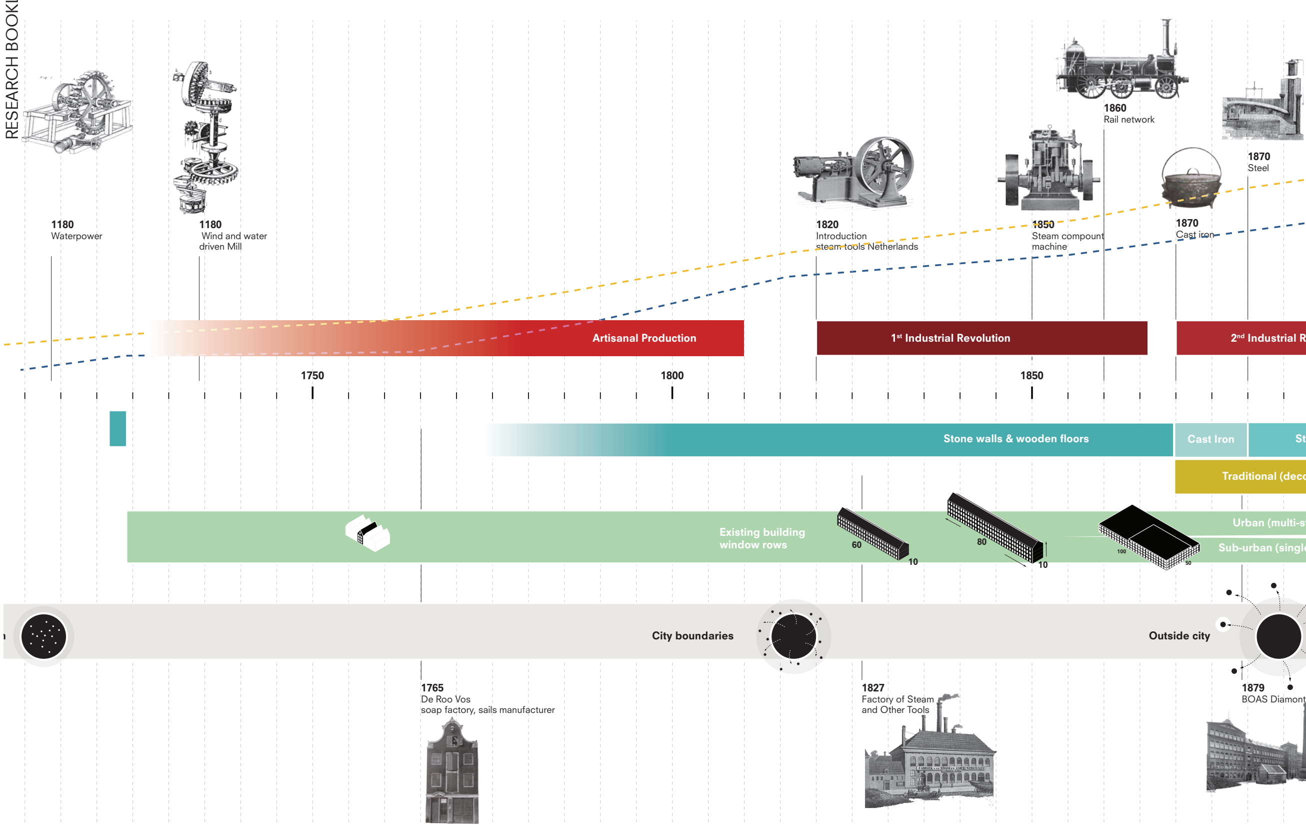
The production has been dynamic. This timeline shows the evolution of manufacturing in The Netherlands with a focus on Amsterdam. On top important events that influenced manufacturing. The yellow line shows the amount of jobs in manufacturing and in blue the average size of a production facility. In red the industrial revolutions. Blue the construction method of factories, in yellow the building style, green the building typology, grey the relation to the city and on the bottom exemplary projects that reflect the evolution of manufacturing.

1. The prior examples to the factory are the workshops in Amsterdam meant for convicted people as part of their sentence. Before the industrial revolution artisanal production took place in o small scale, integrated in the city.

2. From the introduction of steam tools the first factories started to appear around 1827. First small but after innovations of havier machinery these started to grow. During the 2nd industrial revolution factories were made of new material such as iron, steel and later concrete. The first factories were made in a traditional style, only after 1920 architects started to experiment with the factory typology. An example is the van Nelle factory in Rotterdam.

3. Expansion of the rail network meant that production could take place further outside the city. The office typology became more important to the factory typology. Again factories moved outside the city and the need to build multi-story disappeared.

4. After the WO2, digitalisation had great influence on the factory. Factory complexes grew and flexibility became an important topic. Moreover, production outside our country. We now find ourselves at the start of the 4th industrial revolution. The start of the era of urban manufacturing. Due to for example the 3D printer production can happen on a much smaller scale within the urban environment.



First Industrial Revolution

through the introduction of mechanical production facilities with the help of water and steam power

Second Industrial Revolution

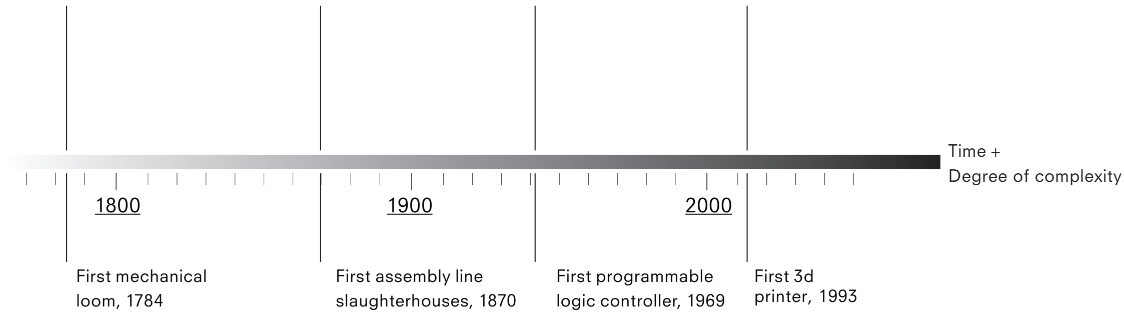
through the introduction of a division of labour and mass production with the help of electrical energy

Third Industrial Revolution

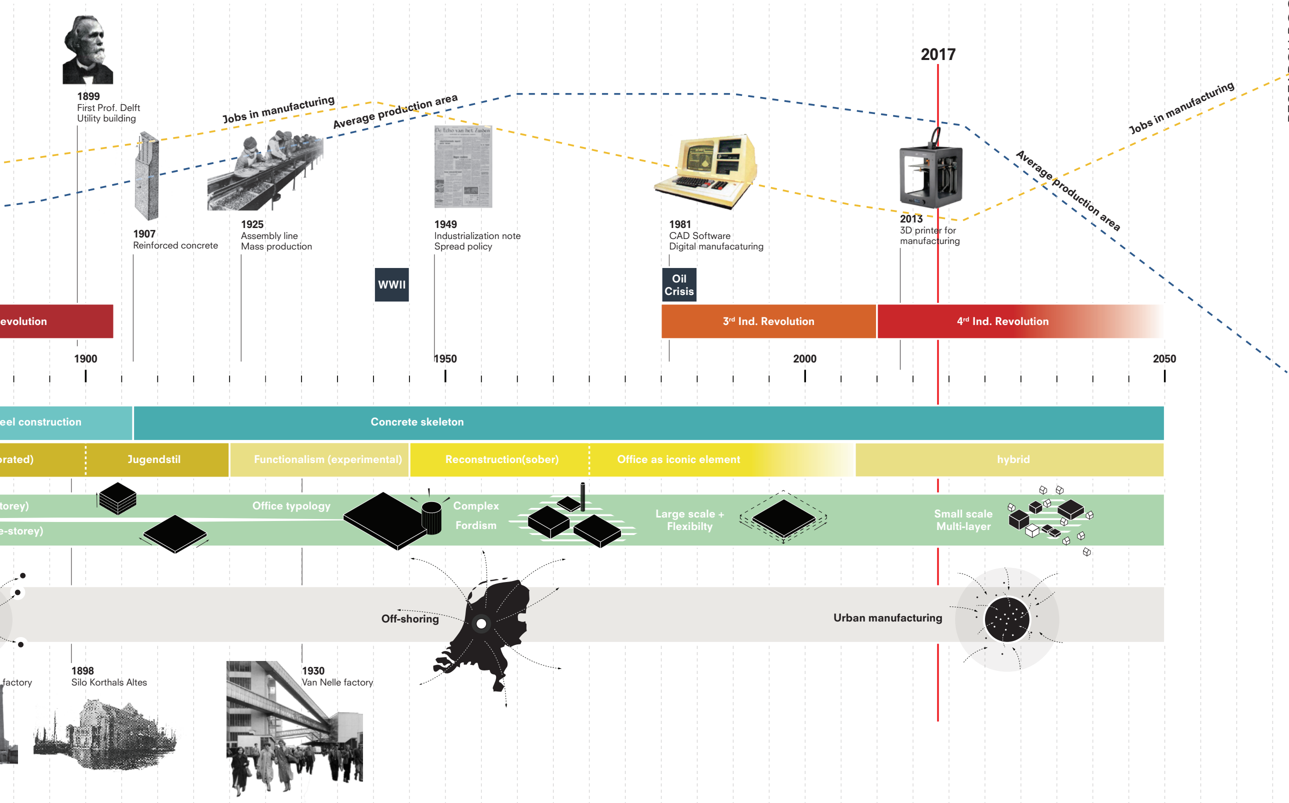
through the use of electronic and IT systems that further automate production

Fourth Industrial Revolution

through the use of cyber-physical systems



caption.[i1]



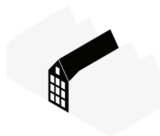
Evolution of Manufactoring

Typology

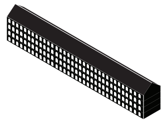
I will zoom in the factory building you just saw.

- The Roo Vos was a sails manufacturer in Amsterdam. The layout of the building was simple with production on the ground floor and storage on upper floors.
- The Boas Diamont factory represents the start of the first IR. A large machine room in the centre of the building and a boiler room and coal storage separated.
- The Fagus Factory in Germany was a shoe manufacturer. The office takes an prominent place on the top floors. Futhermore , the production process is cut up in different rooms for sawing, metal work, packaging etc.
- In the Van Nelle (Tabaco) Factory the production line is represented through the exterior by bridges that connect production floor, dispatch centre and storages spaces.
- The Berluti Shoe Factory in Italy is compact factory, besides the production floor specific spaces are assigned for education and product design connected to large halls.

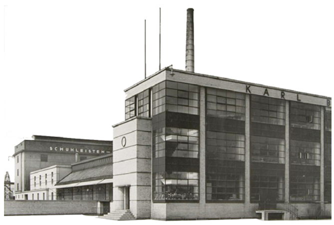
If we compare the program bars and sizes of the facilities we see that the office gained important and besides production and there is more spaces reserved for service space.

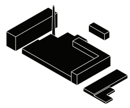



1765
De Roo Vos Sails Manufacturer

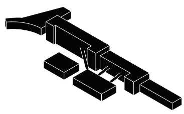



1878
Boas Diamond factory

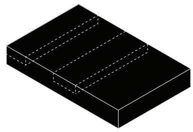




1913
Fagus Factory

1930
Van Nelle factory

2015
Berluti Shoe Factory

facade

production
(drying, manufacturing, sawing)

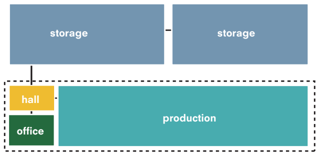
technical
(machinery, boiler, coal storage)

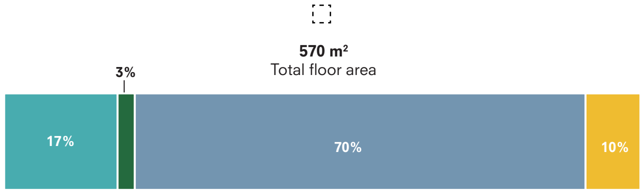
office
(office, meeting room, education)

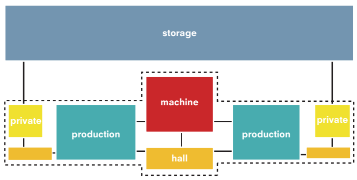
logistics
(storage, packaging, dispatch)

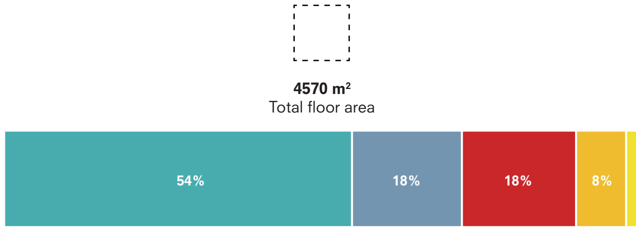
service
(toilets, changing room, cafetaria)

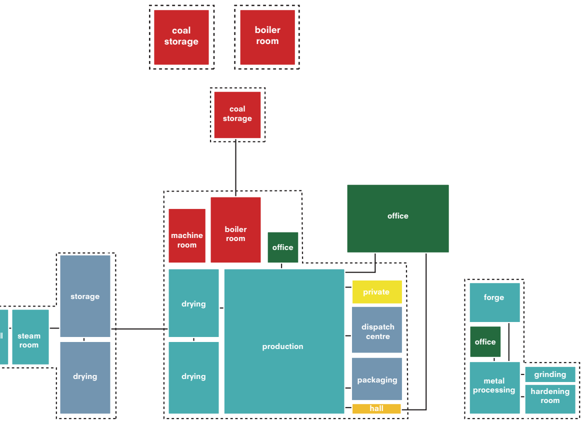
hall
(stairs, hallway, agora)

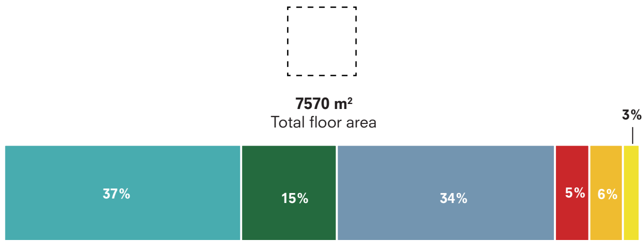

storage
storage
hall
office
production

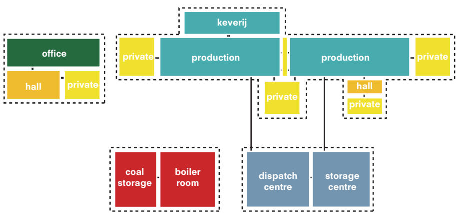

570 m²
Total floor area
3%
17%
70%
10%

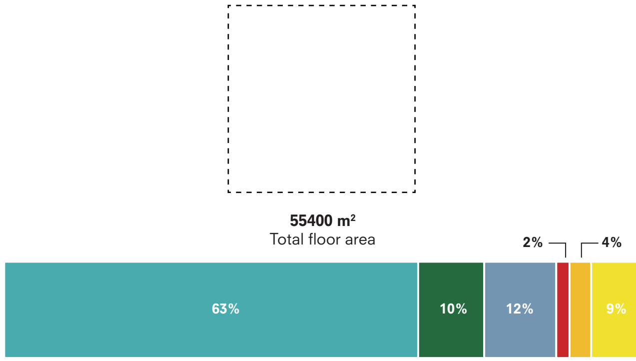

storage
machine
private
production
production
private
hall

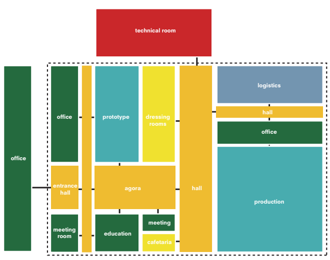

4570 m²
Total floor area
54%
18%
18%
8%

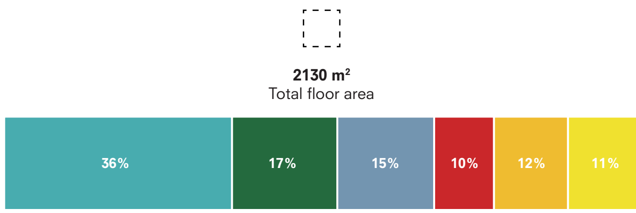

coal
storage
boiler
room
coal
storage
office
machine
room
boiler
room
office
storage
steam
room
drying
drying
drying
production
private
dispatch
centre
packaging
hall
forge
office
metal
processing
grinding
hardening
room


7570 m²
Total floor area
3%
37%
15%
34%
5%
6%


keverij
office
hall
private
private
production
production
private
private
hall
private
coal
storage
boiler
room
dispatch
centre
storage
centre

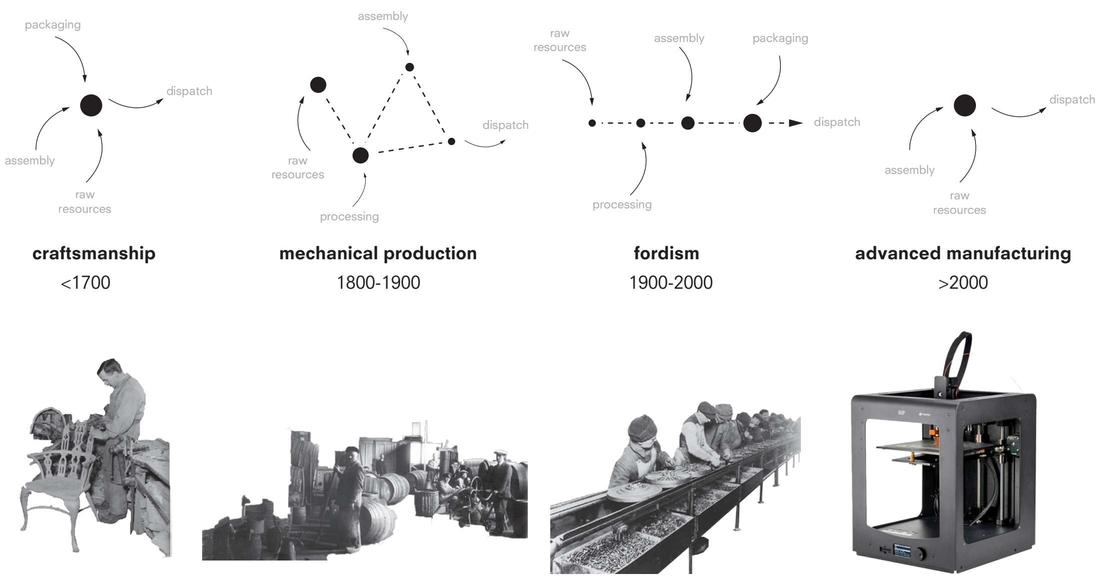

55400 m²
Total floor area
2%
4%
63%
10%
12%
9%


technical room
office
office
prototype
dressing
rooms
logistics
hall
office
entrance
hall
agora
hall
production
meeting
room
education
meeting
cafetaria


2130 m²
Total floor area
36%
17%
15%
10%
12%
11%

Production chain

The production chain in time of craftsmanship was one dimensional, production, assembling took place within the same room. This changed during the 1st IR. Different spaces were assigned for different functions. The assembly line meant a continues flow of goods going through the different stages of the production process. Now we are in the period of advanced manufacturing. Production can again take place in compact spaces and the production process doesn't contain much steps.

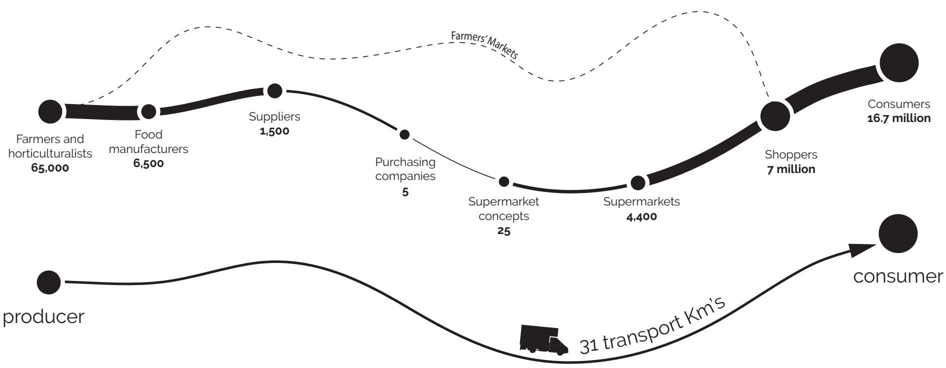


caption.[i1]


ANNA EN MARIA.VAN AMSTE

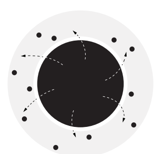
diverging relation between production and the city

As told, the relation between the city and production has been dynamic. First integrated into the urban environment and combined with commercial and residential functions. Such as this brewery in the inner-city of Amsterdam. To pushed outside the country to so called sweatshops in low wage countries. The distance between producer and consumer has been growing. Resulting in more transport, environmental pressure and mental disconnection to the production process. Also, this resulted in more and more middle man (as in this example of the food supply chain). The urban factory is all about shorting this chain, and restoring the relationship between production and the city.
There used to be a clear border between production and consumption. Reintegrating production within the city will fade out this border. The question this project seeks to answer is: were lies the balance?

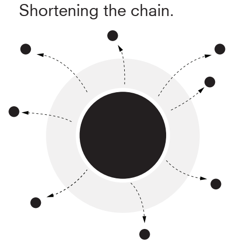


Shortening the chain.

Mercantile City
Manufacturing activities were closely integrated with residential and commercial activities within the city.



Industrial City
The industrial revolution drove urbanization and economic growth. Industries were relocated within the city boundaries.

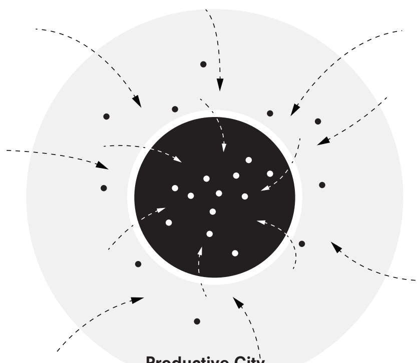


Planned City
Due to factories' nuisance activities and zoning regulations, manufacturing was relocated outside the city.

Fabrication activities intregrated in the city of Amsterdam.

Sweatshops in low wage countries. Source: Edward Burtynsky (2004).

Piecemeal City
Industrial activities are more and more segregated from other functions. Manufacturing is offshored to low-wage countries.



Productive City
Due to clean and less space consuming ways of manufacturing, production is again integrated in the city.

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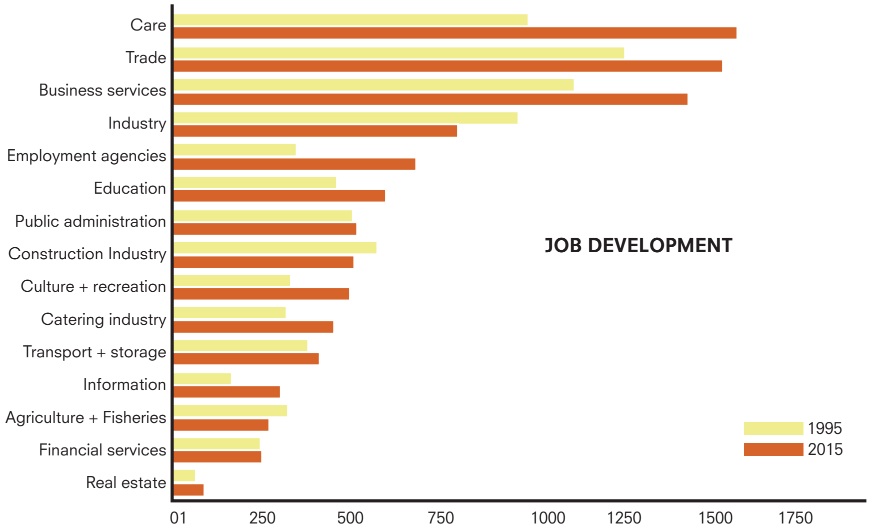
Changing trends

Over the past 40 years the share of jobs has been declining. Moreover, we can see a shift from jobs in industry, to jobs in knowledge industries. But production costs abroad are rising. Wages are rising, as are shipping costs. On the other hand prices of robots are decreasing, which makes it less favourable to offshore production program abroad.

Connotation of production

Lastly, our image of production needs an update. We think of production as a noisy, pollution acitiy. This view of outdated. Contemporary manufacturing is clean and quiet.



From industry to the knowledge economy. Source: CBS Statline (2016). Arbeidsvolume en werkzame personen, kwartalen; nationale rekeningen

Connotation of production. Volkswagen factory in Dresden (left) and (right)

Changing trends

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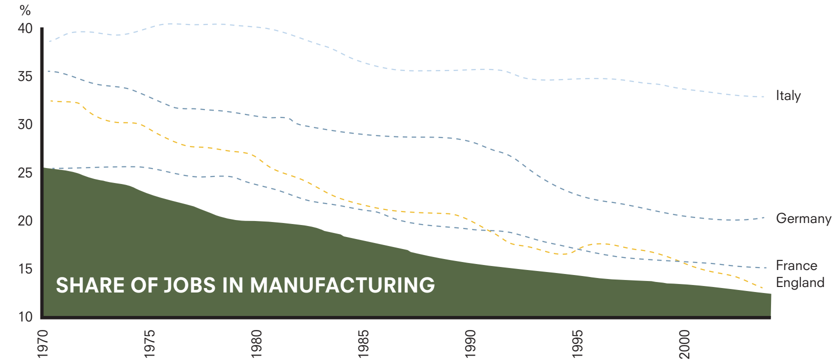
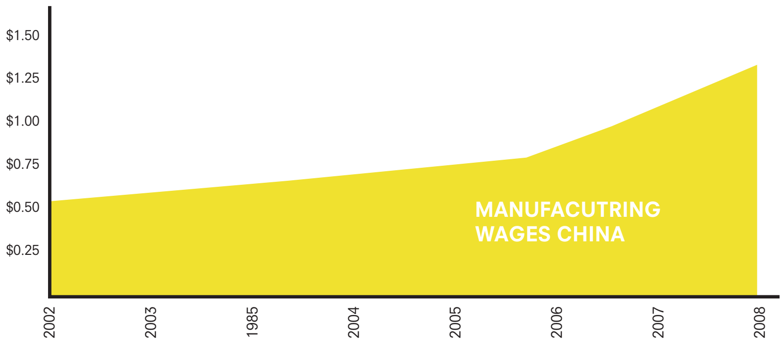
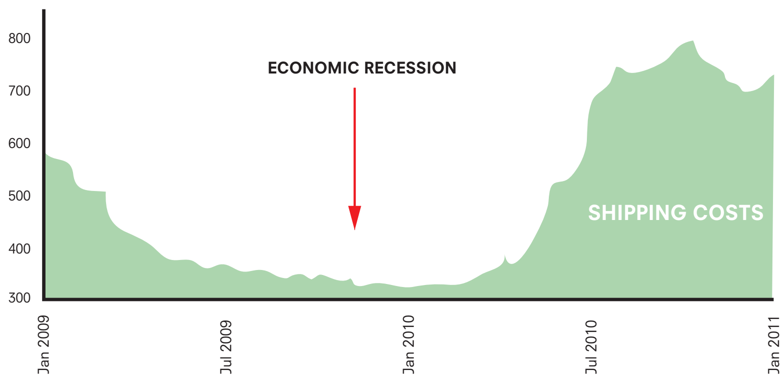
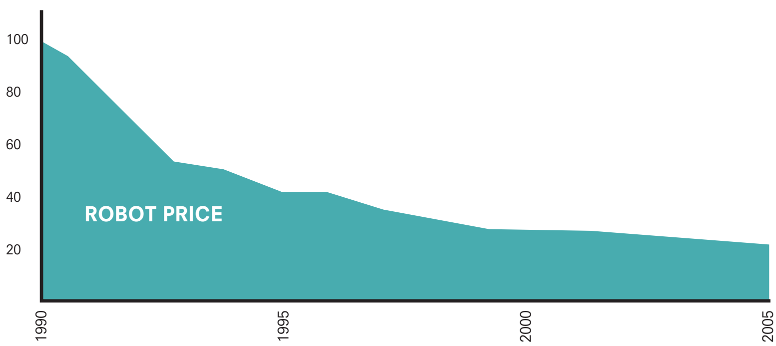
Sweatshops in low wage countries. Source: Edward Burtynsky (2004).









Increasing production costs abroad.Source: Brendan I. Koerner (2011). Made in America: Small Businesses Buck the Offshoring Trend

Innovations in manufacturing

But since the industrial revolution lot has changed. There has been great changes in the manufacturing process. Our manufacturing landscape is changing rapidly. Study reveals the promissing innovation in terms of manufacturing:

- 3D printing is an additive process of building objects, layer upon layer, from 3D model and scanning a 3d physical object and translate directly into a 3d model.

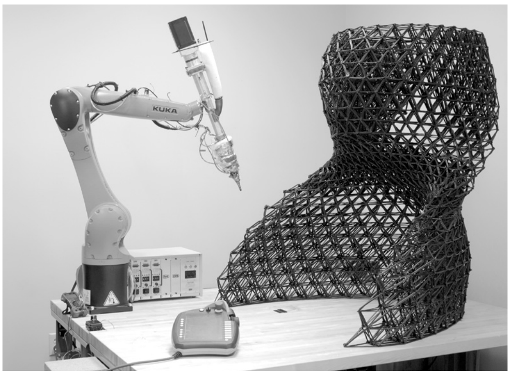
- Advanced Materials refers to discovering and making new materials such as Lightweight, High-strength Metals and High Performance Alloys, Advanced Ceramics and Composites, Bio-based Polymers
- Internet-of-Things (IoT) advanced machinery that allow objects and machines to interact digitally.

- Advanced robots that work percize naggate to a workplace complex task and less human intervention.

These innovations will save time, money and will increase quality. Moreover they will have a strong spatial consequence. According to Elisabeth Reynolds, Executive Director of the MIT Industrial Performance Centre. Changes in advanced manufacturing technologies as well as the economics of
manufacturing have significant implications for the location and spatial organization
of production.

Traditional vs advanced manufacturing

Traditional manufacturing of the 20th century is linear. Raw material are fabricated into parts which are assembled into finshed products. Advanced manufacturing includes material design, the recycling of material and the integration of software into products.



3D printing. Source: Branch Technology

3D scanning. Source: Scott Page. Designboom.

Innovative materials. Bio-based polymers. Source: WUR Wageningen University & Research. Biobased products innovation plant.

Advanced robotics. Source: Indumation (2017). The Belgian factory, Process, Infrastructure auomation show. Kortrijk

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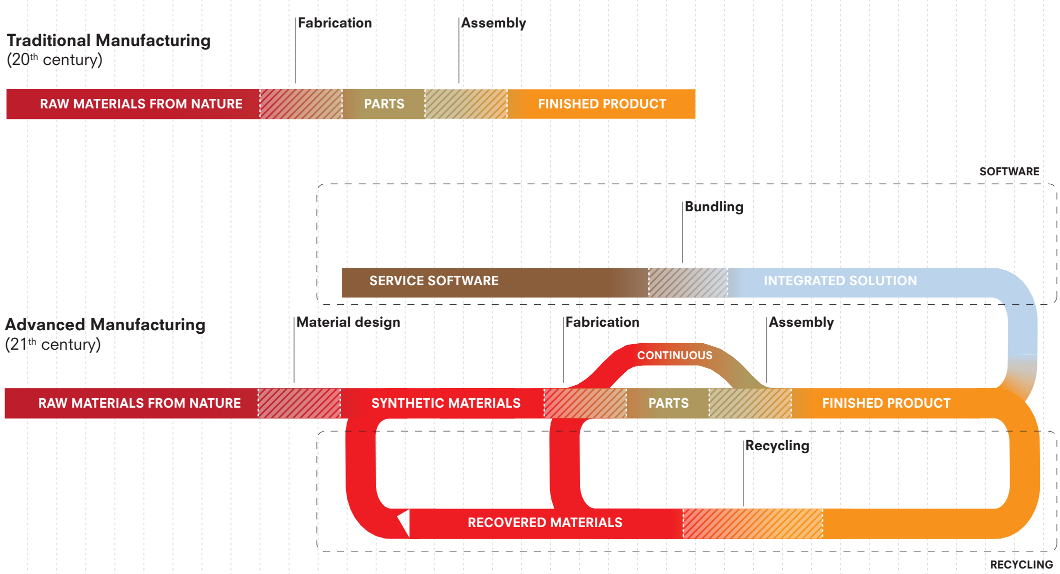


Traditional manufacturing & Advanced Manufacturing. Source: own image based on: Reynolds, E. B. (2017). Innovation and Production: Advanced Manufacturing Technologies, Trends and Implications for US Cities and Regions. Built Environment, 43(1), 25-43.

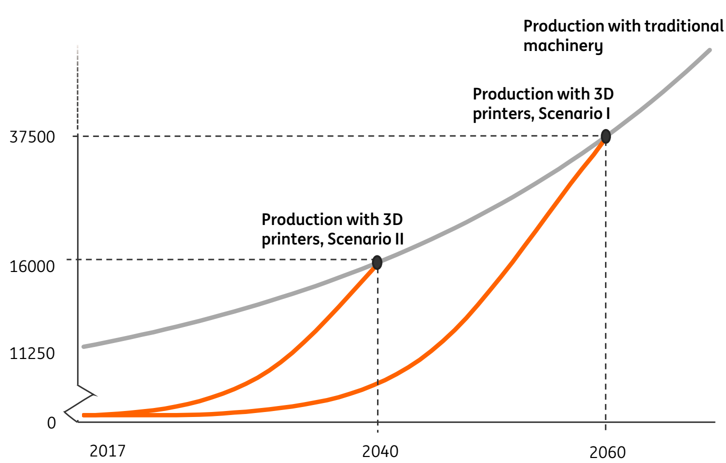
AM

AM

Innovations in manufacturing

Ucilis suntem invel modi re modi re ratetur restinctum aboremperum iurit experro dolendes dollandit omnihic atempor epudamus quo quam eum ea suntinum int lam re consernam solor acerro erit ea simus si delibusae nihil mossequi que opta quiamus eostrum quaeped magni intemqu iaerum fugit aditiunto dolesenis dipsusdam, occab id qui se rehene quaturio. Res si consecto moloreium voluptas eossint et unt dolorem velestis eosam fuga. Ugit esti simolup tatium faciend igendig nihilig enitiberia doloriatem quam est voluptatem. Bis accus dia natia ides doluptus ipsunturiae odistio is doluptis pa que que vent presti ium ventoriatet quod qui in ea dit, nust essed essit ulles reruntur? Ciis dundanimet, qui bere digenihil ilibusa dolorat emporat venia inimaxi magnihitibus mincipsant inciisimus eos di aut et, ommolorem et inulligeni occuscit fugita qui doluptat volorro ommodia con cor audit expe nos quo que ex essi ut a ni tem quosanis plitatquis es vent volessintia dit volupta tempore heniam ut incid quos sapeliquide doluptatem ini sitae sit, odit debitatiam, conem quaspellam il ius ea volupta tureperro od excepernatur se sint ut volorem. Tem faccum doluptatur rehenis dicilig natatur? Officide coriate mporita pra sit ea dolum que eum in nessedi genditae. Neque et odit acculparum endiam facesed quia vene veliquidebis id quis moluptate porerchit omnimincium ipid ut excestrum sus, vendit hil molorum re odioreh

Fig 5 3D printing's impact on world manufacturing production, ING scenarios I and II* (US$bn)



Source: ING. (2017). 3D printing: a threat to global trade. Amsterdam: ING Bank Economic and Financial Analysis.

Source: Luce Studio. http://lucestudio.com/work/nissan-machine-in-a-box/

SITE

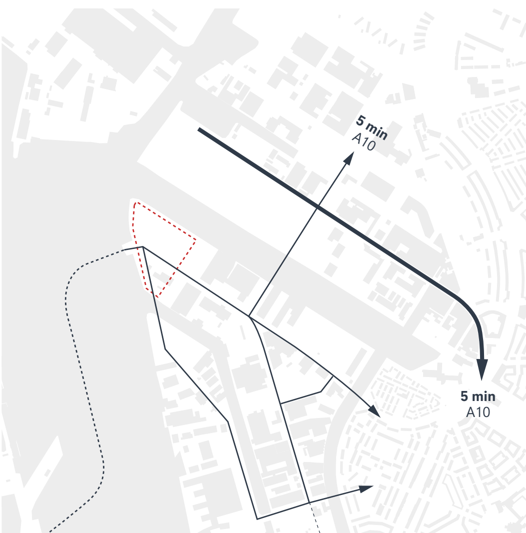
SITE

Site analysis

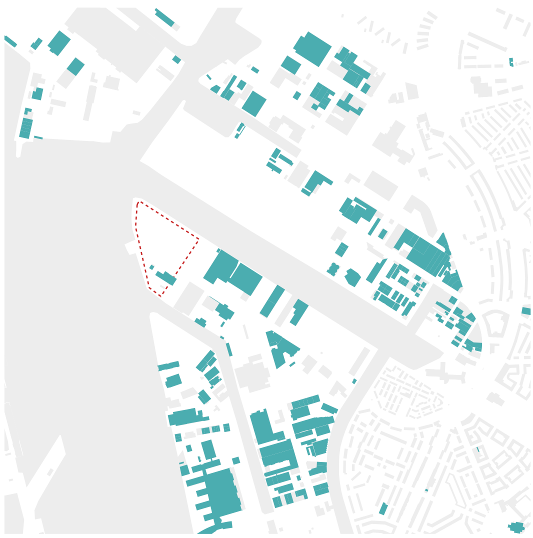
The Urban factory will be realised in the Buiksloterham area in Amsterdam North.
- The Buiksloterham has not always been there.
- Only around 1850 the Buiksloterham was created as a result of drumping sediment of the river IJ here.
- For a long period the area stayed unused and was only used for agricultural purposes.
- Later a new strip of land at the river IJ bank was made, now called Overhoeks.
- After 1900 the IJ bank started to be used for among others the Fokker airplane factory.
- Now, Buiksloterham became a model for any city grappling with what to do with a decaying industrial zone.

The area is now characteristed by large vacant land. Most of the building contain a industrial function. De site is located at the river IJ bank at the tip between two former harbours. Due to its industrial function the site has good accesable from the ringroad and over wide industrial roads. Although in decay there are a lot of existing and future incubators that can strengthen the urban factory. NOt a stand alone project. Seek for relationsships that the city provides.
- Neef Louis product design company
- De Ceuvel an temporary initatives in which ways of sustainable urban development are looked for.
- New Energy Docks is a business incubator for sustainable projects and products.
- And others

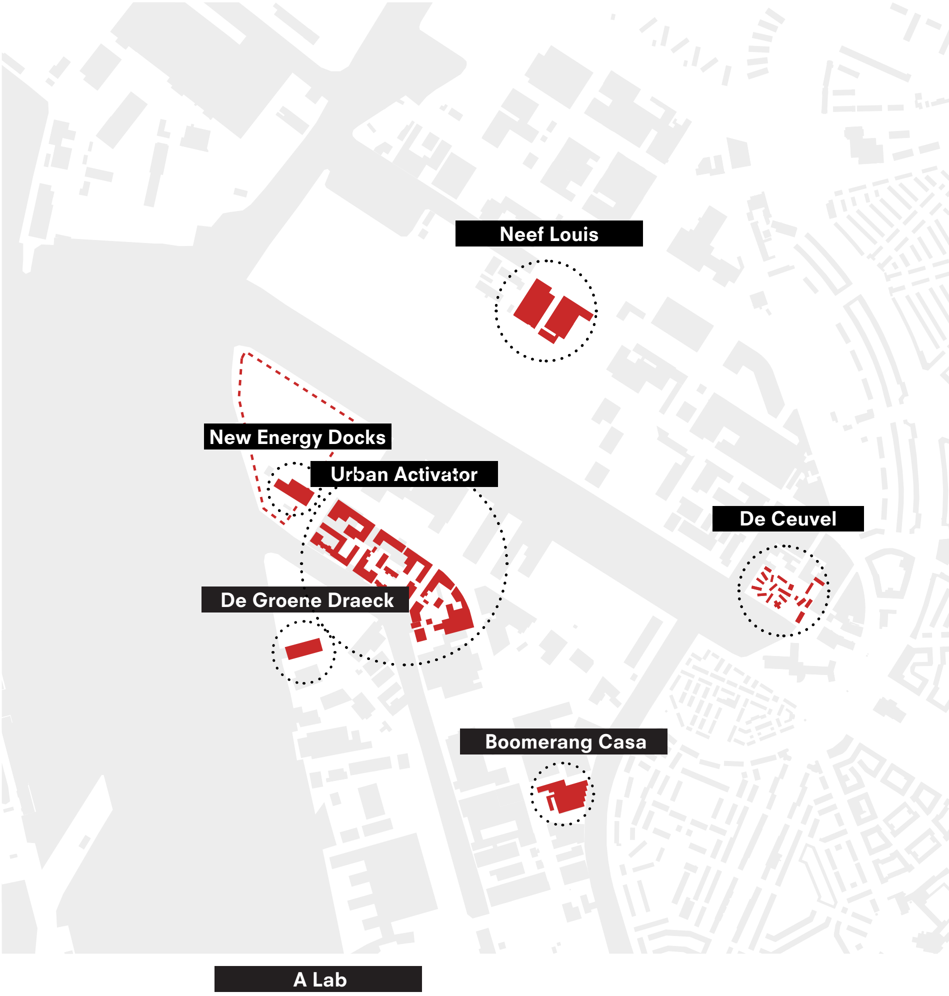
These incabators can form a cluster and Also seek relationships with ther functions in the cities such as universities etc.



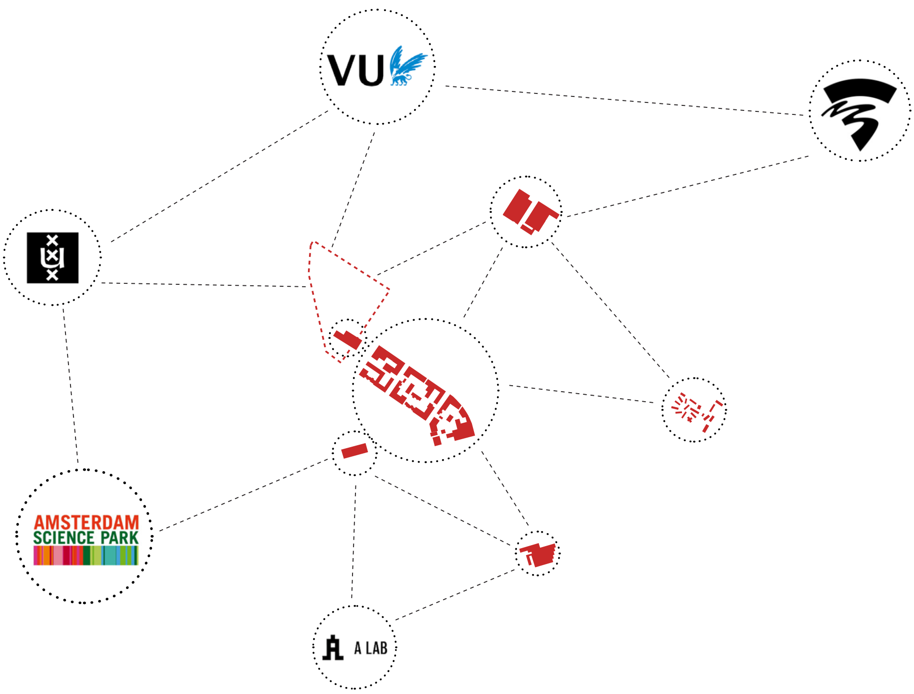
Accesability



Industry



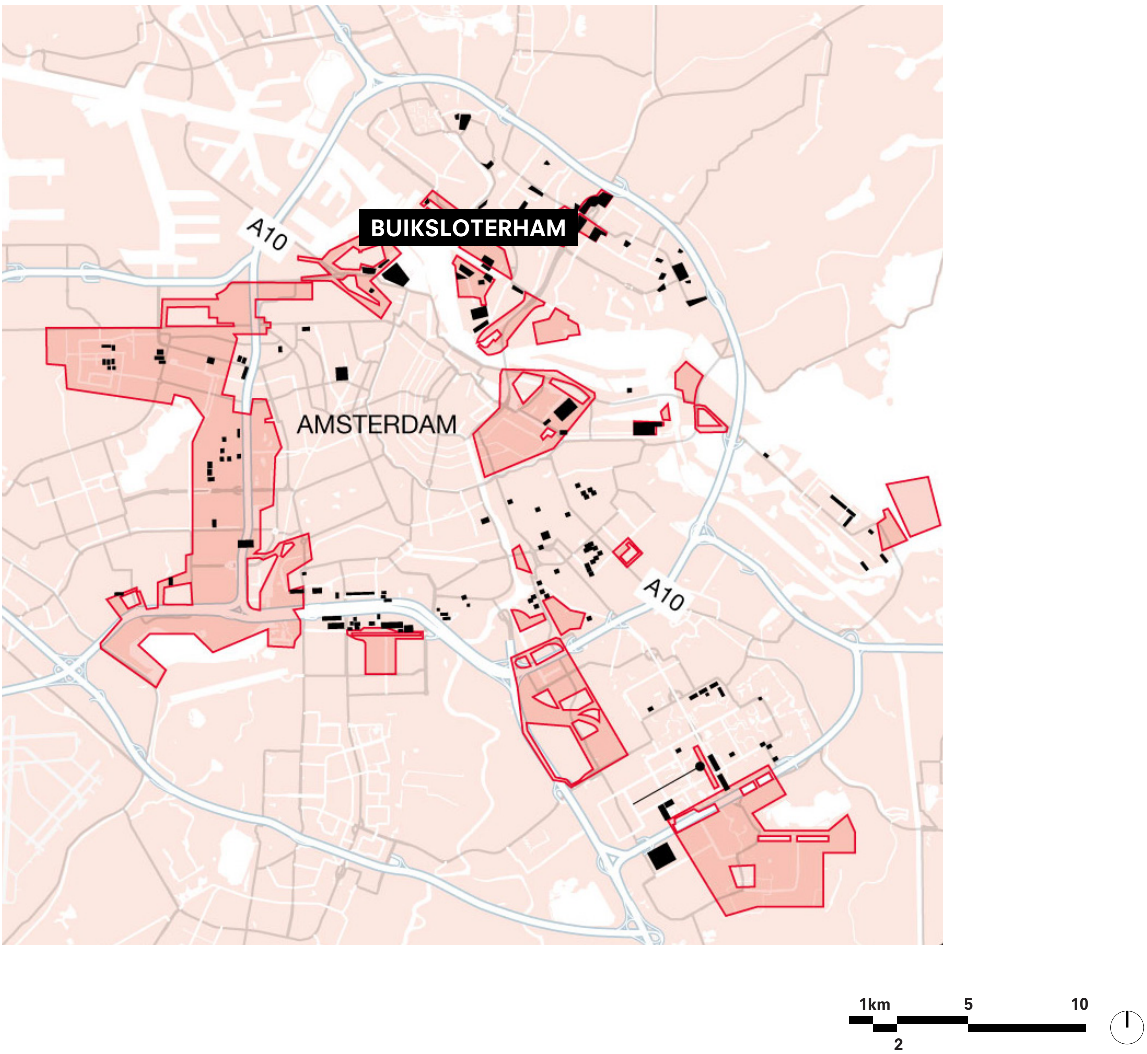
Incubators



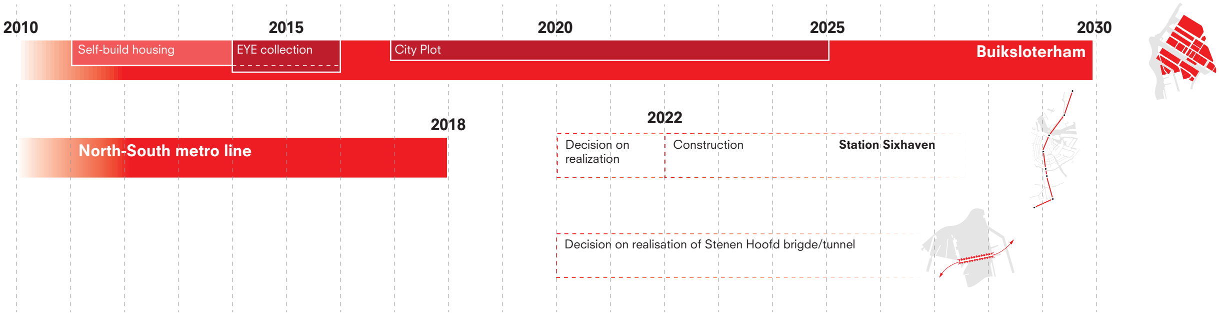
Network

Area in transition

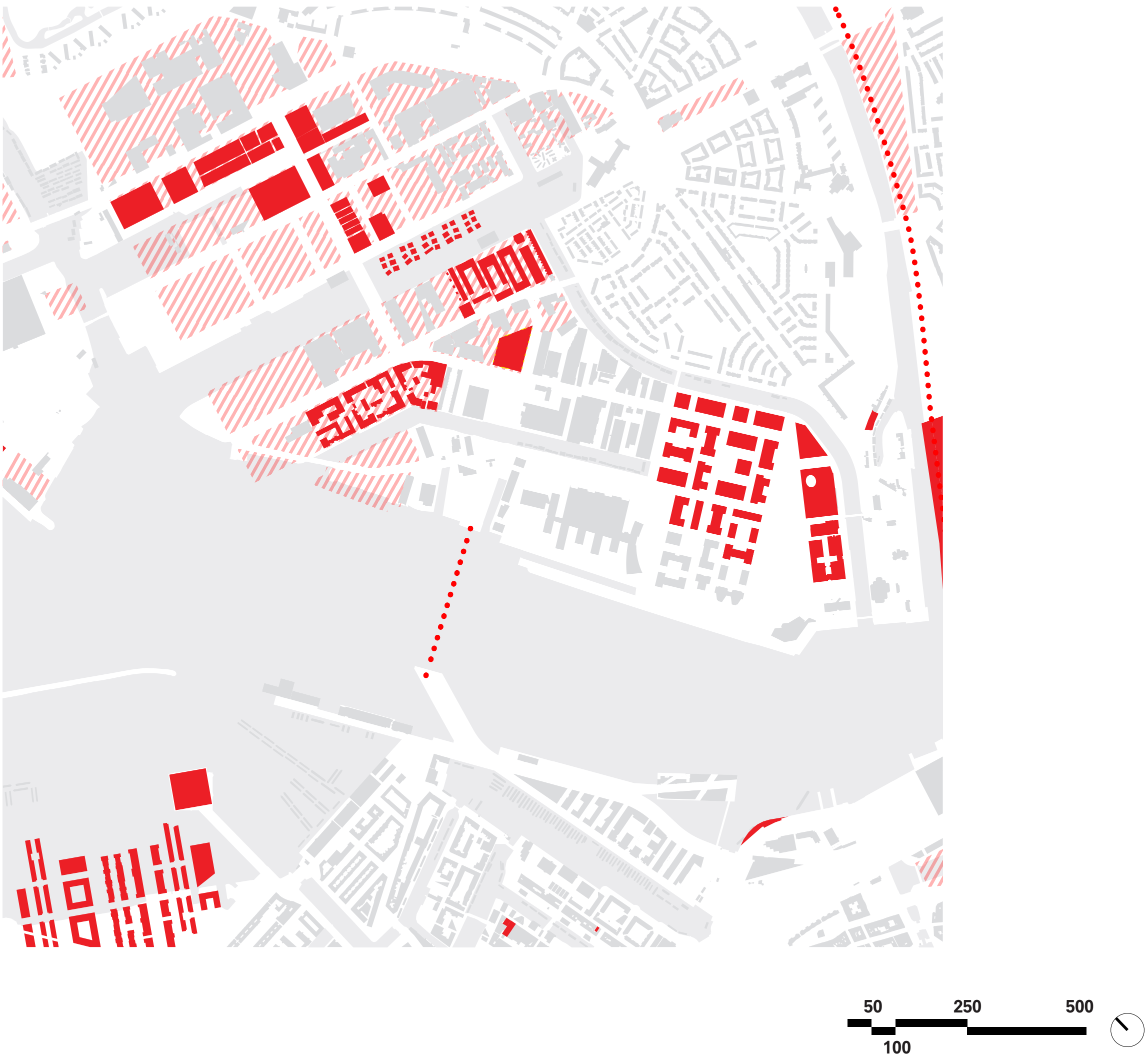
The area is part of a bigger vision of the city the build 12.000 houses in the ringzone. Buiksloterham is in close proximity to the city centre. In the coming 15 years the area will be transformed into a neighbourhoods for living and working. About 4500 houses. This will be done in a timeframe of about 15 years. Important is the relasition of the north-southline and possible Stenen Hoofd bridge. Both aiming at better connecting north and south.



Area in Transition
Source: David van Unen (2016, Februari 14). Op deze locaties wil Amsterdam 12.000 nieuwe woningen bouwen. Het Parool



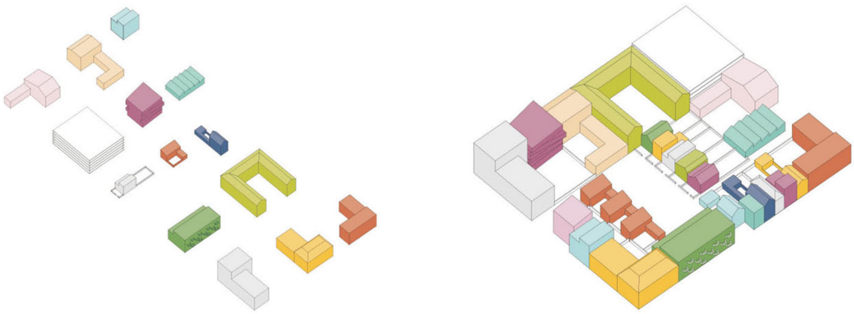
Time frame



Area in Transition

Area in transition

The image of this part of the city will change into aHigh density, low rise housing and working neighbourhood. Because of the big dimensions of the industrial grid new mixed block typologies designed. Typical is the innovation of the inner courtyard. Although designed by different developers and self build housing this will be the character of the neighbourhood.



Porous and Mixed urban block typology
Source: Gladek, E., Odijk, S. v., Theuws, P., & Herder, A. (2014). Circulair Buiksloterham: Een Living Lab voor circulaire gebiedsontwikkeling. Visie & Ambitie. Amsterdam: Metabolic, Studioninedots, DELVA Landscape Architects

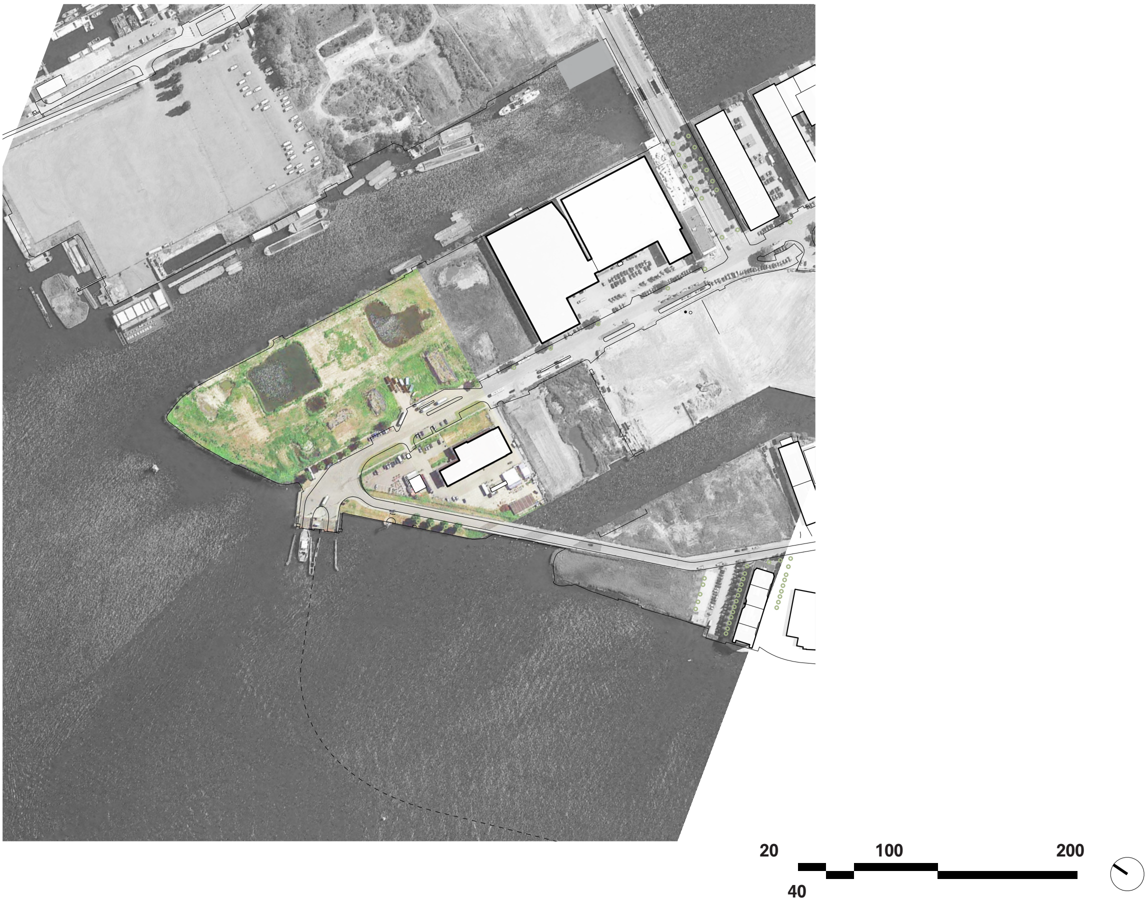
Mixed working and living neighbourhood.
Source: Gladek, E., Odijk, S. v., Theuws, P., & Herder, A. (2014). Circulair Buiksloterham: Een Living Lab voor circulaire gebiedsontwikkeling. Visie & Ambitie. Amsterdam: Metabolic, Studioninedots, DELVA Landscape Architects

Cityplot
Source: Gladek, E., Odijk, S. v., Theuws, P., & Herder, A. (2014). Circulair Buiksloterham: Een Living Lab voor circulaire gebiedsontwikkeling. Visie & Ambitie. Amsterdam: Metabolic, Studioninedots, DELVA Landscape Architects

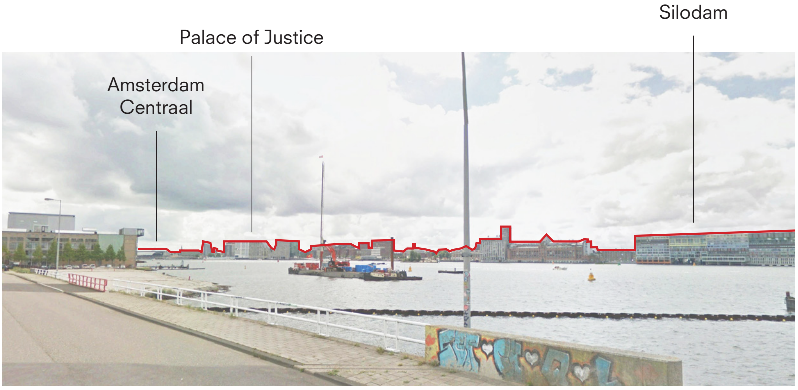
Use of couryards
Source: Gladek, E., Odijk, S. v., Theuws, P., & Herder, A. (2014). Circulair Buiksloterham: Een Living Lab voor circulaire gebiedsontwikkeling. Visie & Ambitie. Amsterdam: Metabolic, Studioninedots, DELVA Landscape Architects

Site

As said the Urban Factory is not a project on itself but part of the productive city vision in which production is decentralized. The Urban Factory is an exemplary project that could be replicated. As can be seen the site is now vacant for a large part. Copmanies have left. Characteritic is the that it is neighbored by water from three sides and that the ferry is docking here. The future layout will be dense low rise. Connection to the water and better connection of the different land tones by new roads. The plot is about 42300 m2 which is large. This is because not all land will be occupied by the urban factory but also by planned residential and commercial functions. The factories is located at the sunny side of the IJ al year long.
The plot is characteristic is now monotonous and closed of for most part. The architecture can by described as anonymous. The harbour structure and relation with the water is still visible. It is also a sight location. The Amsterdam Central Station and landmark at the Southbank are clearly visible.



Site. Source: Google Earth



View from site. Source: Google Streetview

Anonymous shed. Source: Google Streetview

Harbour structure. Source: Google Streetview

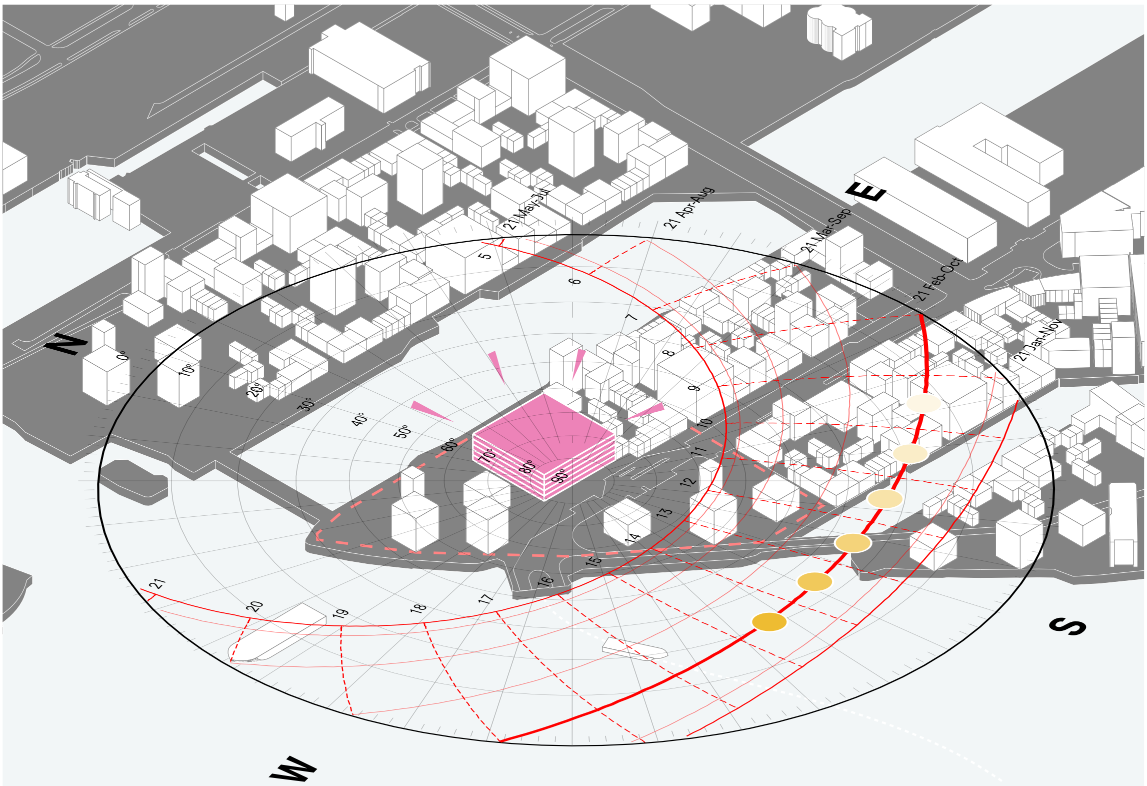
Fenced monotonous landscape. Source: Google Streetview

Site

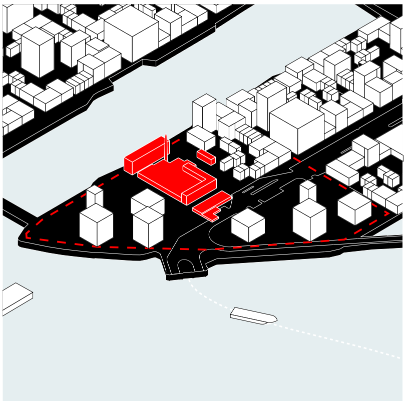
For reference the program is places onto the site. A average building area os 20.000 m2 seems suitable.

The site is choasen because of its visibily, accesbility over land/water/air, future urban fabric that is open for integration with the urban factory and the possibily to seek for relationships with other program.

SITE FEATURES
VISIBILITY FROM THE SOUTH
+
INFRASTRUCTURAL CONNECTIONS OVER BOTH LAND,
WATER & AIR
+
POROUS URBAN FABRIC ALLOWS FOR INTEGRATION
+
POSSIBILITY TO FORM 'PRODUCTION CLUSTERS'

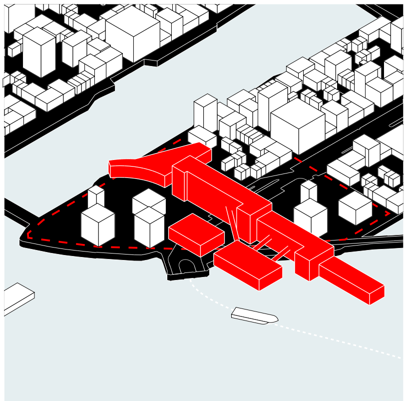


Sunny side of the IJ



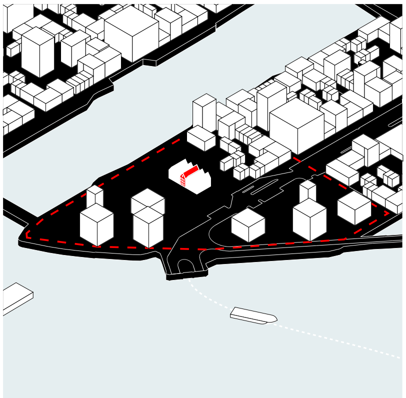
7570 m²

FAGUS FACTORY



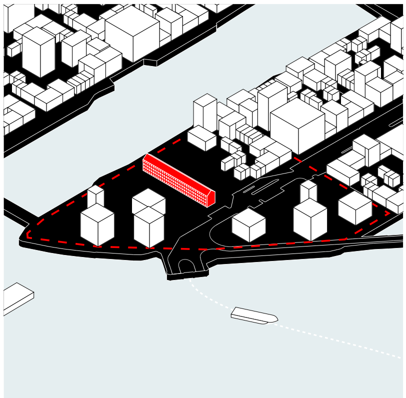
55400 m²

VAN NELLE FACTORY



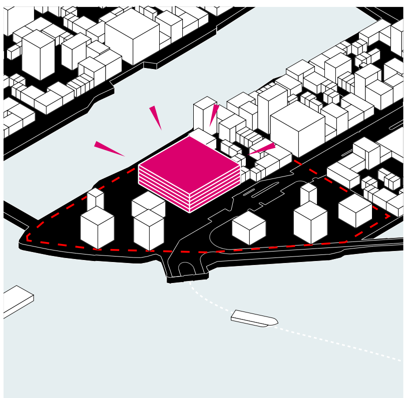
570 m²

ROO VOS SAILMAKERS



4570 m²

BOAS DIAMONTFACTORY



19900 m²

THE URBAN FACTORY

PROGRAM

PROGRAM

Product

The spectrum of consumer products that can be produced through digital manufacturing is broad. The choise of product is based on the fact that in 30 years most people will have tools to manufacturing simple household items within their home. The urban factory will focus on the more complex manufacturing of customized, on -demand bikes and bike gear. This is just for illustration. Everything can be produced. Avanced manufacturing is not restricted to specific product. Flexibility

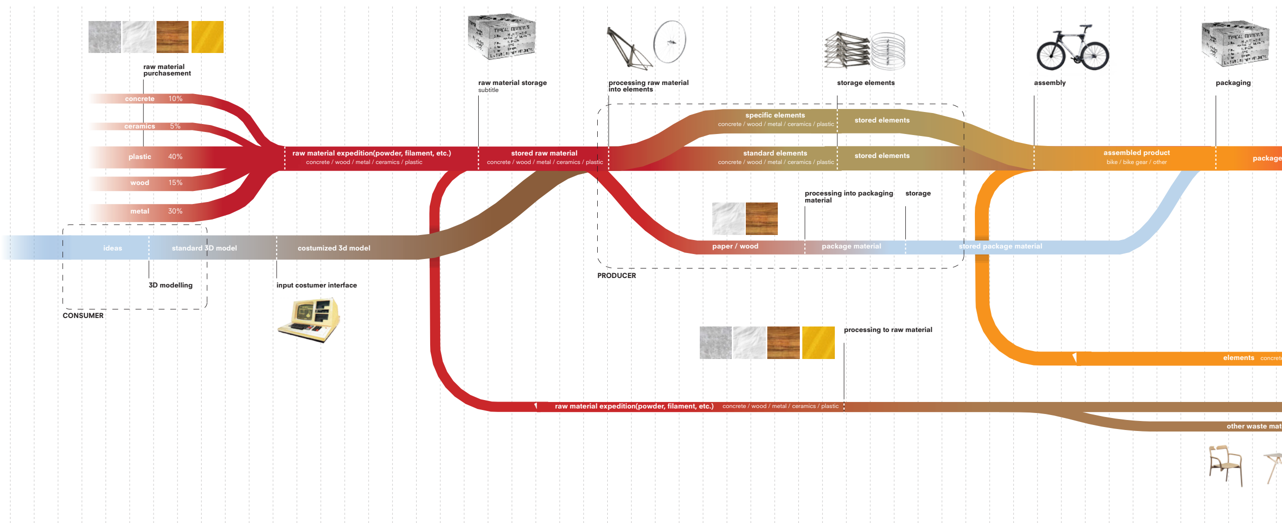
Supply chain

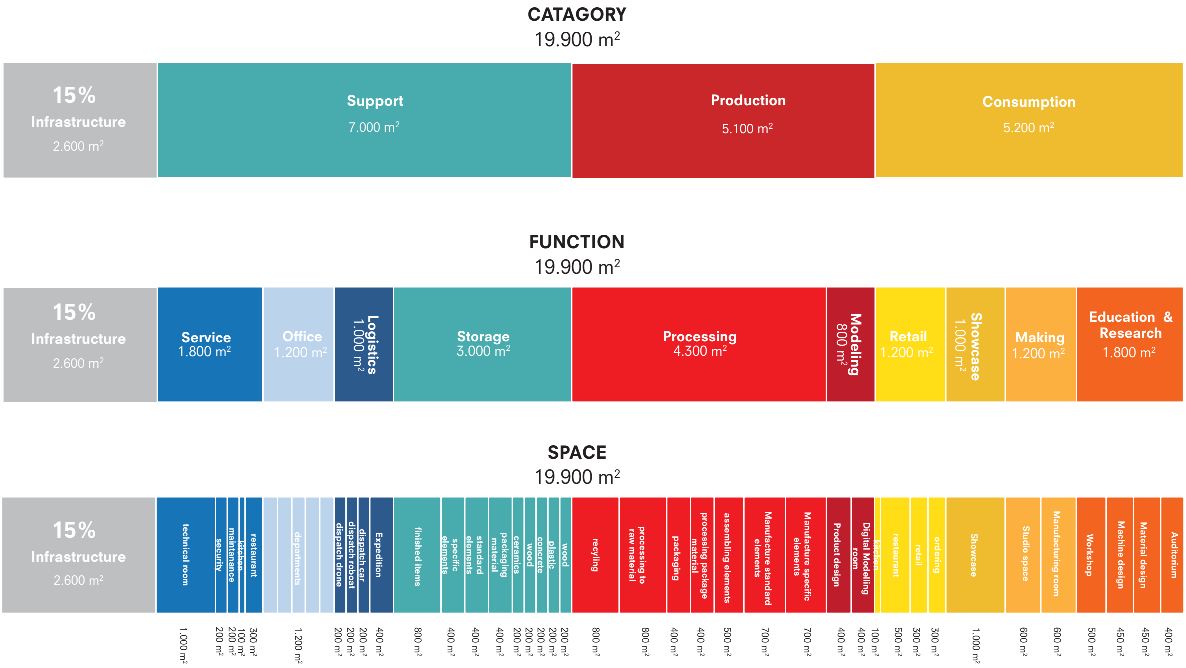
The supply chain looks as following. Ideas are translated in digital models. At the same time is processed into specific and standard elements. That together are assembled into the final product. Also package material is produced locally. The packaged product is stored. After products are eithers ordered and dispatched thourhgh self driving cars, boats or drones. Or they are are showcased locally and sold. After the product is used it can either be locally repaired, going as waste material back into the system of disposed. Recyled products are transformed back into raw material.
The system is circulair with a less waste as possible .

Program

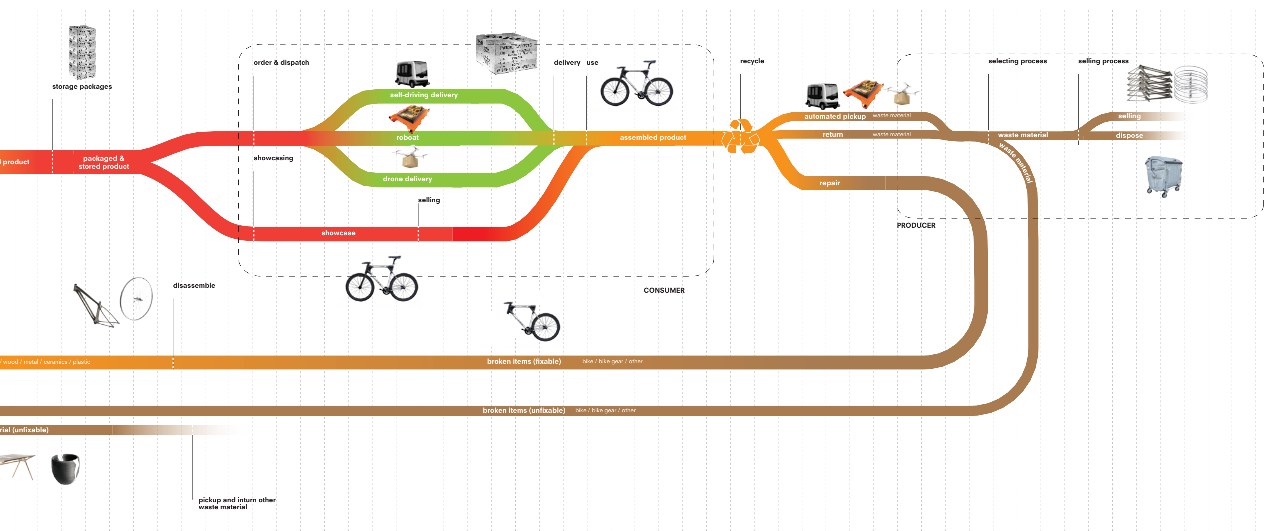
The supply chain is translated into the program, roughly divide into support, production and consumption section. Important is the education and research section, the showcase retail, making , modelling and processing sector. The functions are cut up in more specific spaces. Moreover, 15 percent of the program is assigned to infrastructure.

Digital manufacturing spectrum





Preliminairy program study



Supply chain and circulairity

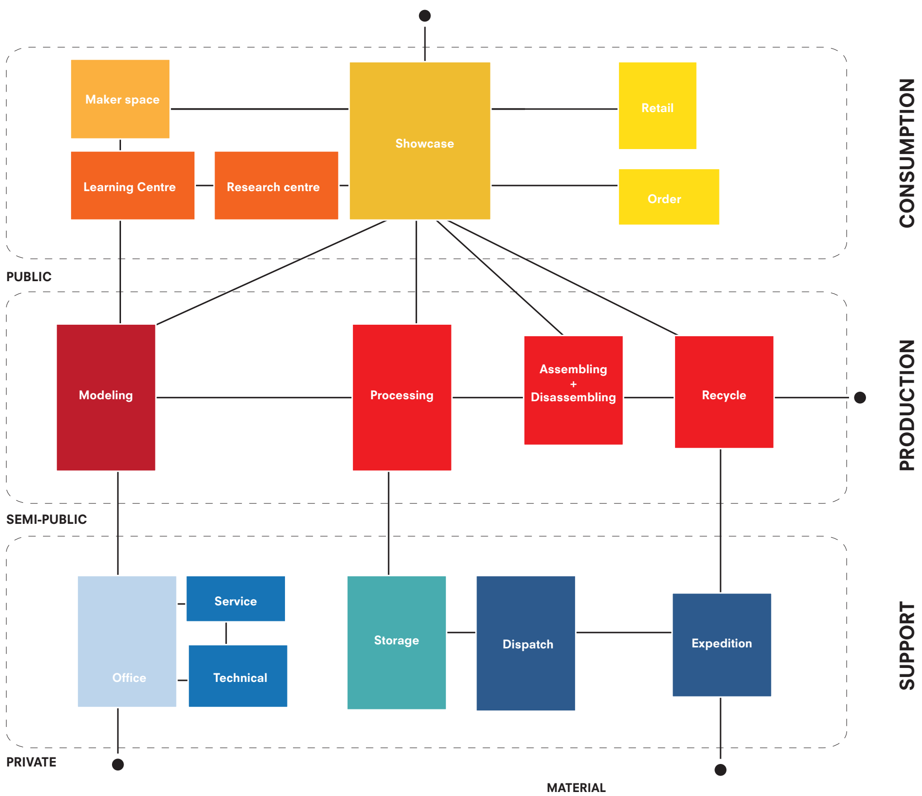
Preliminary organisation

The showcase, retail, learning research departments are in the public domain open for consumer to entrance. The production is is situated in the semi-public domain. This part of the program is visible for public and semi accesable. Functions such as office space, storage, deispatch are more close and private. Public, Staff and material all enter the building from different sides.

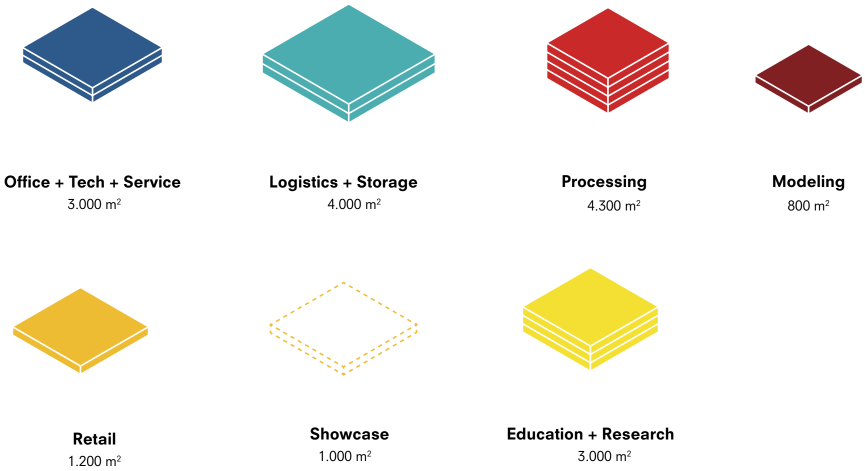
Mass study

The following study elements are chosen by
- place within the organisation of the building (public/private)
- the function
- spatial restrictions and needs (sunlite etc.)
- Here the program is stacked with public in the bottom and private at the top
- Scattered with public program connected different programmatic volumes
- Same but in a more organic form contradicting the surroudnings
- In the last option the program is exploded and only connected by their proximity between each other. This option integrated very well with surroundings.

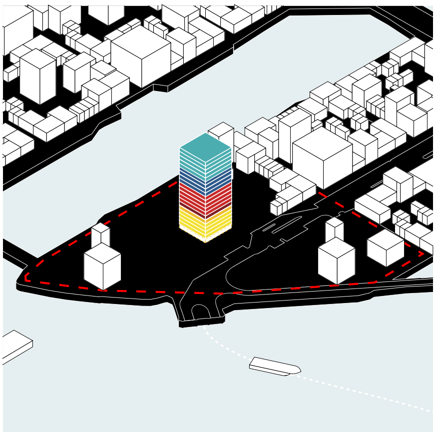
Of the four directions I will chose a in between of the exploded and scatterd option because of their ability to integrated with the surroundings.



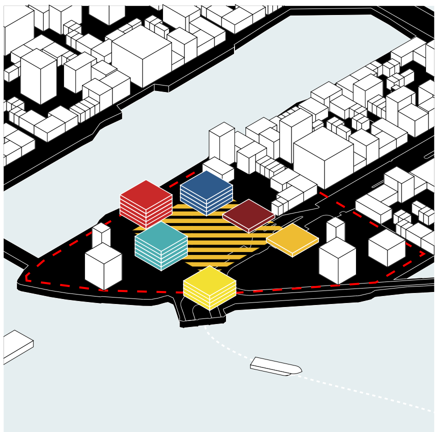
Preliminairy organisation program scheme



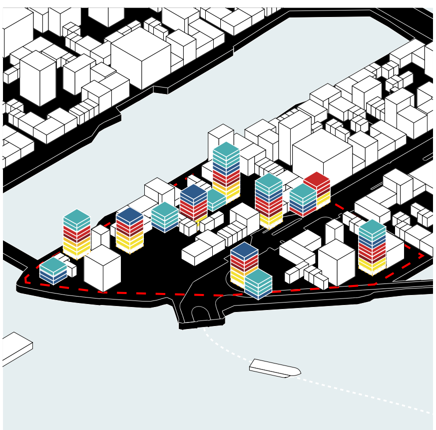
Preliminairy program elements



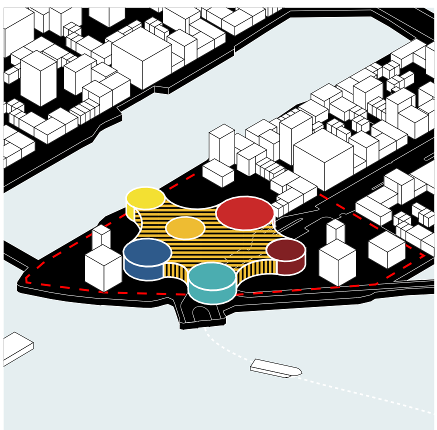
Stacked



Scattered + communal space



Scattered + integrated



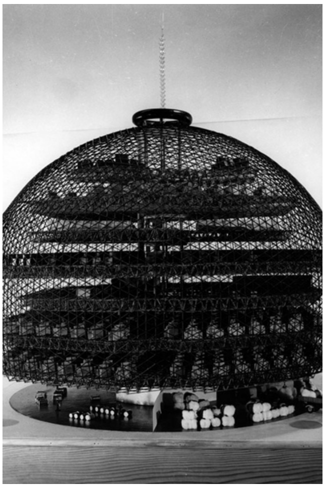
Organic

Spaces

Here I will present a first approach to three of the most particular spaces of the building and their basic spatial requirements.

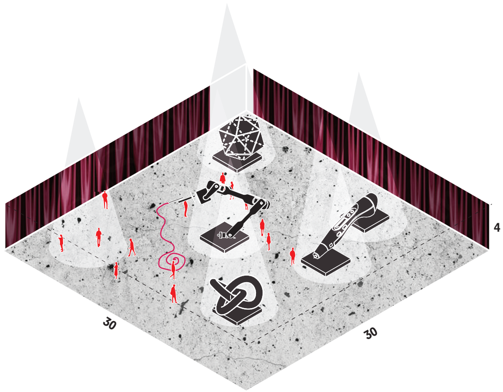
- The showcase needs to become the manifestation of advanced manufacturing. Large artificial spots, curtains within a flexibilixble open space define the room. The space refers to expositions halls and musea.
- The processing room will be a vertical orientated space since talking machines are not ground bound any more. Space for technique below the seling should be reserved. The space needs to be transparent to expose the process to the public. The space is using references to contemporary car factory such as the Volkswagen factory in Dresden.
- Within the material design lab research is done to new innovative materials. Again space needs to be reserved for tubes. The space is light and divides in a computer space and a laboratorium space. It refers to modern laboratory in the the UK and US.

Die Gläserne Manufaktur
Volkswagen factory Dresden

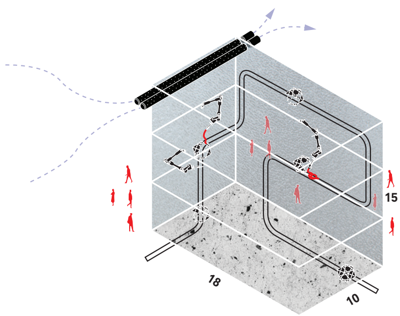


Buckminster Fuller
Automatic Cotton Mille 1952

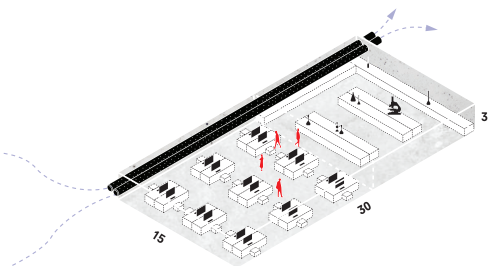
Sainsbury Laboratory
Cambridge University (SLCU)



SHOWCASE



PROCESSING ROOM



MATERIAL DESIGN LAB

PROGRAM STUDY

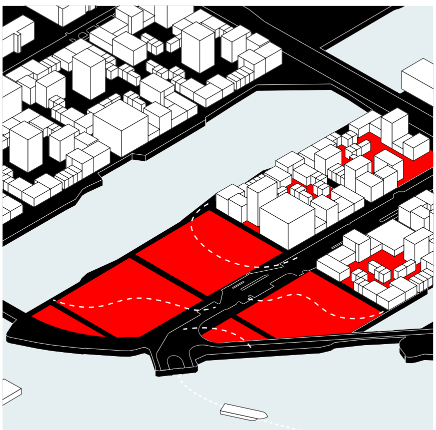
Site restrictions

- The new developments should correspond to the subscribed large scale urban grid.
- The new block should be permeable instead of solid.
- Maximum building hight is 30 which corresponds with the surrounding blocks. At the waterfront this is 100 meters that aims at creating landmarks at the waterfront area.
- The connction with the water is important when it comes to transport.

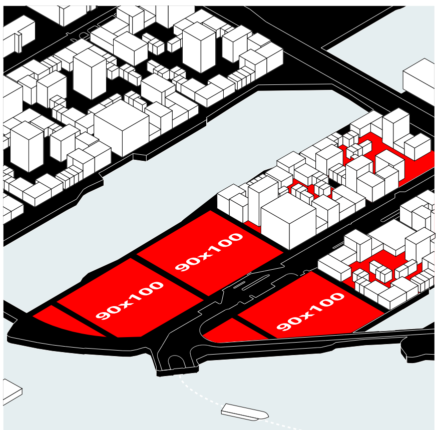
Design principles

- Overarching design principles are transparency and exposing of the production process
- Since building in an urban environment the building will eb multistory, creating a landmark
- The layout of the building needs to be flexible and should be able to adapt to future changes in technology.

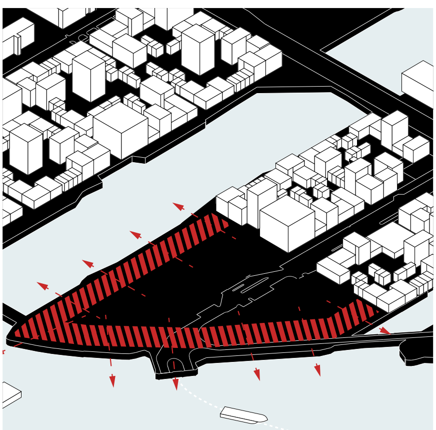
rium space. It refers to modern laboratory in the the UK and US.



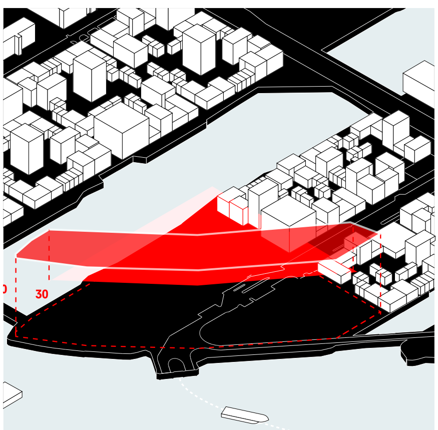
Permeable



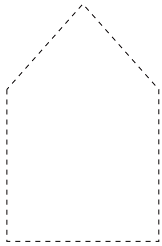
Urban grid



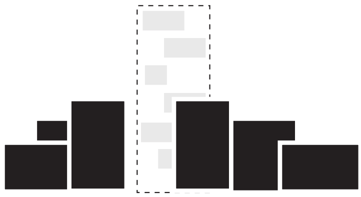
Connection to the water



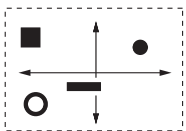
Maximum building hight



TRANSPARANCY



MULTISTORY



FLEXIBILY

RECYLING

ESSAY

ESSAY

The progressive globalisation leads to increasing distances between sites of manufacturing and dense areas of the consumption of goods i.e. cities. The relation between Dutch cities and production has been evolving constantly through history. Starting from a strong relationship, in a time before the industrial revolution, when manufacturing was embedded in our cities, to a time of segregation of industrial sites. Manufacturing and other functions such as living and commercial space got more separated. Producer and consumer are moving away from each other. Manufacturing is relocated to suburbs and developing countries because of lower production costs.

This paper is looking into supply chains of consumer goods and aims to improve these and make them more sustainable in a way that sets an example for other industries and businesses. 'Re- shoring' certain manufacturing functions back into cities could help to decrease CO^2 emissions. Bringing producer closer to consumer helps decreasing the number of transport kilometres consumers goods have to travel to our front doors and thus the level of CO^2 emissions. Innovative manufacturing with the help of robots will lead to cleaner production processes that can have a place within residential areas in cities. Since the use of robots will increase and the costs will decrease off-shoring production facilities to low-wage countries will be less favourable. More important, urban manufacturing will provide the city with jobs, stimulates local economies and increases public awareness of the production process and the meaning of goods.

Introduction

Global climate issues forces governmental institutions to look carefully at their city's urban metabolism and how to make flows of energy, social flows (people), food, air, goods, sediment, energy (heat) moving through the city more sustainable.

The energy goal of the city of Amsterdam is stated in the structural vision entitled 'Structural Vision Amsterdam 2040: Economically strong and sustainable' [1]. In the document a non-quantitative goal is stated: "Amsterdam chooses to generate a large part of its energy demand itself." [1]. Amsterdam wants to achieve a CO^2 reduction of 75 percent by the year 2040. The total net reduction of Amsterdam by that year 2040 should be 3.925 kiloton CO^2 [1]. This number is equivalent to the CO^2 emission caused by the burning of 3.3 square kilometre of coniferous forest. This number is consists of energy savings and energy production. By the year 2040 Amsterdam is planning to reduce 500 kiloton CO^2 through wind energy (400 MW energy production[2]) and 650 kiloton CO^2 reduction through solar energy (1000 MW energy production[3]), mainly on roofs, all within its municipal borders [1].

These numbers show a great ambition for the future in terms of transition from fossil energy towards sustainable sources of energy. This is in line with the endorsement by European leaders to reduce CO^2 emissions with 80% to 95% by the year 2050 [4].

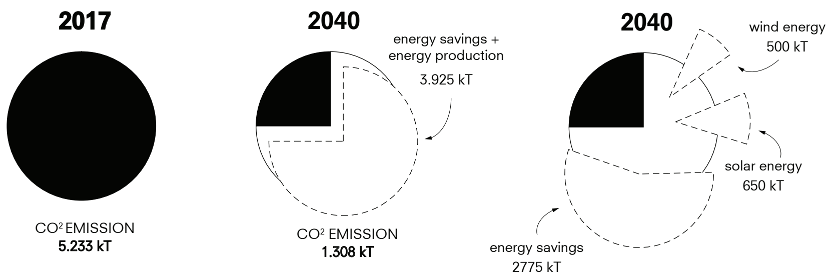
Urban metabolism and designing with flows as studied by people as Dirk Sijmons but also AMO, the think tank of the architectural office [5], and Eric Frijters and Olav Klijn (FABRIC)[6]. FABRIC studies different flows such as social flows (people), food, air, goods, sediment, energy (heat), within the city. Regarding the city of Amsterdam analysis of the flows of material shows that the flows of goods, building materials, food and electricity production in the city are the most relevant in terms of environmental quality and sustainability.

Therefore, this paper examines the flows of both goods and food from the producer to the consumer and looks into possibilities to shorten the supply chains, and therewith contributing to the energy goals of the city of Amsterdam. Improving consumer goods supply chains contributes only little to the accomplishment of the goals stated by the municipality of Amsterdam. However, this paper shows a method how also other industries and businesses should look carefully into their supply chain and research ways to make these more sustainable.

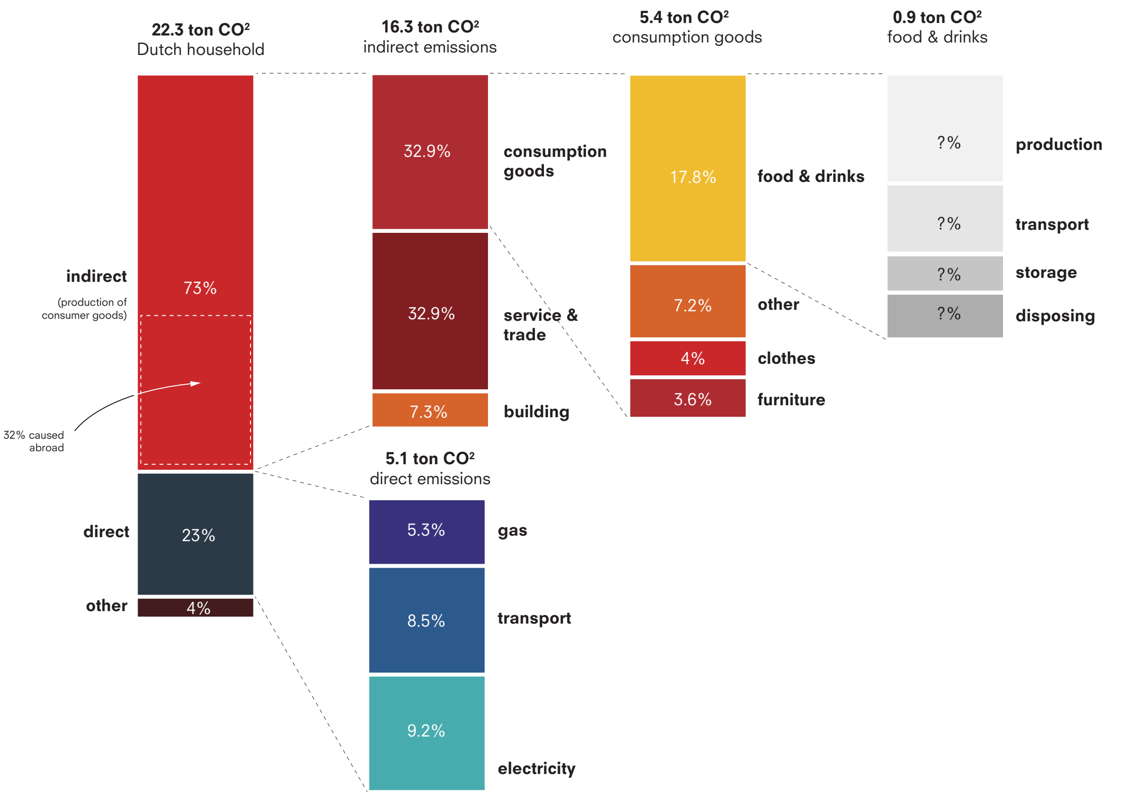
This paper tries to find answers to the question: In what way can the city play a role in adapting the current production-consumer chain to decrease the ecological footprint of our consumer goods?

The following sub-question are raised:

- In what way could cities not only be consuming but also productive?
- What could be the energy savings when certain goods are produced within the urban environment instead of (far) outside the city or abroad?
- How could the productive city stimulate the local economy by keeping financial resources within the city?
- How can we increase the public awareness regarding energy used in production and transportation of our goods? [7.]



Sustainability goals of the municipality of Amsterdam for the year 2040[1].



CO^2 footprint of an average Dutch household .[2]

The ecological footprint of consumer goods

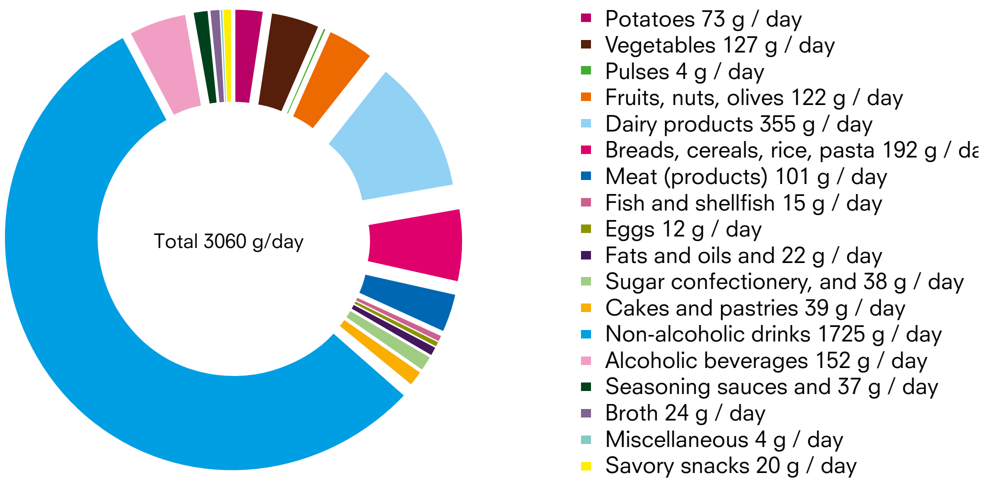
The average CO^2 emission of a Dutch family with two children is around 22 tonnes a year. Only 23 percent of the greenhouse gasses emission is produced directly by heating our homes, personal transportation and electricity. The other 73 percent of greenhouse gasses is released during the production of consumer goods, 43 percent takes place abroad. Most of the CO^2 emission is released outside the Netherlands, in places in which our daily consumer goods (such as food and clothing) are produced, packaged and transported from [8].

Great human impact on the environment originates from transportation and manufacturing of consumer goods. From the food we consume, to the clothing we wear, to the objects we fill our houses with. Almost a quarter of the total CO^2 emission in Europe is caused by the transport sector, mostly by road transport and short sea shipping [9]. Due to globalization this impact is growing since distances between producer and consumer are increasing [9]. This means that our goods require more transport kilometres to get to our front doors. Moreover, different from other sectors, the share of the total CO^2 emission caused by the transport sector is growing.

The Dutch consumption behaviour has consequences on our ecological footprint. The production of our consumer goods resources seize space and energy which cause environmental pressure [10]. 20 years ago 85% off the spending of a Dutchman was used for purchasing consumer goods related to living (furniture, kitchen stuff or garden tools), food and clothing. The spending on these consumer goods have risen significantly and will even increase more the coming years till 2030 and thus will the CO^2 emission caused by the production and transportation of these goods [11].

At the same time the world population is growing rapidly, as is our total goods consumption. By 2050, there will be 2 to 3 billion more people living on earth as there are now. Moreover, these people will consume twice as much as now [12]. 70 percent of the people will live in cities by 2050, far away from production. These numbers tell us that environmental pressure caused by production and transportation of goods is rising and will continue to do so in the future if we hold on to our current system of supply chains.

Improvement of the production chain can have a positive effect on the Dutch CO^2 profile as shown in the diagram above. Bringing production program of consumer goods closer to the costumer base (i.e. cities such as Amsterdam) can result in the reduction of CO^2 emission caused by transport



Food consumption, 1-79-years olds.[3]

and storage of goods. These measures will contribute in achieving the stated CO^2 emission goals of Amsterdam.

The food supply chain

The second largest human impact on the environment comes from food [12]. 30% percent of the CO^2 emissions effect caused by Dutch consumers in their daily life are due to their food consumption [7]. The environmental impact of the average diet ('food print') of a Dutchman is 8 kilograms CO^2/per day [13]. The Columbia University, Wageningen University, and NASA together did a research on food demand per capita (in kilograms) [14].

The human yearly menu consists of starches, fruits, vegetables, proteins, dairy and fats. Per capita more than 550 kilos is consumed during the year. For comparison: this is almost as much as the weight of a cow. The food we consume has a certain carbon footprint. This footprint is build-up of growing, rearing, farming, processing, transporting, storing, cooking and disposing of the food.

During the production of food load on the environment is mainly generated in the form of energy consumption, consumption of raw materials, including water, emission of pollutants such as fertilizer, pesticides and greenhouse gases. Also food production has an environmental impact due to its use of land area [7].

"If all Europeans would eat vegetarian - no meat products and eggs - then the would EU achieve half of its environmental objectives before 2020"[13]

Research shows 31 transport kilometres (per truck and per boat) are needed to bring the food for a single person from the producer to the store during one year. The CO^2 emission strongly depends on the amount of kilometres and the mode of transport (overseas or locally produced).

Especially fruit and fish are mostly imported from abroad. The total import food mileage for Dutch consumption amounts to 207 million kilometres per year. Broken down, the import from the mainland (continental) is 206 million kilometres (99.4%) and the overseas import is 1.3 million kilometres (0.6%).

Decreasing the food print could be achieved by implementing different measures. Vertical urban farming could help making the food supply chain more efficient.

Impression Stadshaven project [4]

Case study: Stadshaven

Stadshaven is the city harbor region of Rotterdam. Exemplary for many cities in Europe, such as Amsterdam [22,23] , Malmö [24], commercial port activities are migrating further outside the city. Rapid urbanization puts more pressure on the post-industrial district close to the city centre. Also in Rotterdam the municipality want to transform the area in a mixed-use working and living neighbourhood.

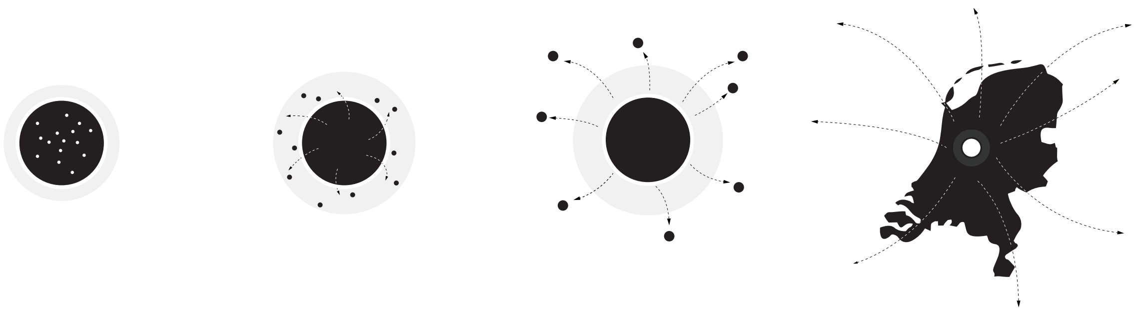
For the Merwehaven and Vierhaven (part of de Stadshaven) criteria were set up for sustainable city development. A set of these criteria regarded the self-productivity of the plan. One of these criteria was that the district is a net producer of food and clean water.

This criteria is planned to be met by the implementation of dual-functional with greenhouse production stacked over the warehouses and workshops. A fish farm is planned in a area on the East side of the district. The food balance is calculated by the means of calculation food consumption versus production based upon standards.

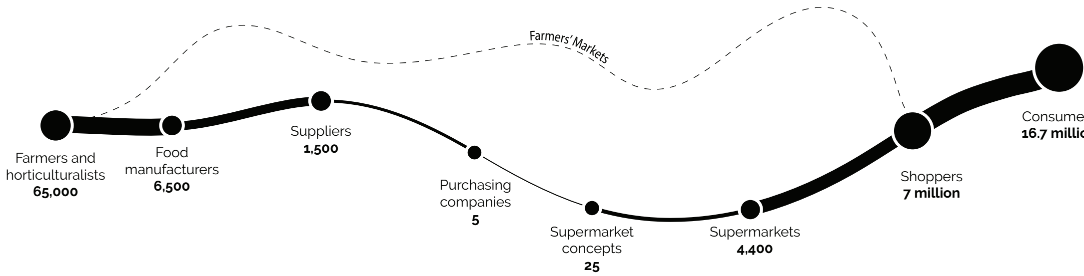
The food consumption per group per person is converted to square meter greenhouse needed per person. Research shows that one person needs 20 square meter of green house to produce the food it needs in one year. This number includes an estimation of additional infrastructure needed [14]. The number builds upon the notion that the efficient of urban food production will be bigger in the future. There will be innovative methods of food production regarding the stacking of trays of crops, efficient digital inside climate regulation and innovative nutrients. Also not all types of food are suitable to be produced in greenhouses. Fruits are preferable grown outside in public space. Also, meat production should still happen outside the city.

The estimated number of citizens (25,000) in the newly developed area is divided by the number of square meters greenhouse (750,000 m2) created in the master plan. This number could be achieved by the stacking of greenhouses on top of existing buildings and on top of each other. The need for 20m2 * 25,000 citizens = 500,000 m2 greenhouse needed is comfortably met. The over-production of good can be sold within Rotterdam.

The project does not look into the infrastructure facilitating urban food production. This should be investigated further.



The dynamic relation between industry and the city. [10]



The strong concentrations in the food chains gives the purchasing managers of supermarkets a great deal of power. [5]

Different vertical urban programs such as Square Roots in Brooklyn, New York are proving that urban food production on a large scale is feasible. To make the food supply chain more sustainable following measures should be taken:

- Reducing the footprint is possible by changing the type of food we consume. The energy load of vegetables and fruit are the lowest. Where the energy demand for animal products are the highest. Meat production is in general not suitable for vertical urban production.

- Changes is de mode of production can make the food production process more efficient. Vertical urban farming requires no soil and reduces use of water. Moreover vertical farming takes place in an extremely controlled environment taking away the chance of crop failure and increasing the efficiency.

- Transportation: especially transport by air contributes significantly to the energy demand. Producing food in an urban environment ensures short lines between consumer and producer, reducing energy of transportation.

- Buy size: About 10% of food sales are discarded. Urban food production, close to the market is causing less food surplus since production can be better tailored to the demand.

The role of production and the city

Research on the transport of goods executed by Carla Eickmann and Marcus Halder tells us something about the changing relationship between production and the urban environment.

"The progressive globalization leads to increasing distances between sites of manufacture and the area of the consumption of goods"[9].

However, this was not always the case. The relation between Dutch cities and production has been evolving constantly through history. Researchers Minjee Kim and Eras Ben-Joseph define a few key periods which describe the evolving relationship [15].

The first period is the time prior to the industrial revolution starting in the second half of the 18th century. Artisanal production took places in inner city areas. Also because of infrastructure to transport goods over long distances was lacking. Industry and housing was situated in the

From Block edge development with inner courtyards towards a free centre and neighbourhood-related facilities. Structural concept. [6]

Case study: Freie Mitte Vienna

The 'Freie Mitte' project North-East from the inner city of Vienna is one of the most important urban development areas of the city. The plot of about 85 hectares acts like a void in the dense city center. The former railway district has been vacant for many years and is currently used as an informal park by residents. Studio Vlay used a SMART strategy which resulted in the following financial, ecological and urban quality benefits.

The urban office Studio Vlay decides to, instead of filling the entire plot with flat building blocks to keep the precious open space and to own use the edges of the plot to build on with a high density. Focus of the urban plan is therefore on the design on the landscape of the urban inner space and note so much on the surrounding buildings.

This urban intervention leads in numerous ways to savings of resources. Due to the compact buildings on the edges of the plot no additional roads cutting through the area are needed. The plan relies on the existing road network. Financial savings can be used to invest in slow traffic through the inner space.

Also, the added value of the large inner space increases the value of the newly developed building on the edges of the plot and existing property of the neighbourhood. This added value can be invested through the property owners in the park.

The landscape keeps the rough and organic character of the current informal park. The financial costs of the design of the park are there for significantly lower than for an intensely designed park.

Also, because of industrial functions in the past, part of the plot contains polluted soil. The pollution is mainly concentrated on the inner part of the plot. By not building on the central area costs of cleaning and moving the soil are avoided. Moreover, the natural filling of the inner space has a purifying effect through which the pollution will slowly disappear.

Part of the developing strategy of Studio Vlay was the way they dealt in a flexible way with municipal policies on urban development. Municipal policies provide for fixed budgets for certain elements of urban developments such as infrastructure, parks, squares, playgrounds and nature. By the above-described strategy Studio Vlay made sure certain budget would remain almost untouched, such as infrastructure. Intensive consultation with the municipality took place to use untouched budgets to broad that of others. This resulted in added value for the inner public space.


88 *Producers' Classified List*

THE FARM TO TABLE PLAN

Postmaster General Burleson has designated this office as an intermediary between the producer and the consumer, by which means it is hoped to reduce the cost of living and, at the same time, provide the producer with a ready cash market. The entire plan is being worked out and conducted in the interest of the public welfare. In order that efforts in this direction may meet with the highest degree of success, the cordial co-operation of both producer and consumer will be necessary. In this connection, a careful reading should be given this pamphlet and instructions complied with in every particular.

This office cannot furnish names of those having for sale containers to be used in shipping eggs and produce, but it is suggested that firms having such containers for sale, communicate with the producers whose names appear on this list.

Inquiry Blank That May Be Used By Consumer

[SUGGESTION]

FROM FARM TO TABLE

VIA UNITED STATES PARCEL POST

TO...

POST OFFICE...

STATE...

Please send me information and lowest cash prices of the following:

..........................dozen eggs ....pounds lard

..........................pounds butter ....honey

Farm products, poultry and other articles as follows:

....

....

Please let me know how much you can send me daily or weekly, properly packed in accordance with the Postal Laws and Regulations, via United States Parcel Post.

NAME...

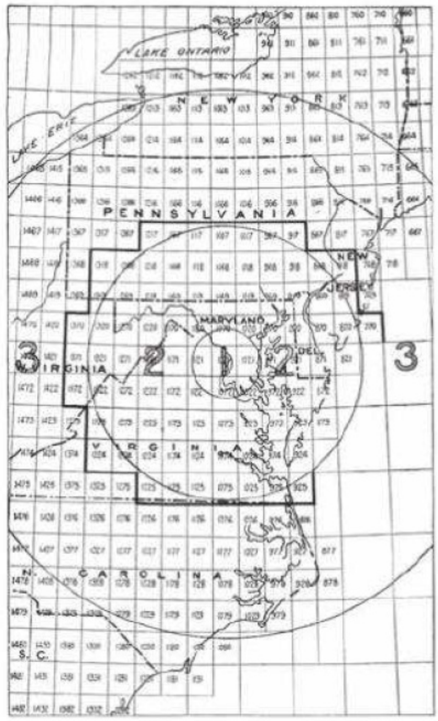
STREET and No...

POST OFFICE...

STATE...

Press of United States Post Office, Saint Louis, Missouri

Correspondence relating to the shipment of farm produce by postal motor truck service [7]



Postal zone map [8]

same areas and even within the same buildings. Amsterdam grew from the trade of goods. Examples are the numerous breweries spread throughout Amsterdam.

The second period is the one of the industrial city: 1750-1880. The first industrial revolution leads to innovations within the manufacturing process such as the invention of steam power and powered machinery. Cities grew strongly with manufacturing driving urbanization and economic growth. The Westerlijke Eilanden part of the Western inner-city of Amsterdam both housing and manufacturing coexisted. Workers lived in close proximity to their job.

The third period is the one of the planned city: 1880-1970. The community realised the consequences of polluting manufacturing industries on the residential environment. Zoning regulations had to segregate factories from living environments to provide for healthier living conditions for residents.

Amsterdam was big in clothing industries. Almost half of all clothing factories were situated in Amsterdam [16]. Industries were relocated more distant from the city centre, for example at the North bank of the river IJ.

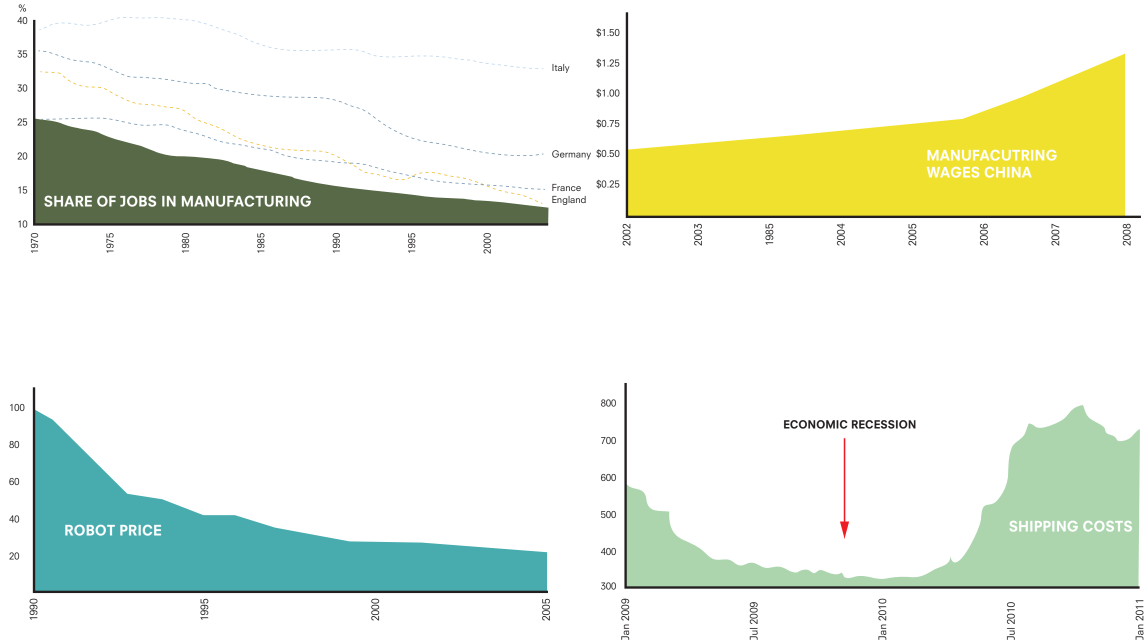
We are now in the period of the piecemeal city: 1970-present. The de-industrialisation of the city started the second half of the 20th century. Manufacturing and other functions as living and commercial space got more segregated. Producer and consumer are moving away from each other. Manufacturing is relocated to developing countries because of lower production costs. European cities such as Amsterdam are now merely focused on research, development and other knowledge-economy services rather than production [17].

The consequence of this is not merely the energy required to bridge the distance between makers and user. Consumers also lose awareness of the production process. Regaining this awareness could possibly have a positive effect on the economical use of consumer goods, reducing waste.

Shortening the chain

The diverging trend between producer and consumer causes certain issues of which some are concerned with the environment. As more and more energy is needed to bring our daily products to from factory or farm to our front doors.

Re-integrating some of the productive program back into the city can help shortening the chains



Manufacturing abroad gets less favourable [9]

between producer and consumer. Producers have a more direct connection to the consumer base in the cities.

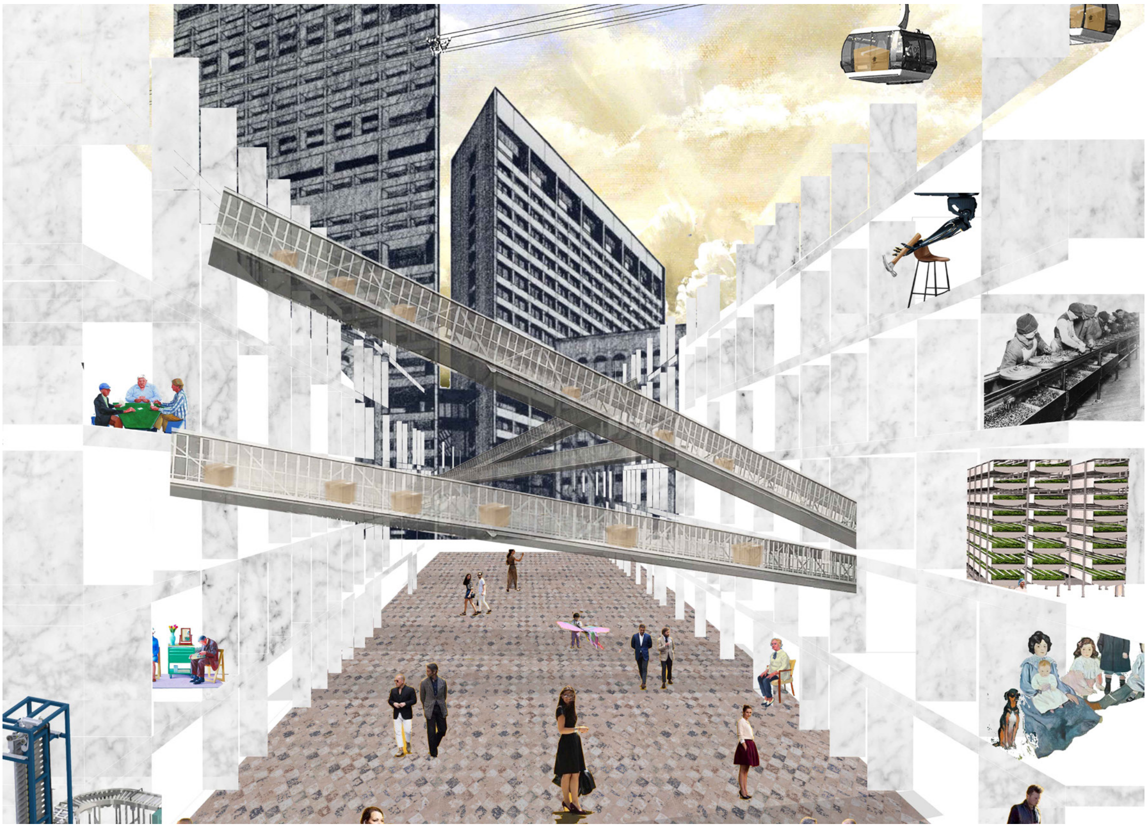
Re-shoring production in the city also makes sure that commuter traffic will decrease, since production program will locate itself both close to its market but also close to right skilled labour. In the Netherlands commuter traffic has been strongly increasing the last 10 years because working people are living in bigger proximity to their place of work [18]. People are living approximately about 20 kilometres from their work in 2014. In 2006 this was still less than 14 km. More than three quarters of these trips are made by car [19]. The city provides for both shorter connections between living and working but also a more dense public transport which would make the car unnecessary for commuting.

Farm-to-Table

A short live program which worked with this idea was already present in 1914 when the United States Post Office Department initiated an idea to ship food directly from rural farmers to urban consumers through the mechanisms of the postal system [21]. The plan relied on the existing postal logistics. The postmaster managed information on goods and pricing from farmers and spread this information through posted advertisement, and bulk mails. At the other side of the chain local consumers mailed their order for groceries' through the local post office which was then communicated to the farmers. The idea combines connecting local food production and consumers by use of existing (locally specific) infrastructure. The initiative was back then looked upon as a strong anti-middle man populism. The so called "Farm-to- Table (FTT)" program was later introduced in over twenty-eight cities. Within each of the cities the differ slight in terms of operation and was adapted to local circumstances. This was at the centre of the postal system.

The demise of the program started when the central government started to intervene The ability of the government to link the farmer and the consumer proved limited. The government intervention was aimed at achieving higher efficiencies but caused bureaucracies and therewith higher costs for both farmers and postmasters. The overly active government meant the end of the program in 1920.

The Farm-to- Table program shows the potential of local food production and direct connection to



The productive city scenario and its consequences on the urban environment of the city of 2050 [10]

the consumer. Moreover the program shows the indispensability of a platform that connections production and the community to each other in a direct way, and the need to adapt this platform to local demands and possibilities that differ from city to city and from neighbourhood to neighbourhood. The internet provides a communication system through could connect makers and users better, without intervention of purchasing companies that re-distribute food and goods.

Conclusion

Bringing producer closer to consumer helps decreasing the number of transport kilometres consumers goods have to travel to our front doors and thus the amount of CO^2 emissions. Innovative manufacturing with the help of robots will lead to cleaner production processes that can have a place within residential areas in cities. Since the use of robots will increase and the costs of robots will decrease off-shoring production facilities to low-wage countries will be less favourable. Moreover, transportation costs and labour costs in third world countries such China are rising.

Urban production of consumer goods will contribute only little to accomplishment of the goals stated by the municipality of Amsterdam. However, this paper shows a method how also other industries and businesses should look carefully into their supply chain and research ways to make these more sustainable.

Besides the advantages urban production of food and goods also has its down side. Production costs will increase. Producing companies will have to offer additional services in return such as on-demand and personalized production that will out-wage the expenses for consumers.
Urban production will only be suitable for goods for which on-demand production is suitable and of which the public values its local origin.

Productive city Amsterdam

Amsterdam became throughout history into an city which relies on consumption more then production. Bringing back production facilities into the city of Amsterdam will have its consequences on the urban environment.

The existing city and future developments are focussing on residential, commercial and working program. By adding production to the list neighbourhoods will get an increasingly varied appearance. Since urban production relies for a large part on the interaction between consumer and producer, new production facilities will have an open, transparent. This invites consumers and local residents to observe and intervene in the production process. Users see what it takes to produce certain goods. As awareness grows of the energy used for production, the more economical users will use their consumer goods

Since the production process, due to digital production and the internet of things, gets cleaner, smaller and can have alternative shapes (vertical). Implementation of the production process in mixed, dense neighbourhoods short, direct and efficient distribution lines can be realised between maker and user. These line will be both physical (visible) and digital (invisible). Personalized production will replace mass production. This results in the production of smaller batches and more on demand production. Computer interfaces help costumer to communicate its preferences to the producer. CAD innovations will reduce high production costs now associated with customized production. Moreover, customized production of user goods will increase life of service and therewith production of waste.

Footnotes

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Images

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Appendix: A circular future

The beginning of the 21st century is characterized by a major energy transition and the awareness that a more sustainable society is necessary. This transition has a major influence on the built environment of our sites in Amsterdam Central, Amstel and Zuidoost. We expect a decentralized energy network with the advantage of being more efficient, resilient, equitable and adaptable to changing conditions. Current waste will be a resource in the future. This resources will be collected and reused in innovative products to create value or function as new energy sources. Buildings will be a mix of functionalities that are connected due an immense volume of real time data in a smart and efficient way. The buildings are composed out of modular components and everlasting structures. In 2050 energy, resources and building components will all become part of a smart network, creating a circular future in Amsterdam.

Group collage of the future of energy.

Conclusion

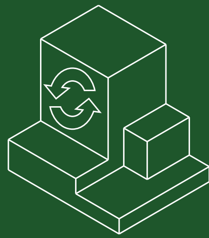
In 2050 Amsterdam has completed the energy transition from fossils to renewable energy. The city is now fully independent from fossil fuels. Energy complete generated locally through clean natural sources of energy such as the wind and sun. Also more innovative sources are used to generate energy, such as waste water and the extraction of its embodied energy and biogas. The heat produced by digital server farms is now used to run the district heating.

Energy produced by wind and sun is stored in the form of gas or liquid on a local level, close to the demand. In this way energy produced in times of small demand can be stored and demand peaks can be taken care of in later stages. Common in the energy production and storage is combined with public functions. In this way these facilities generate a certain public awareness for the origin and use of the energy we use in our daily lives, which leads to a more economical use of energy.
This connection between renewable energy production and creating higher social-economical value is for the inhabitants of Amsterdam is created by local hubs in which citizens their selves can invest in for example collective realisation of solar panels. Again community sense and public accessibility are important.

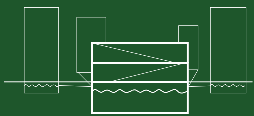
In 2050 the city of Amsterdam has managed to adapt nor only flows of energy in a more sustainable way but also flows of goods, people and material. Houses will no longer be seen as a product but more as a service. Corporation will own the complete Amsterdam building stock. Residents and tenants of office or commercial space will have a subscription on each space they use. This forces housing companies to provide for sustainable buildings. Here for they have three options. They can provide for building that last for a long time, they provide for buildings that are modular and can be demounted or buildings that are build out of recycled materials.

Also changes in flows of goods have got consequences on the urban character of the city. Most of the consumer goods will be produced locally inside Amsterdam. Due to digital production and CAD innovations production facilities can be small, clean and embedded in mixed use neighbourhoods which provides for short supply lines to the consumer base, shared facilities and knowledge institutes. Production facilities are scattered around and form local clusters, making full use of the advantages that Amsterdam provide.

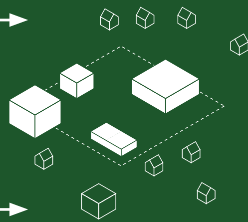
The high variety of functions and increased density give Amsterdam an advantage in terms of efficiency and productivity. New build projects city become the park of the bigger structure, it should enrich the self-sufficient system. They have to be optimised by the space use, the function needs to relate not only to the citizens demands but to the general needs of the city. Amsterdam has a flexible and hybrid space use which enables the city to adapt to future changes in needs and keep the optimum balance between green space, housing, commercial, etc.



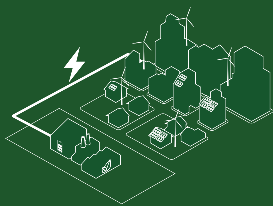
Creating Value
In the future waste does not exist. All resources are collected in a hub were new local value is created.



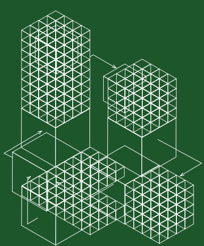
Water and its embodied energy
Gathering the wastewater for reuse of its embodied energy such as biogas and heat on a decentralised level for the sake of resilience and economic yield.



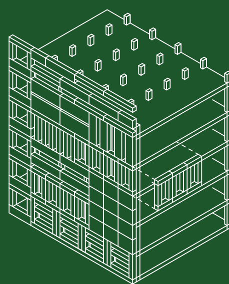
Production and the city
Making of consumer goods takes place in the city, embedded in the costumer base and close to shared facilities relate to distribution, selling, production, recycling and knowledge institutes.



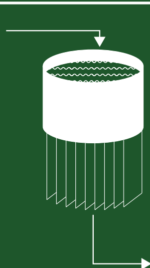
Decentralized energy systems
With an increase in local energy production through solar and wind there is a need for storage of energy. Local power to X plants can transformed the surplus into liquid or gas form.



Optimised dense city development
Cities with combined functions can operate in a more efficient and smart way. There is no longer waste of time, space and energy.



Finite resource design
The depletion of resources is an opportunity to evaluate the way we use material. To give a long lifespan to buildings and components is a challenge for the designer.



The changing face of energy
The relationship between the renewable energy industry and the cities is changed through human centred design for manufacturing facilities.

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THE POST-INDUSTRIAL PARADIGM

Constructing Alternatives for the development of the Buiksloterham area Amsterdam

The relation between the city of Amsterdam and industries has always been dynamic. From its founding industries were deeply integrated in the city. Now we find ourselves in a time in which industries are almost completely segregated from the city. This position paper describes the post-industrial paradigm in which European cities are developing their former, obsolete, industrial harbour areas. It explains the negative effect of the post-industrial approach on the social inclusivity and diversity that was typical for the former harbour areas. This paper examines different case studies in Europe and tries to use the findings to form a position on the development of the Buiksloterham area in Amsterdam. The Buiksloterham, located at the river IJ front, became a model for any city wrestling with what to do with a decaying industrial zone. Risks concerning gentrification are on the verge.

The relation between industry and the city of Amsterdam has been evolving constantly through history. Researchers Minjee Kim and Eras Ben-Joseph define a few key periods which describe this variable relationship (Kim & Ben-Joseph, 2013, pp. 2-12).
Prior to the industrial revolution starting in the second half of the 18th century, artisanal production took place in inner city. Industry, housing and commercial functions were located in the same districts and even within the same buildings. Amsterdam grew from the trade of goods. Examples are the numerous old breweries spread throughout the inner-city of Amsterdam. Industry was well integrated along other activities in the everyday life of all social-economic groups.
The industrial revolution marks the period of the industrial city between 1750 and 1880. Industrialisation leads to innovations within the manufacturing process such as the invention of water wheels, coal fired steam power, and intercity railways (Hatuka & Ben-Joseph, 2017, p. 11). Amsterdam expanded strongly with manufacturing driving urbanization and economic growth. At the Westerlijke Eilanden part of the former Western harbour area of Amsterdam both housing and industry co-existed. Workers lived in close proximity to mall industries, shipyards, and storage facilities of herring, corn, tobacco, wine, salt, anchovies, cat skins, pitch and tar).
The third period is the one of the planned city between 1880 and 1970. The city realized the consequences of polluting manufacturing industries on the residential environment. Zoning regulations had to segregate factories from living environments to provide for healthier living conditions for residents. Industries were relocated more distant from the city centre, for example at the North bank of the river IJ, in the Buiksloterham area.
We are now in the period of the piecemeal city starting from the 1970s. The deindustrialisation of the city started the second half of the 20th century. Manufacturing and other functions as living and commercial space got more segregated and relocated far outside cities. Industries are relocated to developing countries because of lower production costs due to lower wage levels and more favourable tax climates. European cities such as Amsterdam are now merely focused on research, development and other knowledge-economy services rather than productive industries (Katz, 2012). This period in can be defined as the post-industrial era, an era of consumption rather than production.

The post-industrial paradigm

The post-industrial society is described from the piecemeal city period on as a near-future society based on technological innovations such as information systems and telecommunications that would make the old non-rational system obsolete (Bell, 1976). This technocratic society is no longer based on manufacturing industries, in favour of the service sector. The post-industrial paradigm is based on the idea that through digitalisation, polluting, dirty industries and heavy physical effort could be closed and that this could be exchanged for clean, smart knowledge and service industries (Dunham-Jones, 2001, p. 10). Post-industrialism poses speed, mobility, direct action and flexibility as core values of the new modern society. In the Netherlands, same as in the rest of the Western world, the amount of jobs in producing industries decreased while more and more people started to work in offices.
Globalisation made it possible, through the use of information and communication systems, that goods are being distributed all over the world. The notion of location became less important, while the world got more integrated. Makers and users of product got more segregated and distances between producer and consumer are increasing (Eickmann & Halder, 2003, p. 1). Manufacturing program is offshored to other low-wage countries such as China or India or relocated (far) outside our cities. At the same time unemployment of unskilled labour is the result in city districts from which industry moved away.

Post-industrial urbanism

The loss of significance of place which causes a lack of materialism and physical experience is damaging the liveability of parts of our cities. The relocation of productive landscapes out of our cities have caused homogenous cityscapes which are particular apparent in former industrial harbour at the inner city edges. The everyday city and liveability for economical lower classes stay behind during the post-industrial transformation of the city.
Cities as Amsterdam are struggling to develop post-industrial areas like the Buiksloterham. How to deal with the post-industrial paradigm? What alternatives are there for developing post-industrial districts into mixed non homogenous, consumer based neighbourhoods?
Urban planners try to revitalise harbour areas through big projects such as festival terrains at the NDSM former ship wharf in Amsterdam Noord or conferential centres and cultural podia as can be seen at the Amsterdam Overhoeks area. These

developing projects tent to overlook the necessity to include all social classes. Taking the example of the NDSM wharf in which the remains of the shipping industry are now refunctioned to cultural and some residential spaces. Dr. Mari Paz Balibrea, Senior lecturer in Modern Spanish Literature and Cultural Studies at Birkbeck, University of London, argues that the socially symbolic potential of these industrial remains are reduced, since re-contextualization disconnects the old factory buildings from local history (Balibrea, 2001, p. 190). This local history of social struggles and human relationships taken place at the NDSM wharf is replaced by a promise of equality and absence of conflicts through consumption.

These urban regeneration processes of former harbour areas seem to have one goal in common, which is showcasing and selling the city as being a stylish and exciting metropolis. This approach of urban renewal is named the 'Barcelona model' by Balibrea (Balibrea, 2001, p. 187). Here the 1992 Olympics started a culture-led generation of the water front area and improvements of infrastructure. The 'Barcelona model' can be found in city renewal projects all through Europe. Particular former harbour areas are subject because these are often located at prominently defining the city's skyline. This so called 'waterfrontization' is focussing on the prestige of the city seen from abroad rather than from inside. These radical changes in harbour areas can cause a sense of alienation at the loss of their environment habitat (Balibrea, 2001, p. 189).

Case studies

This transformation has been clearly visible at Docklands in London, a former industrial harbour area in the East and South-East of London at the river Thames. The area is exemplary for many harbour cities throughout Europe, struggling with outdated harbour area in close proximity to the inner city. Often the traces of the past are still apparent in forms of pollution, large paved surfaces and building remains. When in the second half of the 20th century ships became too big to research London's dock, industrial program was pushed further outside the city. From the 1980's de area rapidly evolved into neighbourhoods dominated by high end office space and residential buildings. The London Docklands Development Corporation (LDDC) failed to maintain the social inclusion of local residents. Gentrification occurred since local resident were not able to apply within the new comer finance and media industries at Docklands. The city development did not provide for suitable housing for lower-income households (Muskett, 2014).

A similar case can be found in Malmö. Malmö in Southern Sweden has lately developed the post-harbour area called Bo01 within the Västra Hamnen district (Danish Architecture Centre, 2014). The waterfront development includes about 600 dwellings, offices, shops and other functions. The new urban plan is said to be focused on sustainable solutions right from the initiation. The district produces for a large share its own energy. This is made possible by means of wind turbines, solar panels on the roofs and thermal hearting. Despite good intentions the area lacks diversity and is mainly home to healthy, highly educated, white, native residents. This homogenous population has to do with the housing prices that starts at around twice the national housing prices in Sweden (Danish Architecture Centre, 2014).

Buiksloterham

Like many European cities Amsterdam is growing fast in terms of inhabitants. At this moment Amsterdam has about 835.000 inhabitants but by 2020 this number will be 871.000 and in 2040 this could be around 1 million. Therefor the municipality decided to build around 70.000 houses between 2010 and 2040 (Gemeente Amsterdam, 2011, p. 91). The city hereby focusses on the ring zone, the area around the ring road A10, in general, and the Buiksloterham area in particular.

The Buiksloterham area in particular, is one of the areas of interest. Were before there was only small interest, now The Buiksloterham area located at the North side of the river IJ is the last 10 years on the agenda for large-scale redevelopment (Gladek, Odijk, Theuws, & Herder, 2014, p. 25). The former industrial harbour area will be transformed into an urban mixed use area for working and living. The Buiksloterham development is part of a bigger structural vison by the city to expand the inner city area.

The Buiksloterham area is exemplary for cities struggling to develop former industrial districts located in close proximity of the city centre and part of the prominent waterfront skyline. Rapid urbanisation puts more pressure on this valuable land.

The Buiksloterham polder was first instance merely used for agricultural purposes. Later the area became home to a Fokker airplane factory, a Shell oil laboratory, a large shipbuilding company and other manufacturing businesses. Also the worker neighbourhood Volewijck is planned along the Noord-Hollandsch Kanaal.

Already since the last decades the Overhoeks district, part of Buiksloterham transformed rapidly. Large building projects have been realised, focussing mainly on high end residential buildings, cultural amenities such as the EYE museum, Adam-

tower and office space.
Richard Marshall describes waterfronts as important places in the city were cities van showcase cultural expression (Marshall & Marshall, 2004). The prominent Overhoeks waterfront area seems to distract attention from issues such as employment, housing and public transport.

Renewed relation industry and the city

I would plea for a more local approach to the development of former harbour sites. Healthier balances of uses and users could help to develop the Buiksloterham in a more inclusive way. Over the past decades Buiksloterham lost it productive function and left only with consuming program. The high end housing, schools, cultural, knowledge based amenities now realised at Buiksloterham have behaviour merely consumption and wasting and lacking promoting the community environment. A more balanced use of the area would mean also taking productive economical program into account during devilment. Clean productive industry that recalls the relation between city and industry as it used to be during middle ages. Inclusivity is accomplished as urban manufacturing improves opportunities for less-educated workers as well (Katz, 2012, p. 127). This way of placed-based and thus locally driven urban growth could turn the post-industrial paradigm of former harbour areas into an urban business card to attract tourist but connects to the interest of local residents. It places emphasizes on the community environment (affordable housing, social activity).
The Buiksloterham area, as having a strong historical relationship with industries of all kinds, seems to be a feasible place to enhance local industrial activities as it provides for existing industrial building stock, infrastructure and zoning regulations that allow for this.

Conclusion

From industry deeply embedded in the city Amsterdam is currently struggling with revitalizing the former industrial harbour area of Buiksloterham. On the basis of literature the post-industrial paradigm in the urban planning of similar cases is revealed. Through digitalisation and comprehensive information systems heavy industries, seen as dirty and pollution could be replaced with clean smart society based on the knowledge and service economy. Makers and users first in close proximity to each other moved further away from each other. Loss of significance of place (think of the digital city halls, in which citizens can manage their administrative duties regarding the municipality (Dunham-Jones, 2001, p. 13)) has let to decrease of liveability of lower socio-economic classes living in former industrial areas. Known strategies of harbour revitalization such as refunction of industrial remains or using the waterfront areas as billboards for the city proved unsustainable, as they do not take into account underlying issues such as employment and housing.
Therefor a more local approach is needed. This approach aims for a better variety of users and a better balance between consuming and producing. 'Reshoring' production facilities is promoting social inclusivity that, in the end, will transform the Buiksloterham area into a liveable place for everyone.

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THE MANUFACTORY AFTER THE 4TH INDUSTRIAL REVOLUTION

Architectural consequences of advanced manufacturing on the urban factory

The Fourth Industrial Revolution is reshaping the architectural form of production of our consumer goods (Romero, Stahre, & Taish, 2017). Due to digital manufacturing a different approach is needed to the design of these manufacturing facilities on both an urban scale as on an architectural scale. This paper is examining these new approaches starting from a brief historical overview including the major events that shaped the factory typology in the past, such as the invention of cast iron, steam engine, electric light, commercial escalator and later on computer aided manufacturing, 3D printing technologies (Rappaport, 2016, pp. 12-33). After, the major trends in advanced manufacturing are described which have the biggest spatial influence on the future factory. New technologies such as digital additive manufacturing made the production process more quiet, cleaner and smaller. Lastly, this essay is explaining the spatial consequences of the trends described on the factory typology. The future factory typology has to become, on an architectural scale more physical transparent, adaptable, flexible and dense. The paper concludes with a brief reflection related to the lecture by S. Kousoulas - The undetermined hand; architectural technicities.

Keywords: advanced, additive manufacturing, rapid prototyping, hybridity, neo-cottage, industry 4.0, consumer goods, manufactory, production

Introduction

The evolution of manufacturing had its influence on the typology of the factory from the start of its existence. Prior to the 1st Industrial Revolution production took place mainly in individual households, closely integrated with residential and commercial activities (Hatuka & Ben-Joseph, 2014, pp. 26,27). In Amsterdam and other Dutch cities workhouses were built in the late 18th century in which poor could work on a more or less voluntary basis. There were also more mandatory types of workhouses meant for convicted people who had to work and produce for the common good. Workhouses are seen as the earliest example of a factory-like typology in the Netherlands (Schmidt, 2003). The introduction of mechanical production facilities and water and steam power meant the introduction of the factory typology in the Netherlands around 1830. The first factories were situated within the city. Manufacturing became de driving force behind the growth of population (Hatuka & Ben-Joseph, 2017, p. 11). The 2nd Industrial Revolution is characterised by the emerge of the assembly line that made mass production possible with the help of electricity. Products were being produced in larger batches. Industrial activities grew and due to pollution and development of the infrastructure system were eventually pushed outside the city boundaries. Factories moved out to the industrial hinterland and later on to low-wage countries (Hatuka & Ben-Joseph, 2017, p. 12). As a result, Western cities are predominantly focussed on consuming rather than consuming (Katz, 2012, p. 125). After the third Industrial Revolution the production process became more automated and robotized thanks to advanced IT systems.

Currently, we find ourselves in the middle of the fourth industrial revolution. Innovations such as 3D printing and scanning, new advanced materials, connected machinery and advanced robotics have great impact on the way we produce in the future (Giffi et al., 2015). Advanced manufacturing leads to a quieter, cleaner production process of our consumer goods which can happen on a much smaller scale. Starting from the end of the 20th century production companies are locating their manufacturing facilities back into the city. Reasons for this are for example the proximity to the consumer base, availability of skilled workers and the possibility to form connection between other entrepreneurs (Rappaport, 2016, p. 331). On the other hand, production costs abroad, such as wages and shipping costs, are rising, which makes offshoring production facilities to low-wage countries less favourable. At last, prices of robots that can replace human labour are decreasing (Koerner, 2011).
"Changes in advanced manufacturing technologies as well as the economics of manufacturing have significant implications for the location and spatial organization of production."(Reynolds, 2017)
The relation between production and the city of Amsterdam will be restored. Changes within the production process will have spatial consequences on the layout of the factory typology as stated by Elisabeth Reynolds, Executive Director of the MIT Industrial Performance Centre. This paper is trying to construct an answer to the question: What are the consequences of innovation in digital manufacturing on the architecture of the contemporary manufactory? The focus hereby lays on production of consumer goods in an urban context in the city of Amsterdam.

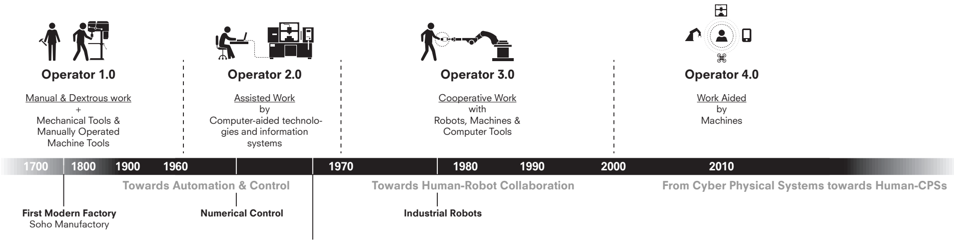

Figure 1: Generations of operators in manufacturing. Own image based on (Romero, Bernus, Noran, Stahre, & Fast-Berglund,

Industry 4.0

Industry 4.0 can be described as a revolution in the way operators and machine interacts that has an impact on the working environment as can be seen in figure 1. Humans and machines do not work independently from each other but cooperate and co-exist (Romero, Bernus, Noran, Stahre, & Fast-Berglund, 2016, p. 1). The operator of the industry 4.0 is performs task aided by machines if needed. The central position of the human operator is not replaced by robots but strengthened. Symbiosis between human and automation can have positive effects on the sustainability of the workforce. For example in terms of safety, health, satisfaction and motivation (Romero et al., 2016, pp. 8,9)

Advanced manufacturing

Rapid prototyping is a collective name for different techniques to quickly produce physical prototypes (Wong & Hernandez, 2012, p. 1). Additive manufacturing is the process of producing physical objects from 3D model data. This technique is now mainly used for prototyping but later will be used within the actual production process. These objects are built up layer by layer, which is more commonly known as 3D Printing. This is in contrast to conventional techniques where parts are assembled into the final product. Parts that are fabricated by conventional methods such as mould casting. Additive manufacturing is a collective term for different print techniques such as Fused deposition modelling (FDM), Selective laser sintering (SLS) and Stereo lithography (SL). (Wong & Hernandez, 2012). Figure 2 shows the underlying principles behind the different techniques

With Fused deposition modelling (FDM), a plastic filament or metal wire is unwound from a coil and supplies material to produce a part layer by layer. Thus, FDM is a solid-based. (Taufik & Jain, 2016). During Selective laser sintering (SLS)
a laser is used as a power source to melt, powdered material (this can be for example nylon or polyamide) layer by layer into a solid product. The powder is binded which creates a solid structure. Stereo lithography (SL) is a technique during which a solid form is 3D printed when a laser beam touched a liquid plastic layer by layer. The liquid material is transformed into solid. In this way a solid shape appears (Wong & Hernandez, 2012).
All 3D printing techniques are similar in their used principles but differ in the phase and phase transition from raw material to final product and the source of power. These innovations have numerous advantages in comparison to conventional production techniques. Goods can be produced in less time, with use of less material, and with less work surface needed.

Dense manufacturing

Manufacturing in a dense city environment with relatively high ground value makes it favourable to build high density production facilities. Since the required space for production and technologies are shrinking thanks to new methods of production, the making process can take place on a smaller plot. Another way to achieve high density is to create the multi-storey factory typology (Rappaport, 2016, pp. 437,438). New production technologies make it possible to organize the line of production in a vertical way. Robots different than factory workers are less ground bound.

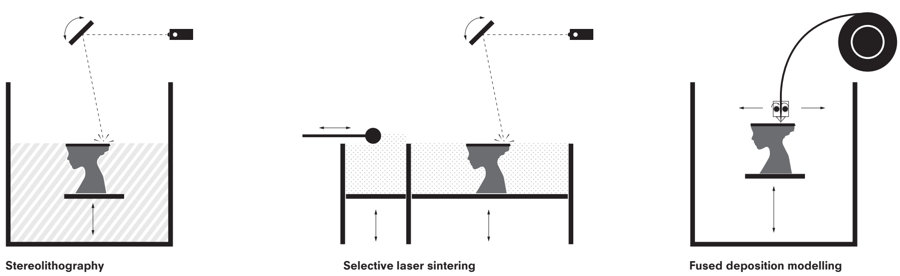

Figure 2: Additive manufacturing. Own image based on (Wong & Hernandez, 2012).

Systems such as vertical and spiral conveyors and freestanding elevator systems increased internal mobility (Rappaport, 2016, p. 330). However, this requires for changes in regulations since current zoning rules do not allow for multi-story industrial developments in most cases.
Moreover, density and infrastructures proves to have multiple advantages over the urban sprawl model, namely: conservation of land, energy, commuting time, carbon footprints and social and other natural resources (Rappaport, 2016, p. 438).

Transparency

As the production process becomes more quiet, smaller and cleaner. This allows companies to commodify the production process itself. Architectural critic, curator, educator, and consultant Nina Rappaport, defines this as the 'consumption of production' (Rappaport, 2016, pp. 438,439). This trend requires the factory typology to become more physically transparent. This allows for the consumer to behold the production process and the workers and get an understanding of the way goods are made. The visibility of the factory becomes a tool of branding (Rappaport, 2016).
The automotive industry is already working with the notion of transparency for a longer period. An early example of this is the assembly plant build in 2001 by the Volkswagen Company in the inner city of Dresden, Germany to produce the new Volkswagen Phaeton. The plant was named 'The Transparent Factory' (Comeron, 2009, pp. 167,168). The factory design was a reaction to the changes in labour and technological society in the way new technologies made it possible to strengthen the connection between costumers and the product. Visibility of the production process is achieved by the glazed facades and glass bridges over the production floor.
The notion of transparency nor only covers the visibility of the process to the outside but also the engagement of public with the process by offering possibilities to learn and get educated. (Rappaport, 2016, pp. 440,441). The VW Transparent Factory in Dresden integrates an educational centre and recreational services. This trend means in a sense the blurring of the conceptual borders between factories, museums and theatres (Comeron, 2009, p. 170). Moreover, this can be explained as the blurring between "material labour (production of durable goods) and immaterial labour (production of meaning, relations and affects)" (Comeron, 2009, p. 170). However, the transparency of the VW Factory is not absolute. Certain elements of the process are hidden outside the public view, such as the underground expedition and the producing of the prefabricated parts outside the factory in Dresden.
The production plant as a branding element will have its effect on the overall design of the factory. In the Modernist period, architects started to experiment with light, air and open workspaces. This can for example be seen in the Van Nelle Factory in Rotterdam with its large glass façades and glass bridges transporting products and connected the different stages of the supply chain. After de 2nd World War factory buildings started to look like sealed sheds mostly due to practical needs of wartime manufacturing. The public function of the factory building will again be emphasized and architects will refer back to the first half of the 20th century as a time of experimentation. If the factory will again by viewed at as an element of spectacle, its architecture needs to represent this. In an programmatic way this could be done by integration of a showcase (Rappaport, 2016, pp. 344,345). An exemplary and contemporary project is the Financial Times Building in London's East India Dock, built in 1988 by Nicholas Grimshaw. The glass façade reveals the printing process, starting from blank paper to the finished newspaper. The transparency is an analogy for the free press freedom and the western open society.

Flexibility and hybrid factory layouts

The factory of the future needs to be more flexible. Since advanced manufacturing is not bound to a specific product of production line the future factory needs to be able to adapt to changing operation environments (Hargrave & Goulding, 2015). Additive manufacturing techniques can produce a wide range of products without making changes to the mode of production. Through flexibility factories should be more able to react to different demands from local markets. This is particular important when producing in an urban environment close to the customer base. Not needing a specific production line for a specific product means that there could be saving of space resulting in smaller and more compact production facilities.
Modernist separation of functions between residential and industry leaded to segregation between the city and industry and mono-functionality. This way of zoning was not limited to the city scale but also played out on the scale of the factory building itself. Smaller, greener and cleaner technologies allow for combining commercial, residential and manufacturing uses in hybrid spaces. The combination of different program can result in synergy and possible cluster forming through economic diversity (Rappaport,

2016, p. 449). In this way services could be used by production facilities as by the surrounding neighbourhood. This can be seen as an integrated version of the company towns, such as the Agnetapark in Delft, build in 1882 and owned by the Royal Dutch Gist and Spirits Factory. This complex included besides the factory building, workers homes, shops, guesthouses, workshops, laundry and bathing facilities and a park (Vries, 1978).

An example of urban synergy accomplished by a hybrid factory arrangement is the Arcola Energy plant in London's East End that produces hydrogen fuel cell systems. Here the factory is combined with a theatre with two stages and a café. The theatre profiles itself as a carbon neutral cultural centre. The added program functions as a testing lab for the products manufactured at Arcola Energy and implemented in the lighting, energy products and solar power installations (Rappaport, 2017, p. 79).

Currently the different stages of the supply chain are geographically situated apart from each other. This can be seen for example in the instance of the Nike shoes supply chain. Design and innovation takes places in Portland in the US. Leather is harvested in Brazil. The actual fabrication of shoes takes places in factories in South Korea, Taiwan and Indonesia and Vietnam (Rappaport, 2016, p. 428) . The last countries are mainly selected on the basis of low wages on a local level, favourable tax climates and lax environmental regulation (Katz, 2012)

The strong distinction between the different elements of the supply chain will be disappearing. Programmatic elements will instead be compressed and combined. Additive manufacturing, now mainly used for rapid prototyping (Research & Design) purposes, will have greater impact on the actual large scale fabricating process. Further integrating R&D with manufacturing is proved to enhance innovation (Reynolds, 2017, p. 25). Thus, architects needs to find smart solutions for combining different program related to different stages of production.

Lastly, emerging technologies bring new types of program with them that the future manufactory needs to incorporate. Figure 3 shows to evolution from traditional manufacturing to advanced manufacturing. Traditional manufacturing of the 20th century is a linear process. Raw material is fabricated into parts which are assembled into finished products. Advanced manufacturing includes material design, the recycling of material and the integration of software into products. These changes in processes naturally require changes program. Conclusions

The change from traditional manufacturing to advanced manufacturing resulted in the restored relationship between production and the city. New technologies such as human-automated symbiosis and additive manufacturing will have impact on the physical form of fabrication. Manufacturing, with the help of new technologies, will be arranged in a dense and vertical way, to be financially and environmentally sustainable in an urban context. Secondly, future manufactories will become more transparent towards to public as a tool of branding and to create greater awareness with respect to how products are made. Moreover, the architectural expression of the factory building will gain importance as the factory becomes an element of spectacle. Lastly, the spatial layout of the factory needs to allow for changes in production, to be able to quickly react on differentiations in customer demand. Flexibility and hybridity is also needed when accommodating

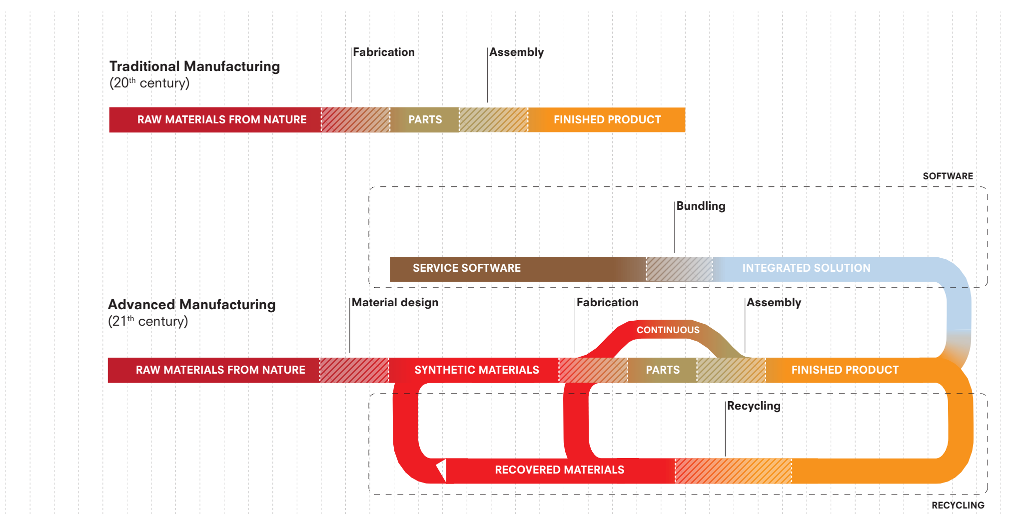

Figure 3: Traditional manufacturing & advanced manufacturing. Own image based on (Reynolds, 2017).

and combing different production program that was first separated. Also, new technologies result in a need for new programmatic spaces related to recycling, material design and software design.

New Urban Questions

This essay relates to the lecture by S. Kousoulas, "The undetermined hand; architectural technicities". Here it is stated that "any technical object is a mode of relation between humans end their environment" (Kousoulas, 2017). Factory typology and its evolution trough time is closely related to technological innovations that have defined the different industrial revolutions, as is the architectural style of the factory. Kousoulas states "to belong to the same style refers directly to the tools shared and not to the intentions. One comes across style when one examines how an assemblage operates"(Kousoulas, 2017). To determine the typological style of the factory now and in the future one needs to look closely into the "assemblage" or method of production.

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REFLECT

REFLECT

Project describtion:

The project is named "The Urban Manufactory: From the Post-Industrial city to the Productive City. ". Amsterdam has become a city predominantly focused on consumers. Makers and user are drifting away from each other, which results in environmental pressure, mental disconnection from the production process and loss of potential provided by the urban environment. Recent trends allow for restoring the relation between the production process and the city. Offshoring production is getting less favourable since production costs in developing countries are increasing. On the other hand, prices for robots replacing human labour are decreasing. Digital fabrication, such as additive manufacturing techniques and other CAD innovations bring back the essence of craftsmanship, namely, on-demand, personalized production of 'batch-size-of-one', tailored consumer goods with a high efficiency, available for all. The Urban Manufactory embeds production program (again) in the urban context and enables interaction between consumer and producer. The building consists of a tower volume in which production floor are stacked. Products leave the building, after assembly, packaging and storage, through are. The production tower has a strong vertical layering starting from a public zone to a service core intended for the vertical circulation of goods and material. The tower sits in a base volume that contains program that has a supportive function. Here a research centre, for the development of material and machinery, an education – and knowledge centre that educates the public regarding digital fabrication, retail, and hospitaly, both used by public and employees, is situated.

Relationship between research and design.

Research done during the P1 and P2 stage of the graduation has informed greatly in the design phase and all aspects of the design phase, thus: site, building program, build form, to the detail. The Complex Projects studio, known for a strong research based design approach provided a method and tools that helped me in connecting hard research and the implementation of this research into architecture. This methodology is especially crucial when designing for an uncertain context, namely that of a city in 30 years.
I started off with an interested in the way the future city of Amsterdam deals with its resources in a more sustainable way. I found that to a large extend the city is a consumer more that it is a producer. More delineated I focused on how Amsterdam dealt with production in the past and how this changed over time and what trends in the production

landscape are for the future. After constructing a scenario of Amsterdam projected as a productive city by 2050 research was done how architecture can play a supporting role in enabling this scenario. The re-shoring of manufacturing program especially that of consumer goods, in the city raised challenges on both an urban- and architectural scale. On an urban scale the future factory had to be integrated in a yet to be developed part of the city, the Buiksloterham district. On an architectural scale, the factory typology had to be rethought in a way that it can enhance the interaction between consumer and producer. Next to this, research done on current and future state of the art production machinery informed me architecturally and made me aware of the technical possibilities of the future factory.

Relationship between graduation topic, the studio topic, the master track and master programme.

The project needs to be seen in the bigger framework of the Complex Projects Graduation studio. The methodology of complex projects is based on working with different scales and cultural contexts which give complexity to the assignment. The AMS Mid-City studio is dealing with a future vison of the city of Amsterdam. Therefor the studio is looking into the whole spectrum of the city, from the city centre to the suburbs. The Amsterdam 2050 vision is set up from the perspective of the three most important issues that the future city is dealing with, namely: energy, health and mobility. All in the broadest sense of the word. The Urban Manufactory is focusing on how the city of 2050 is dealing with energy and more in general resources. In 2050 Amsterdam deals with resources in a more local and decentralized way. In 2050 Amsterdam has completed the energy transition from fossils to renewable energy. Energy is generated and stored locally thought natural resources such as wind and sun. In an extension of this goods will be produced more locally. When designing for Amsterdam in 2050 it is crucial to a bigger vision on the scale of the city. Thereafter the consequences of this vision on the scale of the neighbourhood, building and scale of the detail can be determined.

Elaboration on chosen research method and approach in relation to the graduation studio methodical line of inquiry, and reflection upon the scientific relevance of the work.

The Complex Project graduation studio methodical line of inquiry is divided into two stages. The P1 stage is focussing on understand and investigation of the site. This is done through hard data such as historical development in a group setup. Already here one can explore a personal fascination and initial suspicions. More in-depth research is done on the specific topic of interest (resources) and a site related theme (industry). The P2 stage focusses on spatial research and development of the program and thesis ambition. A preliminary program proposal is developed, the immediate site local and a detailed understanding of the program requirements and needs of the site. The tools for inquiry provided by the studio were: excursion, wallpaper mapping, site model, site book, seminar research book, presentation, poster, personal book, drawing set and building model. Using these tools and following this methodology helped me gradually leading to the specific topic of urban production.

Elaboration on the relationship between the graduation project and the wider social, professional and scientific framework, and the transferability of the project results.

The case of Amsterdam 2050 does not stand alone. Many European cities have been facing a decay of manufacturing activities over the last centuries. The thesis describes possible future changes of the production landscape and the possibilities this could bring for these cities. Decentralized, small scale manufacturing activities that are situated close to the customer base to enhance interaction between maker and user can therefore be implemented elsewhere.
Next to spatial transferability the project also has a certain social transferability. The project is based on a scenario in which consumers behave

differently than they currently do. The daily routine is influenced by the way people buy customized and tailored consumer goods close to their living environment in collaboration with the producer. Interaction and the actual experiencing of the production process will take away the alienation that the public experiences now.
In terms of professional transferability this project proposes a far going scenario and architecture of which professional sustainability lessons can be learned also in a more short-term view. Bringing producer closer to consumer helps decreasing the number of transport kilometres consumers goods have to travel to our front doors and thus the amount of CO_2 emissions. Innovative manufacturing with the help of robots will lead to cleaner production processes that can have a place within residential areas in cities. The thesis shows a method how also other industries and businesses should look carefully into their supply chain and research ways to make these more sustainable.

Ethical issues and dilemmas encountered in doing the research, elaborating the design and potential applications of the results in practice.

The first issue and dilemma the project had to deal with is a degree of uncertainty. Although dealing with a certain degree of uncertainty is inherent to the practice of architecture, architecture is a slow practice and changes of all kind can occur during the process of after that influence the final result. However, the studio topic, the city of Amsterdam in 2050 contains an ever greater uncertainty to deal with. Future trends that define the city are hard to predict. Moreover, the topic that the project is dealing with, namely the shifting manufacturing landscape and the possibilities this brings for the city has also a certain uncertainty with it. Technically speaking, future manufacturing techniques that physically shape the form of the manufactory are impossible to fully predict.
The issue of uncertainty is dealt with in two ways, namely building a scenario and degree of indefiniteness or flexibility. On a large scale, a shared group strategy for the city of central district of Amsterdam in 2050 is constructed by means of a scenario. Decisions are made on the basis of research but they hold a degree of subjectivity and therefor they are assumptions. But this way of scenario thinking helps to, in a later stage, design a building within this future reality. An example is the development of island in the river IJ and therefor the narrowing of the waterway. The feasibility of this intervention is based on research on self-propelled ships that are less depended on sight in the bend of the river, de large demand of housing close to the inner city and the demand for water-rich living environments.

The same scenario thinking is applied in the design stage in which some assumptions are made. An example if the future transport and delivery of parcels through air. This is based on recent extensive initiatives of drone delivery by Amazon and Google. (Wang, 2016).

On a small scale, that of the building itself, the method of indefiniteness or flexibility is used. This means that certain elements of the design are left open on purpose to not lose the project in defining the building to the 'the last brick' that can be defined yet. Moreover fully defining these elements is not unnecessary for the overall concept and the functioning and organisation of the building. An example of this is the production machine techniques that are used in the building. The additive manufacturing machines are defined as enclosed modular boxes with their own inside microclimate, material supply, dust and fume drain and waste material drain. Important when designing the production floor is that future evolutions of the machines can fit in the set framework of production and transport.

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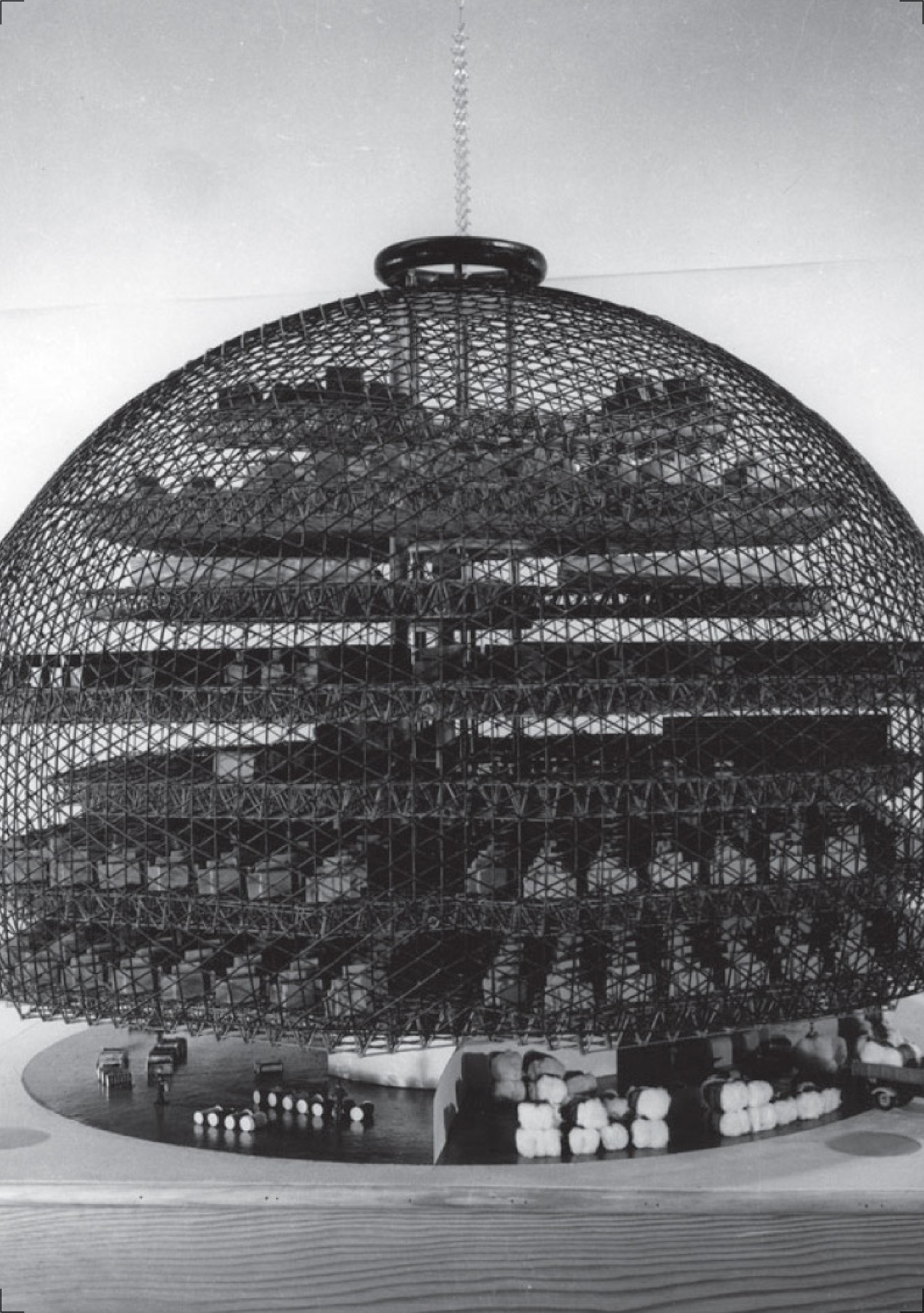

LITERTURE

LITERTURE

BIBLIOGRAPHY

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DOCUMEN-
TATION

/DOCUMEN-TATION

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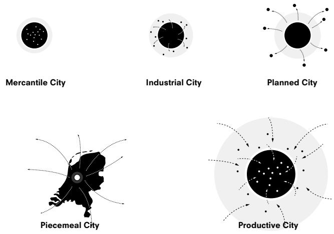
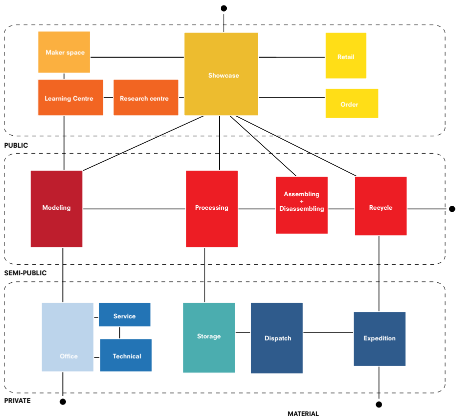
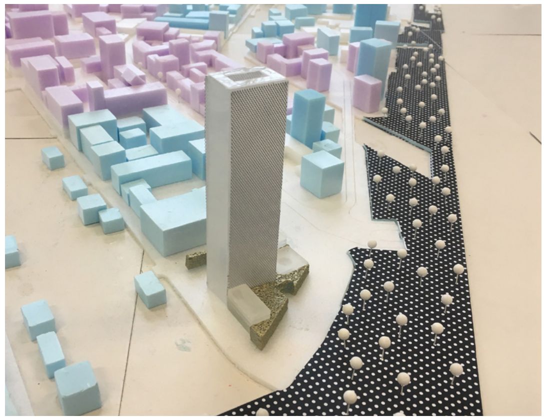


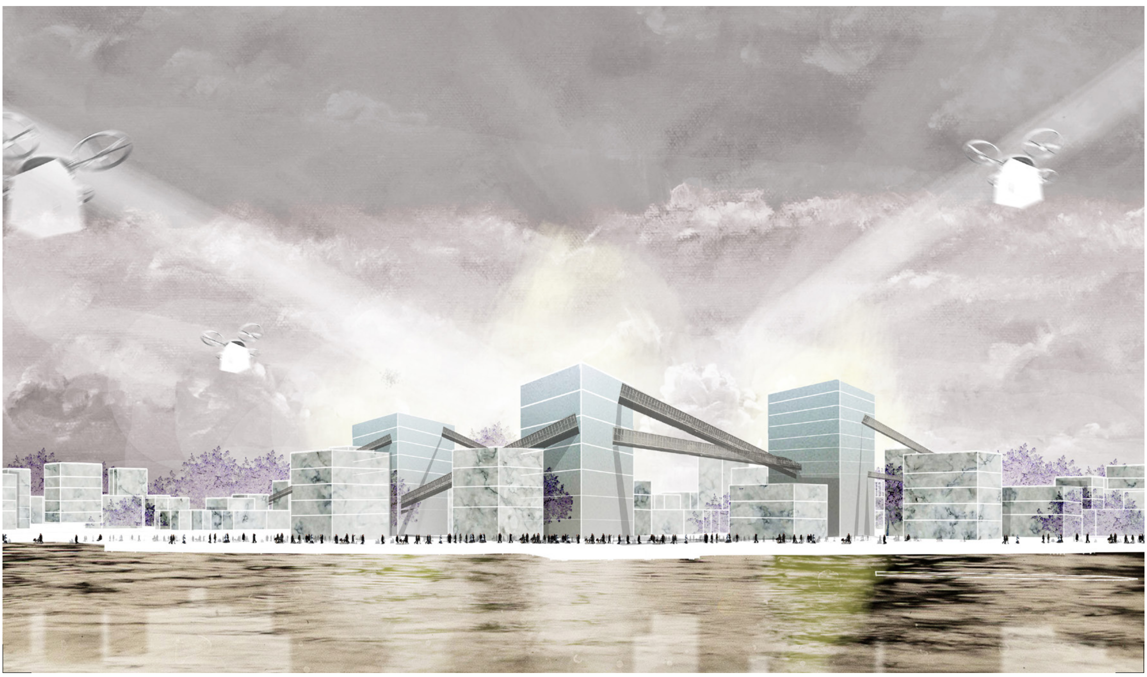
THE URBAN MANUFACTORY

FROM THE POST-INDUSTRIAL CITY TO THE PRODUCTIVE CITY

Sebastiaan van Arkel







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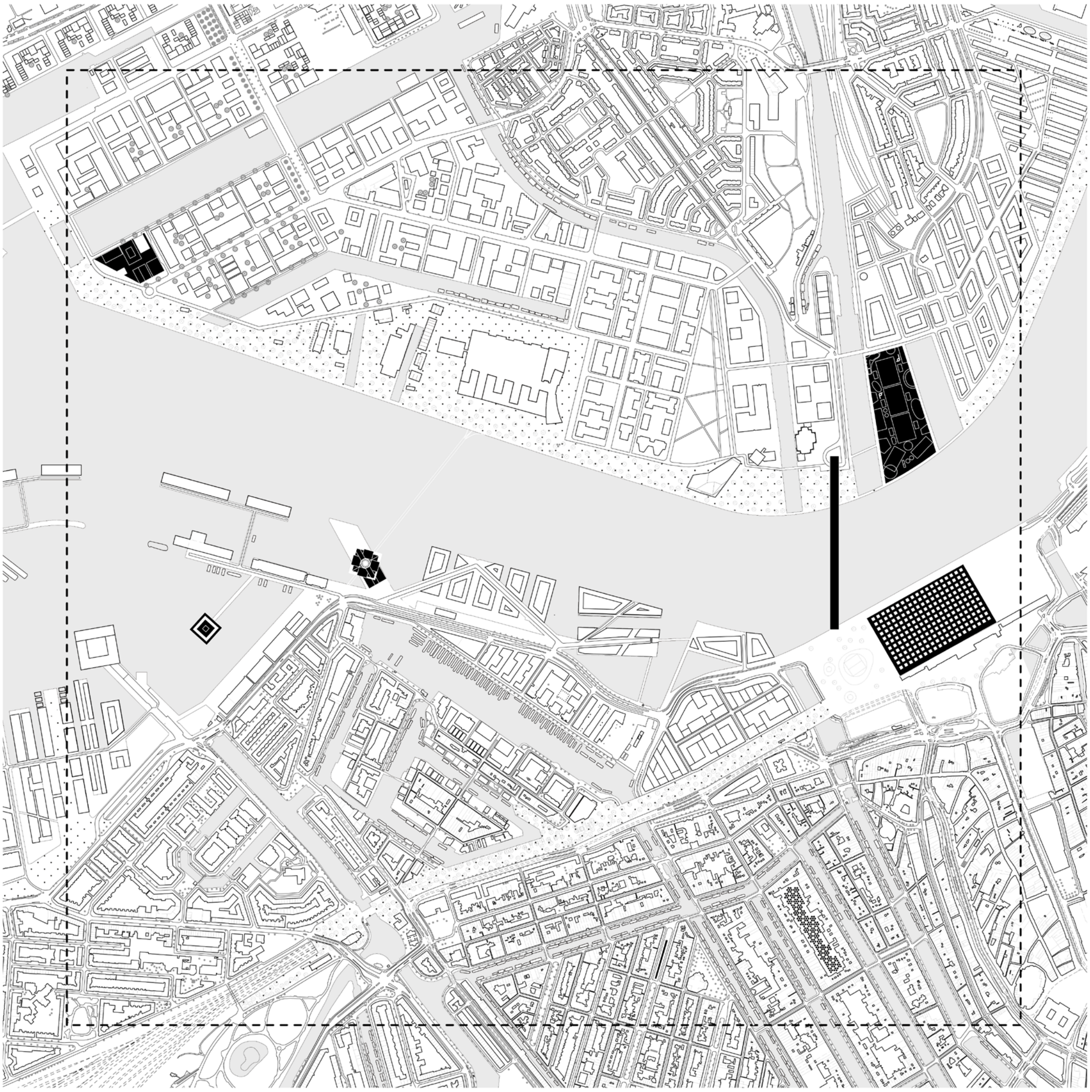
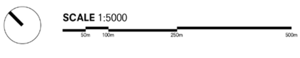
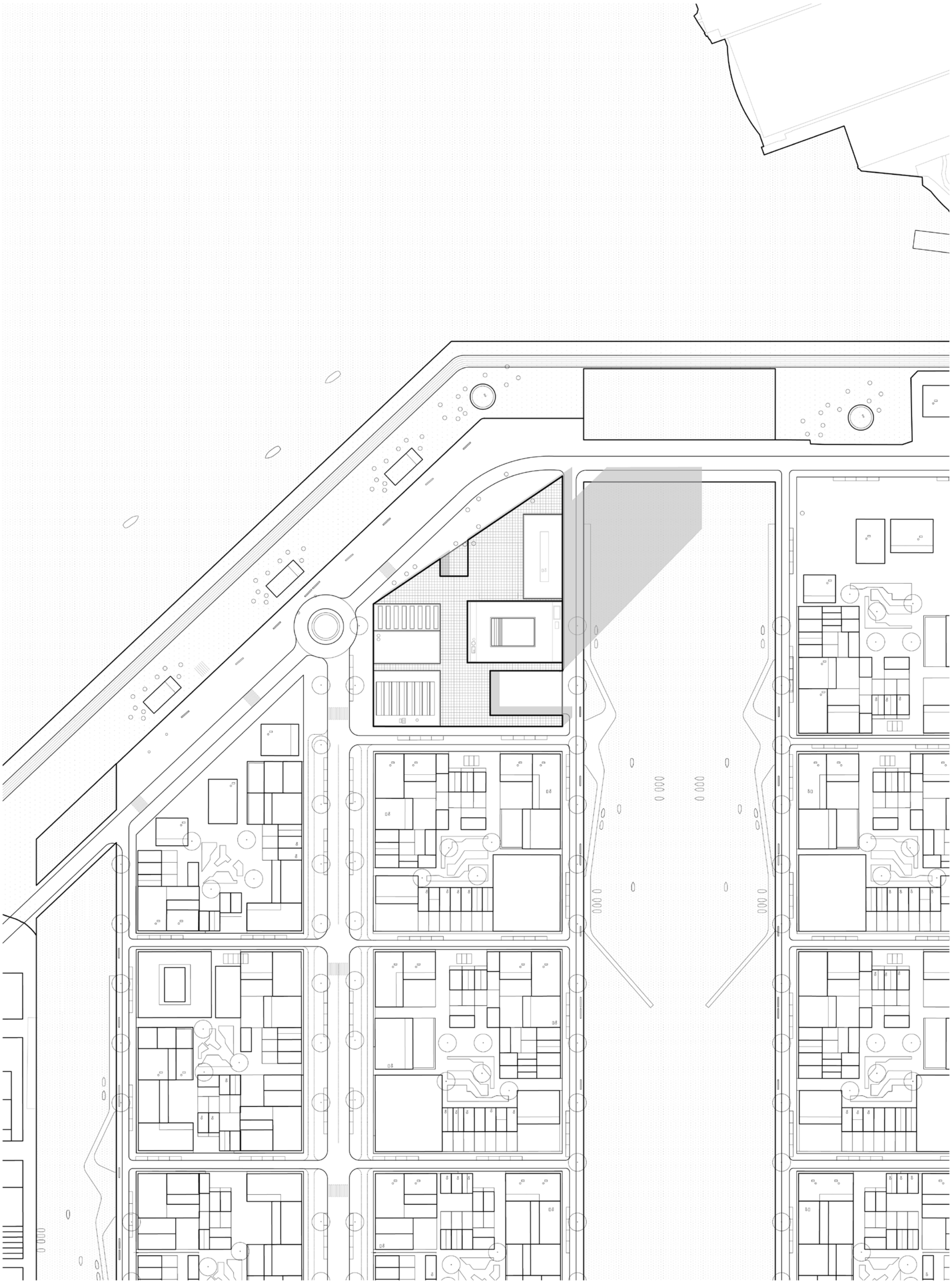




PLAN **LOCATION**

caption.[i1]

SEBASTIAAN VAN ARKEL
4161866
DECEMBER 2017



SCALE 1:1000
10m 20m 50m 100m

PLAN **SITE**

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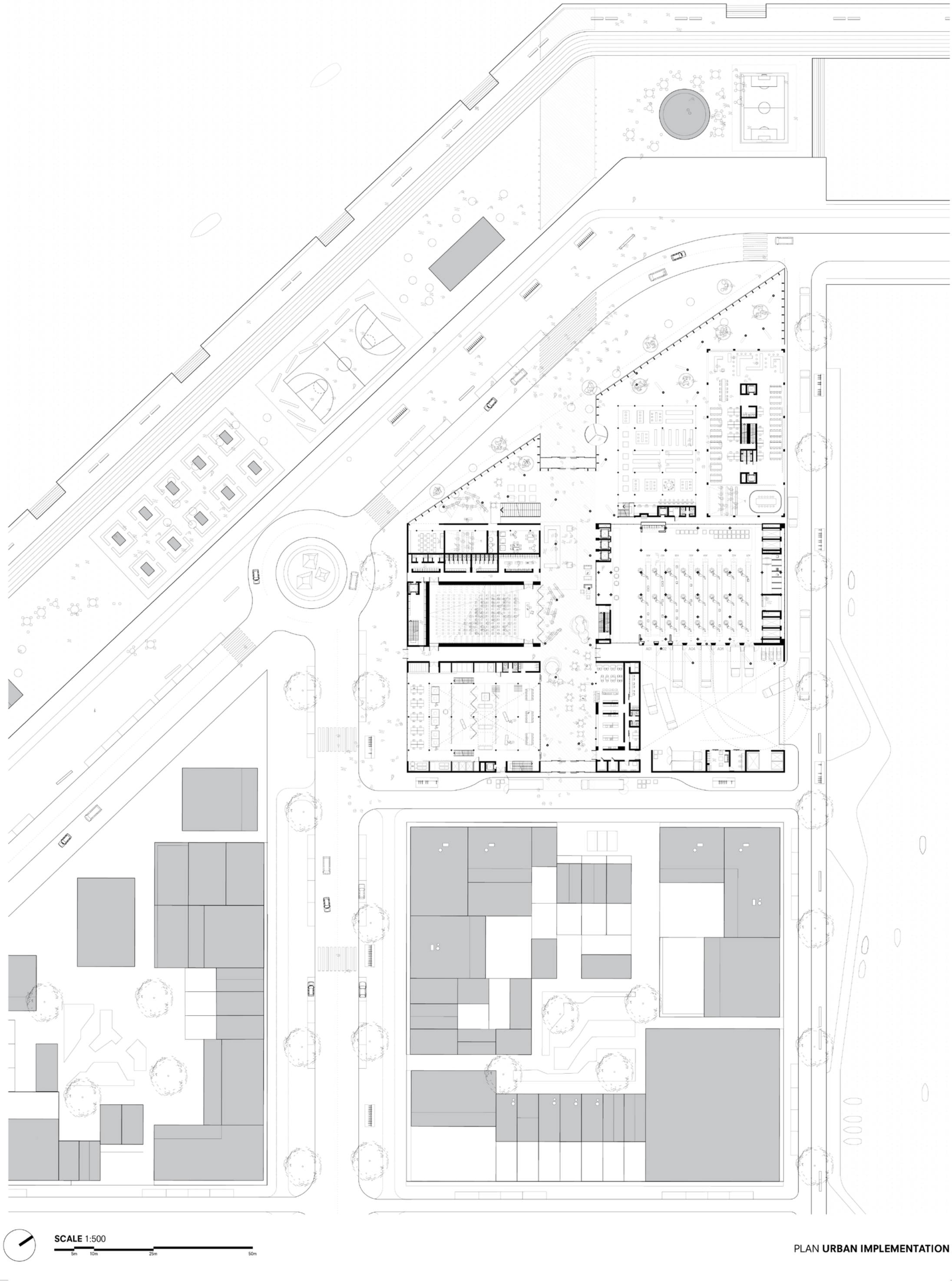
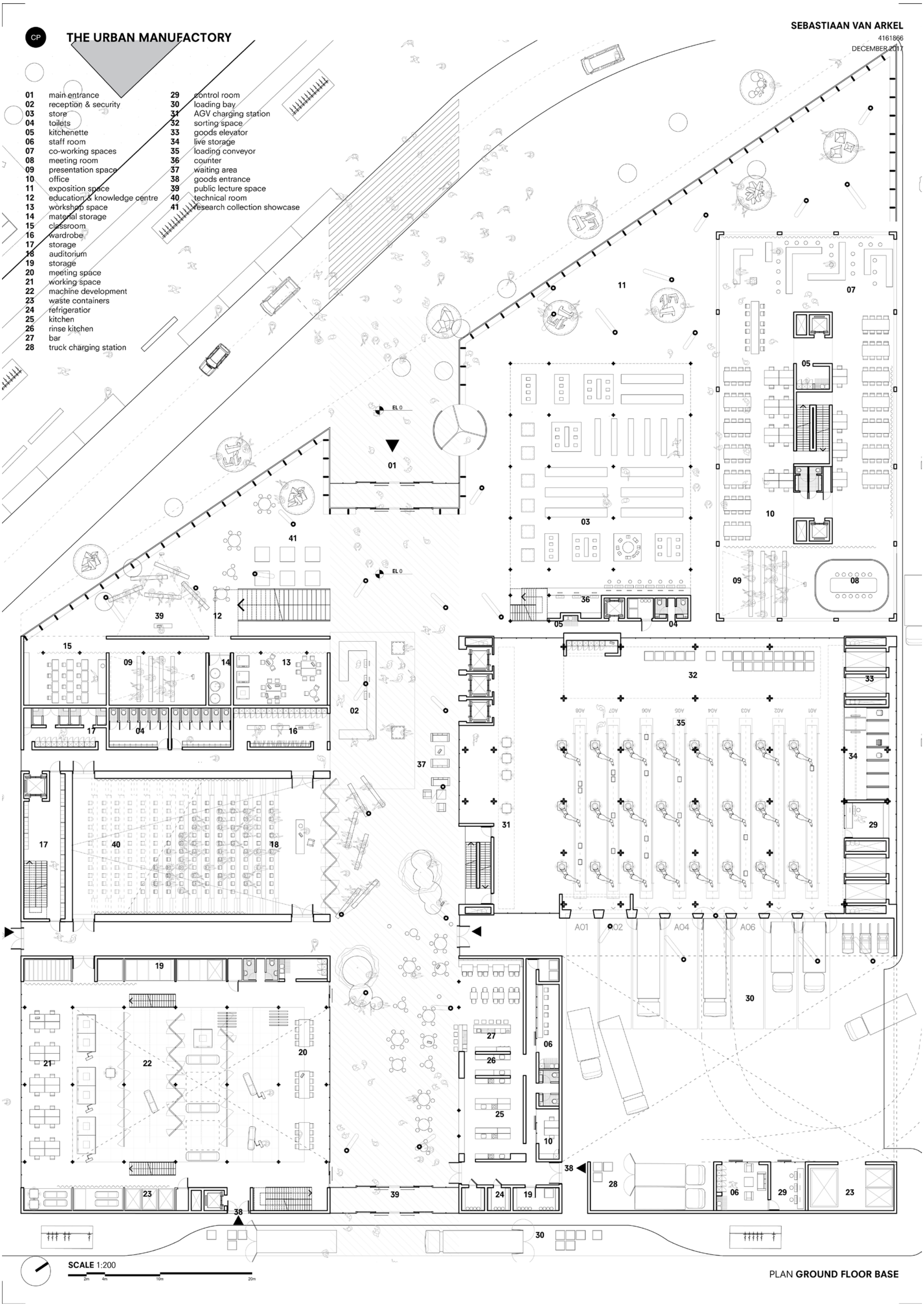


PLAN **URBAN IMPLEMENTATION**

caption.[i1]

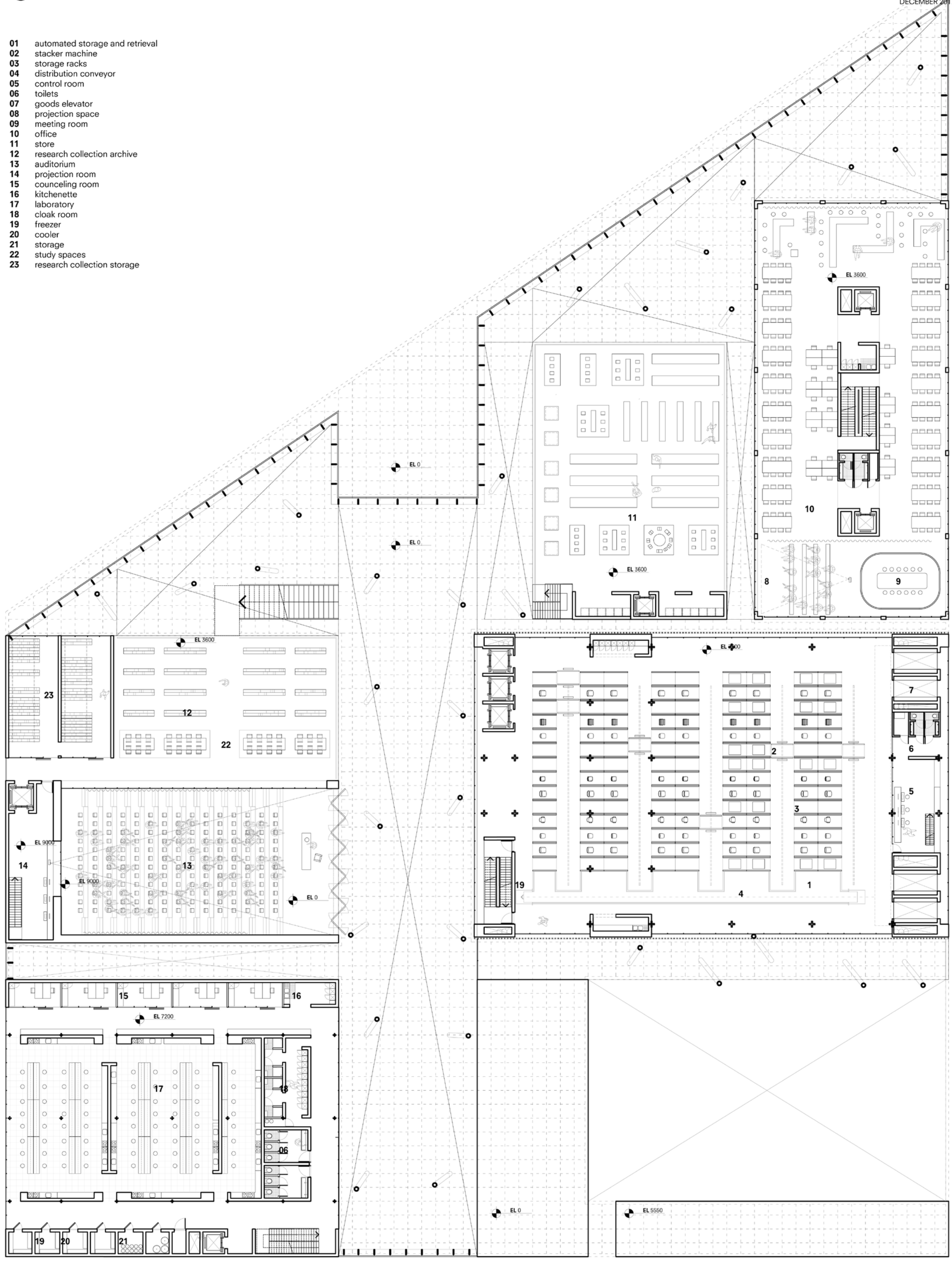

CP
THE URBAN MANUFACTORY
SEBASTIAAN VAN ARKEL
4161866
DECEMBER 2017
01 main entrance
02 reception & security
03 store
04 toilets
05 kitchenette
06 staff room
07 co-working spaces
08 meeting room
09 presentation space
10 office
11 exposition space
12 education & knowledge centre
13 workshop space
14 material storage
15 classroom
16 wardrobe
17 storage
18 auditorium
19 storage
20 meeting space
21 working space
22 machine development
23 waste containers
24 refrigerator
25 kitchen
26 rinse kitchen
27 bar
28 truck charging station
29 control room
30 loading bay
31 AGV charging station
32 sorting space
33 goods elevator
34 live storage
35 loading conveyor
36 counter
37 waiting area
38 goods entrance
39 public lecture space
40 technical room
41 research collection showcase
SCALE 1:200
PLAN GROUND FLOOR BASE

caption.i1

CP **THE URBAN MANUFACTORY**

SEBASTIAAN VAN ARKEL
4161866
DECEMBER 2017

01 automated storage and retrieval
02 stacker machine
03 storage racks
04 distribution conveyor
05 control room
06 toilets
07 goods elevator
08 projection space
09 meeting room
10 office
11 store
12 research collection archive
13 auditorium
14 projection room
15 counceling room
16 kitchenette
17 laboratory
18 cloak room
19 freezer
20 cooler
21 storage
22 study spaces
23 research collection storage

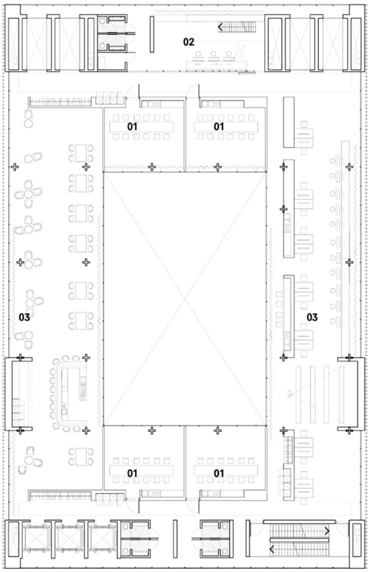


SCALE 1:200
2m 4m 10m 20m

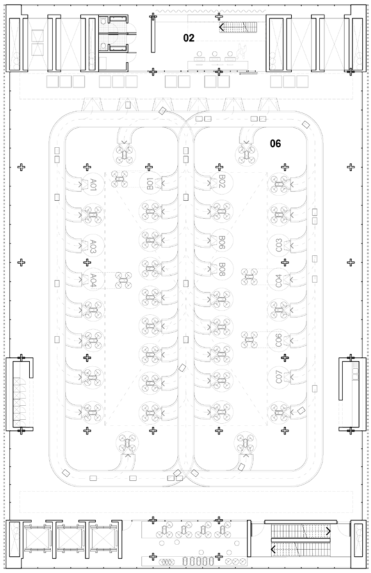
PLAN **FIRST FLOOR BASE**

caption.i1

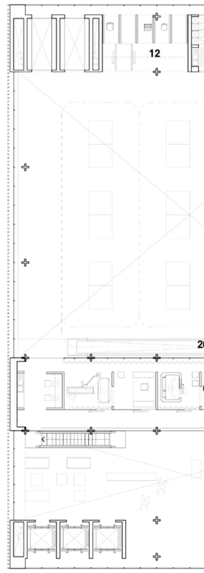
CP THE URBAN MANUFACTORY



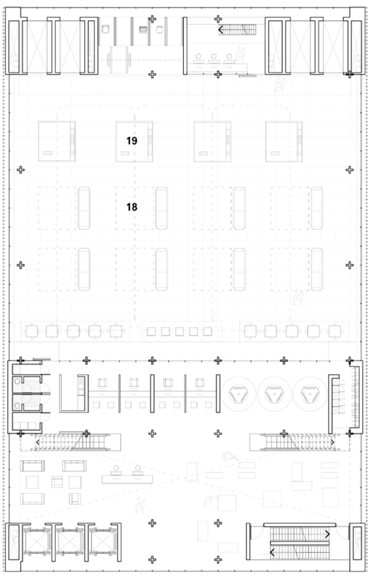
PLAN **AIR CONTROL ROOM TOWER**



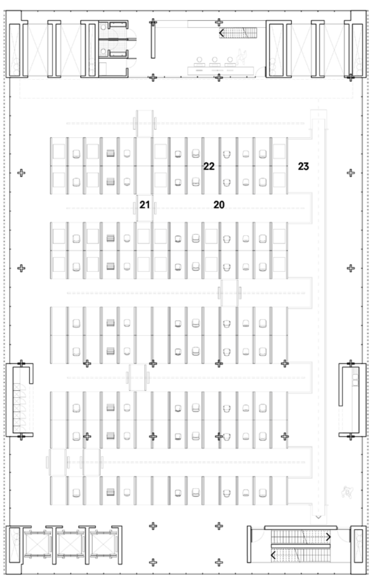
PLAN **AIR TRANSPORT HUB TOWER**



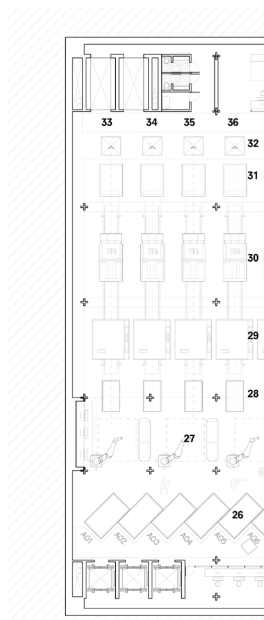
PLAN **MEZZANINE PRODUCTI**



PLAN **UPPER PACKAGING FLOOR TOWER**



PLAN **UPPER STORAGE FLOOR TOWER**



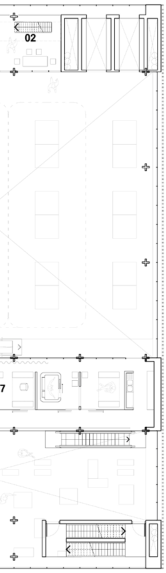
PLAN **MATERIAL RECOVERY**

01	conference room	10	AM machine	19	quality control	28	seperation material types
02	conference room	11	CNC machines	20	automated storage and retrieval	29	cleaning and drying
03	control room	12	live storage	21	stacker machine	30	shredding and filtering
04	air control centre	13	counseling room	22	storage racks	31	extruding and spooling (filament) or milling (powder)
05	sky bar	14	interface	23	distribution conveyor	32	storing in silos
06	drone loading bay	15	wardrobe	24	automated guided vehicle (AGV)	33	metal conveyor
07	analysis room	16	showcase	25	off loading bay	34	glass conveyor
08	AVG charging area	17	assembly robot	26	collecting area	35	polymer conveyor
09	AVG line	18	packaging robot	27	dissambling machines	36	bioplastic conveyor

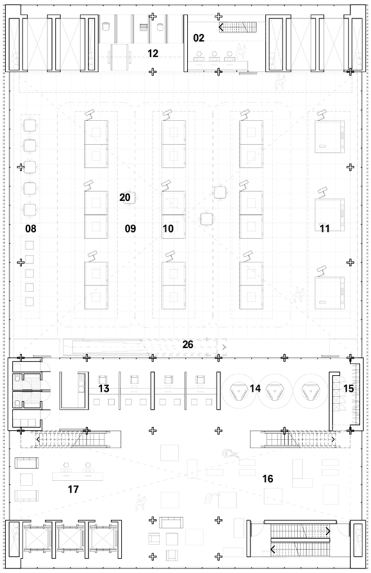
SCALE 1:200

caption.[i1]

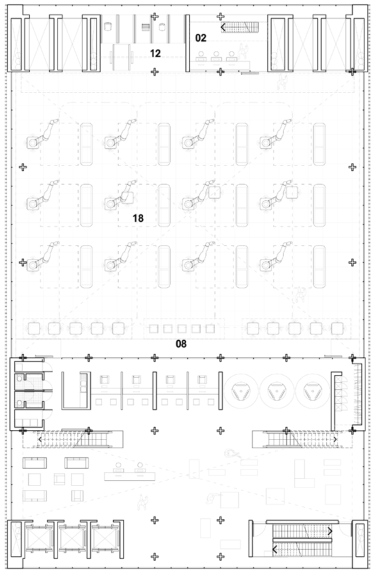
SEBASTIAAN VAN ARKEL
4161866
DECEMBER 2017



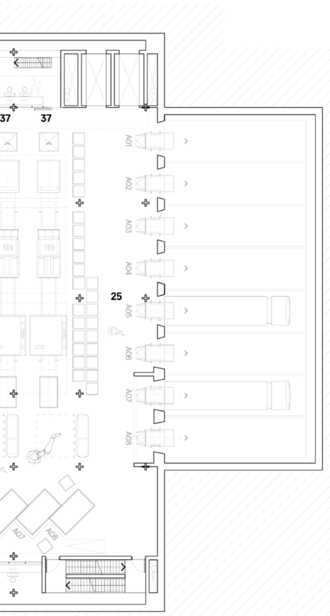
ON FLOOR TOWER



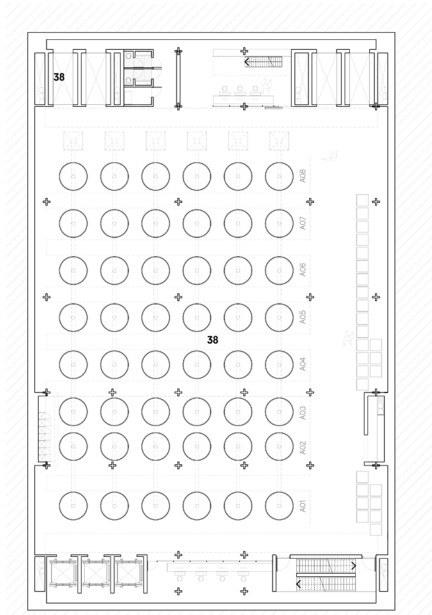
PLAN **PRODUCTION FLOOR TOWER**



PLAN **UPPER ASSEMBLY FLOOR TOWER**



CENTER BASEMENT TOWER



PLAN **SILOS BASEMENT TOWER**

38 silos
39 goods lift
40 floor to floor conveyor

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PLANS **TOWER**

caption.[i1]

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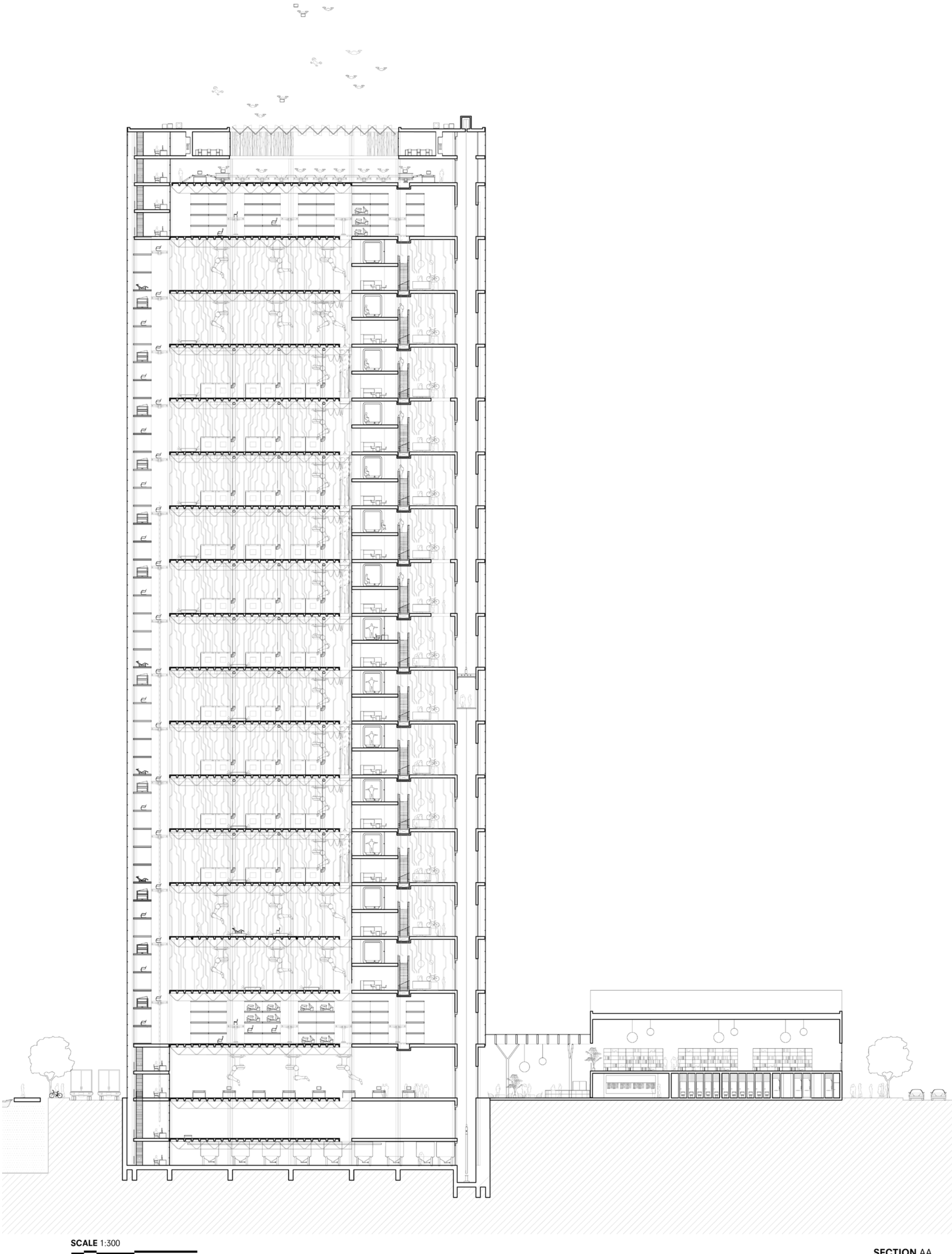

caption.[i1]

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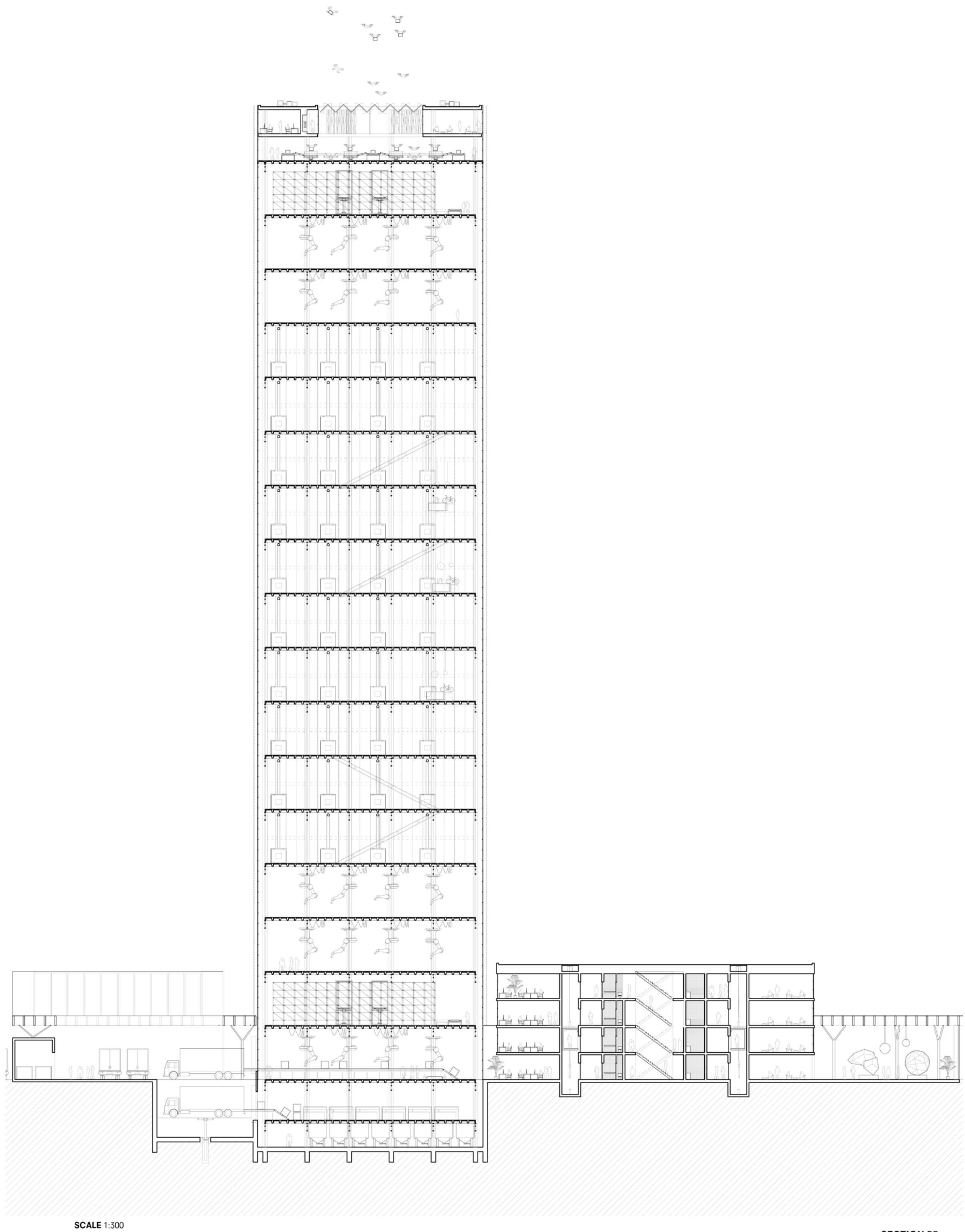
DECEMBER 2017



SCALE 1:300

2m 4m 10m 20m

SECTION BB

caption.[i1]

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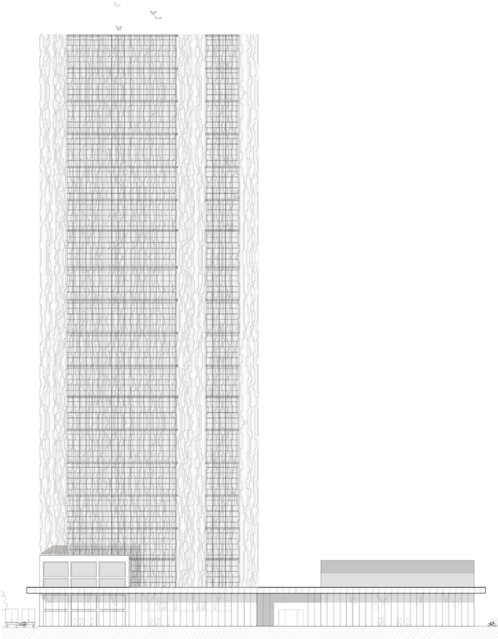
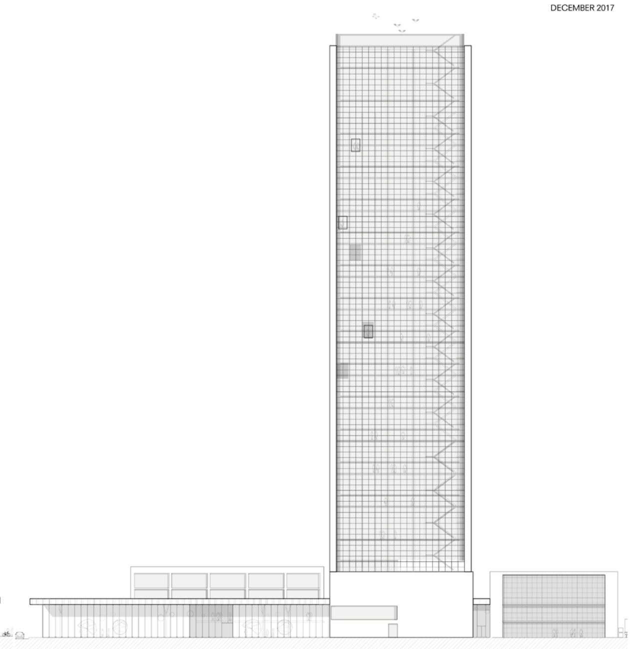
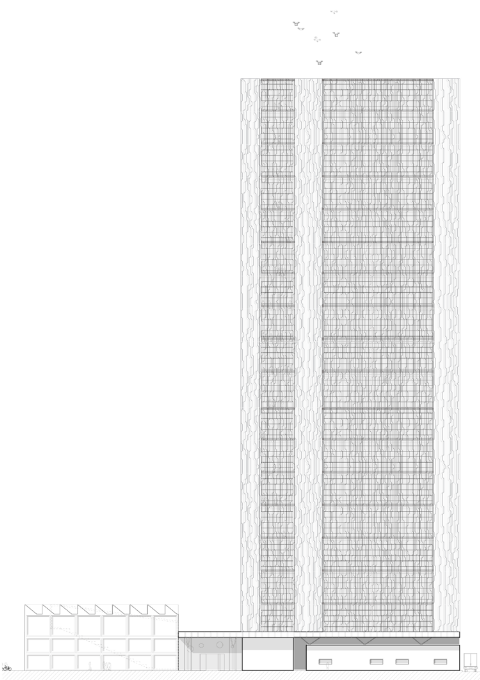


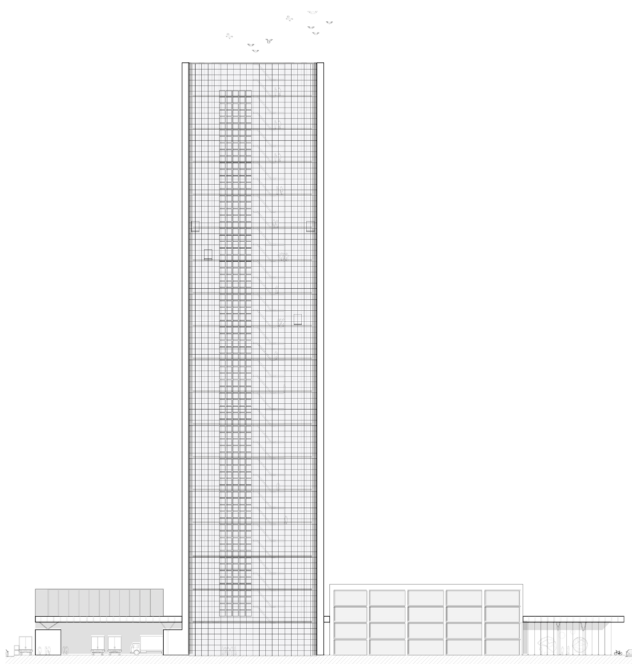
FACADE **NORTHWEST**



FACADE **NORTHEAST**

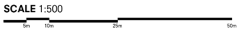


FACADE **SOUTHEAST**



FACADE **SOUTHWEST**

SCALE 1:500



FUTURE URBAN MANUFACTORY FACADE

caption.[i1]

THE URBAN MANUFACTORY

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01 After choosing the right floor and right producing company, clients enter the producers' lobby through the elevator from the public ground floor.

02 Clients go to the reception desk for a first intake. Receptionists gives clarity about following procedure, and tell the client where they need to be during the procedure.

03 Before or after consulting the reception desk the client can have a look and get an idea of the producers activities by viewing the showcased items. Here the client can see and feel the products and their materiality. At the same time the client has a constant view on the production floor to get a sense of how products are made. There is a possibility to take place in one of the seating areas and talk to one another about ones wishes concerning the purchasement.

04 When ready, client continues the procedure and gets to speak with the producer at one of the counseling spaces. Here consumer and producer get in physical contact. Producer tells about the possibilities and gets to know what demands the client has. The producer can clarify the production process by easily point out to the production floor in the back were there is an overview over the process.

05 After speaking to the producer, the client continues and signs in, in one of the self learning digital interface booths. Here the consumer can, by means of an easy and for everyone understandable platform do a lot of the custumized design steps by themselves. Valuable costumer information is saved and is also later used by the company to optimize product development.

06 If necessary clients can hang their coat and lock up their belongings before proceeding to the next step in the production process.

07 Clients take the escelator to the physical analysis booths on the mezzanine floor. Here client get physically analyzed. Also this valuable costumer information is saved in a data base and used to optimize the production process.

08 After going through the analysis procedure the client leaves the mezzanine floor by the second escalator. The client leaves the lobby through one of the elevators that brings them back to the ground floor level. At the same time the producion process begins and finished custumized and tailored products are brought to the client home.

09 The production process starts with the supply of raw material coming from the silos in the basement of the building. Raw material in the form of powder or filament is transported through ducts.

10 Parts of the product are manufactured by the additive manufacturing machinery.

11 When ready the machine remove waste material and clean the finished part. Finished parts are then loaded on an Automated Guided Vehicle (AGV).

12 If possible new parts are directly fabricated on the product. If not, finished parts are temporary stored in the live storage.

13 Parts are temporary stored in the live storage which is an Automated Storage and Retrieval System (ASRS). Parts are stored until they can further processed on the production floor.

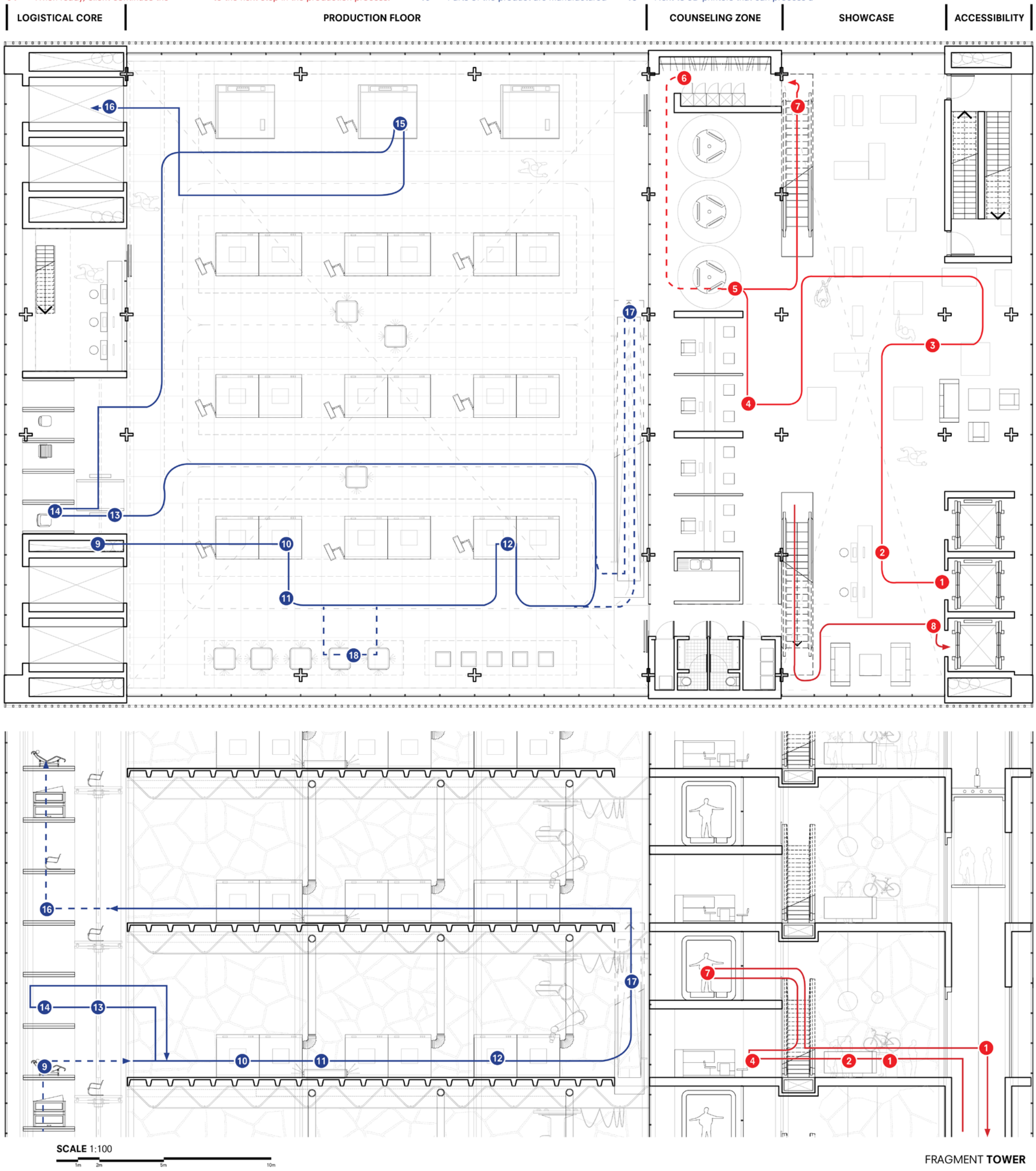
14 Parts stored in the live storage can be viewed from the public zone and from the exterior through the completely glass facade by the public as an etalage.

15 Next to 3D printers that can process a wide range of materials there are (according to the producing company) also CNC machine that can layered manufacture wood.

16 Finished parts and products are after the printing process is finished transported to assembly floor, packaging- and quality control floor and transport floor. These are located in the bottom and top of the building, depending on the mode of transport (through air or over land).

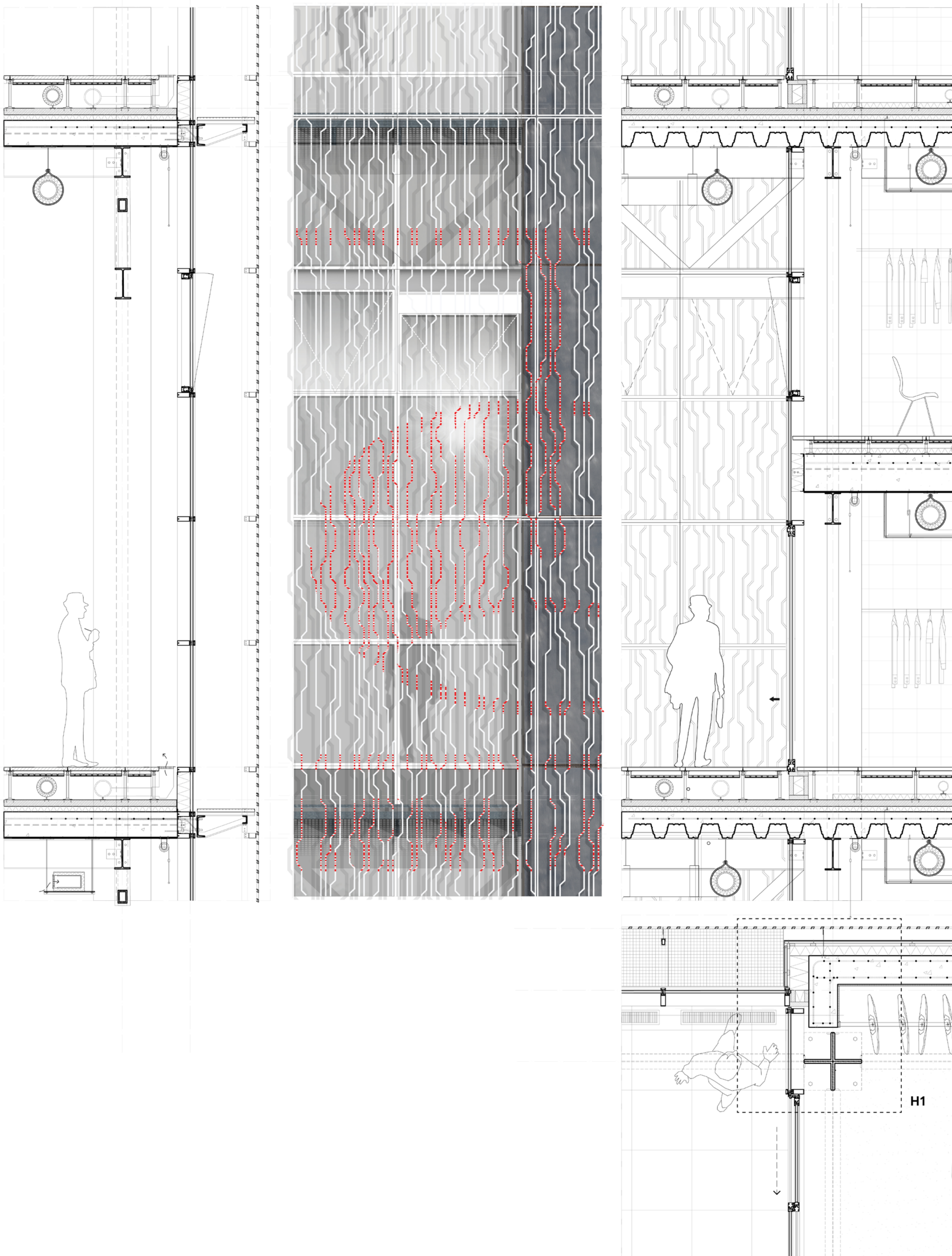
17 If needed producing companies can extend their production capacity by linking 2 or more production floors by means of a vertical conveyor.

18 AGV's that run on electricity can be charged and stored in the designated areas at the side of the production floor. Here also the ranks can be stored that are fixed on the AGV to move parts and products.



FRAGMENT **TOWER**

caption.[i1]



SCALE 1:5

5cm 10cm 25cm 50cm

caption.[i1]

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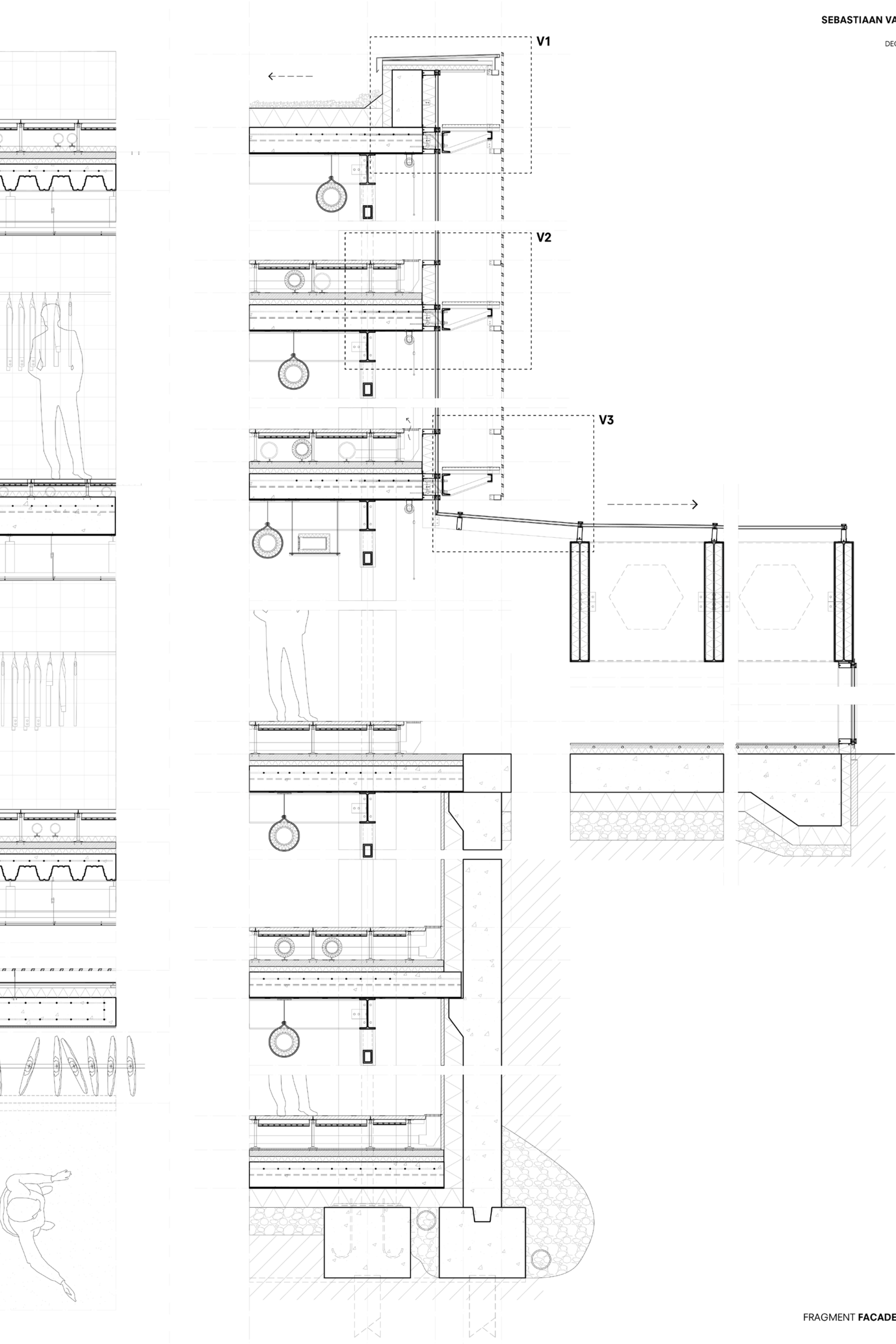
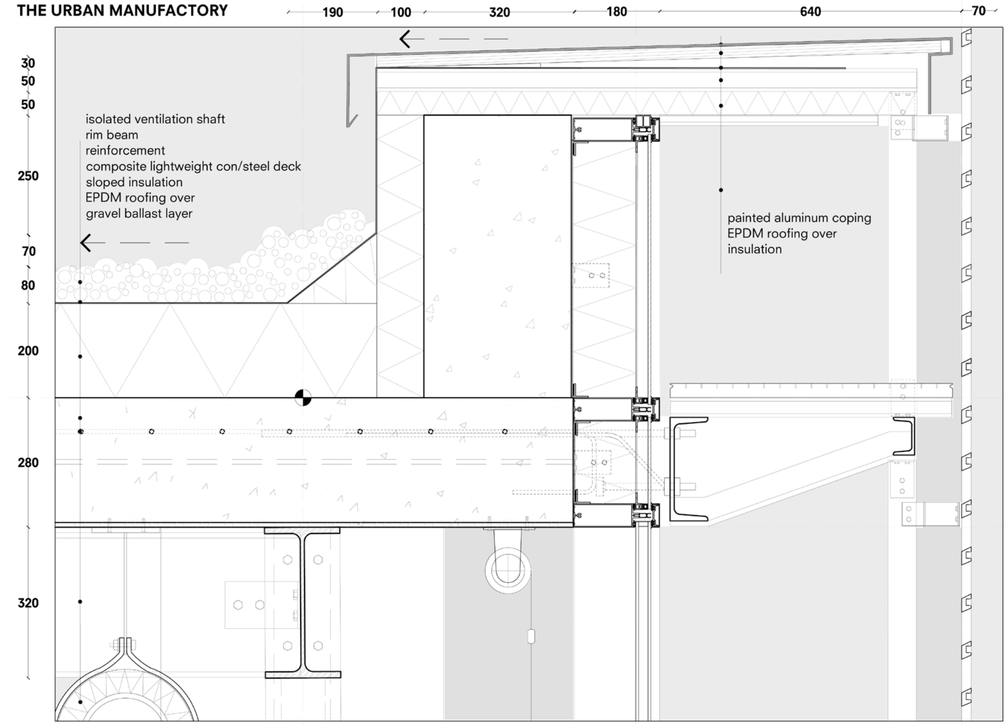


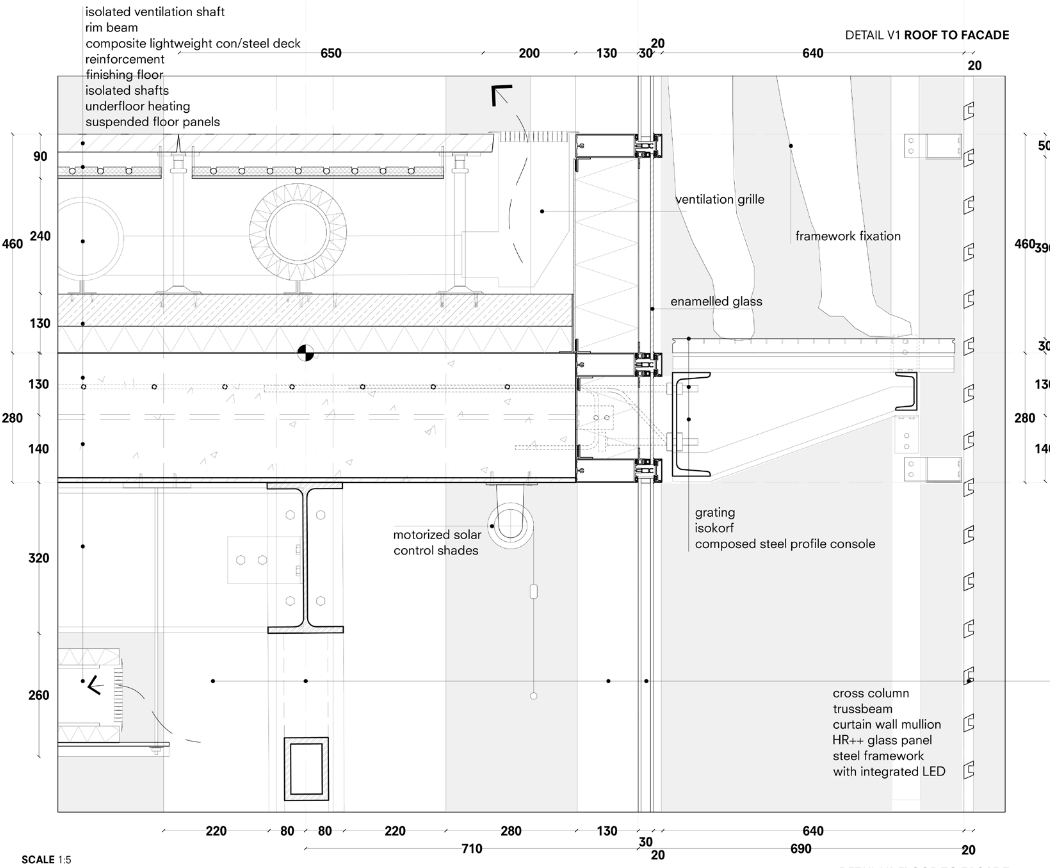
FRAGMENT **FACADE TOWER**

caption.[i1]

CP **THE URBAN MANUFACTORY**



DETAIL V1 **ROOF TO FACADE**

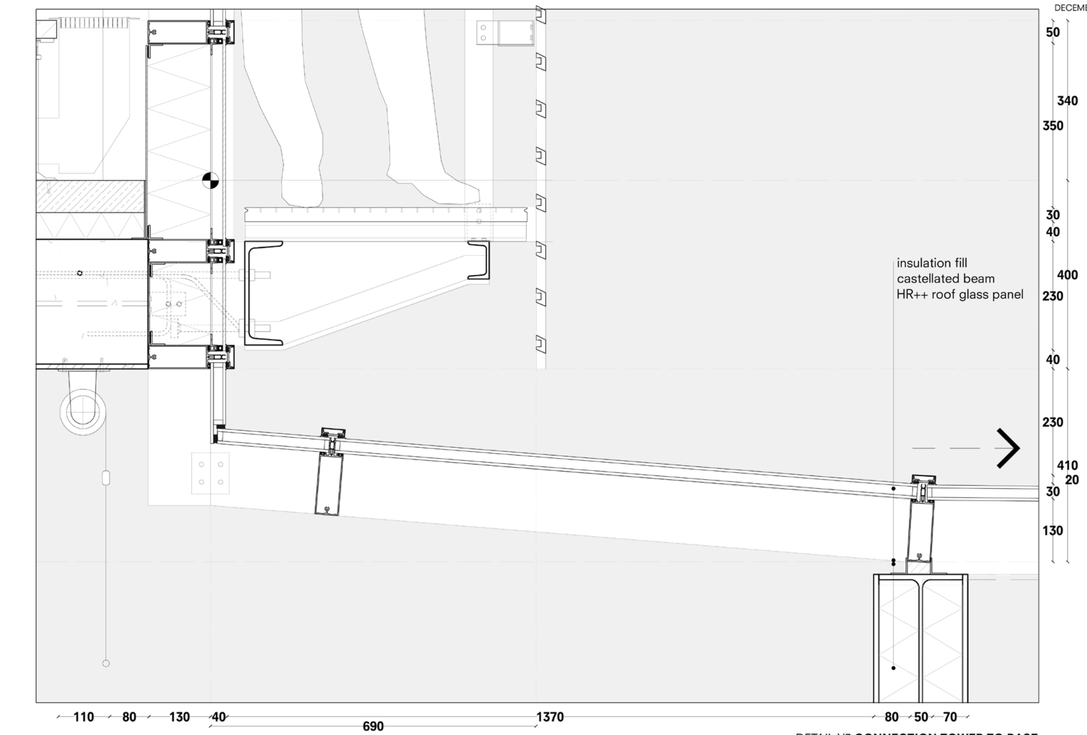


SCALE 1:5

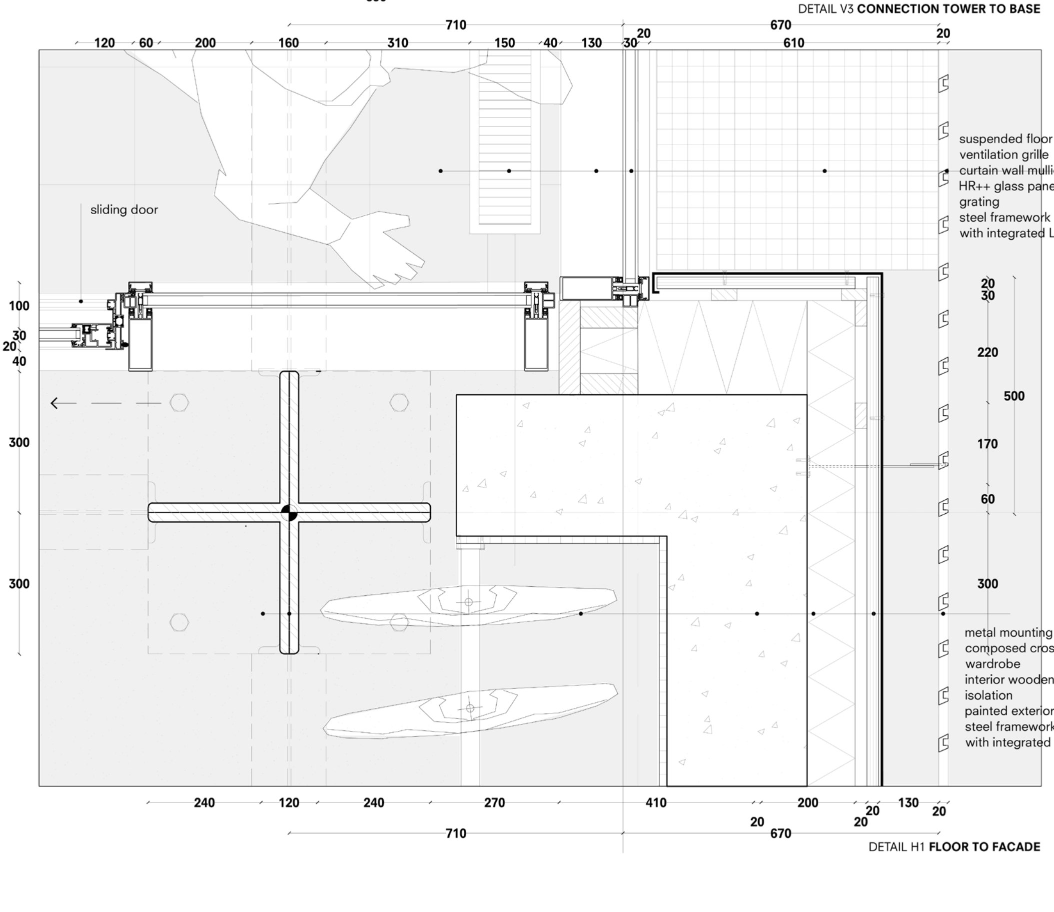
5cm 10cm 25cm 50cm

DETAIL V2 **FLOOR TO FACADE**

caption.[i1]



DETAIL V3 **CONNECTION TOWER TO BASE**

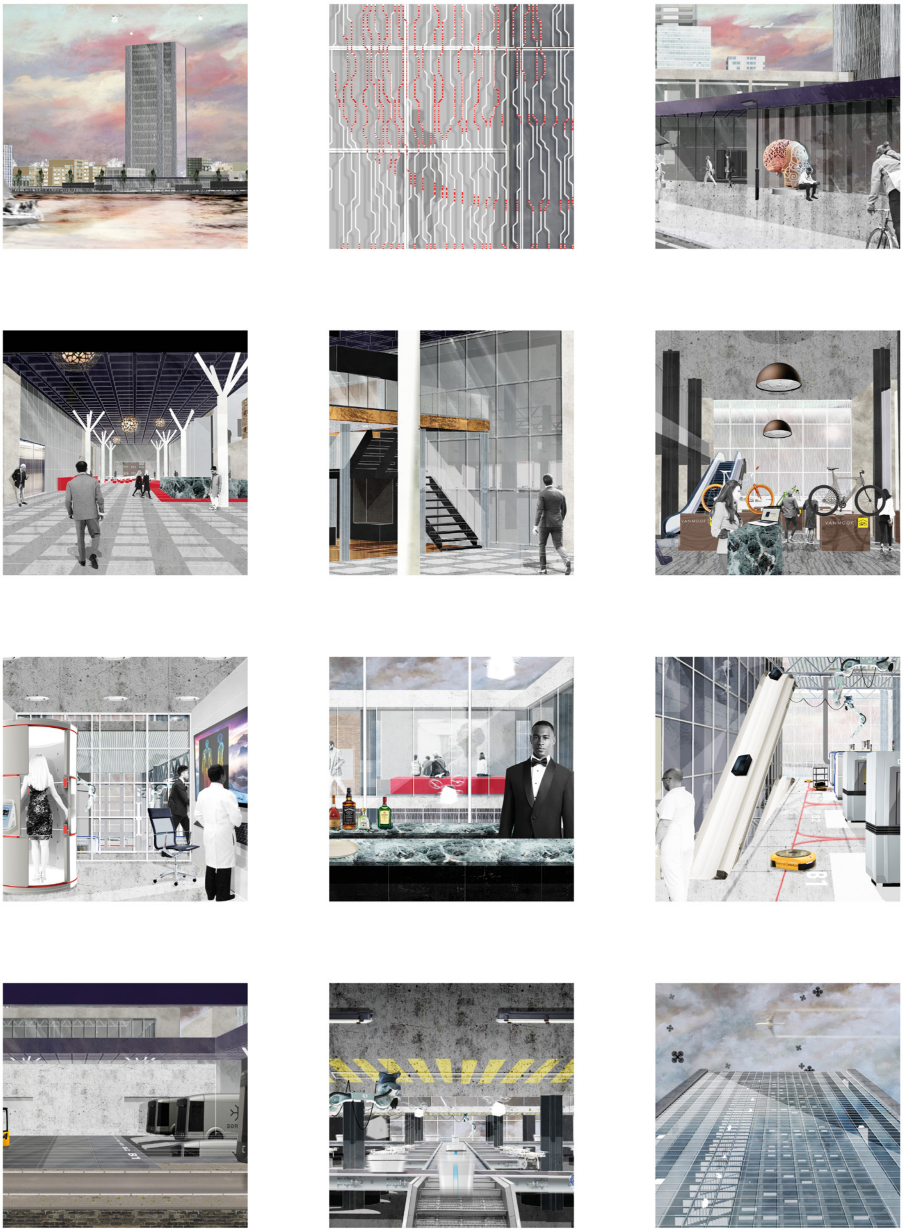


DETAIL H1 **FLOOR TO FACADE**

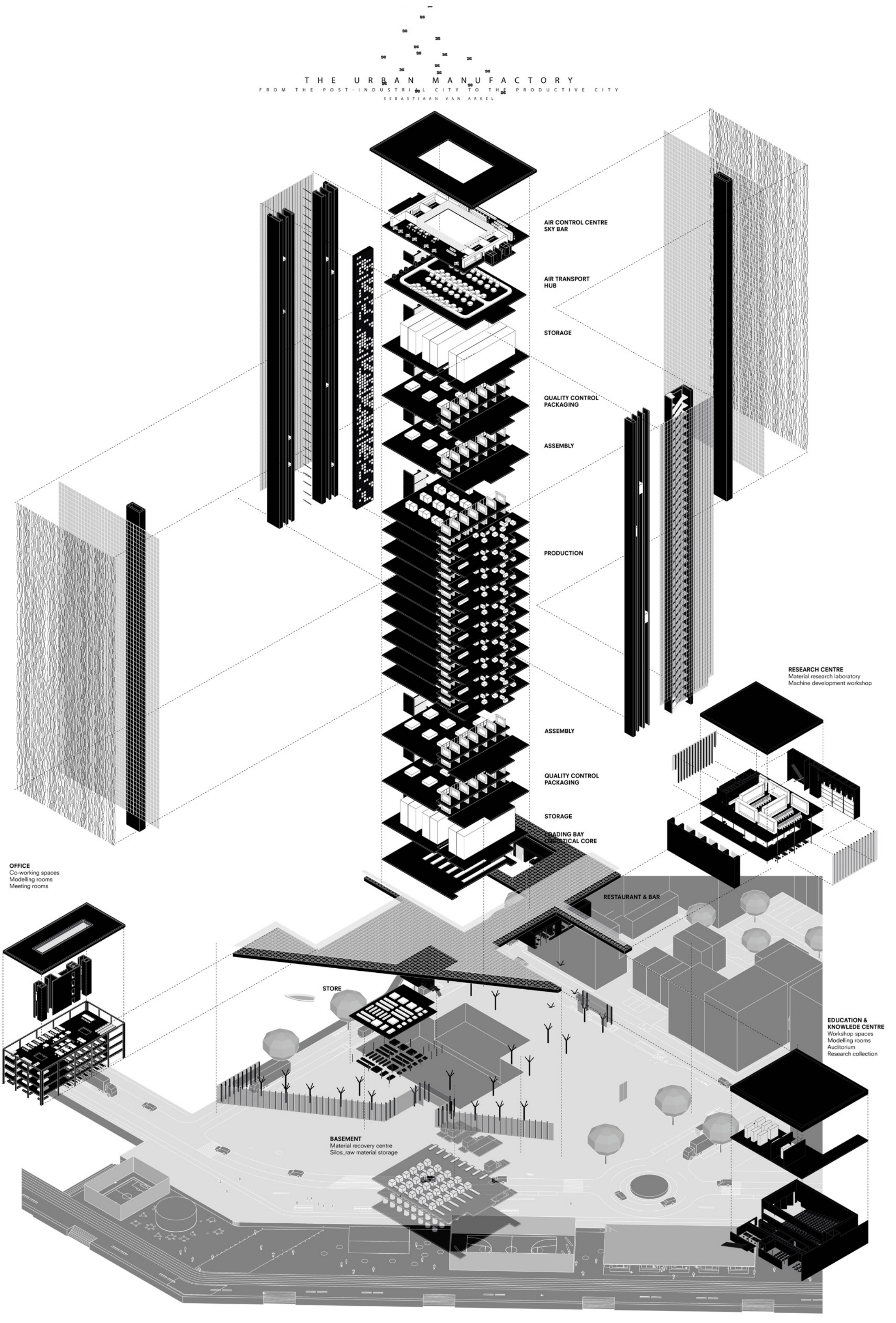
caption.[i1]


THE URBAN MANUFACTORY
FROM THE POST-INDUSTRIAL CITY TO THE PRODUCTIVE CITY
SEBASTIAAN VAN ARKEL
B2
B1

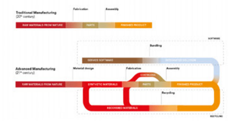
caption.[i1]

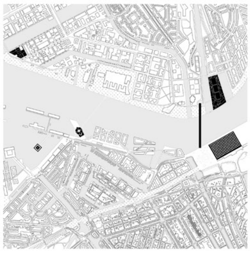


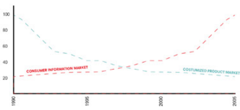
caption.[i1]

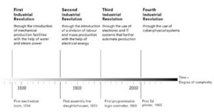

THE URBAN MANUFACTORY
FROM THE POST-INDUSTRIAL CITY TO THE PRODUCTIVE CITY
SEBASTIAAN VAN ARKEL
AIR CONTROL CENTRE
SKY BAR
AIR TRANSPORT
HUB
STORAGE
QUALITY CONTROL
PACKAGING
ASSEMBLY
PRODUCTION
ASSEMBLY
QUALITY CONTROL
PACKAGING
STORAGE
LOADING BAY
VERTICAL CORE
RESEARCH CENTRE
Material research laboratory
Machine development workshop
OFFICE
Co-working spaces
Modelling rooms
Meeting rooms
RESTAURANT & BAR
STORE
EDUCATION &
KNOWLEDE CENTRE
Workshop spaces
Modelling rooms
Auditorium
Research collection
BASEMENT
Material recovery centre
Silos_raw material storage

caption.[i1]







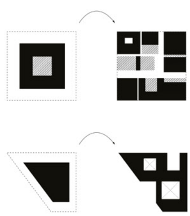


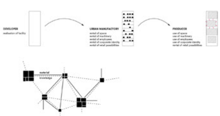
THE URBAN MANUFACTORY

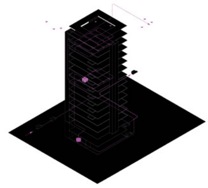
FROM THE POST-INDUSTRIAL CITY TO THE PRODUCTIVE CITY

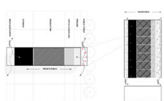
SEBASTIAAN VAN ARKEL

AMSTERDAM HAS BECOME A CITY PREDOMINANTLY FOCUSED ON CONSUMERS. MAKERS AND USER ARE DRIFTING AWAY FROM EACH OTHER, WHICH RESULTS IN ENVIRONMENTAL PRESSURE, MENTAL DISCONNECTION FROM THE PRODUCTION PROCESS AND LOSS OF THE POTENTIALITIES PROVIDED BY THE URBAN ENVIRONMENT. RECENT TRENDS ALLOW FOR RESTORING THE RELATIONSHIP BETWEEN THE PRODUCTION PROCESS AND THE CITY. OFFSHORING PRODUCTION IS GETTING LESS FAVOURABLE SINCE PRODUCTION COSTS IN DEVELOPING COUNTRIES ARE INCREASING. ON THE OTHER HAND, PRICES FOR ROBOTS REPLACING HUMAN LABOUR ARE DECREASING. DIGITAL FABRICATION, SUCH AS ADDITIVE MANUFACTURING TECHNIQUES AND OTHER CAD INNOVATIONS BRING BACK THE ESSENCE OF CRAFTSMANSHIP, NAMELY, ON-DEMAND, PERSONALIZED PRODUCTION, TAILORED OF CONSUMER GOODS WITH A 'BATCH-SIZE-OF-ONE', AVAILABLE FOR ALL. THE URBAN MANUFACTORY EMBEDS PRODUCTION PROGRAM (AGAIN) IN THE URBAN CONTEXT AND ENABLES INTERACTION BETWEEN CONSUMER AND PRODUCER. THE BUILDING CONSISTS OF A TOWER VOLUME IN WHICH PRODUCTION PROGRAM IS STACKED. PRODUCTS LEAVE THE BUILDING, AFTER ASSEMBLY, PACKAGING AND STORAGE, THROUGH AIR AND OVER LAND. THE PRODUCTION TOWER HAS A STRONG VERTICAL LAYERING STARTING FROM A PUBLIC ZONE TO A SERVICE CORE INTENDED FOR THE VERTICAL CIRCULATION OF GOODS AND MATERIAL. THE TOWER SITS IN A BASE VOLUME THAT CONTAINS PROGRAM THAT HAS A SUPPORTIVE FUNCTION. HERE A RESEARCH CENTRE, FOR THE DEVELOPMENT OF MATERIAL AND MACHINERY, AN EDUCATION - AND KNOWLEDGE CENTRE THAT EDUCATES THE PUBLIC REGARDING DIGITAL FABRICATION, RETAIL, AND HOSPITALY, BOTH USED BY PUBLIC AND EMPLOYEES, IS SITUATED.









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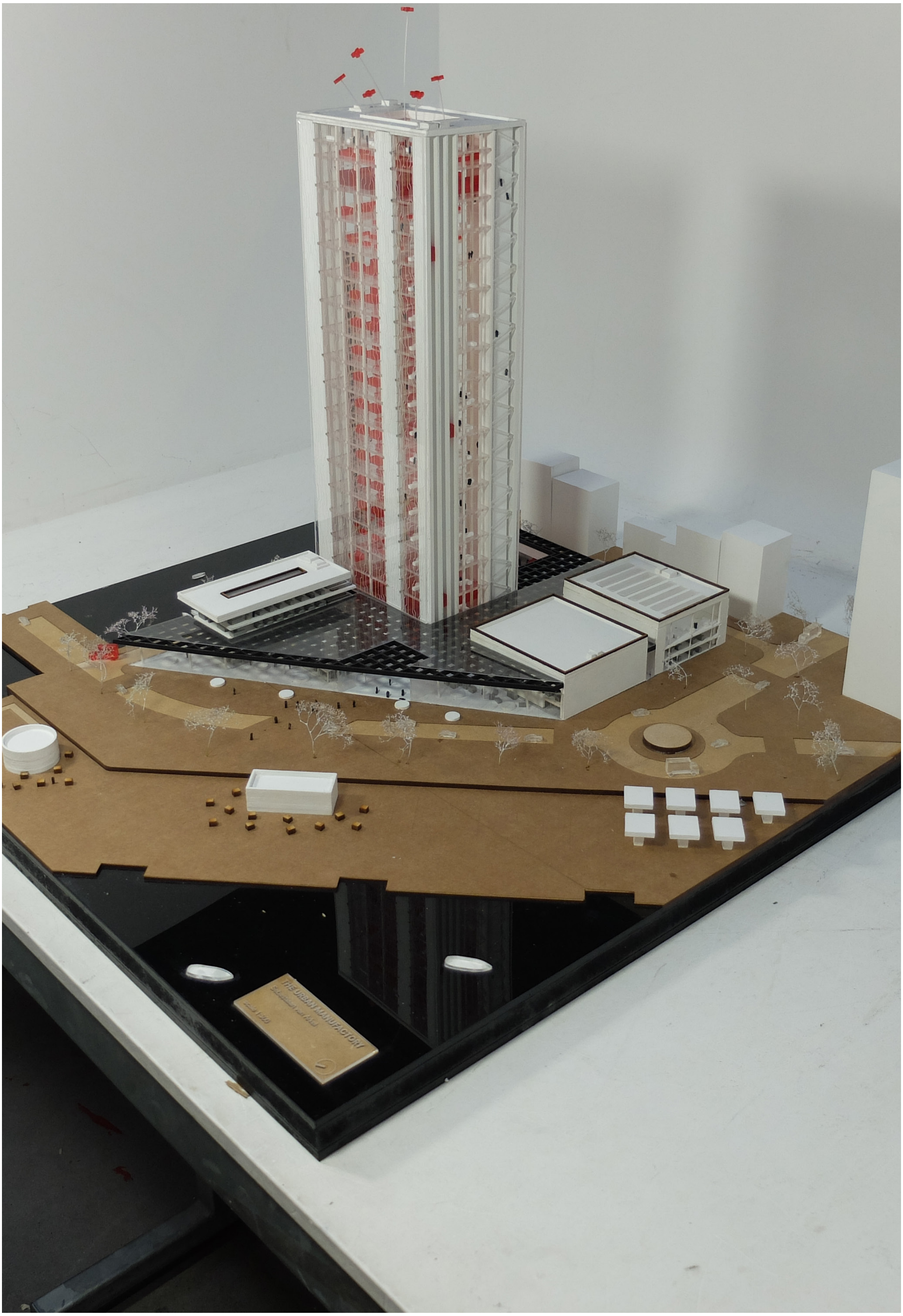

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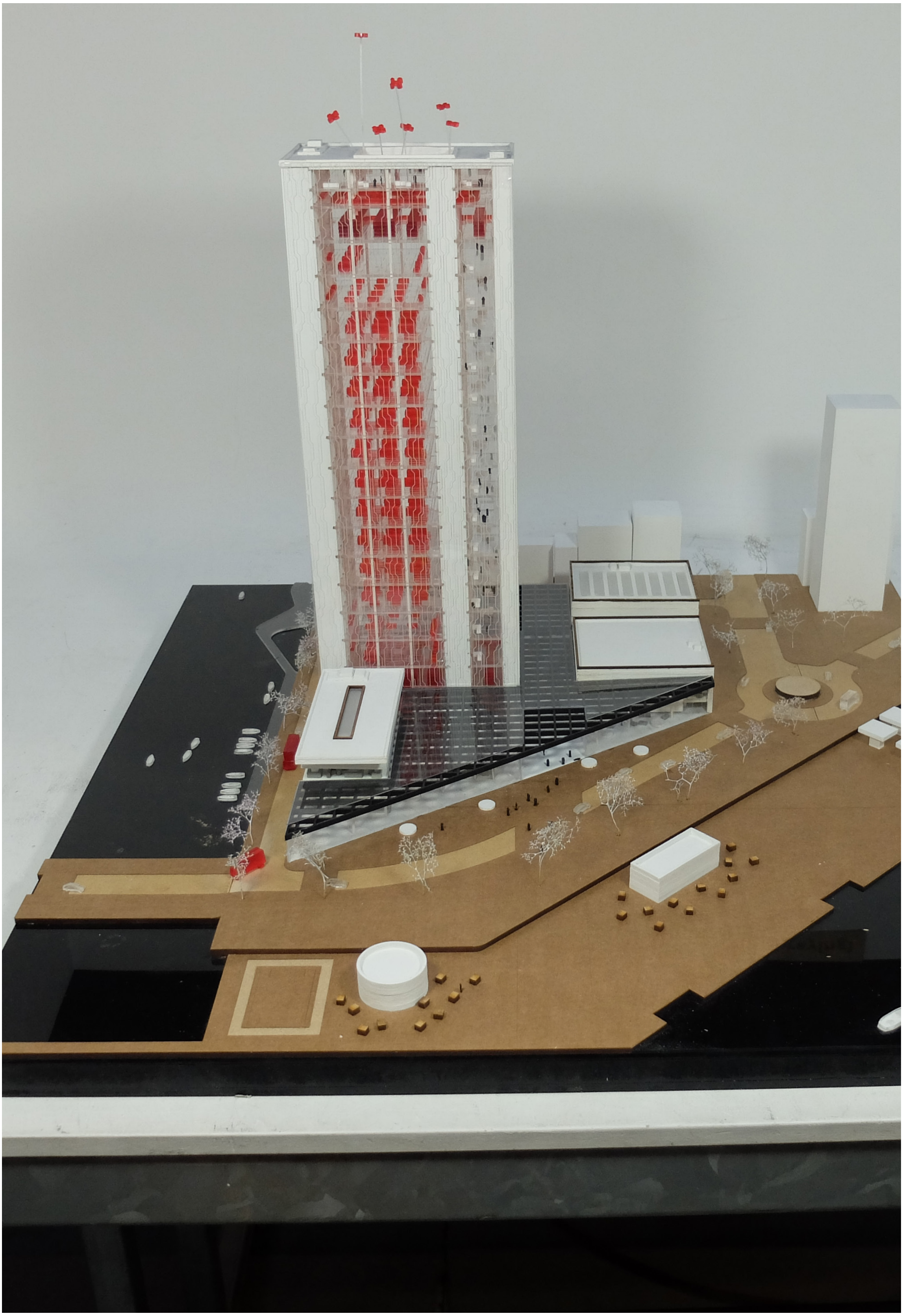

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