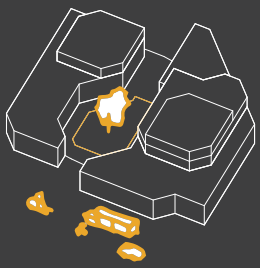
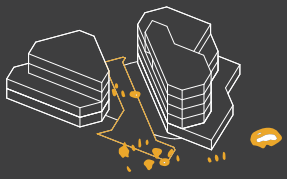


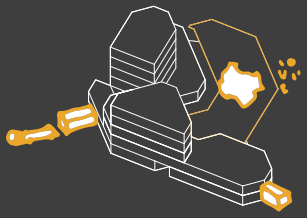
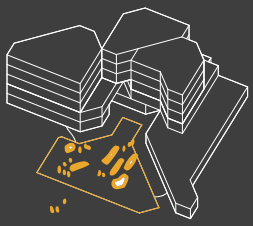
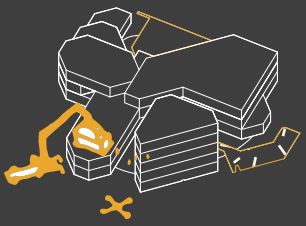
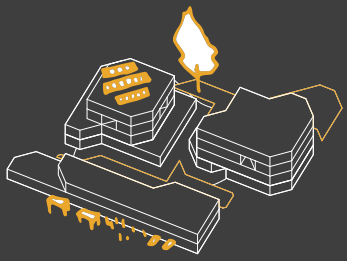

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Problem analysis

Structural change

The Adam Opel Werk I in Bochum was once a symbol of successful structural change in the Ruhr valley. With its closing at the end of 2014 it becomes aware again that the region still is in a structural change. The following paragraphs give an outline of the history and how three industrial revolutions influenced the region and this specific place.

First industrial revolution

Today the Ruhr region is an agglomeration of different cities forming the largest urban area of Germany. Its growth to this size started around two centuries ago with the first industrial revolution. The demand for coal was rising and by using steam engines many mines were able to dig for it around the Ruhr river. A dense network of railways was laid out connecting the main nodes of the coal industry and waterways were used to transport resources down the Ruhr. Its geographical position and connection to the Rhine made it a powerful place in the industry developing from the Alps to the Netherlands. The coal and steel producing and processing industry became the main economic branch attracting many new domestic and foreign workers. Till the beginning of the 20th century the population increased rapidly and so did the urban area (Regionalverband Ruhr, 2015).

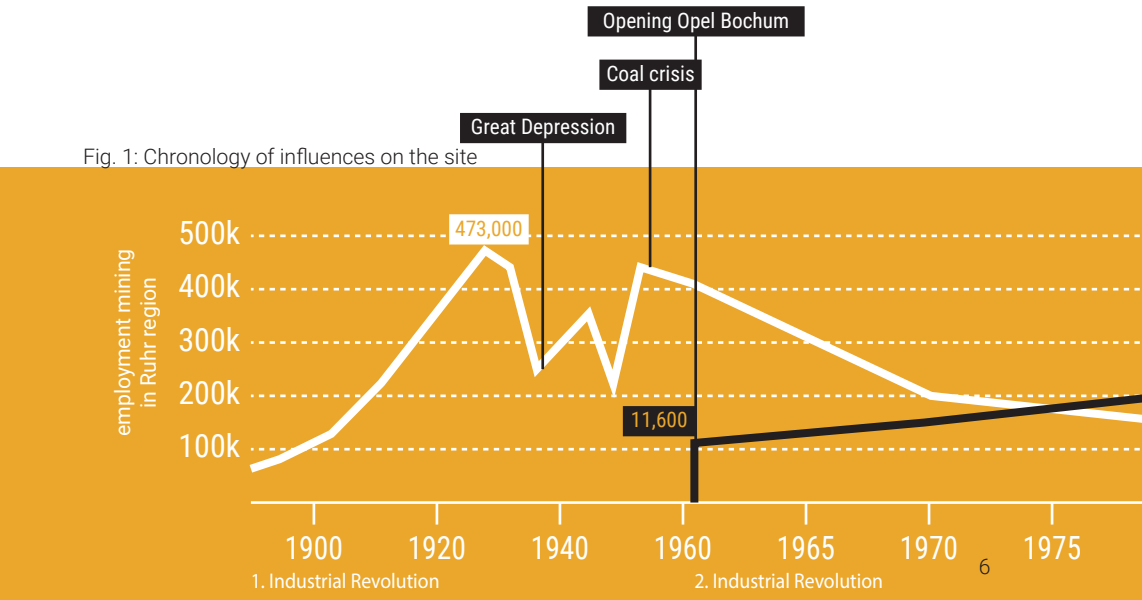


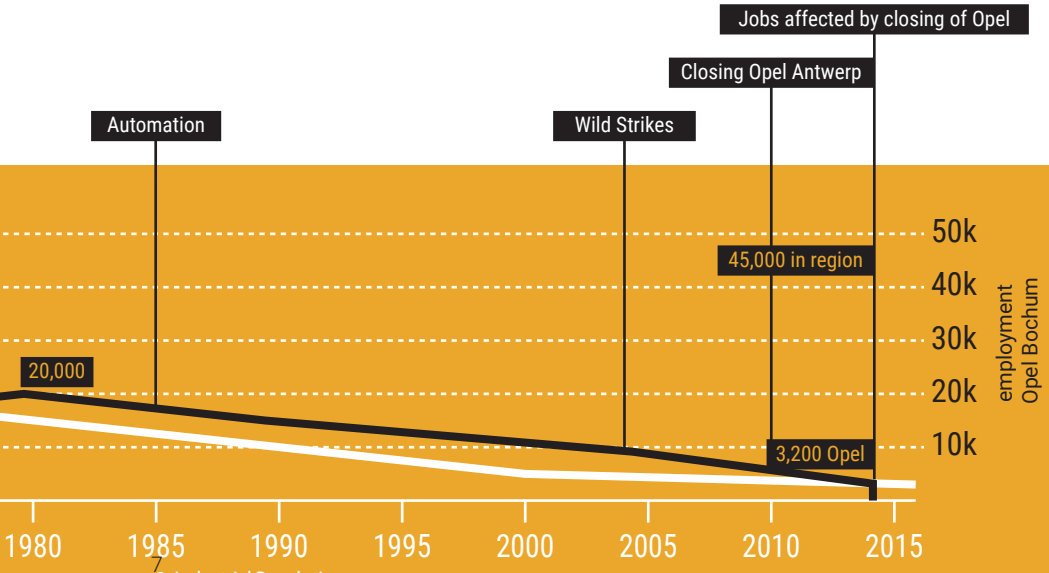
Fig. 1: Chronology of influences on the site

Zeche Dannenbaum was one of the coal mines that developed in this time. It was situated on the site of the Opel factory in Bochum, but in that time rather far away from the city boundaries. Railways connected it to other big companies like the Bochumer Verein. They can still be seen today, the tunnels and shafts however are not visible anymore, but Fig. 5 shows their position.

Second industrial revolution

In the 60s coal energy had to compete against other fossil resources. Oil and gas became more dominant and the German coal industry had to compete against international competitors. The rather mono-functional economy of the Ruhr region suffered. Although the local actors tried to collaborate and lobby for their industry (Butzin et al., 2008), employment was from there on only decreasing till today.

Bochum realized as one of the first cities that it needed to face a structural change. Its steel and coal industry lost around 60,000 jobs in this time. But 1961 the city convinced the car manufacturer Opel, a subsidiary company of the American company General Motors (GM), to build one of its factories close by on the former 65ha large Zeche Dannenbaum site (Stadt Bochum, 2015). Mass-manufacturing as the second industrial revolution was a good continuation for the existing industry, creating 11,600 new jobs and manifested itself on this place as a giant factory (Manzke, 2013). Similar to the beginning of the industrial age



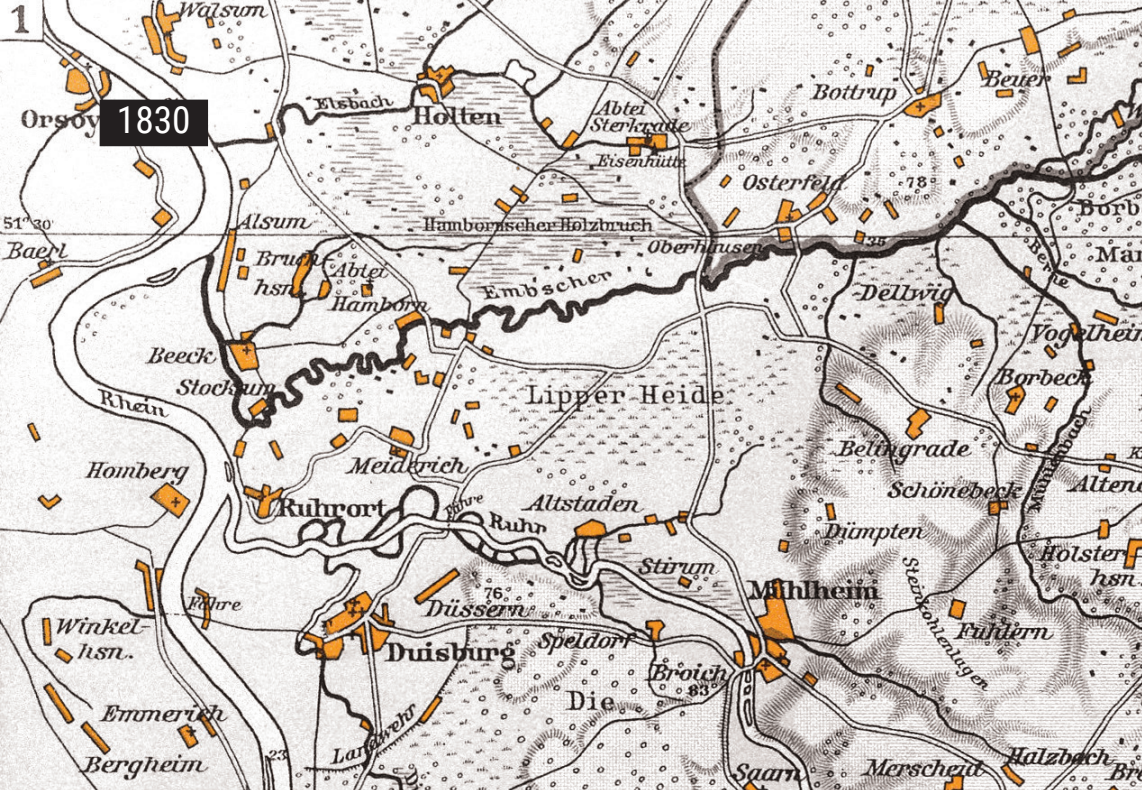
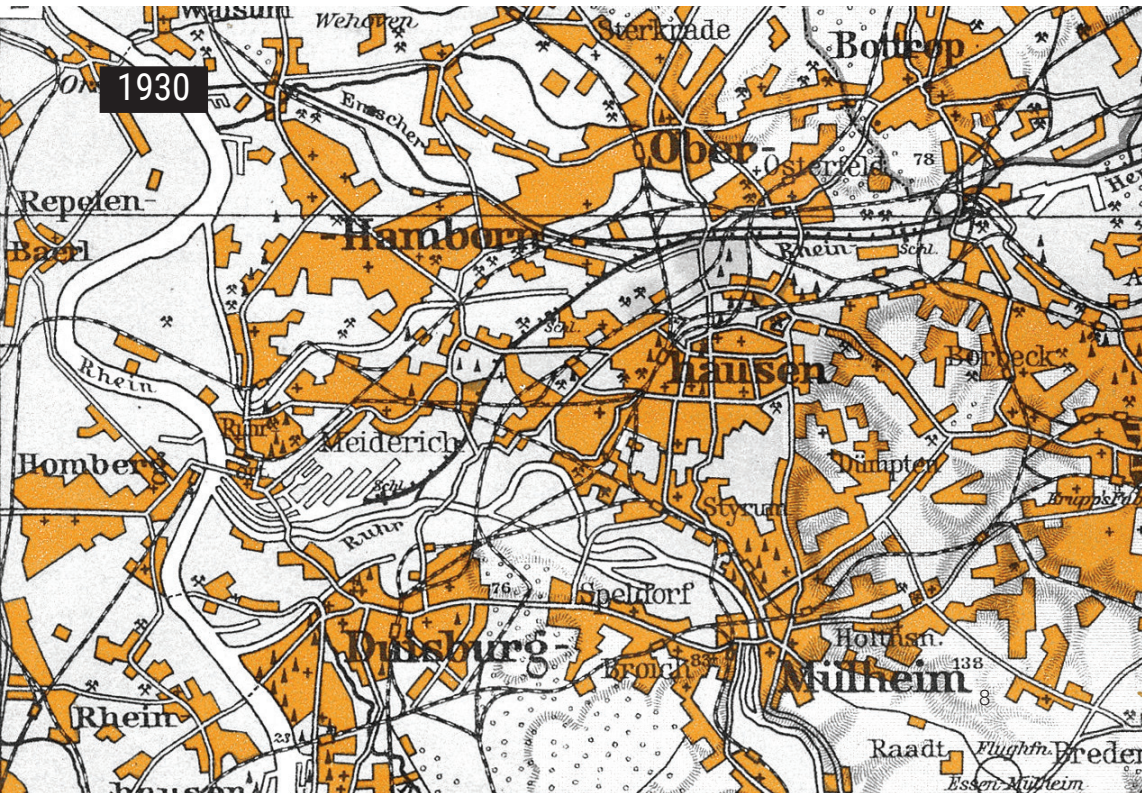


Fig. 2 & 3: Historical maps of the ruhr region 1830 & 1930

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Castrup
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Hillen
Eikel
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Sodingen
Böninghsn.
Gesen kirchen
Riemke
Gärte
Hodel
137
Kirchharpen
Schwarzbach
Uekendf.
Cuternbg.
Rotthsn.
Kornharpen
Bochum
Stoppenbg.
Wattenscheid
Westerfeld
Altenbochum
Werne
Langendreer
Altenessen
Krey
Essen
Läar
Huntrup
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Ruhr
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huge investments were made in new infrastructure. Instead of railways this time highways were needed to connect regionally and education was necessary. The 1962-founded Ruhr-University Bochum was one of several universities built in North-Rhine Westphalia. It was a starting point for a more knowledge-based industry. Besides giving employment and education, all these new projects however changed the urban fabric immensely. One of the still remaining architectural aberrations was the shifting of the Wittener Street, which cut through the centre of Bochum-Laer. The local quality of life decreased a lot, since the surrounding city districts now faced a massive factory and wide streets. The only leftovers of Zeche Dannenbaum furthermore are just one building, which now functions as a college, and some railway fragments (see fig. 18).

Third industrial revolution

Around 1980 Opel Bochum employed 20,000 people, an amount that is nearly one third of the former workers in the coal industry in the city. Afterwards jobs only declined (see fig. 1). First of all the third industrial revolution happened through the introduction of automated fabrication. Robot arms and other machines assisted the workers, they worked more precisely than humans but also replaced many of them. Furthermore employment decreased through wrong decisions by GM and Opel like missing chances on foreign markets (Wannöffel et al., 2015). In 2004 when 9,000 people worked at Opel Bochum the GM management therefore announced to close the local factory.

Dependency on transnational company

Fig. 4: Poster of strike inside the factory

The development that happened after 2004 shows that Bochum has again a certain dependency on one industry branch. Although 9,000 jobs are directly at risk, even more would be in danger locally and regionally through a network of suppliers and subcontractors. But Bochum knew at this point its position in the manufacturing chain of Opel and with wild strikes, workers fought for their right. By stopping their work they were able to stop the production in the factory in Antwerp, which was dependent on Bochum's products. The

Fig. 5. Historical aerial footage of the site from coal mining to glass manufacturing

Fig. 6: Mines of the Dannenbaum pit

Intersection with Boundary
Shafts
Old Tunnels
Old Railway

Fig. 7: City structure till 1960

Old Street
Old Wittener Street

Fig. 8: Building of streets after 1960

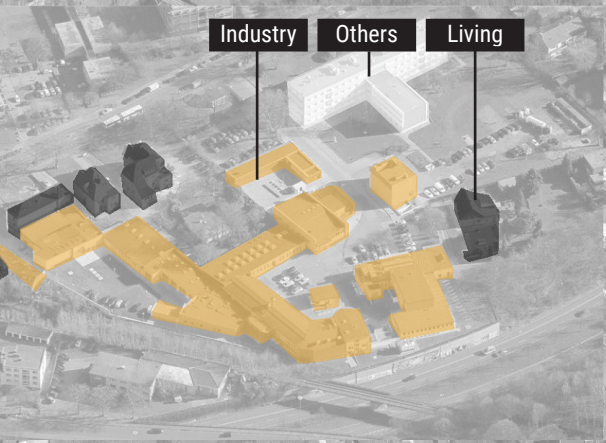
New Streets

Fig. 9: Opel factory from 1961 on

Opel Streets
Covered Streets
Opel Railway

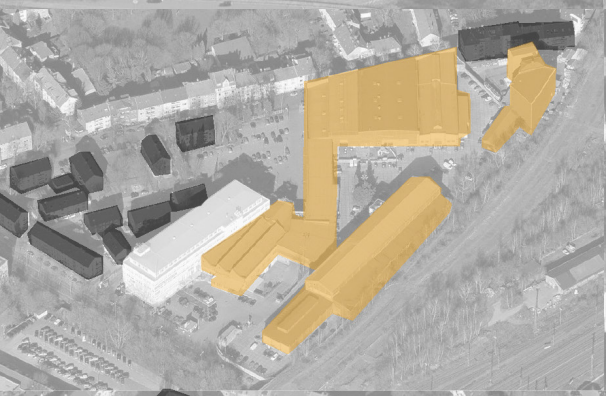
Industry in the city

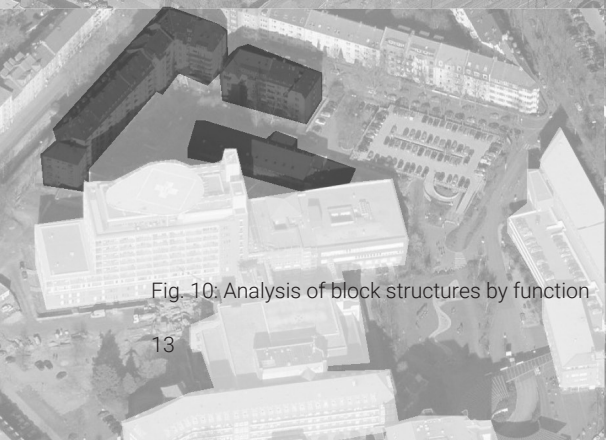
The urban fabric of the Ruhr region and Bochum, which is shown in the pictures of this site often looks like a collage city with living next to industry, which urban planners often would judge as a no-go.



This direct spatial confrontation of people with manufacturing probably adds up to an issue that industry is not very appreciated in the region.

But it also shows that it is possible to have production in inner cities and looking at contemporary trends of bringing it back to the city, we should consider friendly typologies that create dialogues between the living and working people similar like the old craftman's workshop that was always part of a city even before the industrial revolution. Christopher Alexander was imagining this in one of his patterns called "Shopfront schools", where people accidently run into the work of others and learn from them (Alexander et. al. 1977).





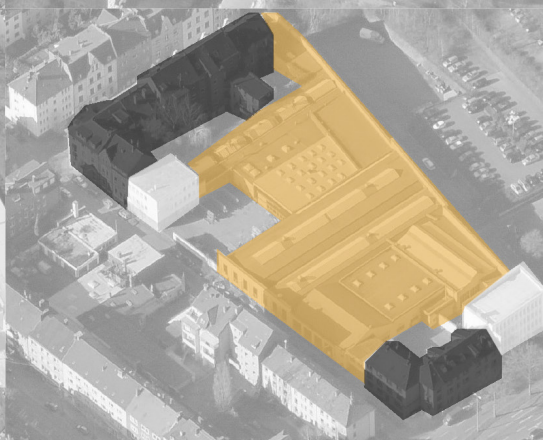
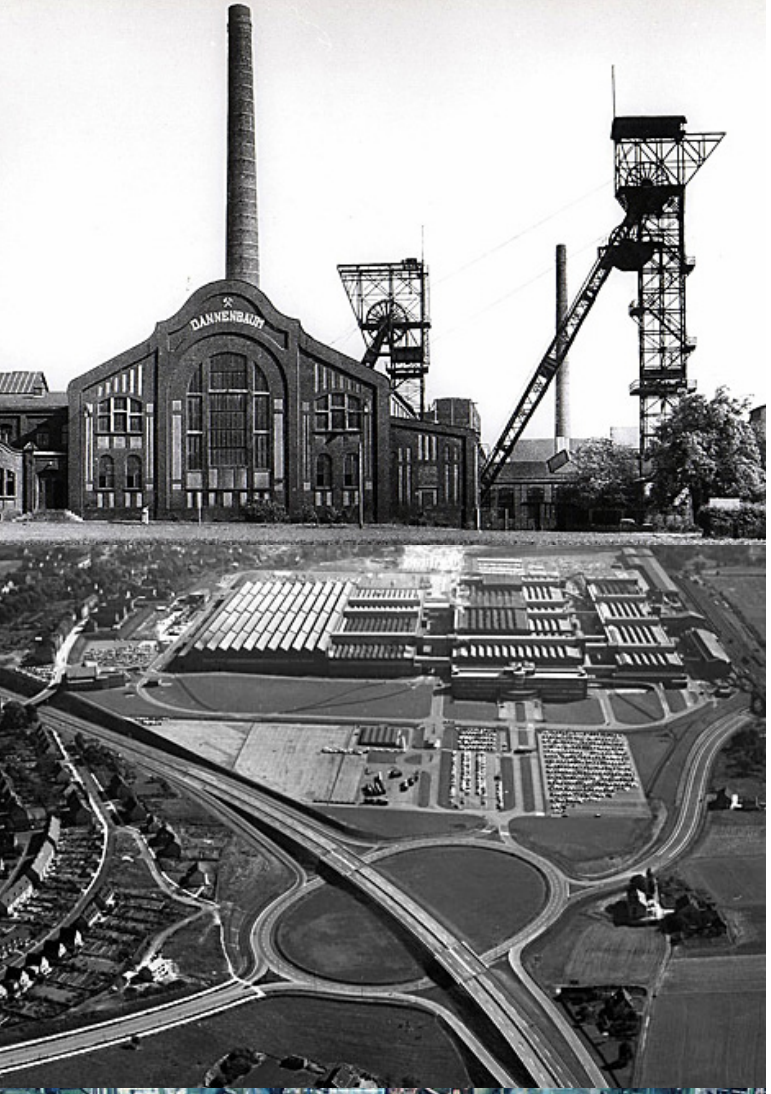


Fig. 10: Analysis of block structures by function



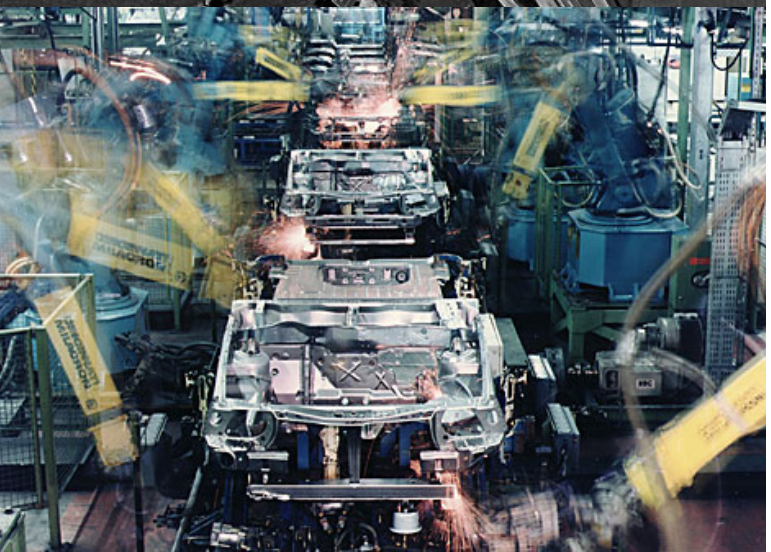


Fig. 11: Zeche Dannenbaum

Fig. 12: Adam Opel Werk I

Fig. 13: Process Automation at Opel

strikes saved the factory in Bochum, however throughout the next years employment was reduced and in 2010 Opel Antwerp was closed (Wannöffel et al., 2015).

The financial crisis in 2008 nearly led to the insolvency of GM and Opel. What happened now was out of control for the people in Bochum. Both companies got financial help through their governments, GM through the Americans and Opel through the Germans. Opel saw it as a chance to split off from GM and the German government tried to assist in negotiations with other companies who were interested in buying Opel. Chancellor Angela Merkel actively pushed this agenda, even speaking to the US Congress about this issue. But ultimately GM did not allow the deal (Carrel, 2009).

Afterwards when GM slowly recovered, it decided again to close the factory in Bochum again. Strikes and negotiations did not help and at the end the workers themselves had to vote for their destiny. Deciding against GM's offered conditions, the management accelerated the closing ultimately to end of 2014. By getting a two-year temporary work in other companies 3,200 jobs were directly affected, estimations for the region go up to even 45,000 jobs (Dagdelen, 2012).

Fig. 14: German chanellor Merkel speaking to Opel staff

Fourth industrial revolution?

Leaving behind a disrupted network of the car industry and unused infrastructure Opel still had to invest 500 Million Euros in the closing of the factory to make it useable afterwards again. The destruction of the huge halls is already happening, although the administration building and maybe the biggest hall D3 still may have a chance to be protected as a monument (see fig. 18). Considering that the Ruhr region is known for its industrial monuments from the first industrial revolution it would be a great chance to keep parts of this monstrous factory, too.

A group called "Bochum Perspektive 2022" was set up to redevelop the area. They try to attract new high-tech and innovative industries which fit under the label *Industrie 4.0* or the local label *Bochum 4.0*. These are political initiatives to favour companies with digitized and connected production. *The Internet of Things* is one of the key-phrases of this agenda. DHL a logistic company is already in negotiations to create a distribution center with 600 workers on site (Thomaschek, 2015). Furthermore the site is part of the UniverCity plan, a city development which is supported by six local colleges

and universities, who are seen as motors for Bochum's economy. The Worldfactory is one initiative resulting from this plan, which could be implemented on site. It is meant as a campus where industry and the Ruhr University Bochum work together and give students and start-ups a chance to develop their ideas (Gruß-Rinck et al., 2014). Digitized, creative, and innovative industries are often seen as part of the fourth industrial revolution, but if Bochum develops the area mainly with a few big players, will it produce the same problems again? History has shown that structural change is unavoidable, how can it be made a continuous part of the local industrial culture?

Figure at the bottom

Fig. 15: Destruction progress of the Opel factory in november 2015

Figures on the right

Fig. 16: Administration building of Adam Opel Werk I already has a temporary status for a monument.

Fig. 17: The largest hall D3 still facilitates many technical services, but does not fulfill fire safety regulations.

Fig. 18: Inside of hall D3 cars were mass manufactured. Between the transverse axies are around 20 crane runways.

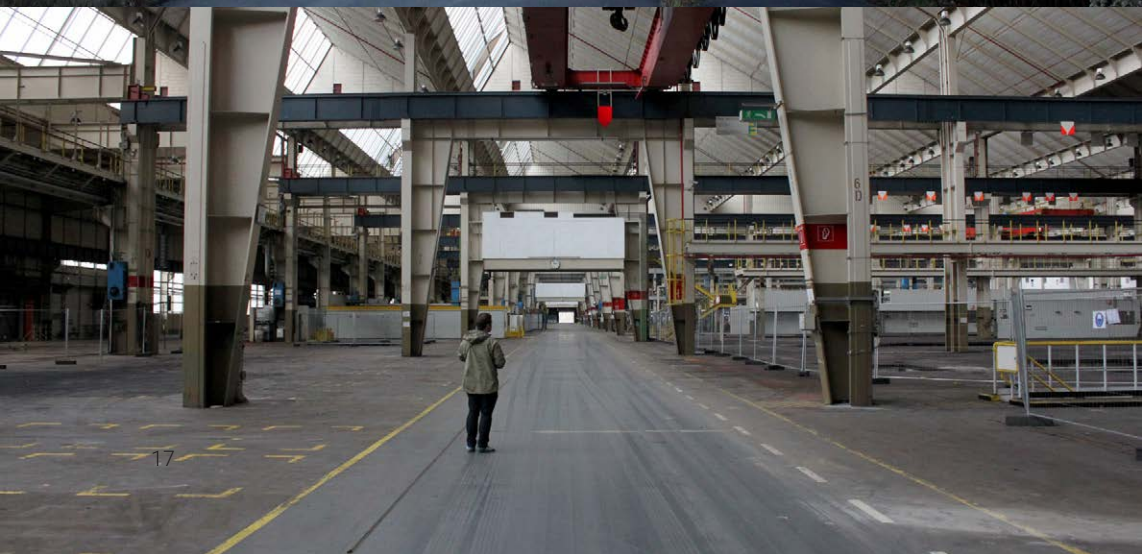


Fig. 17: Atmosphere around the site.

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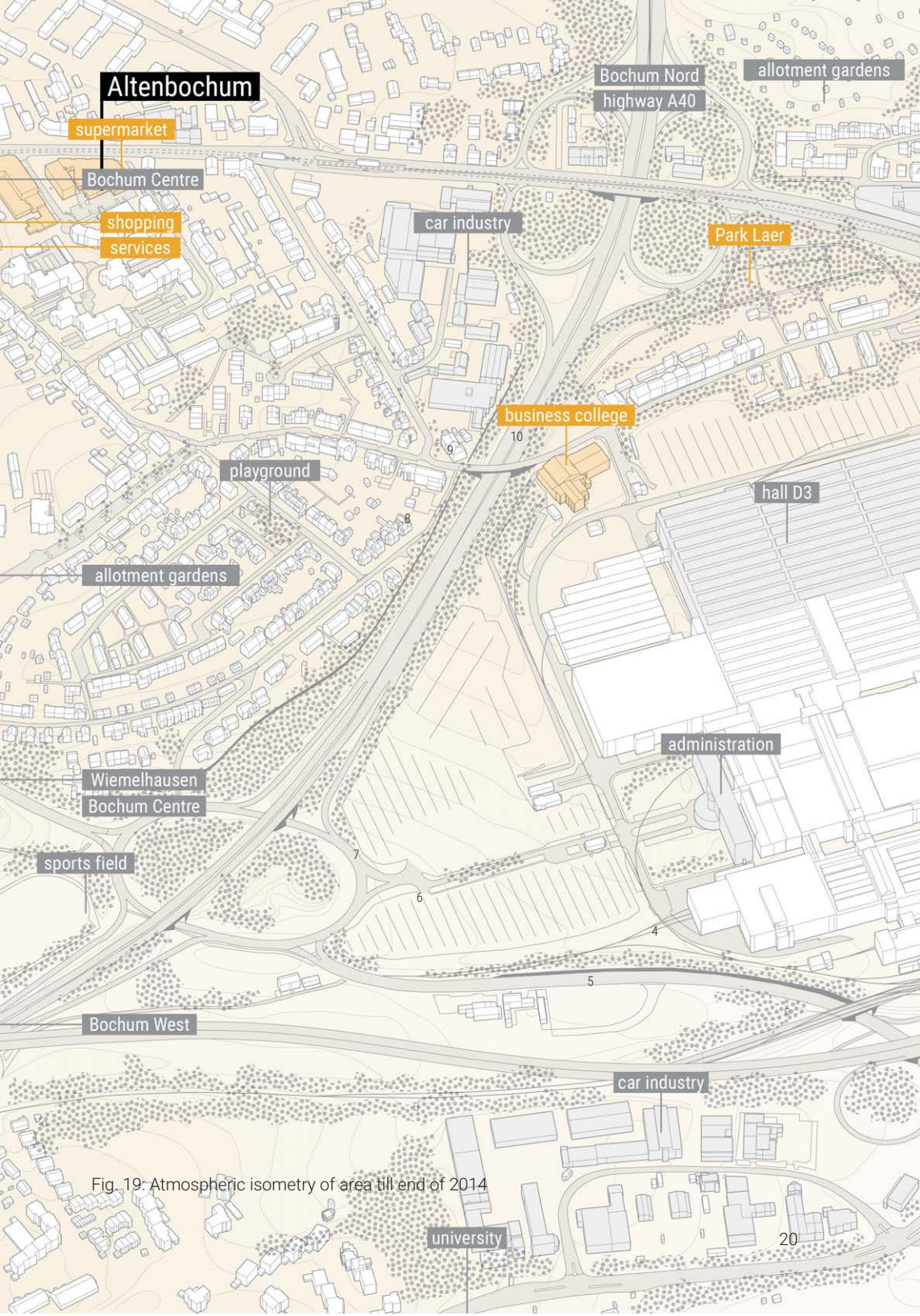
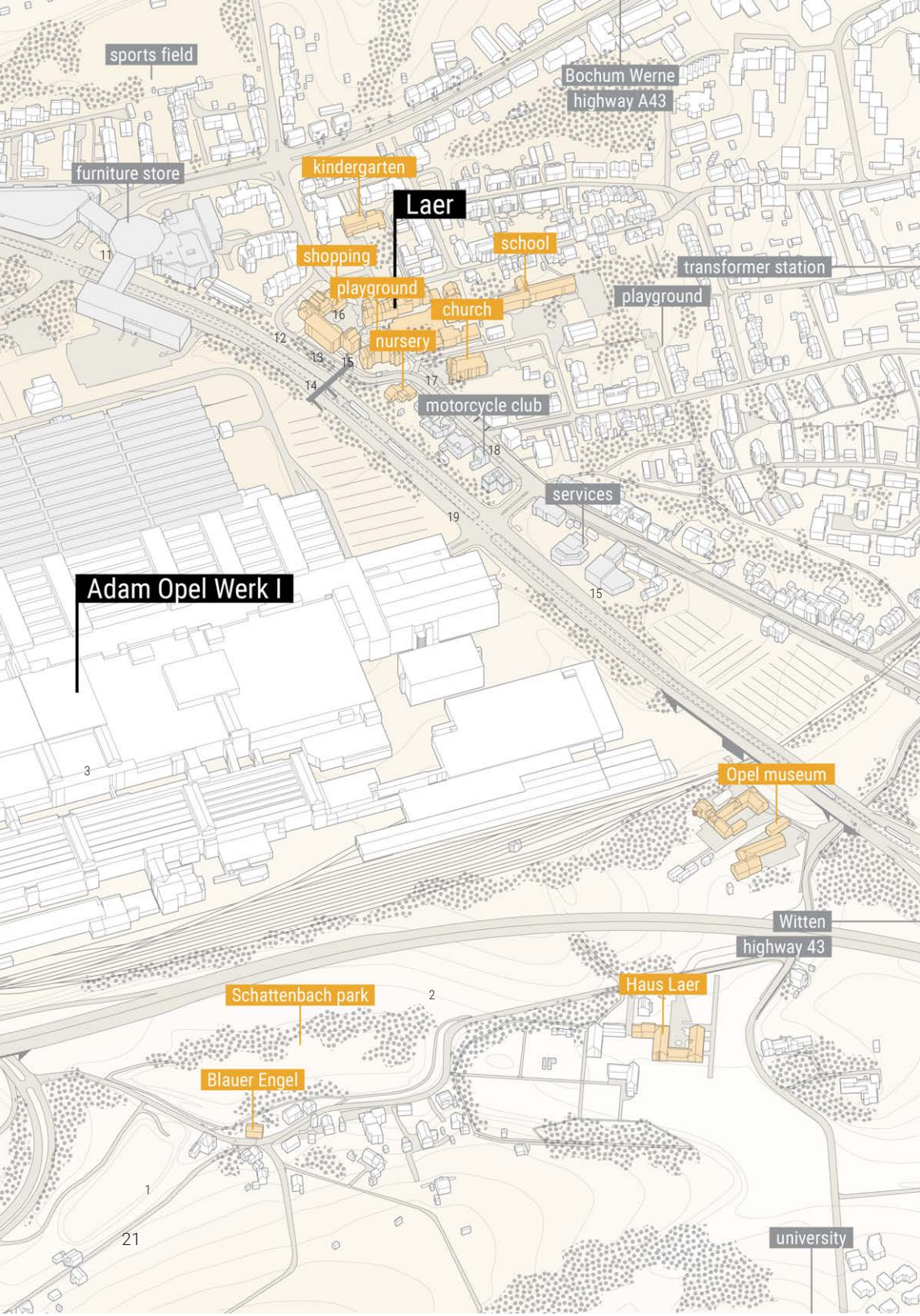


Fig. 19: Atmospheric isometry of area till end of 2014


sports field
Bochum Werne
highway A43
furniture store
kindergarten
Laer
shopping
school
transformer station
playground
playground
church
nursery
motorcycle club
services
Adam Opel Werk I
Opel museum
Witten
highway 43
Schattenbach park
Haus Laer
Blauer Engel
university
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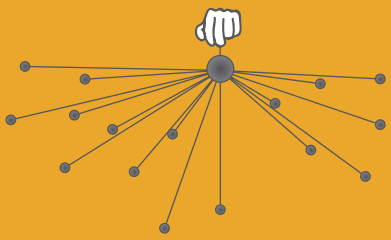
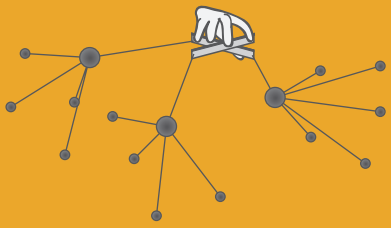
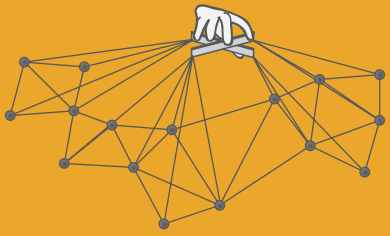
Dependency on Coal and Steel



Dependency on Opel



Dependency on netarchical System



or

Commons-based Peer Production

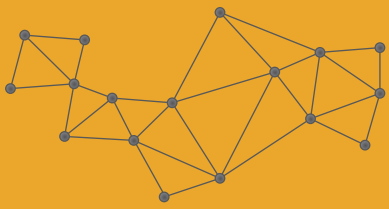


Fig. 20: Dependencies of Bochum

Challenge

Occupying **a space of 65ha** and bounded by large streets the Opel factory has been an industrial and infrastructural monument of the mass-manufacturing age. It divided its surroundings, connected with its regional suppliers and had to compete globally. Now that it is gone, it leaves a **void in a disrupted network** of work, education and transport. **Structural change** becomes unavoidable. But instead of finding a one-time solution it should become a continuous part of Bochum's culture. In an innovation-based economy **innovation** is eventually the best way to move forward (Castells, 2004). Therefore the site needs to reconsider the demands of all scales, **locally, regionally and globally**. It has to find talent, knowledge and innovation and needs to **create social and spatial values**. Its **spatial and organisational structure** becomes crucial for its success.

Research questions

How can the site of the Adam Opel Werk I
establish a social, stable and strong economy for Bochum
in the context of the disrupted car-manufacturing industry?

Bochum's competitiveness

Looking at the reasons for the decline of **Bochum's competitiveness**, what are weaknesses and potentials?

- How did the economy develop spatially, demographically and by sector?
- What kind of forces led to the closing of the Opel factory?
- What are strengths, weaknesses, opportunities and threats for the local economy?
- Could new trends in mobility be a chance for the disrupted car-manufacturing industry?

Space & organisation

How does a working environment need to be **structured organisationally and spatially** on the area to be social, stable and strong?

- What are good conditions for a strong and stable environment in general and specific for the site?
- How can social values and responsibility be introduced in the acting of involved companies?
- What would make the area less vulnerable and more competitive in the broader economic context?
- What kind of spaces and functions are needed for a new manufacturing economy?

Local context

What are the **local conditions** of the site, its surroundings and its position in the region?

- What is the condition of the existing site, are parts valuable and should be reused?
- In what relation does the area stay towards its surrounding neighbourhoods, does it need to be improved?
- What is the position of the site in the region and how should it change?

Inolved Actors

Who would be involved in the restructuring of the location?

- What is the structure of local, regional and global actors in Bochum's economy?
- How is the community in Bochum and around the site?
- Which economic sectors are interesting for the site?

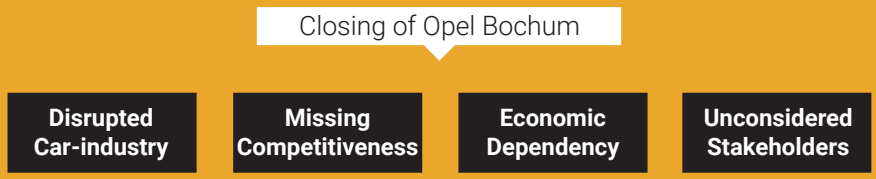


Fig. 21: Scheme of theoretical framework

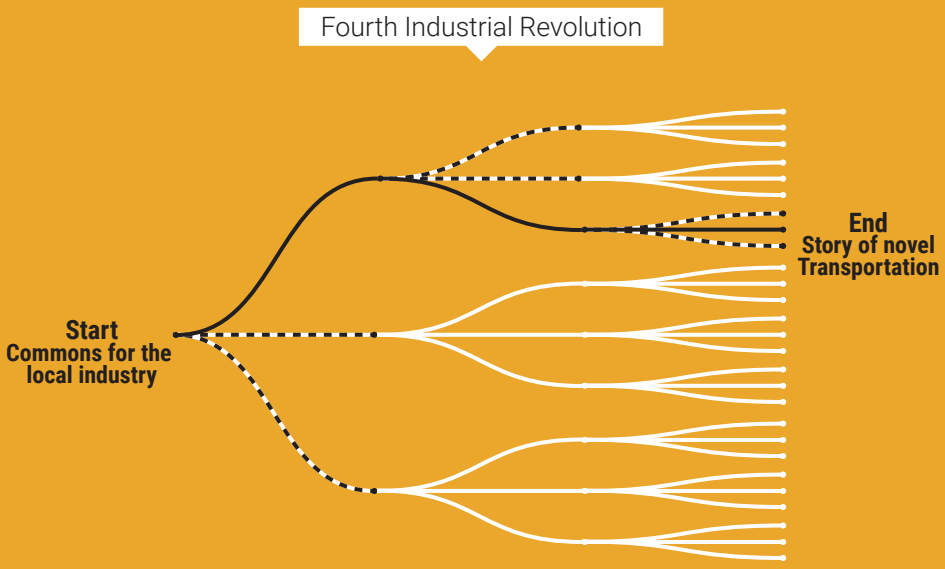
Theoretical Framework

Disrupted car-industry

The closing of the Opel factory affected 3,200 jobs directly, 10,000 locally and 45,000 regionally. These numbers show the influence of the company on the network of suppliers, subcontractors or salesmen, who were dependent on the car-manufacturer and were earning their money with related tasks. Not only jobs, but also knowledge could get lost, if it is not being reused. Bochum, the Ruhr-Region and North-Rhine Westphalia have expertise in the field of transportation and a great mobility-network. Instead of finding other economic branches, there is a big chance in novel transportation methods like electric or autonomous vehicles that could make use of the existing infrastructure. The disrupted network could be reconnected, including the lost knowledge and jobs.

Missing Competitiveness

Three industrial revolutions already happened on the site of the Opel factory. Each time new innovation introduced structural change and brought economic development, but each phase also ended with a downturn for employment and industry. With the closing of the factory the area faces a recession again. Its comptititvenss on the global market is not good enough, since the local industry relied on conventional working processes and products. To take part in the global economy, which is driven through innovation (Castells, 2004), the region has to favour it. It has to become essential for the site. The local economy has to explore new branches, processes and products.



Economic dependencies

At times of the first industrial revolution Bochum was already mainly dependent on the coal and steel industry. Through market liberalisation and international competitors this economic branch declined. The new Opel factory gave hope to the people. But it was creating just another centralized network for the local industry, disguised as strong transnational company that would last. Relying on the local market only, Bochum's industry cannot survive for a similar reason like the coal and steel industry. The global market has too advantageous competitors. But through collaboration local companies can become a strong node in the global economy. Commons can facilitate this alternative economic model and even attract actors outside the local network (Dellenbaugh et al., 2015).

Unconsidered Stakeholders

Railways of the end of the 19th century already connected the site to the Ruhr region. Later on Opel as part of a transnational company placed its factory on the site as a node of its manufacturing network. Regionally and globally connected, it cut through the local urban fabric, leaving behind a dysfunctional city-district Bochum-Laer. A new spatial and organisational structure has to involve actors on all scales and needs to negotiate their demands for the site to respect the needs of others and be successful.

Fourth Industrial Revolution

The first Industrial Revolution with its huge consolidation of the built environment has paved the way for mass-manufacturing and the division of labour, but introduced great social, hygienic problems of growing cities. In city planning the second Industrial Revolution was seen and praised as the solution for the problems of the first by introducing the division of functions and mass-manufacturing of cities. But soon it was criticised for its centralised planning, missing an understanding human scale and individual demands. Over time technological developments became more and more precise and efficient driven by the education of specialised workers. But simple regular jobs were partly replaced by machines. Automation raised fear and optimism and for some it promised to solve the diverse needs of a consumer society. But, as Colin Rowe pointed out in his book Collage City, it would be the "literal extension of total design into total management" (Rowe & Koetter, 1978) creating another centralized dependency on an automated process.

The third Industrial Revolution was also the birth place of Information Technologies. The raise of the internet has shown us new organisation forms that overcome traditional hierarchical structures. The **digital** world now invades and **merges with the phyiscal world**. The **Internet of Things** is the catchphrase of the fourth Industrial Revolution. An interconnected world always informing one another.

Production will come back to our cities as **manufacturing will be distributed** to produce heavy things locally and the light objects or design globally. And **mass-customization** is ending the rationalization of former ways of design and planning enabling us to embrace the diverse demands of society.

Again the Industrial Revolution promises us to solve all of our problems and some examples show, how communities evolve out of the Internet, who produce and share as peers common resources. Open Source initiatives try to make them accessible to a wide audience as trustworthy software and slowly also as hardware.

But the revolution is also driven by other players. They want to control the infrastructure of the 21st century with all of its data and users. Their netarchical structures create new centralised dependencies to make their own community obedient and those who don't follow are spit out of their society.

The fourth industrial revolution leaves us therefore with the ideological battle of a convenient consum-oriented dependency on netarchical companies and an inconvenient commons-based peer-production.

Considering the failure of centraized dependencies, we might not want to extend total managment into total nurturing, but choose a social and reliable path.

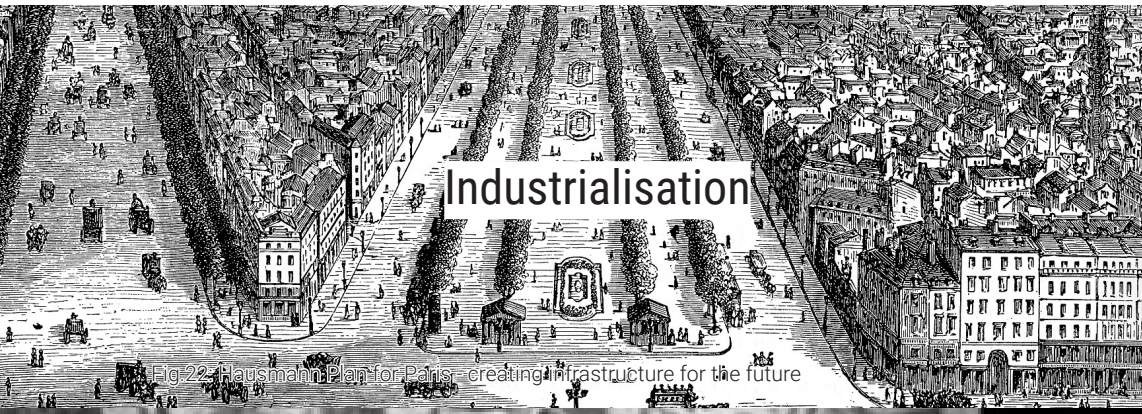


Fig.22: Haussmann Plan for Paris - creating infrastructure for the future

Fig.23: Le Corbusier pointing on his Plan Voisin - division of labour becomes divison of functions

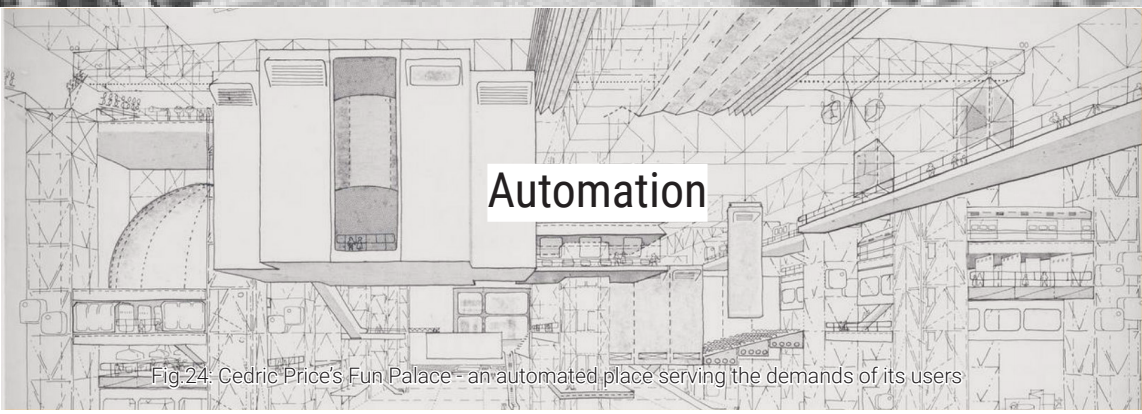
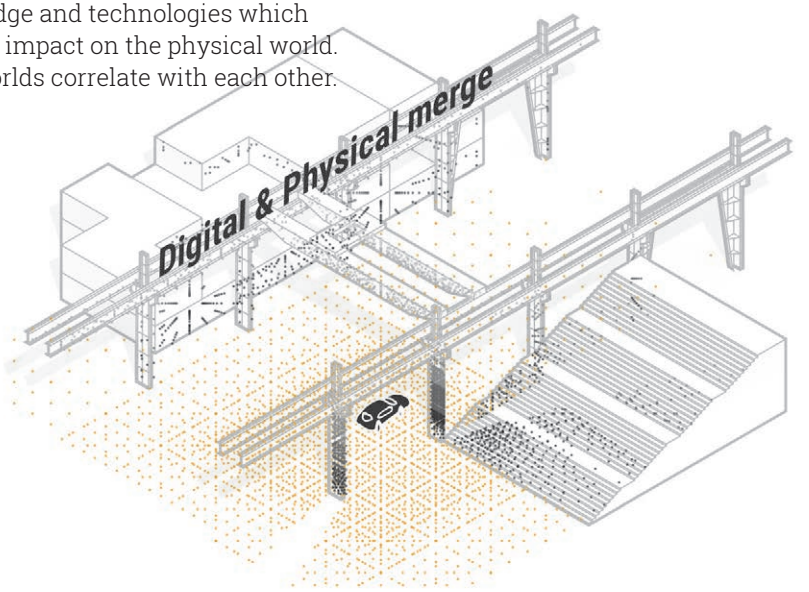


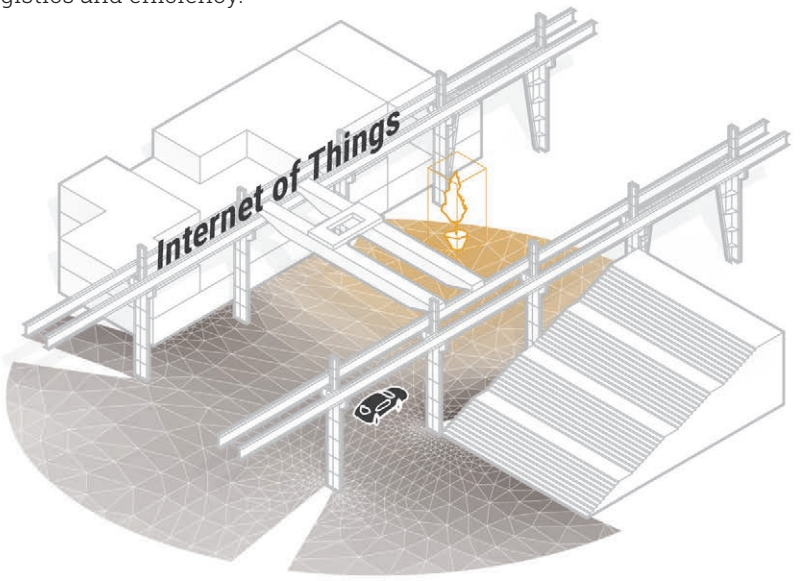
Fig.24: Cedric Price's Fun Palace - an automated place serving the demands of its users

And now?

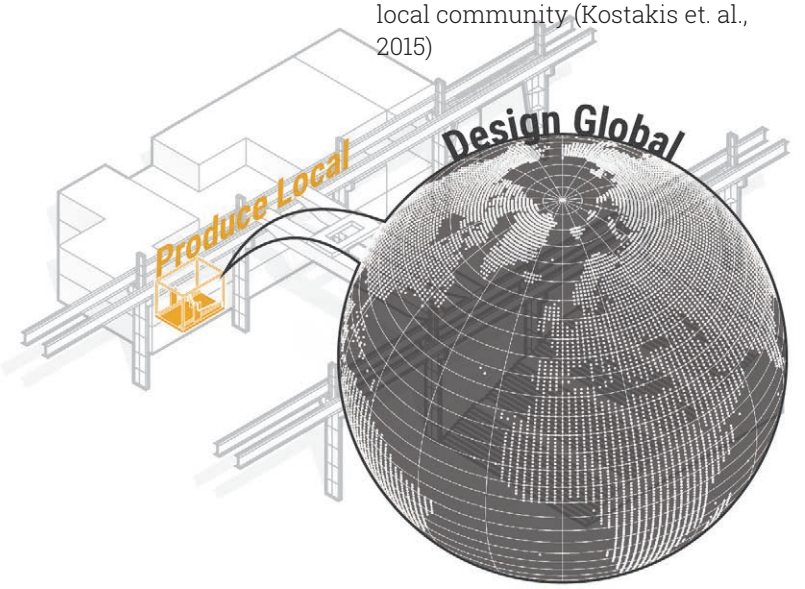
The digital world tries to represent our physical world through analysis of data and abstraction. It gives us new knowledge and technologies which have an impact on the physical world. Both worlds correlate with each other.



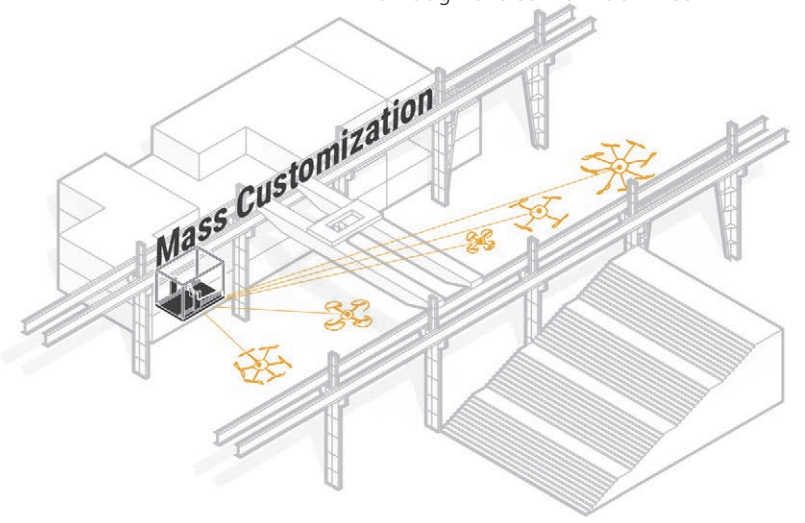
Objects communicate seperate from humans in the internet of things to allow i.e. autonomous functions or better logistics and efficiency.



Joining a diverse global community and manufacture locally to reduce expensive logistics and support the local community (Kostakis et. al., 2015)



Different demands can be served easily through technologies that allow the fabrication of different products through the same machines.



Commons

Through sharing resources, the commons introduce social values in a capitalistic environment. The community of contributors works together in creating them. By investigating them and their impact on a local industry in my theory paper *Commons for local industries* I concluded that they can help local networks to become a node in a global network and overcoming economic dependencies on a few big actors. If commons are created open and flexible, they can evolve over time. Their spatial structure should represent in this instance their organisational structure.

- local network to global node
- introducing social values
- spatial and organisational isomorphy

Resources

- created and adapted by the community
- often commonly shared basic requirements
- should be easy accessible physically and monetarily
- Digital resources like intellectual property, open source software or hardware blueprints
- Physical resources like public space, hacker- or makerspaces

Theory Paper

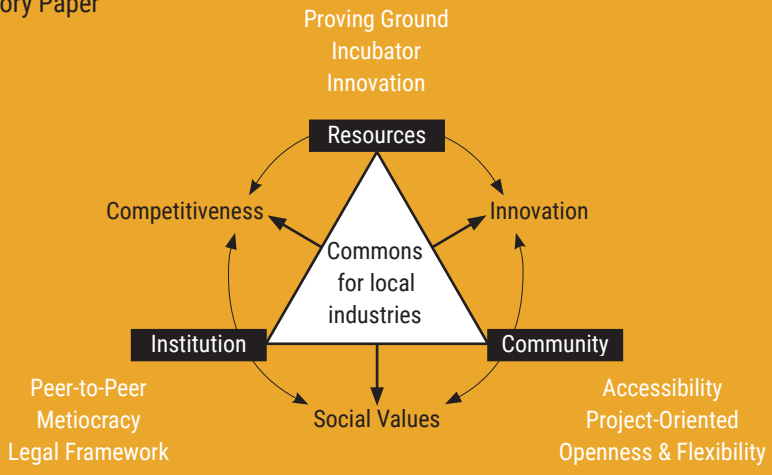


Fig. 26: Summarizing scheme of theory paper

Community

- likes freedom, flexibility and profit-oriented working
- formal & informal networking
- often hackers, tinkerers, makers - creative class
- needs to attract diverse and motivated user-base not only locally but also globally
- equal accessibility can adress integration and education of all social groups
- metiocratic community
- organisations contribute in their own interest

Institution

- open and flexible organisation which evolves and changes over time
- small communities up to 150 people profit from face-to-face contact and can organize themselves
- big communities are organized in decentralized project-oriented clusters or modules
- peer-reviewing and metiocracy that create responsibility on all levels
- legal framework to avoid exploitation through i.e. licensing and sanctions

Industry can profit from sharing basic requirements in the value-chain like logistics, co-working spaces and innovations

Industry can grow through diverse innovation, the business models need to be build around the community introducing social values

Industry can be open and protective at once through a well organized institution that allows the creation and sharing of the commons

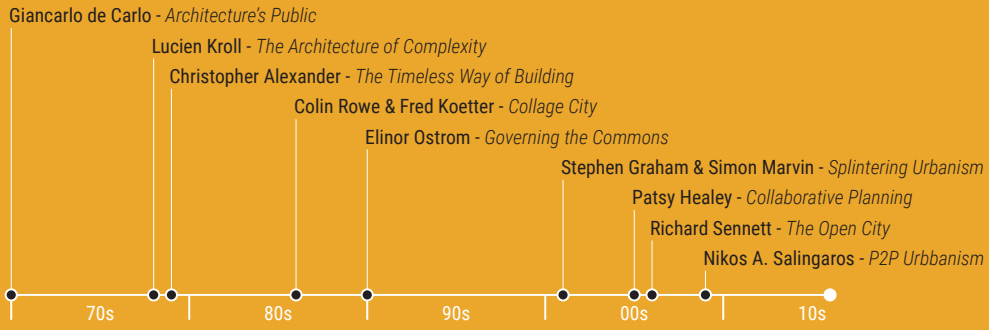


Fig. 27: Timeline of literature dealing with participative planning or the commons

Literature dealing with collaboration and the commons loosely always relates to these terms:

Openness

We need to design open systems, which can be changed and are inclusive and accessible rather than exclusive and closed. Otherwise we will be dependent on vulnerable systems as history has shown also in Bochum.

Evolution

As the most successful open system, evolution has shown its adaptability and survivability. It is inherent to us and would create diversity and openness, if we allow changing of the DNA of our societal and spatial organisation.

Negotiation

Closed systems are organised often strictly hierarchical and are therefore easily manageable with the weakness of ignoring sometimes crucial demands In open systems, where everyone could have an opinion on the development, directions need to be negotiated. Which does not mean that everyone's demands will be satisfied.

Conflict

If everyone is able to participate, confrontations are inevitable, since opinions and needs differ. A culture of transparent, open and informed negotiation has to help solving these conflicts, to avoid corruption and build up trust and empathy.

Elinor Ostrom defined eight principles to design the Commons:

- "Define clear group boundaries
- Match rules governing use of common goods to local needs and conditions
- **Ensure that those affected by the rules can participate in modifying the rules**
- Make sure the rule-making rights of community members are respected by outside authorities
- Develop a system, carried out by community members, for monitoring members' behaviour
- Use graduated sanctions for rule violators
- Provide accessible, low-cost means for dispute resolution
- Build responsibility for governing the common resource in nested tiers from the lowest level up to the entire interconnected system" (Ostrom, 1990)

P2P Urbanism by Nikos A. Salingaros:

"P2P (Peer-to-Peer) Urbanism is an innovative way of conceiving, constructing, and repairing the city that rests upon five basic principles.

- P2P-Urbanism defends the **fundamental human right to choose the built environment** in which to live. Individual choice selects from amongst diverse possibilities that genereate a sustainable compact city those that best meets our needs.
- All citizens must have **access to information concerning their environment** so that they can **engage in the decision-making process**. This is made possible and actively **supported by ICT** (Information and Communication Technology).
- The users themselves should participate on all levels in co-designing and in some cases building their city. They should be stakeholders in any changes that are being contemplated in their environment by governments or developers.
- Practitioners of P2P-Urbanism are committed to **generating and disseminating open-source knowledge**, theories, technologies, and implemented practices for human-scale urban fabric so that those are free for anyone to use and review.
- Users of the built environment have the right to **implement evolutionary repositories** of knowledge, skills, and practices, which give them increasingly sophisticated and well-adapted urban tools." (Salingaros, 2011)


HYUNDAI

Graphical analysis of collaborative common spaces. Public and private zones are seperated through nearly invisible walls. The width of paths are like thresholds and before one goes into a more private zone he might first start a conversation to build up trust and get access.

Fig. 29: Allmende -Kontor Tempelhof, Berlin

Fig. 30: Prinzessinengarten, Berlin

Graphical analysis of collaborative housing. The buildings form courtyards or have rooms as semi-public space. Balconies on the upper floors serve as private or communal outdoor space.

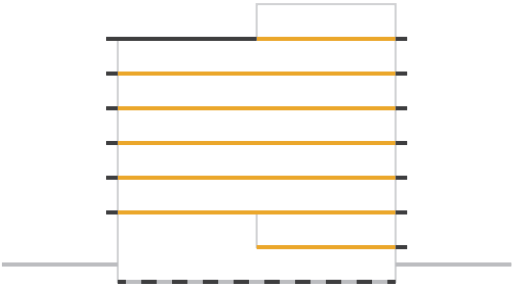


Fig. 31: Ritterstraße 50, Berlin - Heide und von Beckenrath Architekten

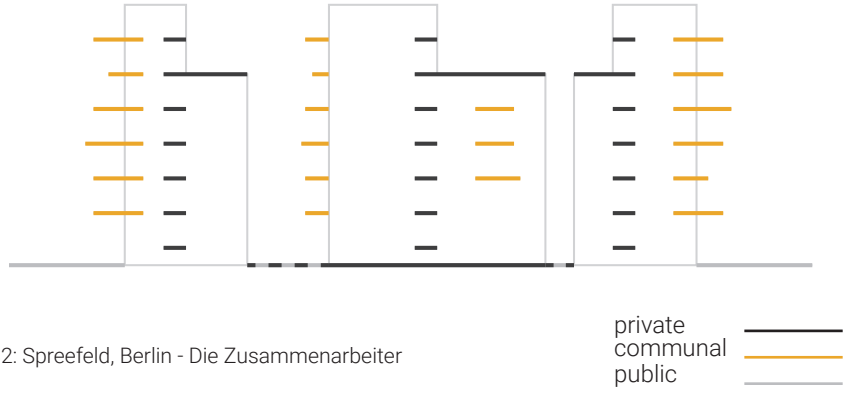


Fig. 32: Spreefeld, Berlin - Die Zusammenarbeiter

Graphical analysis of collaborative working and recreation. The public blends seamlessly into communal space. Higher platforms create sightlines and give the feeling of an agora as a public meeting place.

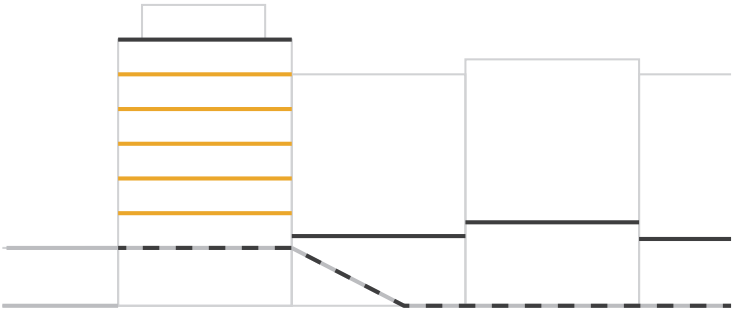


Fig. 33: Schieblock, Rotterdam - Gemeende and Zones Urbaines Sensibles

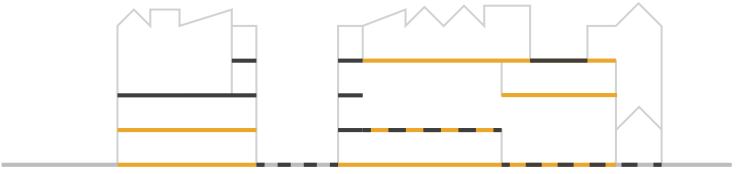


Fig. 34: Holzmarkt, Berlin - Genossenschaft für urbane Kreativität


YES!

Graphical analysis of collaborative industry and working. The boundaries between private and public are rather clear defined, but community space is conciously wanted and used especially for networking.

Fig. 35: RDM Campus, Rotterdam - Groosman Architects

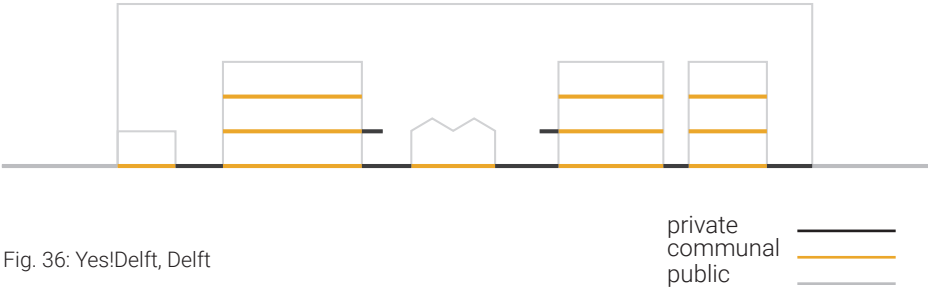


Fig. 36: Yes!Delft, Delft

Openness

The graphics on the right side show a more elaborated quantative analysis of public and private space.

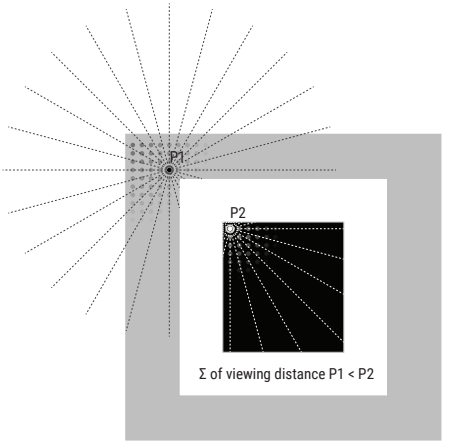
From each point in a grid of points, similar to a bitmap, rays are send out in all directions up to a certain distance. If they hit an obstacle they stop. The sum of the distance of rays for each point gives a hint about the public and privateness of the spot. If you cannot look very far, your spot is rather difficult to observe and gives you more privateness and if you can look far you can be seen rather easily by others. Calculating this value for many values in form of a grid that is overlayed on a plan, it creates a bitmap of private- and publicness.

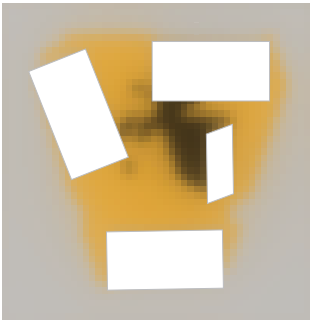
The first graphic shows a calculation of a simplified traditional block. If their is no opening the division of public and private space is very clear.

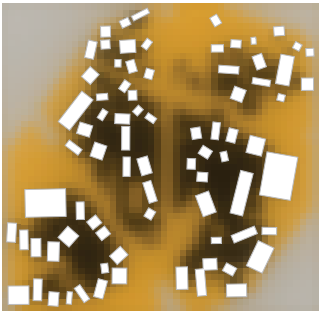
The second bitmap shows the example of Spreefeld in Berlin. The community space is easily accessible from the outside, but the positioning of the buildings creates invisible bounaries and thresholds that may keep people outside at first place except they are curious and want to have a look.

The gradual thresholds become even more visible in the example of the urban gardening project Allmende Kontor Tempelhof in Berlin. From my own experience I can say that I went into the common zone only slowly and would step into the private zone only after starting a conversation with one of the locals. It is a very natural process of accessing a community and slowly becoming part of it.

More gradual an diverse public and private space represents the commons much better than clear borders, although this might be contrary to Ostroms first principle of defining clear group boundaries. But the group boundaries are still clear and accessible is granted, which then goes along with the seventh principle and also the second principle of P2P Urbanism concerning accessibility and right to intervene.







private
communal
public

Open Source

Processes of the open source culture can be an inspiration on how common resouces can be managed. They represent a culture of "problem solving and problem finding" (Sennett, 2008) as described by Sennett.

One essential part is the forking, meaning the copying of a project an adjusting it to one's own needs or merging it later on again with the old project. This has an evolutionary effect as the graph of the forking of Linux distribution on the right shows.

The graph below shows the way how projects on Github are managed and a proposal how it could be translated into a spatial design.

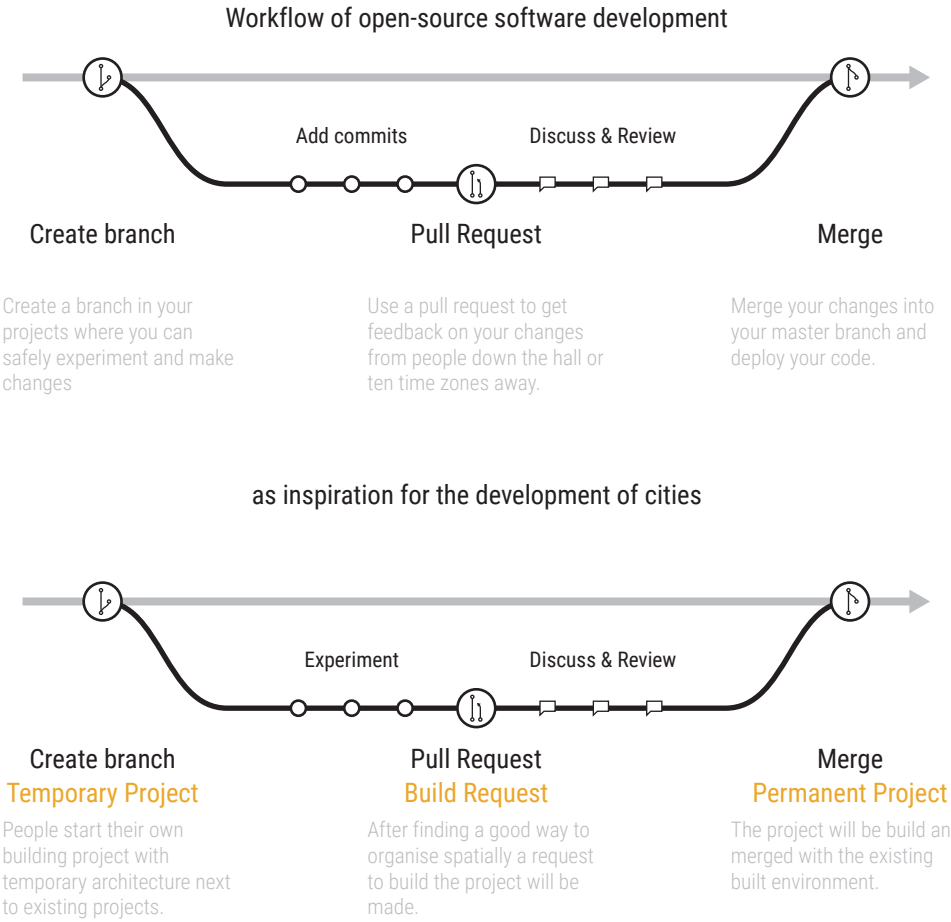


Fig. 37: Github process of developing Open-Source software as inspiration

Trust and Transparency

The Snowden-revelations have shown for communication how netarchical structures can misuse networks. A discussion about safe ways of communication started.

Digital communication can only happen safely when it is encrypted, but to ensure that there is no backdoor, the software needs to be transparent. Only Open Source Software would give security, since it can be validated by independent experts. This of course does not go along with capitalistic forces, since it is difficult to make money out of software which is available for free. But only then the communication is trustworthy.

In a collaborative industry similarly designs should be made open source. Imagine autonomous cars with proprietary software, they could transport one not the direct way, but ways that stimulate and manipulate one's demands and gather data about private travel logs. This will be the future for the technologies that are developed right now. They are not open and not trustable.

With open source technologies however this local community could attract a global community and would be able to collaborate. They just would not make money through conventional business models, but others as I have pointed out in the attached paper at the end of the report.

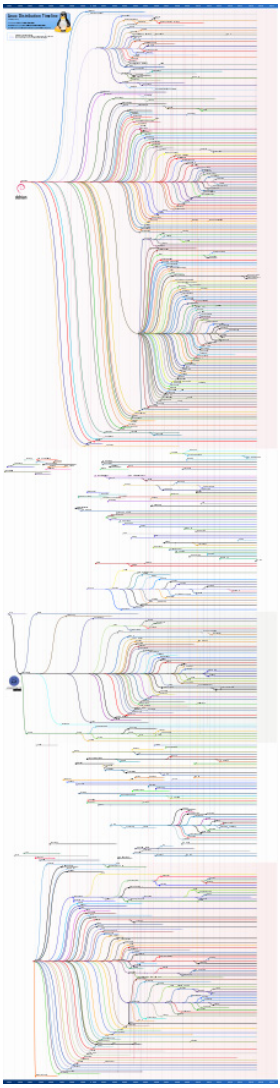


Fig. 38: Forking of Linux distribution

"The most familiar and most magnificent open system familiar to all of us is Charles Darwin's version of evolution" (Sennett, 2006)

Novel Transport

Opel as a car-manufacturer was integrated in a good network of suppliers and infrastructure in Bochum. Now that the local factory was closed it leaves behind a disrupted car-industry. Howsoever the conditions to reconnect the network are quite good in the region of North-Rhine-Westphalia. Alternative transport modes are supported through political initiatives (Elektromobilität NRW, 2014) and the network of research, development and industry is still small, but already quite developed in the region as fig. 24 shows. This gives the former Opel site the chance to become a node in the industry of new mobility, helping also other local companies to jump on the bandwagon. Important however is, that they do not concentrate on one small branch in this field, but try to create a broad diversity of work. Otherwise the industry gets too dependent on one branch again.

Influenced by the Shenzhen excursion of my design studio (see chapter *Shenzhen Excursion*) I am proposing to introduce not only electronic mobility but furthermore all kinds of agile small vehicles and robots. In the last few years trending products have been researched and developed - drones, autonomous cars, service robots, humanoids and other transportation devices. They need to be able to navigate and work in the public traffic system, therefore the site should become not only a place to develop them but also a test ground.

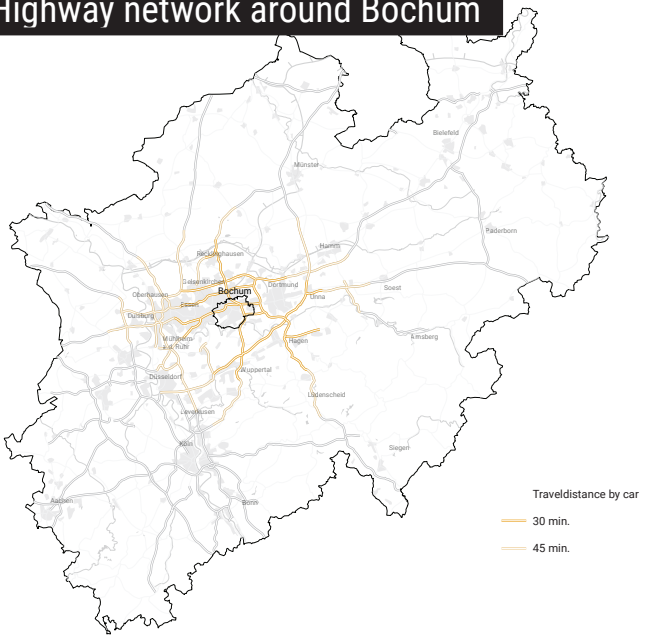
Since it is not yet sure what kind of technology will be integrated in our environment and how, it is clear, that the site will have to adapt over time to different demands. The industry needs to be flexible and innovate over and over again, especially since many of the transport modes are not yet invented. Who knows how biotechnology will influence movement or what effects more efficient energy sources will have? Structural change is unavoidable and needs to become part of the local culture, only then the site can become a model for the future of transport.

To get in touch with the topic and get a grasp on the future, I first of all interviewed start-ups that are developing alternative ways of transportation for the urban environment. From their answers I could get to know certain challenges and demands of the upcoming industry. Next I looked up regulations and testing conditions for autonomous vehicles. Building up on this, investigations on the human-robot interaction gave insights on safety issues. A traffic system needs to take the movement of autonomous and manual movement into account. Furtheron some research has been done on the spatial future implications of novel transport techniques. The influence on street layout and the other results are presented on the following few pages.

Fig. 39: Highway network around Bochum

Fig. 40: Electric mobility network in NRW

Highway network around Bochum



Electric mobility network in NRW

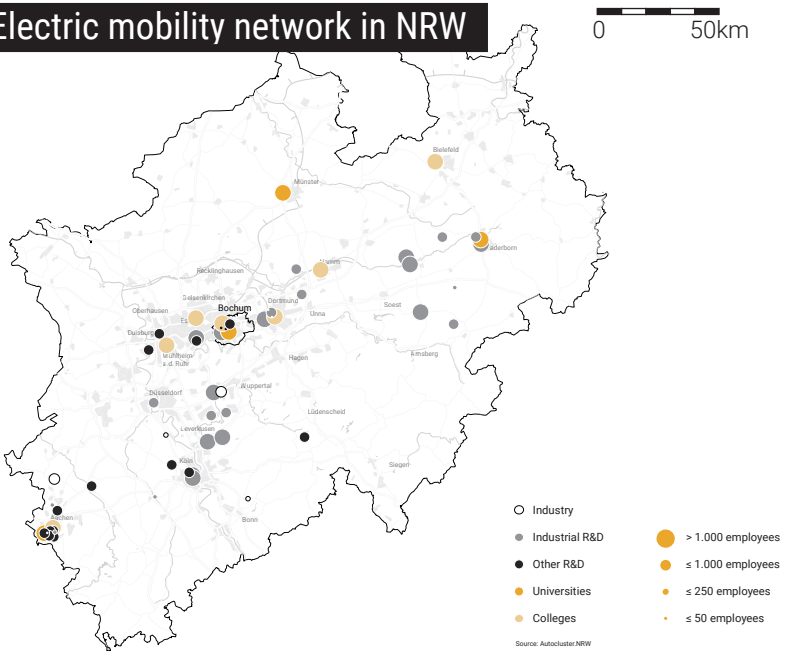


Fig 41: Regional connection to industry

Educational and public transport

Fig 42: Educational and public transport

Mellow Boards

Founders
Johannes Schewe
Kilian Green

Location of Company
Spread over Germany

Place of invention
Founders met in Morocco combining their expertise and idea.

Production
Partners in Germany, assembly in a hall in Munich

Testing
Every suitable place

Remarks
Germany needs to develop acceptance for alternative transportation

Scuddy

Founders
Jörn Jacobi
Tim Ascheberg

Location of Company
Office and assembly hall at same place in Kiel, next to the house of one of the founders

Place of invention
Product emerged out the founders' studies at university

Production
Made in Germany and mostly local in Kiel

Testing
Locally on the courtyard and streets

Remarks
Missing financial support for SMC's

unu

Founders
Elias Atahi
Pascal Blum

Location of Company
Berlin with network in D-A-CH region

Place of invention
Founders met in Asia where they studied and developed the idea

Production
Produced in foreign countries

Testing
Speedtest to 50km/h on 1km lane at factory

Remarks
New urban mobility concepts for a broad audience

Fig. 43: Profiles of mobility start-ups

Three different Start-Ups were so kind to give me insights in their field of working. The all produce small and agile electronic vehicles to change the way of transportation that we are used to today.

By asking them questions about the moment of invention, founding of their business, structure of their company, the testing and regulations for their vehicles and their own vision for urban mobility, I got a better understanding of the topic.

To summarize, I can conclude the following important aspects for companies that develop novel transportation methods:

- Acceptance and support is needed for alternative transport modes
- Entrepreneurs profit from both: informal and formal networking
- Size of companies rather small to medium sized, since it is more efficient and profitable to outsource tasks
- Companies decide consciously for Made in Germany, but supplier network can also be global
- Testing requirements differ by product and regulations

Advent of new Transportation

The beginning of the 21st century has brought up many new innovations and ideas on how movement will happen in the future. The development of efficient batteries allows us nowadays to motorise the smallest vehicle like drones or robots but also bigger ones like electric cars that pollute the environment less. A lot of money is invested in even greater projects like high-speed trains or transportation methods to even commercialise space-trips. But the most interesting development is the self-driving car. It promises to be safer than human-drivers and will take away this daily time-consuming activity.

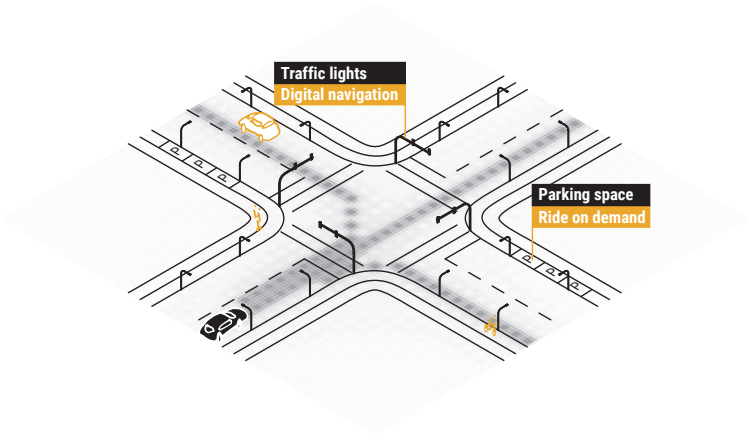
Autonomous vehicles, be it cars or something else, navigate through analysing our environment and having a digital map of it. They therefore won't need physical traffic signs. Parking will also be less and less visible in cities, since cars will be ordered on-demand like Knight Rider. Instead they will park in the outskirts, charging their batteries and waiting to be commissioned.

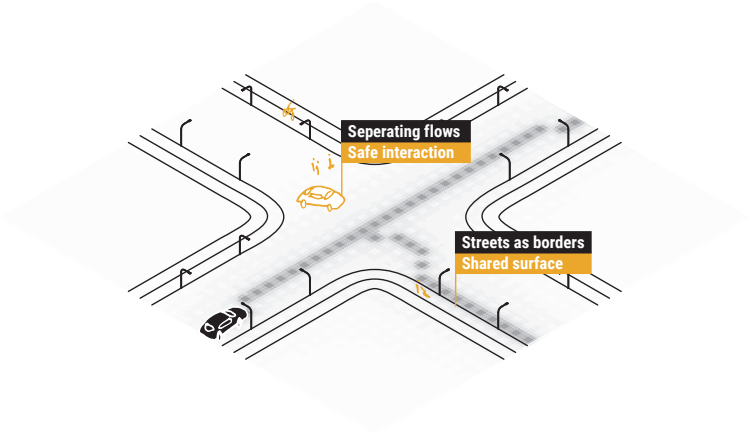
At the moment car manufacturers test autonomous driving mostly on highways and rather simple environments, where only other cars are involved and the streets are better observable. The supreme discipline however is the driving in inner cities. If cars can interact safely with humans and their surroundings, streets won't be borders and we won't need a seperation of traffic anymore.

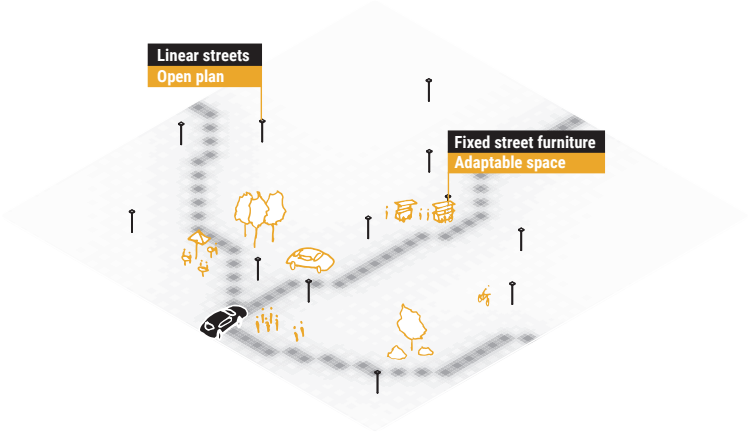
Shared surfaces will become the dominant typology of public space, symbolising a new unhierarchical, self-organising traffic (McDonald and Rodier, 2015).

This near future will allow us to adapt the streetscape, make it livelier, greener and more spontaneous.

Fig. 44: Impact of autonomous driving.
Step 1: Contemporary street layout
Step 2: First effects of autonomous driving
Step 3: Shared surface as a possible future


Traffic lights
Digital navigation
Parking space
Ride on demand


Seperating flows
Safe interaction
Streets as borders
Shared surface


Linear streets
Open plan
Fixed street furniture
Adaptable space

Interaction

If we use alternative ways of transports it will have a great impact on our use of the public space, especially streets. Not only humans will move around, but also robots in very different forms. The interaction of humans and robots can in general be divided by time and space as the following figure shows. Depending on the skill of the robot, he has to be kept isolated in a safe environment apart from humans or he can move seperated besides them and if possible even integrated interacting with them in the same space (Thiemermann, 2005)

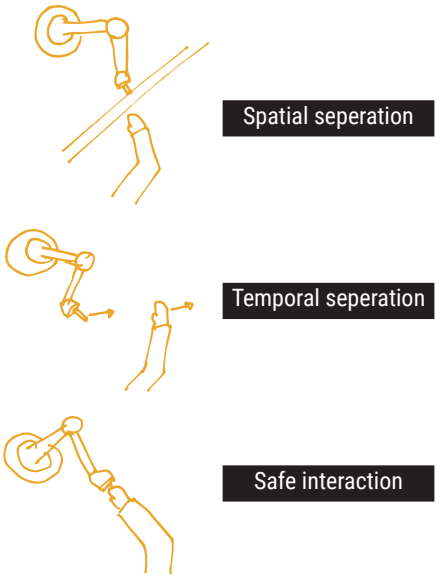


Fig.45: Human robot interaction, based on drawing by S. Thiemermann.

Figures on the right

Fig. 46 & 47: Ford M-City test areal for autonomous cars and its digital representation

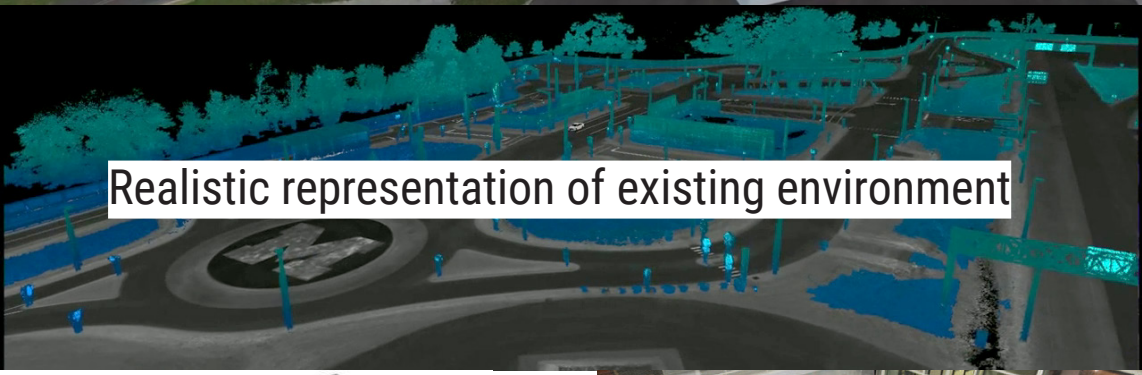
Proving Ground

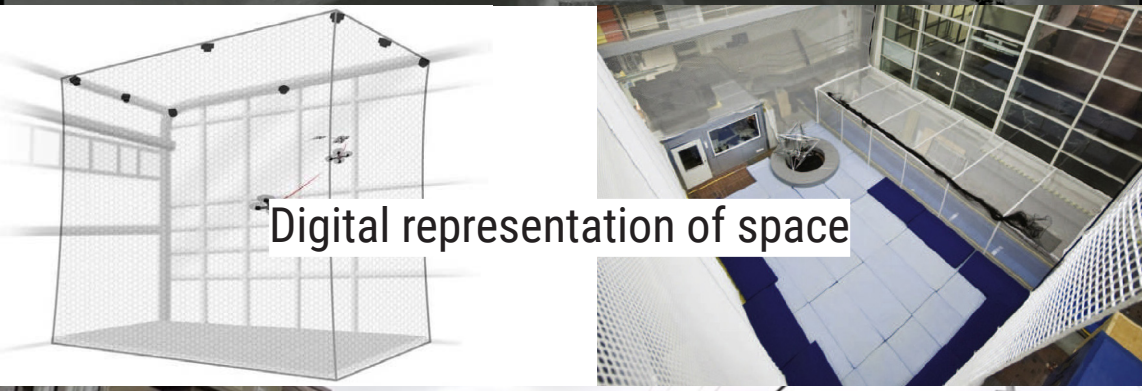
Car-manufacturers are investing a lot in the research of self-driving cars and need to test them properly. Autonomous driving is categorised into five levels ranging from zero, which is actually non-autonomous, so the driving that we are used to at the moment, up to four, which is than fully automated. In California regulations explicitly ask for testing cars in environments like on public roads, before they get permission to drive in normal traffic (Soriano et. al., 2015).
Ford therefore has build M-City a test area in Michigan, of which they also have a digital model (Ford Media Center, 2015). Similar drones need specific conditions to be tested. Besides safety installations like nets, they need to know where they are positioned in space. The Flying Machine Arena at the ETH Zürich facilitates these for example through different techniques like indoor GPS or cameras (Lupashin et al., 2014). Furthermore autonomous machines can learn through the real environment as car-manufacturer Tesla for example does through machine-learning (Fehrenbacher, 2015). The whole site could therefore become a proving ground and model for german cities.

Fig. 48 & 49: The Flying Machine Arena at ETHZ with safety nets and positioning systems

Fig 50: Image of the interface of a machine-learning Tesla car


Isolated test environment


Realistic representation of existing environment


Digital representation of space


SUV
PASSENGER CAR
SPORTS CAR
POLICE
Testing outside of sandbox

Places of Production

New transportation methods can be developed and produced in rather diverse places. Technologies allow already the development of drones at home or in small makerspaces that facilitate all necessary tools. If someone wants to setup a manufacturing business he might start with a smaller or bigger-sized factory. It depends on the organisation of the business and the product, if many tasks are outsourced many tasks, if the order situation is good and other factors. For a collaborative industry the use of rather small entities for production can be useful, since they can be easier replaced and adapt to changes.

The figures on this site show a size comparison. The yellow rectangle represents the size of the Opel site with industry halls in similar scale. It is a huge site nearly as big as the city centre and huge factories could easily occupy the space. But for the collaborative industry that we imagine in this place, rather small to medium-sized companies are preferably that do not create strong dependencies.

Figure on the bottom

Fig. 51: Comparison Opel site to city center

Figure on the right

Fig. 52: Demand of space for different company sizes - dependent on revenue and organisation of business

Size of site
648,000m²

preferably small to medium sized companies

Makerspace
2,000m²

Drone factory
4,000m²
2 storeys

Logistics center
5,500m²

E-bike factory
8,000m²

One-Wheeler factory
15,000m²
5 storeys

Logistics center
19,000m²

Electric scooters
46,000m²

Ruins of Capitalism

Fig 53: Destruction of the 100m high chimney with a special digger

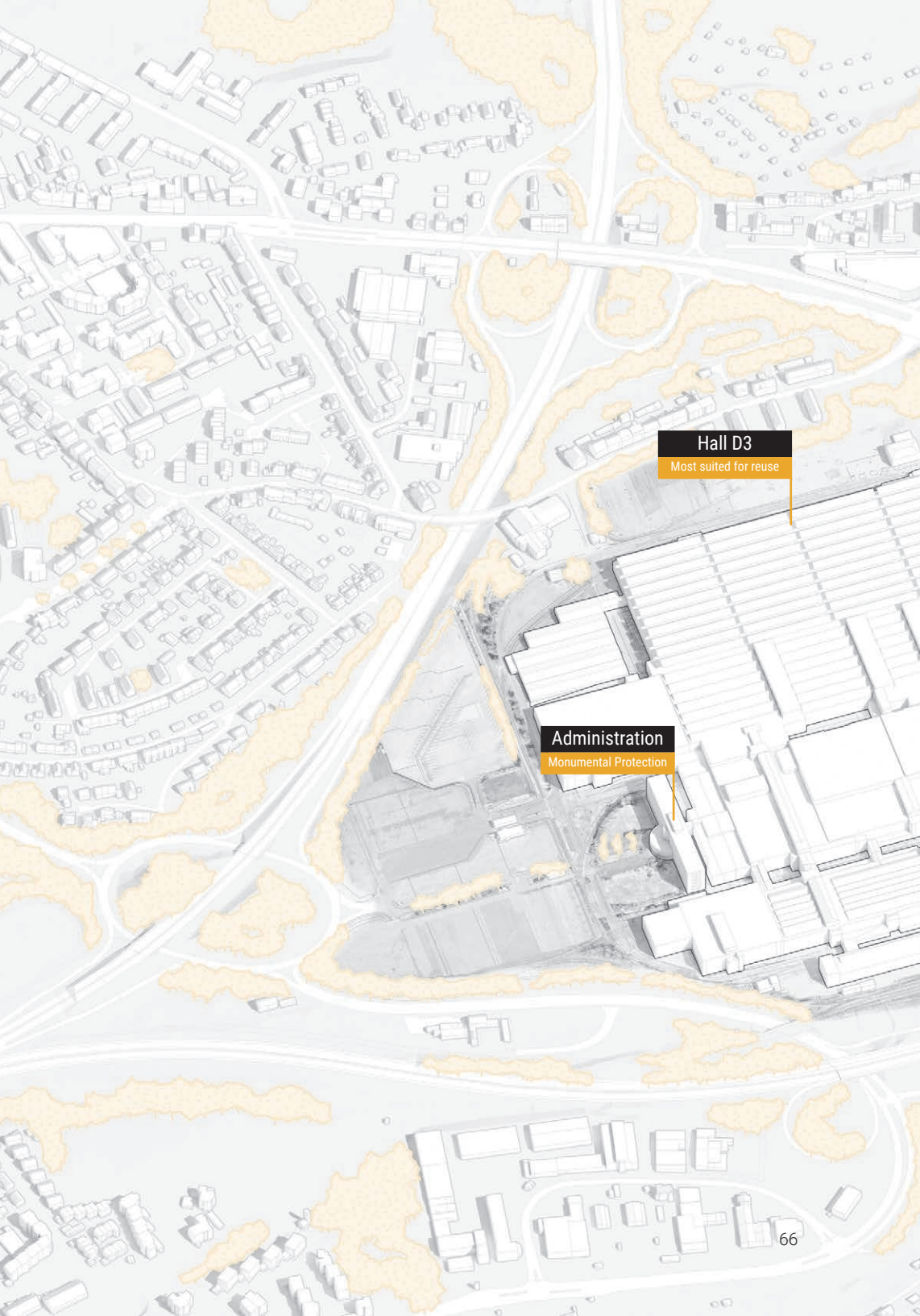
The closing of the factory costs more than

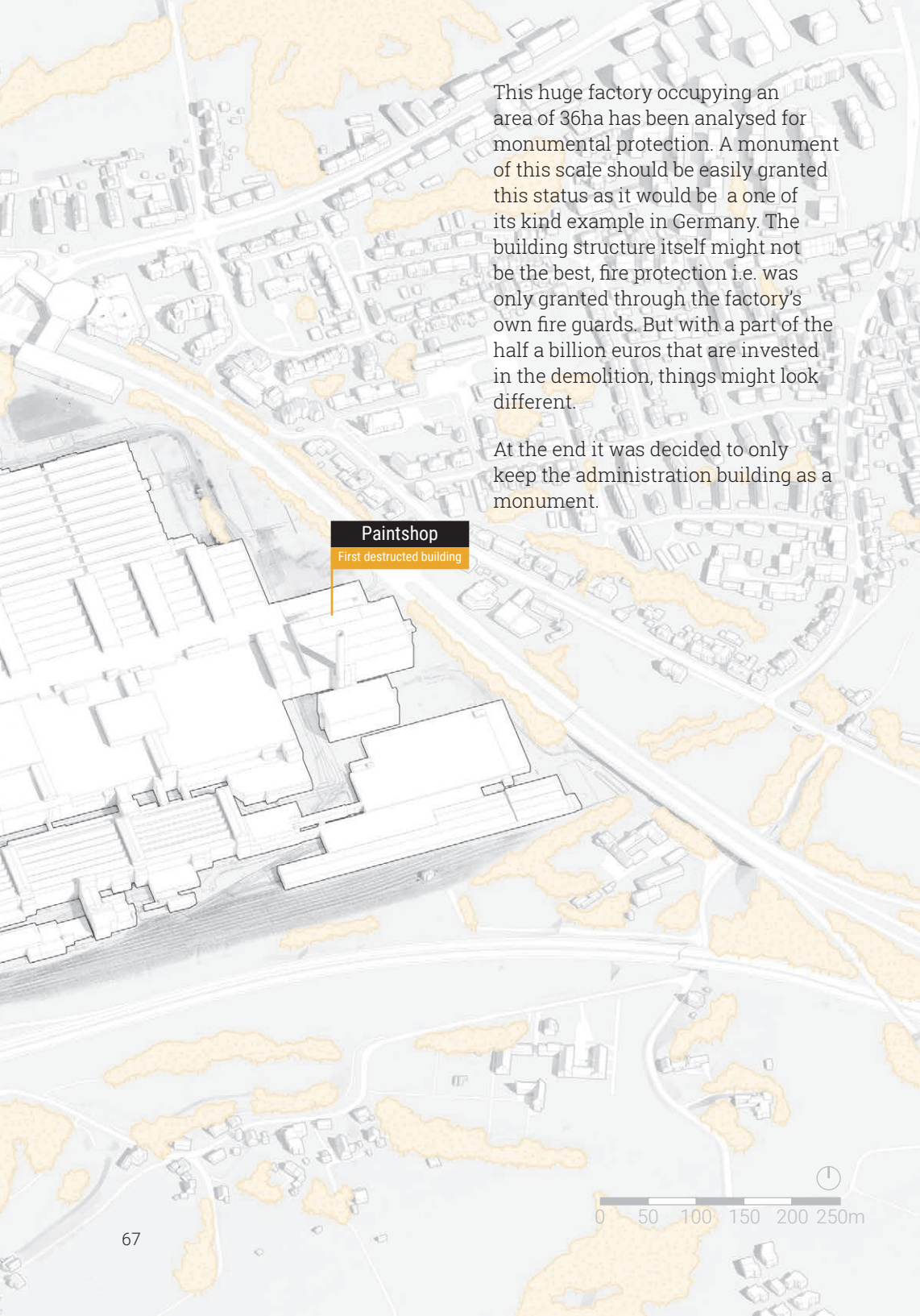
550.000.000€

(Spiegel Online, 2014)
It could have been used for something better than demolition.

Fig.54: Demolition of the paintshop


CAT
CAT
HYUNDAI

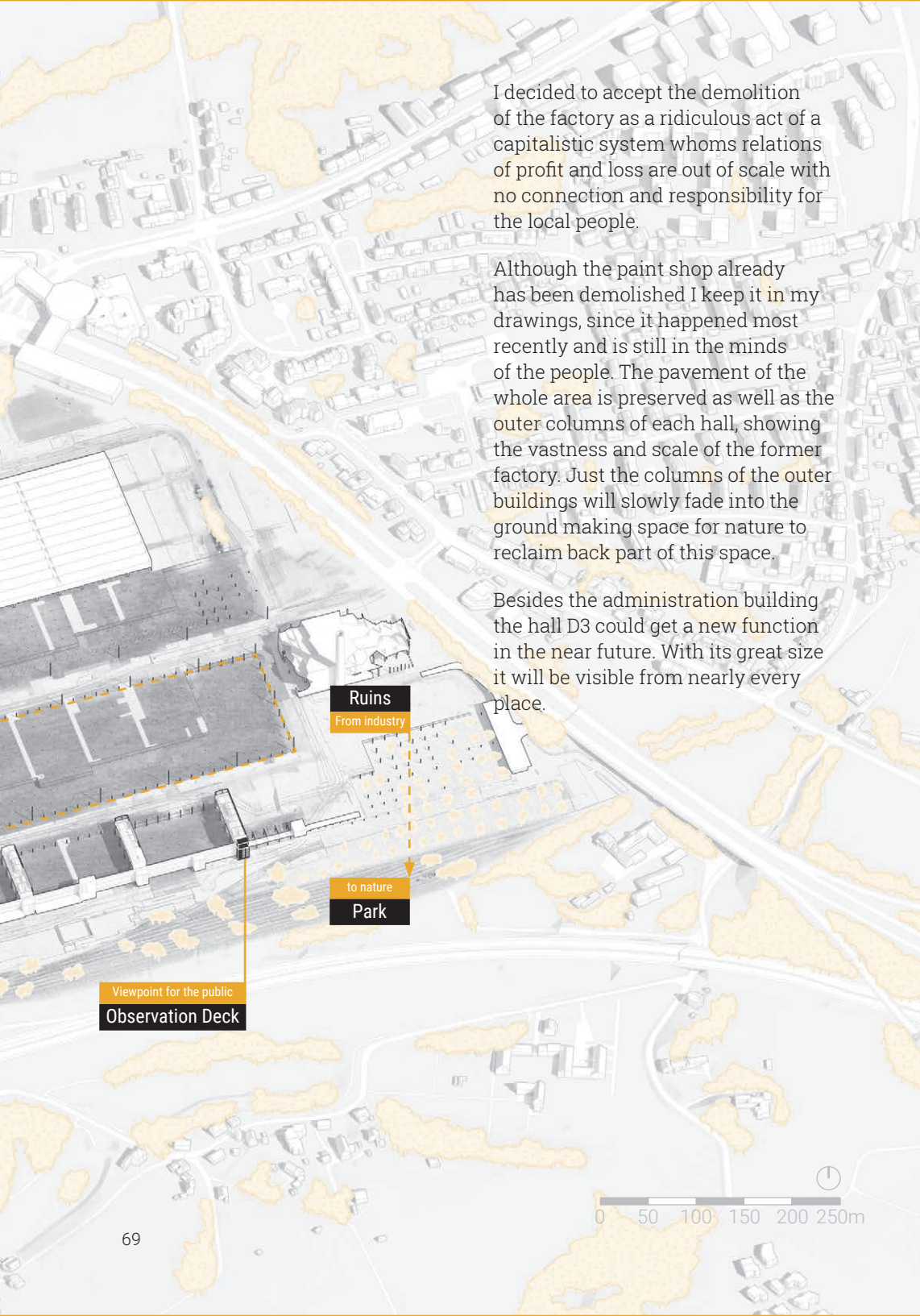

Hall D3
Most suited for reuse
Administration
Monumental Protection



This huge factory occupying an area of 36ha has been analysed for monumental protection. A monument of this scale should be easily granted this status as it would be a one of its kind example in Germany. The building structure itself might not be the best, fire protection i.e. was only granted through the factory's own fire guards. But with a part of the half a billion euros that are invested in the demolition, things might look different.

At the end it was decided to only keep the administration building as a monument.


Vastness
Columns and Pavement outline former size

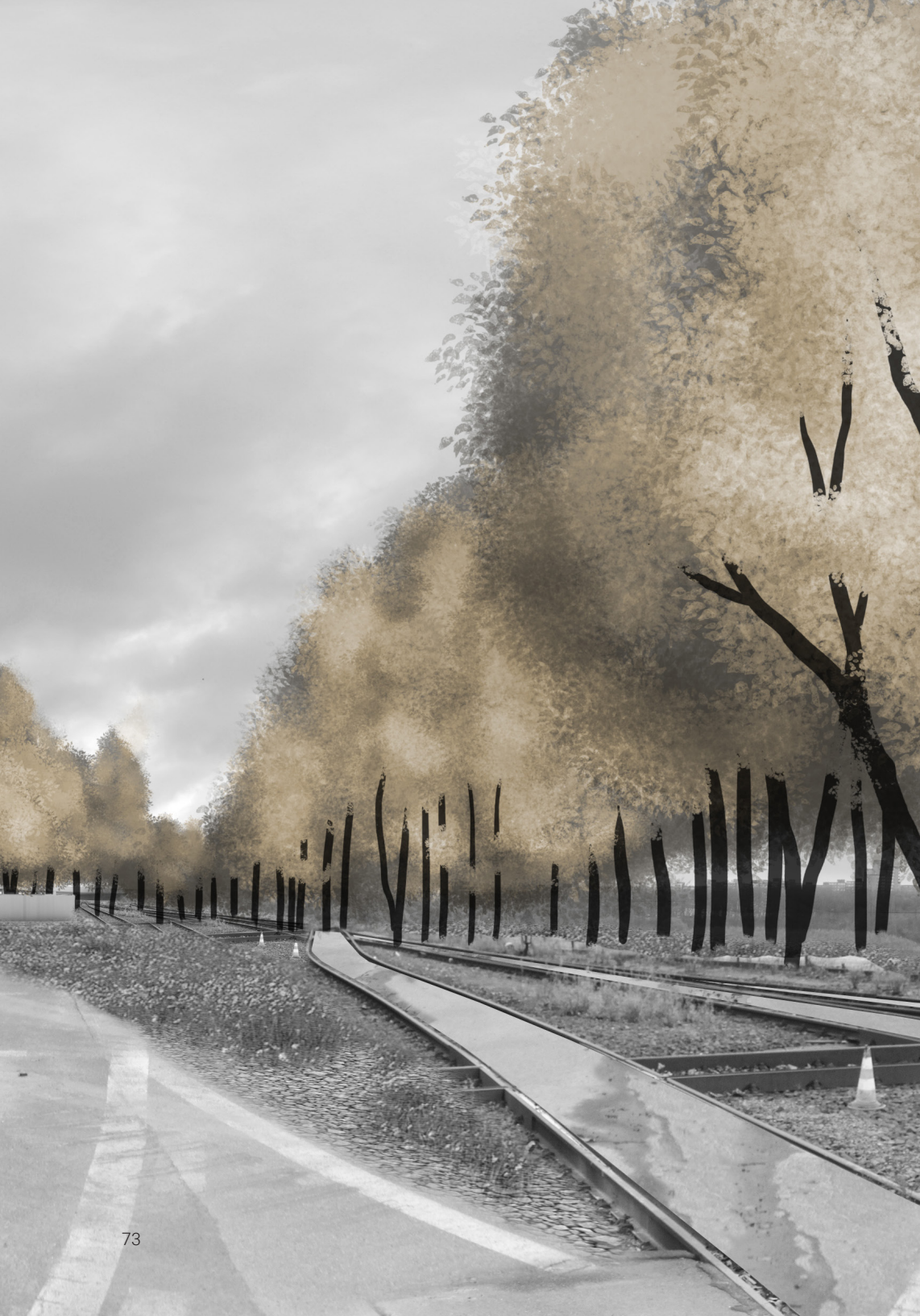


I decided to accept the demolition of the factory as a ridiculous act of a capitalistic system whoms relations of profit and loss are out of scale with no connection and responsibility for the local people.

Although the paint shop already has been demolished I keep it in my drawings, since it happened most recently and is still in the minds of the people. The pavement of the whole area is preserved as well as the outer columns of each hall, showing the vastness and scale of the former factory. Just the columns of the outer buildings will slowly fade into the ground making space for nature to reclaim back part of this space.

Besides the administration building the hall D3 could get a new function in the near future. With its great size it will be visible from nearly every place.


GSL



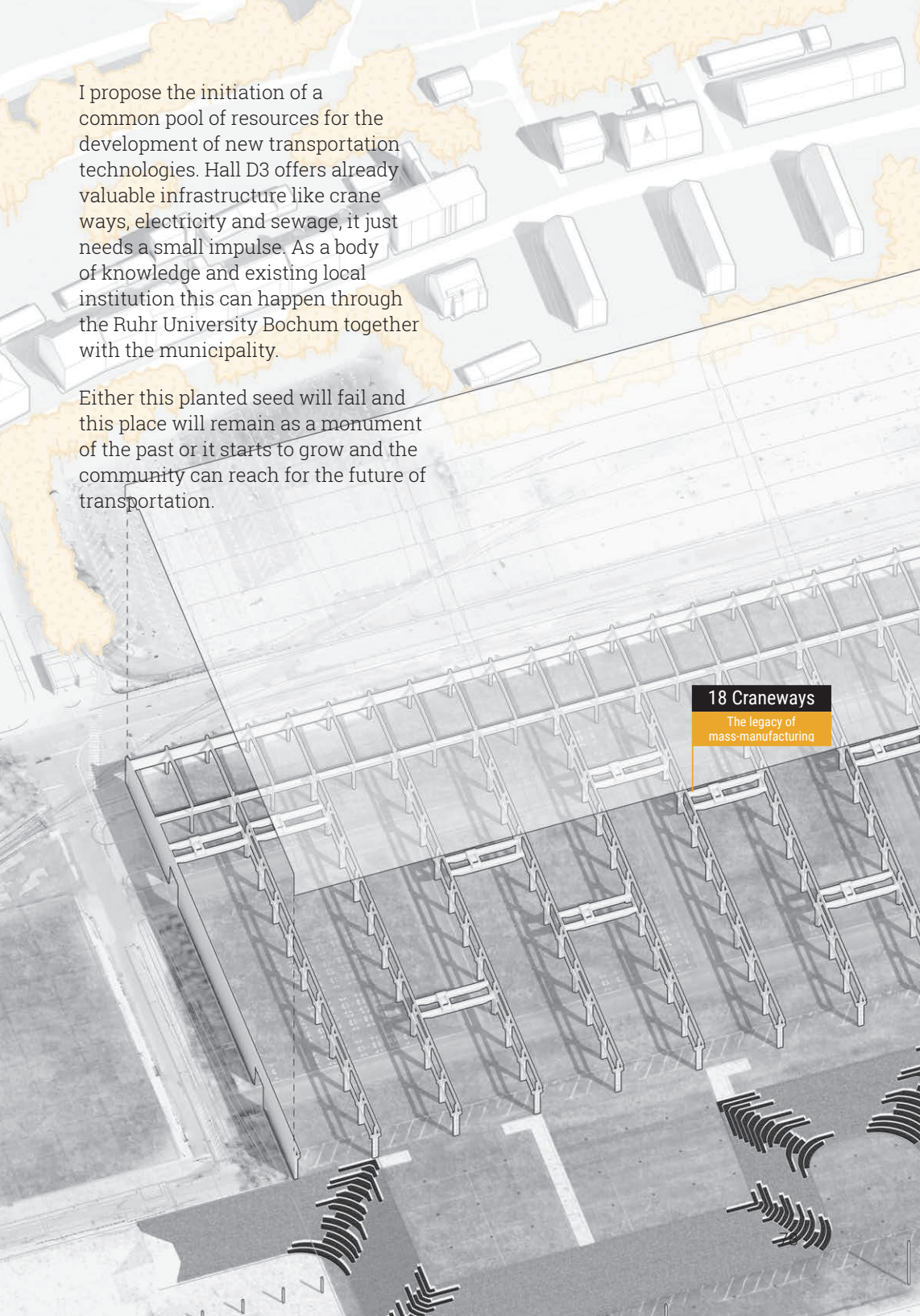
Incubator for a Revolution

Fig 55: View from northside on hall D3

This place went through three industrial revolutions. Each one of them giving birth to the next. It offers enough resources to foster the next revolution! A revolution for transportation that we can trust.

I propose the initiation of a common pool of resources for the development of new transportation technologies. Hall D3 offers already valuable infrastructure like crane ways, electricity and sewage, it just needs a small impulse. As a body of knowledge and existing local institution this can happen through the Ruhr University Bochum together with the municipality.

Either this planted seed will fail and this place will remain as a monument of the past or it starts to grow and the community can reach for the future of transportation.




The Seed
Transportation Research Campus
Opel Terraces
Public space for everyone

Modular Expansion

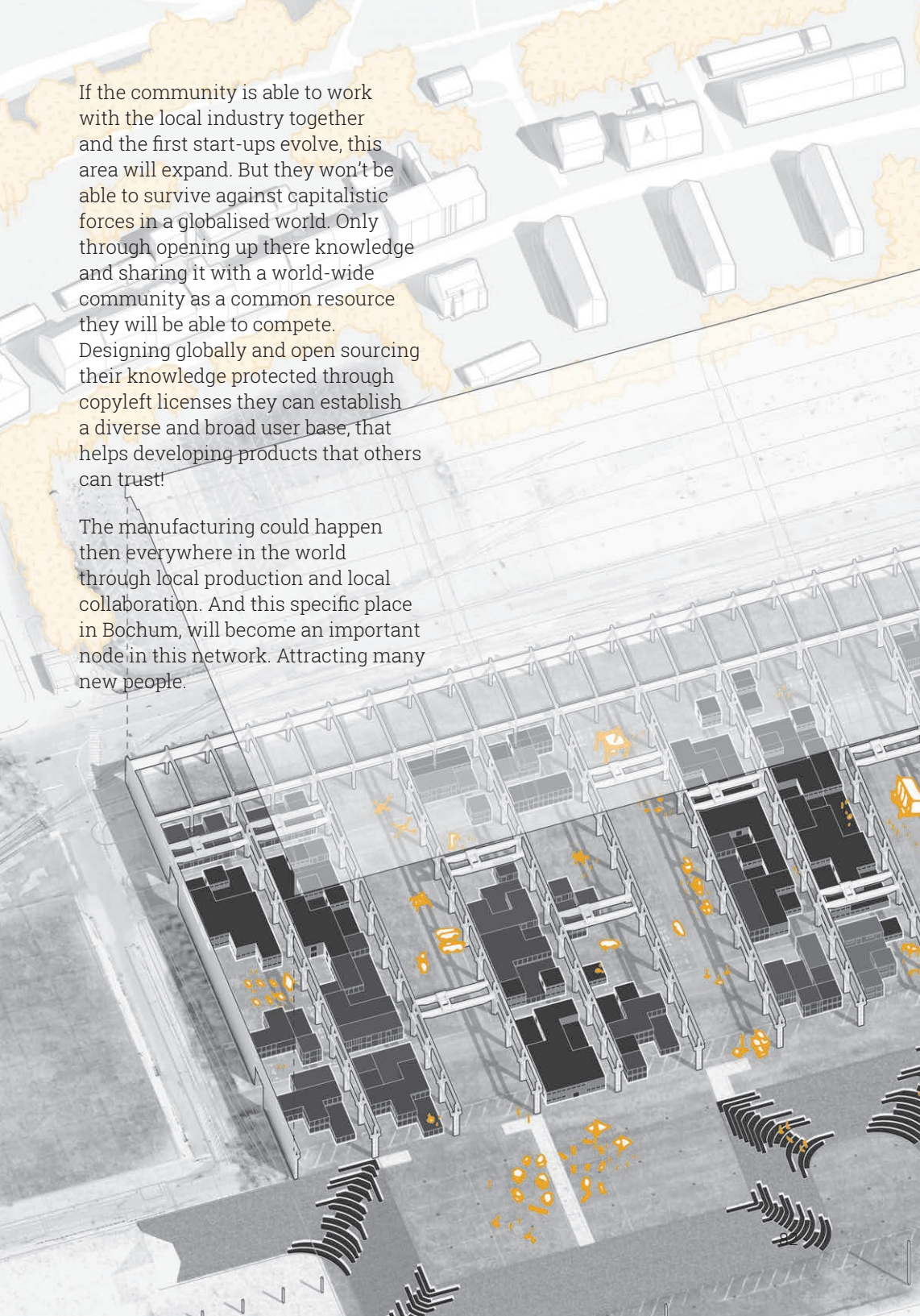
Flexible but structuralistic development of the hall

The hall is able to facilitate a big community. Around 30.000m² can be occupied. All kinds of functions like manufacturing, student housing, cafés or public amenities can find place here making it a little city.

The flexibility offered by the craneways allows the continuous adapatation of the space the way Cedric Price would have liked it to happen in its Fun Palace. However it is working clearly structuralistic through a grid-like modularized organisation. It is the legacy of this mass-manufacturing hall, which was also build upon a grid, that yet constraints a completly free development.

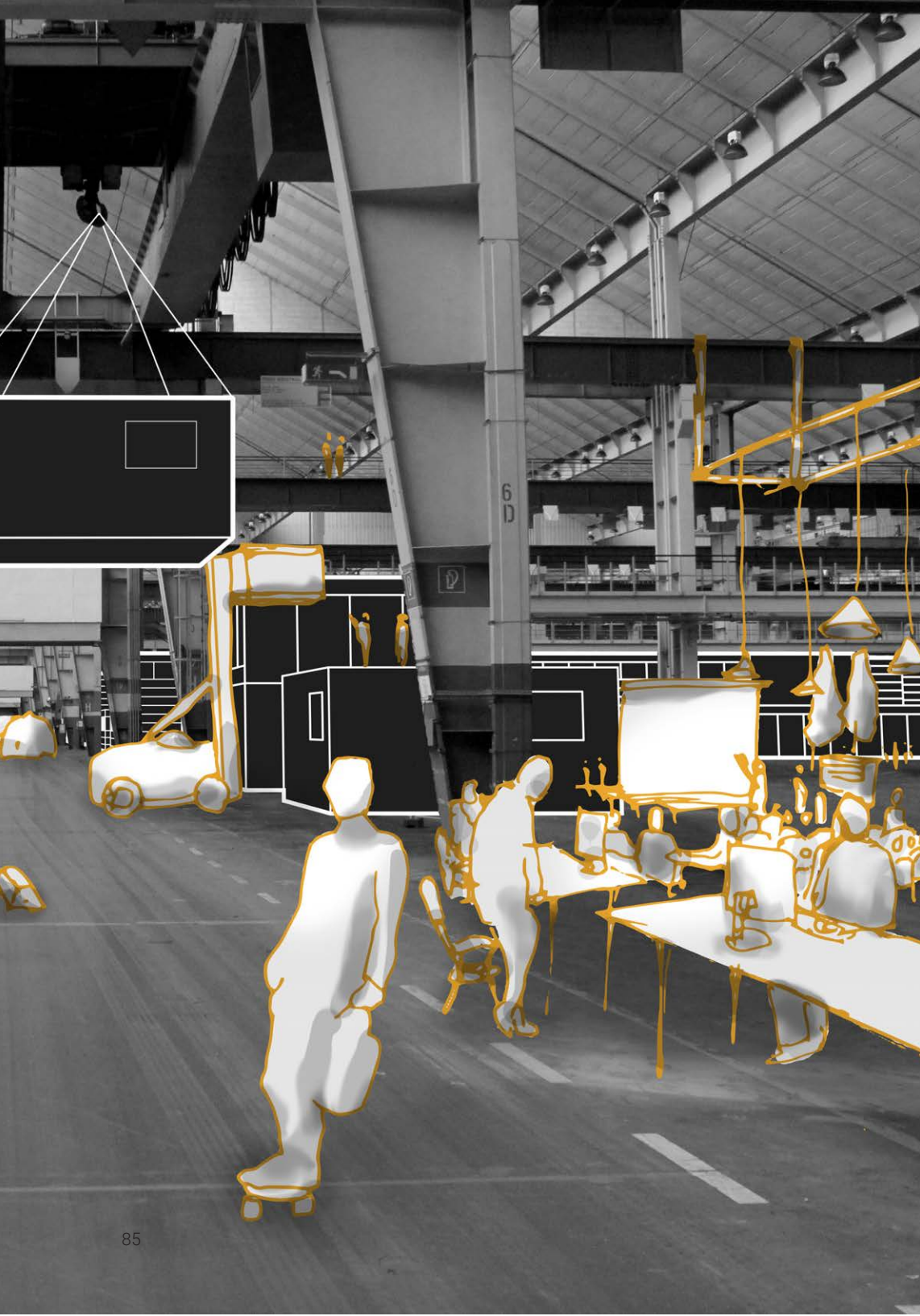
If the community is able to work with the local industry together and the first start-ups evolve, this area will expand. But they won't be able to survive against capitalistic forces in a globalised world. Only through opening up there knowledge and sharing it with a world-wide community as a common resource they will be able to compete. Designing globally and open sourcing their knowledge protected through copyleft licenses they can establish a diverse and broad user base, that helps developing products that others can trust!

The manufacturing could happen then everywhere in the world through local production and local collaboration. And this specific place in Bochum, will become an important node in this network. Attracting many new people.




Global Community
Sharing knowledge globally attracts new commoners
Trust & Transparency
Independent validation of open-sourced vehicles

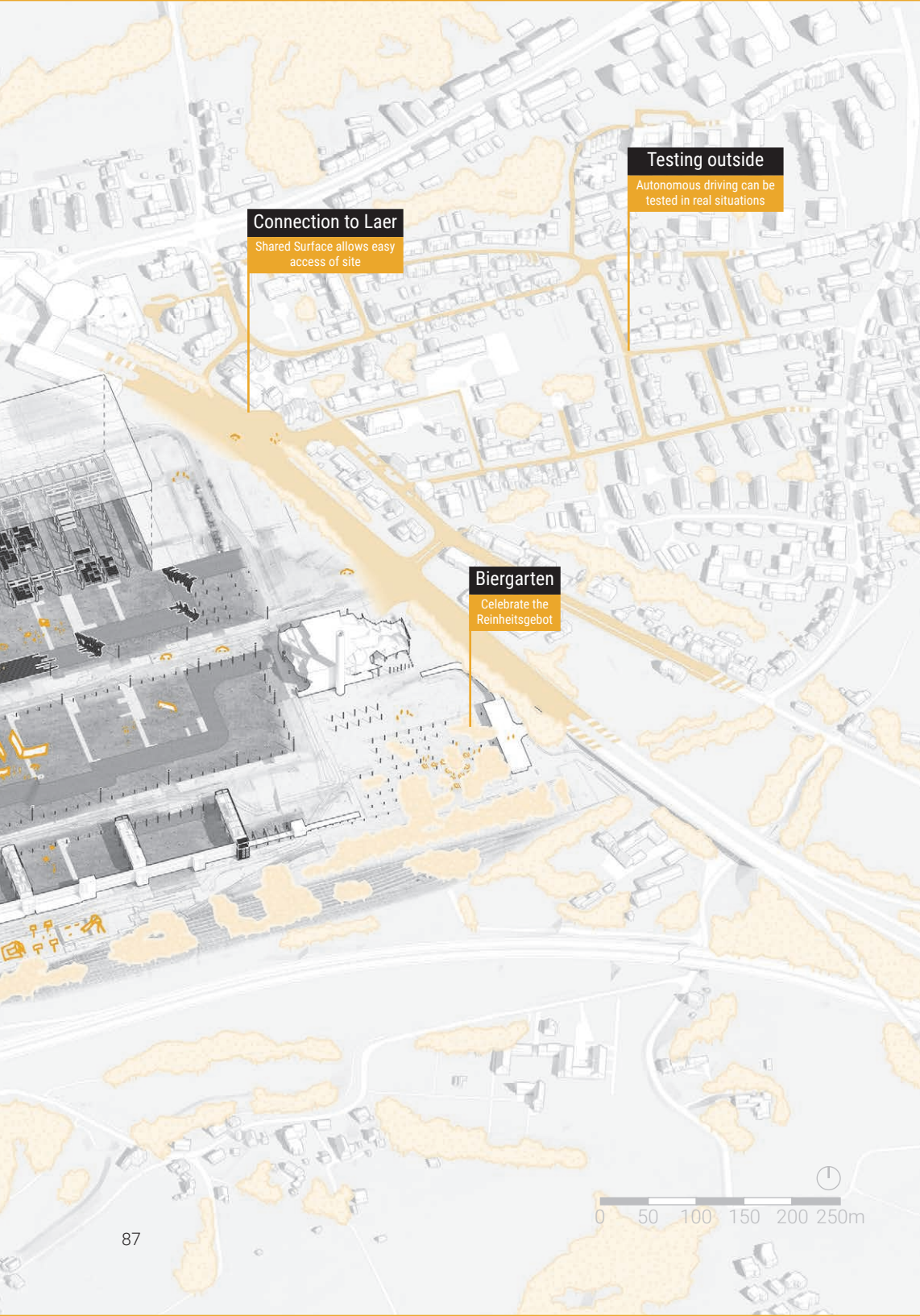
Fig 56: New activities inside hall D3 with reuse of the cranes for flexible structures


6D

The success of the incubator will be proven when the fourth industrial revolution has completly shaped this place.

It will represent itself to the outside as the birthplace of the new trustful transportation with exhibitions and cultural events. It will integrate itself to the local context through public places like a Biergarten or easy access from the surroundings.

This easy access as one of the key ingredients for successful commoning will also be the first sign of a future to come. A future of autonomous vehicles interacting safely with people and their surroundings.


Connection to Laer
Shared Surface allows easy access of site
Testing outside
Autonomous driving can be tested in real situations
Biergarten
Celebrate the Reinheitsgebot
0 50 100 150 200 250m

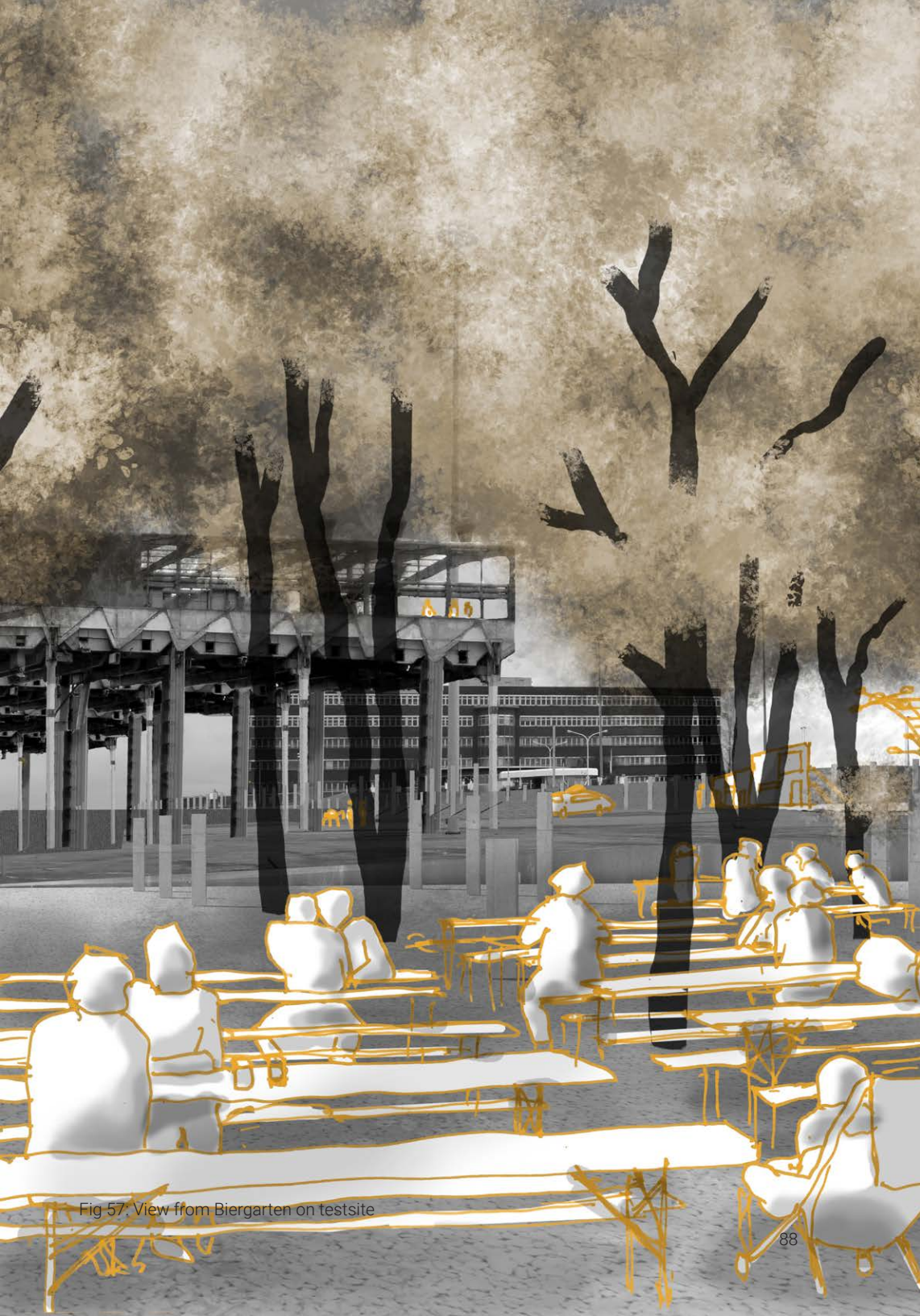


Fig 57: View from Biergarten on testsite

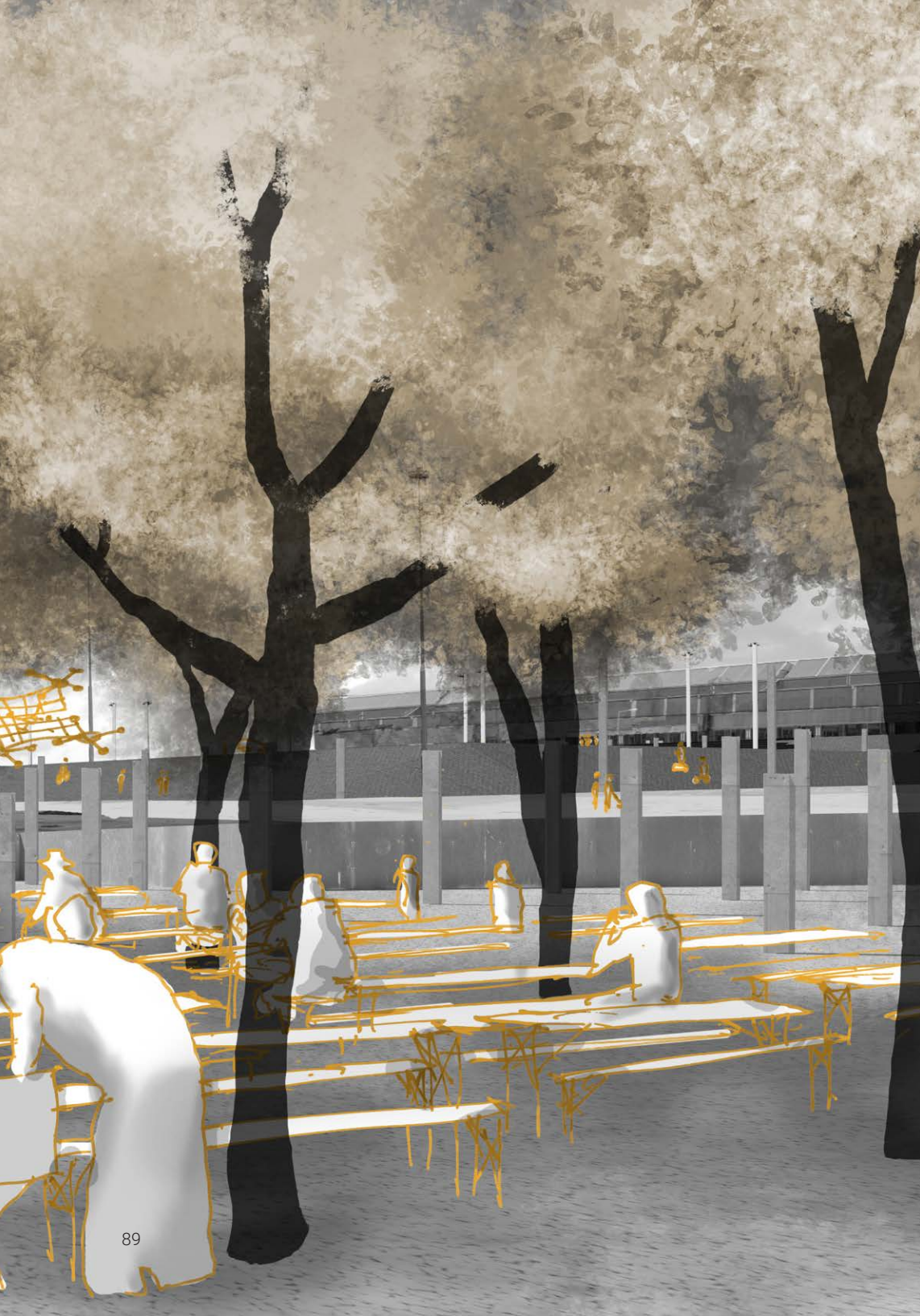


Fig 58: Cultural event at the southern edge of the factory at the old railways

Foundation for Transportation

Fig 59: Still of the movie Ghost in the Shell

“All defense against catastrophic failure of an inflexible system. You want the variety needed to guard against extinction.”
Ghost in the Shell, 1995

How do we plan the future?

Each industrial revolution has its planning paradigm. The questions that nowadays arrive are, who is creating our environment, who plans the future if everyone collaborates in open communities and how could this happening with all the information and technologies that are currently evolving?

Our built environment is a representation of our culture and communication, it is in reciprocity to each other. My answer therefore lays in the utilization of contemporary communication and information technologies to allow collaborative and participatory design. All the data that we generate and harness will become a driver of the planning process and can directly influence the design. We as planners will have to embrace it, but we need to ask the right questions to this huge amount of data. The algorithms that we build up on it can give us valueable feedback, but can also lead to failures.

Therefore the following pages need to be interpreted as nothing final, but as a proposal for an ongoing project of problem-solving and problem-finding that should be critically reviewed similar to software-code that is contributed to an open-source project It is not a finite proposal, a closed system, it is in its essence open as the presented project of a commons-based industry.

Fig. 60: Le Corbusier pointing on a model of his project Ville Radieuse

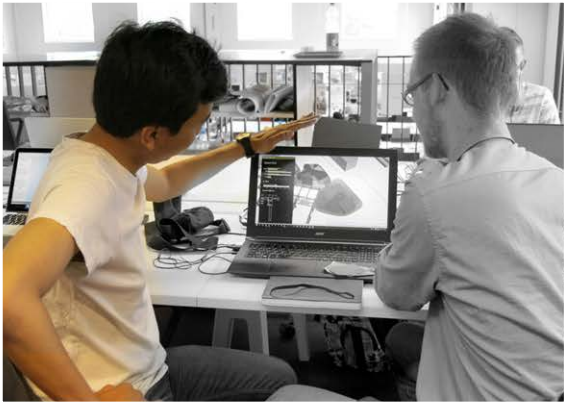







Fig. 61: Collaborative planning with friends of mine








Wahyu

"Niek towers"

Kate

Mick

Alexandra

Wyn

Wenchi

Roos

Fig. 62: Planning results of all participants

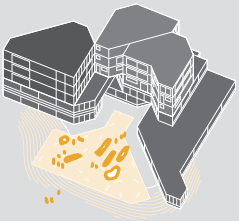
Axel

Nikita

Rakesh

Brian

Floor



Nina

Elias

Lynn

Fig. 63: View from Hall D3 to the northern parking space.

A foundation is an often used legal form of organisation for the commons, but it is also a fundament for a development to come. Once the development of this place is accelerating and expanding beyond the boundaries of the hall, it will need a good foundation to do it well.

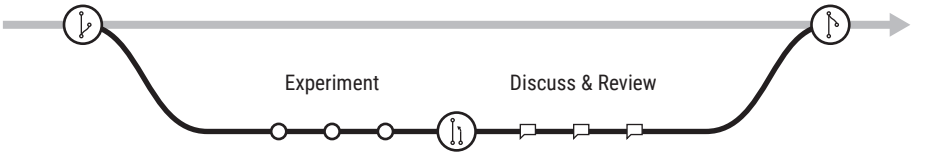
Open planning process

As mentioned in the chapter Open Source, the planning process is based on the workflow of Open Source software development. The following pages will show exemplarily how a new plot is being developed. A plot is in this case called project, since it represents a community that is working on a new branch of the foundation. The placement can happen freely on the open field without constraints of mobility flows, since they adapt continously to changes.

Respected members of the community can start their own project with **temporary architecture**. They get a co-ownership of a part of the project to **experiment** how they want to setup their community spaces. A digital tool allows collaboration between planners and the developers or co-owners of the project and assists the planning process while respecting the demands of the greater community. When satisfied with the spatial composition of the community, a **request to build** the project can be made, to make it a **permanent part** of the foundation. After reviewing and discussing the proposal with the community, it can be build and merges with the existing context.

Infrastructure like sewage expands at the same time as a project is build, creating a decentralized network that is inserted together with the fundaments of the buildings and new green spaces in the open field. In this way asphalt will be broken away only where it is necessary and symbolically acts as the layer of the old transportation on which the new transportation can move freely.

Every new project is a contribution to the existing and creates a new context that needs to be considered in further development. It is a flexible, experimental and open planning process.



Create branch
Temporary Project

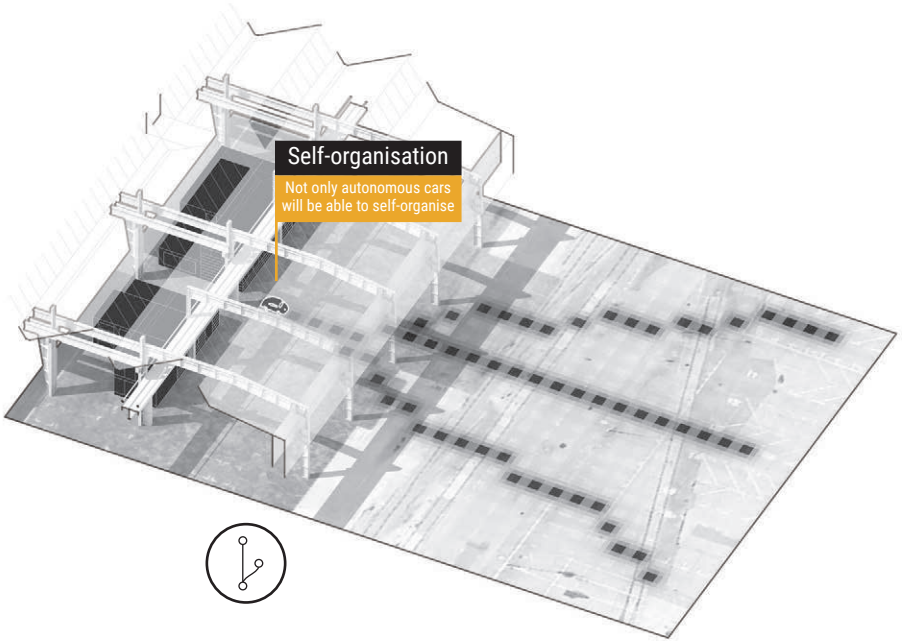
People start their own building project with temporary architecture next to existing projects.

Pull Request
Build Request

After finding a good way to organise spatially a request to build the project will be made.

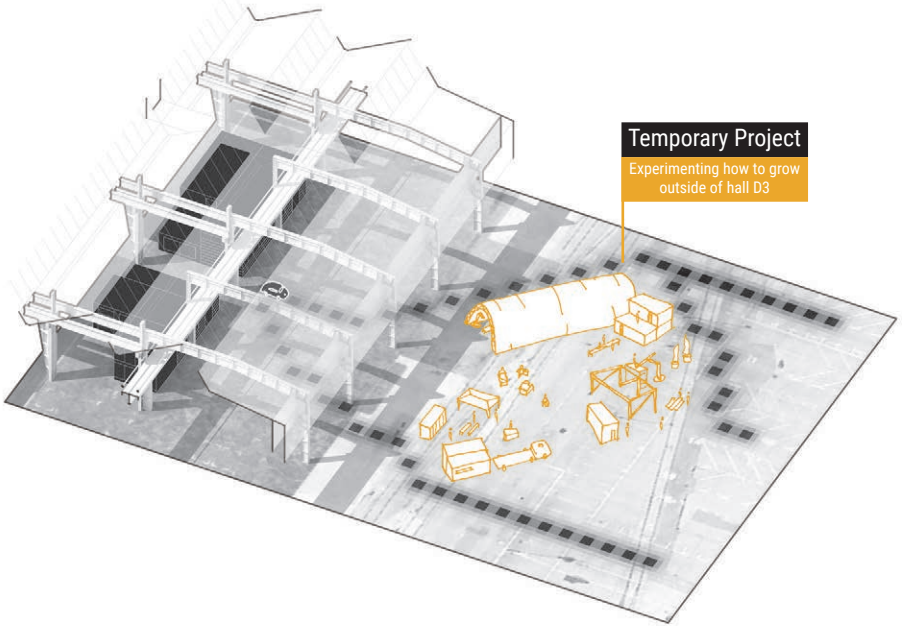
Merge
Permanent Project

The project will be build and merged with the existing built environment.



Temporary Project - Create Branch

People start their own building project with temporary architecture next to existing projects.

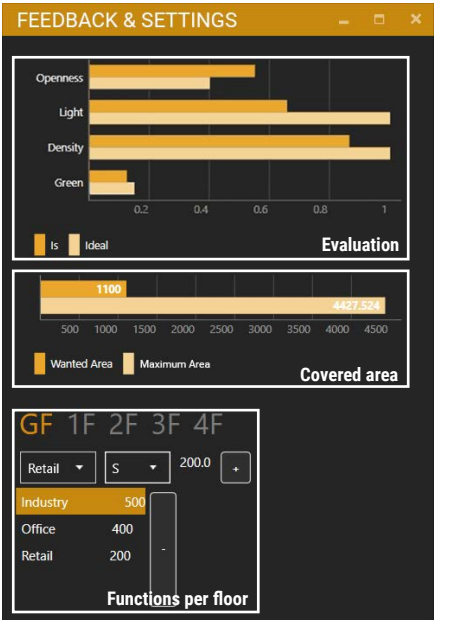


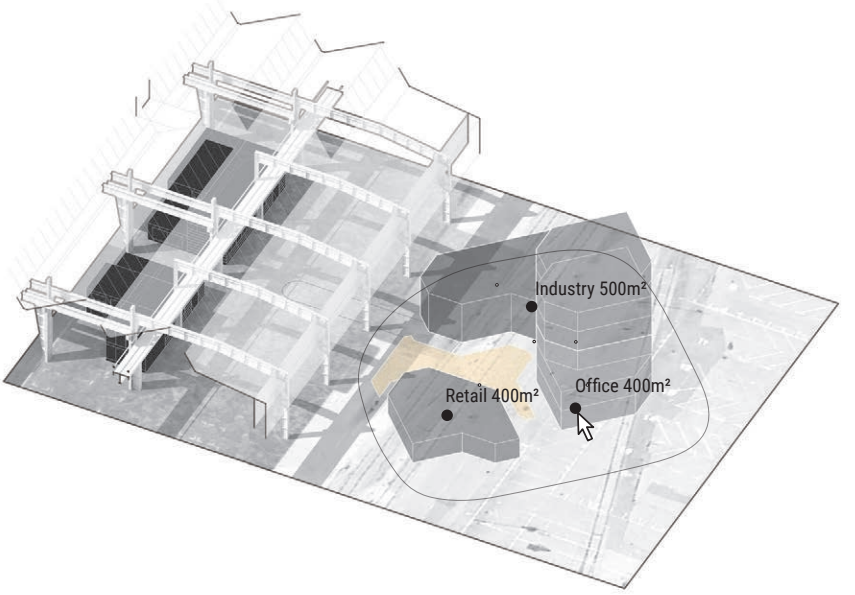
Digital Evaluation

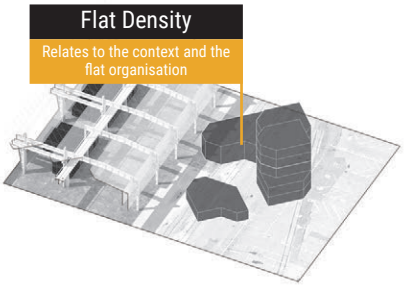
Besides the temporary project a digital representation of a possible zoning of the permanent project needs to be made and evaluated that can be discussed and reviewed.

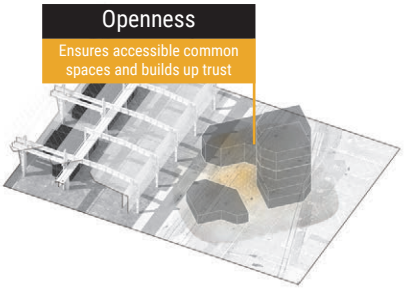
Several factors like Openness, Light, Density and Green-Space, that could be extended by even more aspects, can be analyzed in this digital model and ensure rough spatial qualities, without constraining the architectural expression too much.

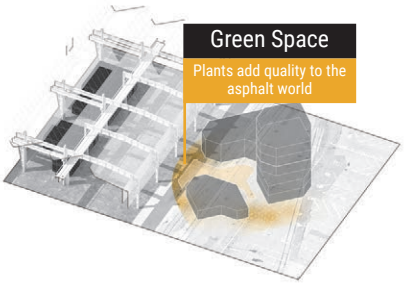
The digital tool allows an interactive positioning of functions and was done collaboratively with friends of mine, leading to much more diverse results that I could have done with my biased mind. In this process of participation very interesting discussions about sightlines, the always changing context or also missing aspects like for example bridges between buildings arose and should inform in a real project the ongoing process of planning.

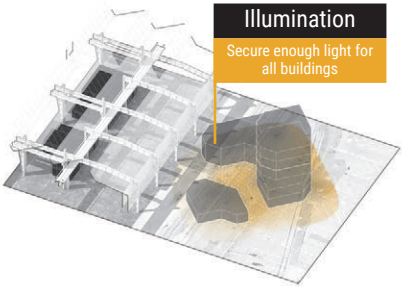


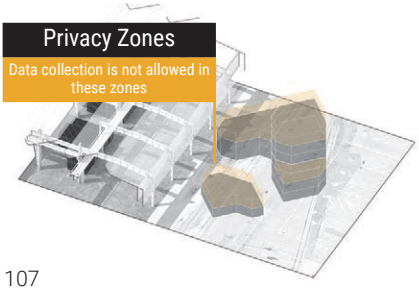












Experiment

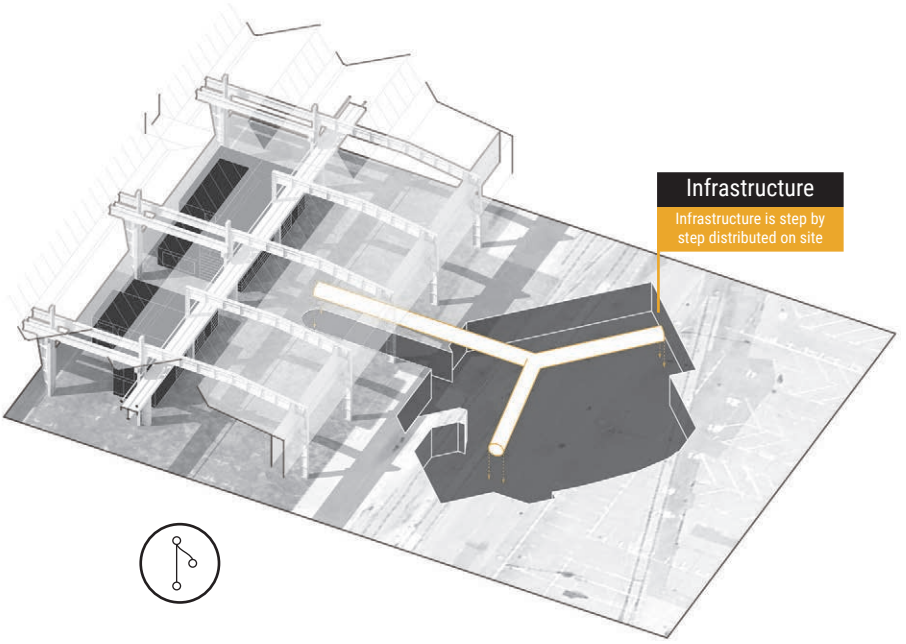
Iterating over various spatial compositions to find a good arrangment that represents the social relations.

Build Request - Pull Request

After finding a good way to organise spatially a request to build the project will be made.

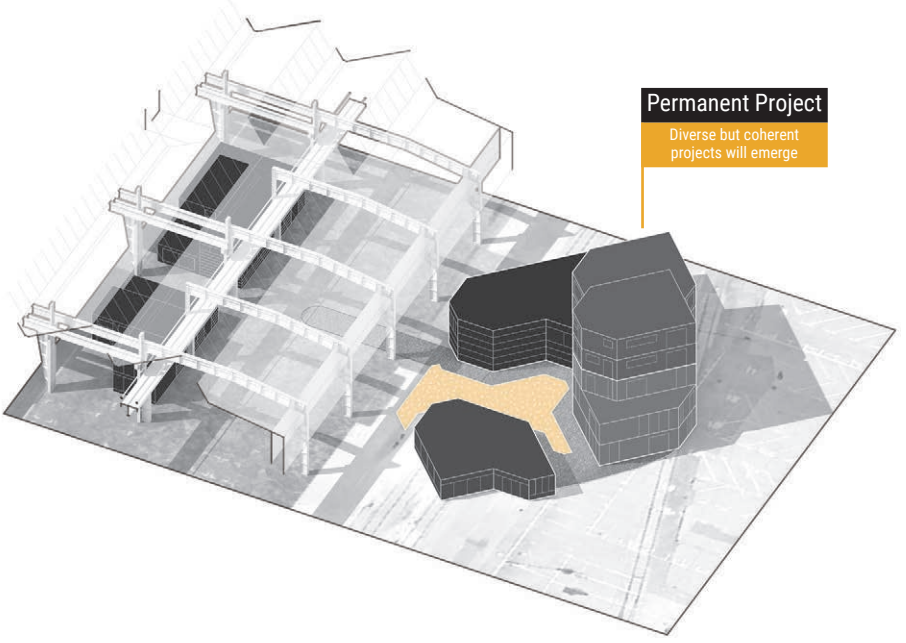
Discuss & Review

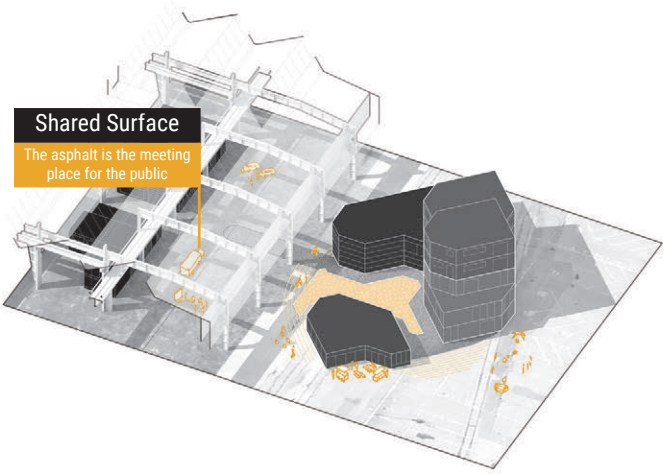
Physical and digital analysis of the space serves as a base for negotiation to decide if this project will be build.



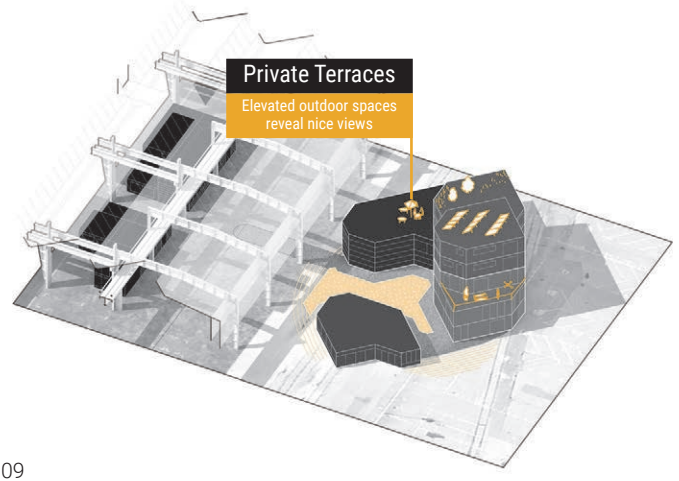
Permanent Project - Merge

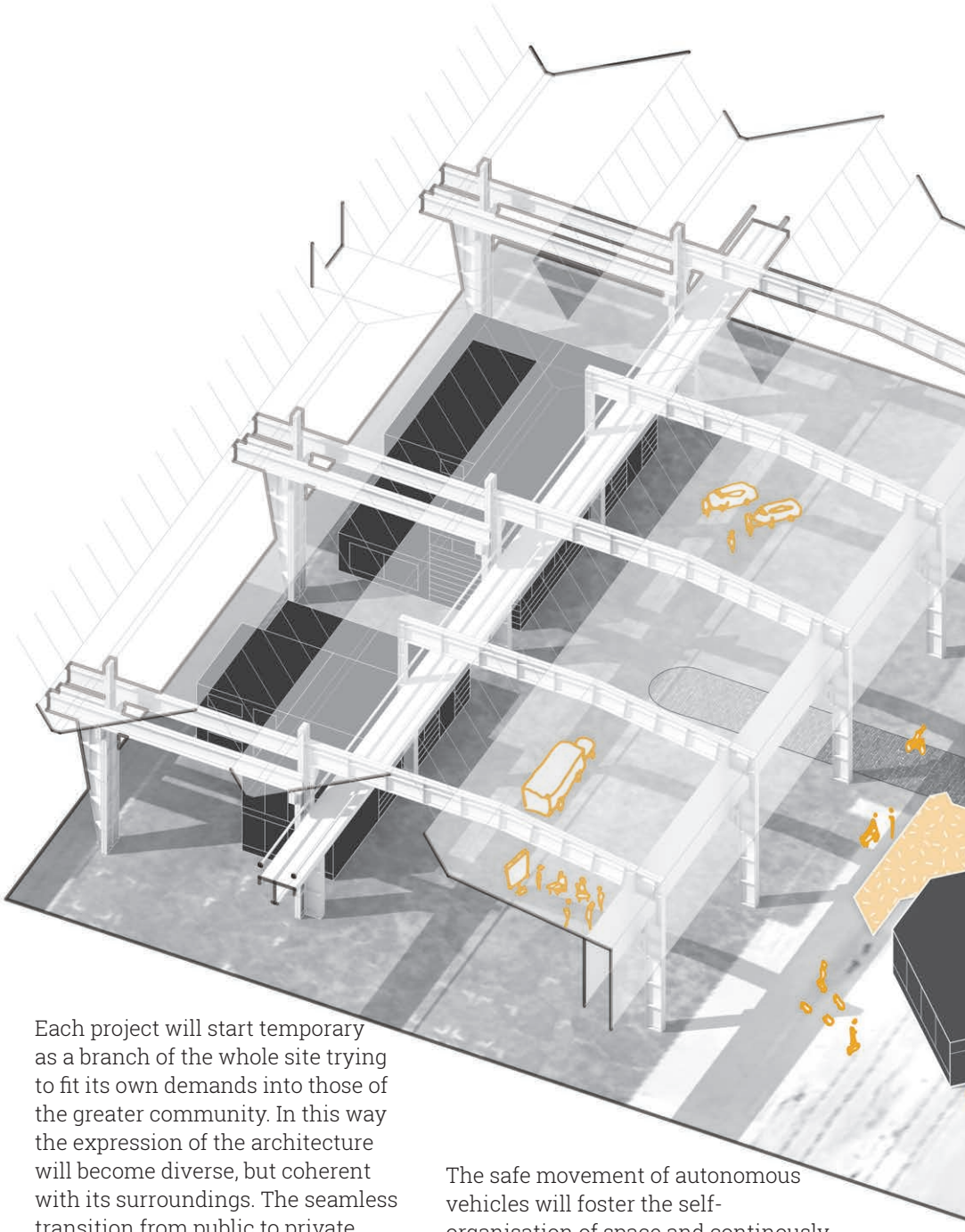
The project will be build and merged with the existing built environment.




Shared Surface
The asphalt is the meeting place for the public


Open Communities
Community space is easy visible and accessible


Private Terraces
Elevated outdoor spaces reveal nice views



Each project will start temporary as a branch of the whole site trying to fit its own demands into those of the greater community. In this way the expression of the architecture will become diverse, but coherent with its surroundings. The seamless transition from public to private space assists collaboration and serendipitous meetings.

The safe movement of autonomous vehicles will foster the self-organisation of space and continously reshape it. Density, greenery, people and flows will be in fluent change.


Problem solving
Temporary architecture can reactivate spaces
Vehicles scan for and show opportunity spaces
Problem finding
Small buildings will be set up autonomously on demand
Mobile architecture

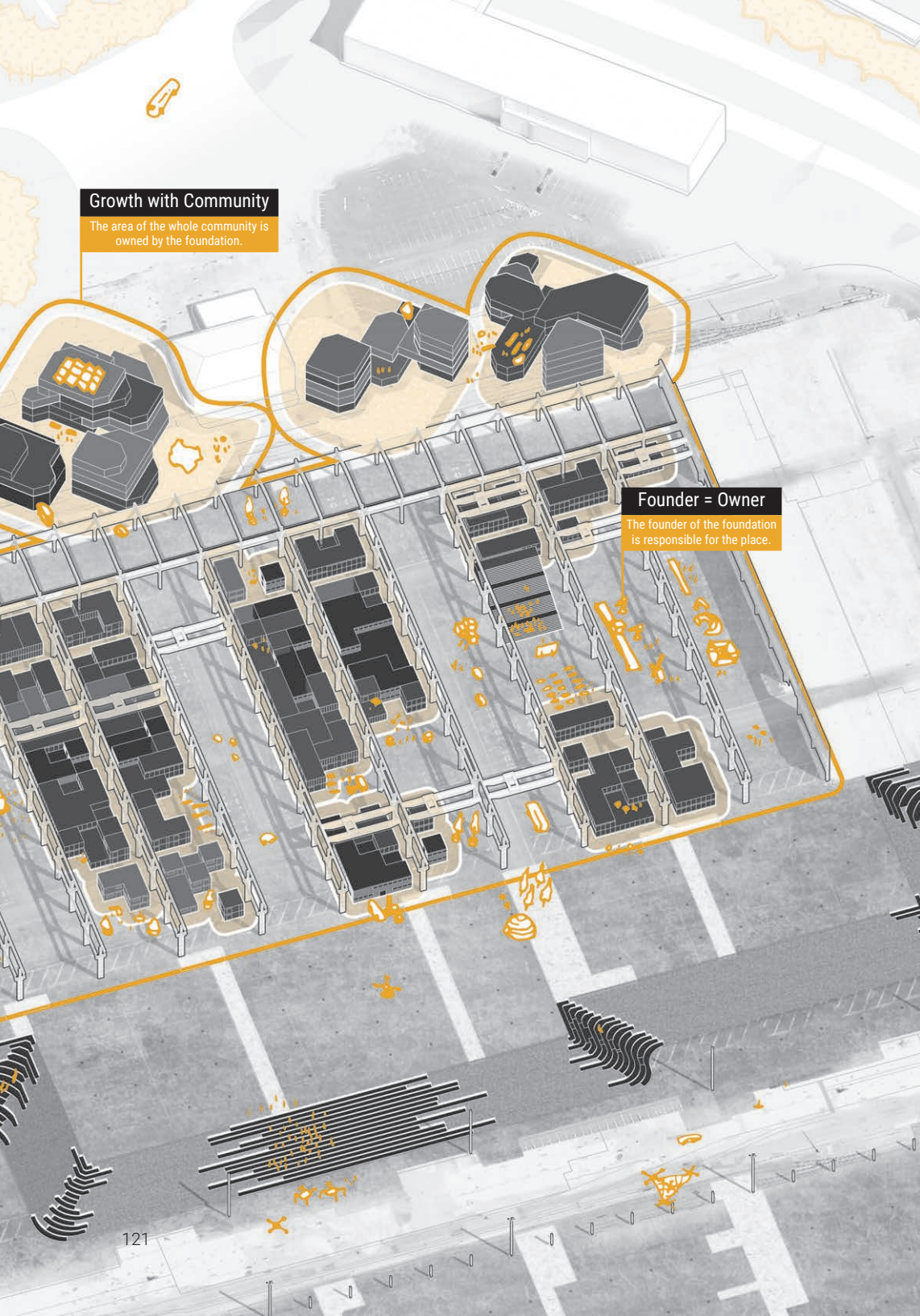
Fig. 64: Zoning of the first development on the open field

Fig. 65: Scenario of a living oriented community.


OPEN DESIGN

Fig. 66: Scenario of a working oriented community - the style of the design is not constrained by the planning.


Nested Ownership
Accepted co-owners get control and responsibilty for a plot


Growth with Community
The area of the whole community is owned by the foundation.
Founder = Owner
The founder of the foundation is responsible for the place.

Ownership

The ownership of the site can be compared to the one of open-source projects. Normally if someone founds a project, he is the owner of it. (Raymond, 2000) So in the case of the site it will be the founder of the foundation, who receives the property that he needs from the municipality. If the community of the foundation grows and needs to expand, it claims more space so that its organisational and spatial size correlate.

If the project becomes to large to be observable by a few persons open-source projects start splitting up their projects in branches. This also happens on the occupied space of the foundation. It splits up in seperate projects that are owned by the foundation, but co-owned by people who earned reputation inside the community and are trusted to be responsible for one project. In this way the ownership is nested and becomes a representation of the community.

Furthermore there can be other cases of ownership that might not even be part of the presented foundation.

I. External larger development

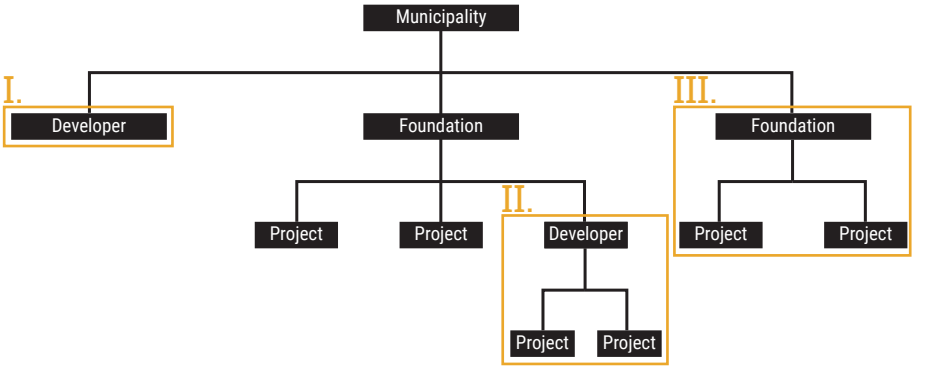
The municipality could sell the property of the site also to other interested developers. It needs to take care however that this is a wise decision.

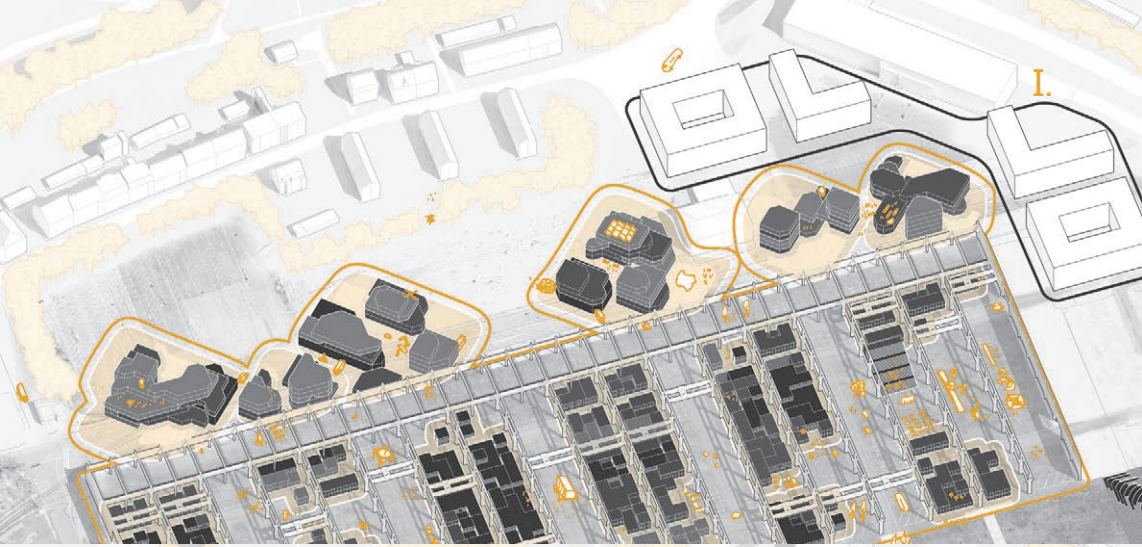
II. Internal larger development

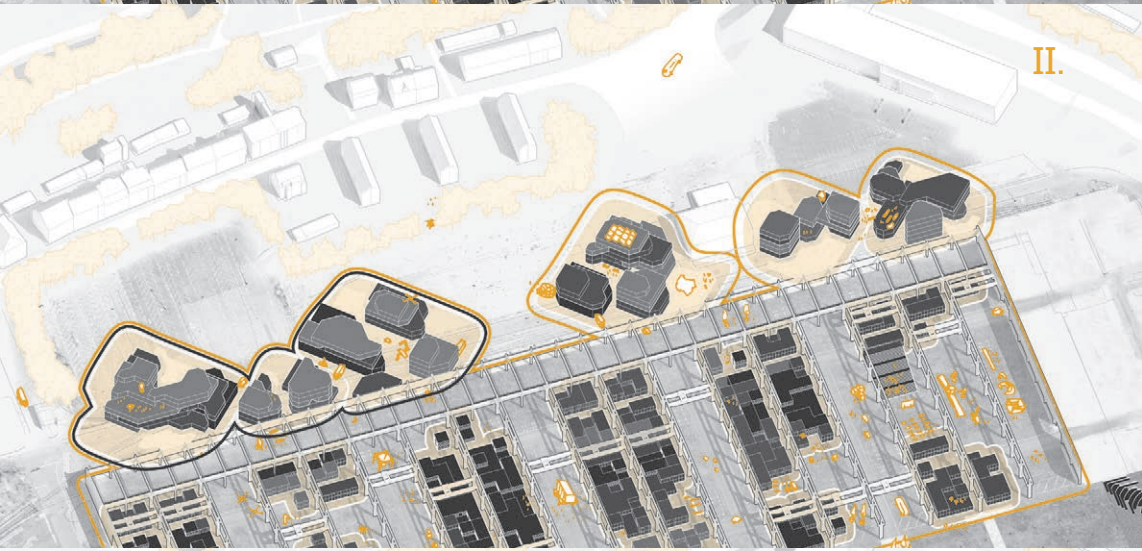
If there is a need for fast expansion or a larger project inside the foundation, this could be done through a development of several plots at once. Another hierarchy of ownership would be introduced.

III. Initiation of another foundation

A new foundation could grow next to the existing one, maybe because it wants to collaborate with the existing one or it is a "fork" of it, meaning a split-off, that was unsatisfied with the direction of the ongoing development or organisation and wanted to change it.




I.


II.


III.

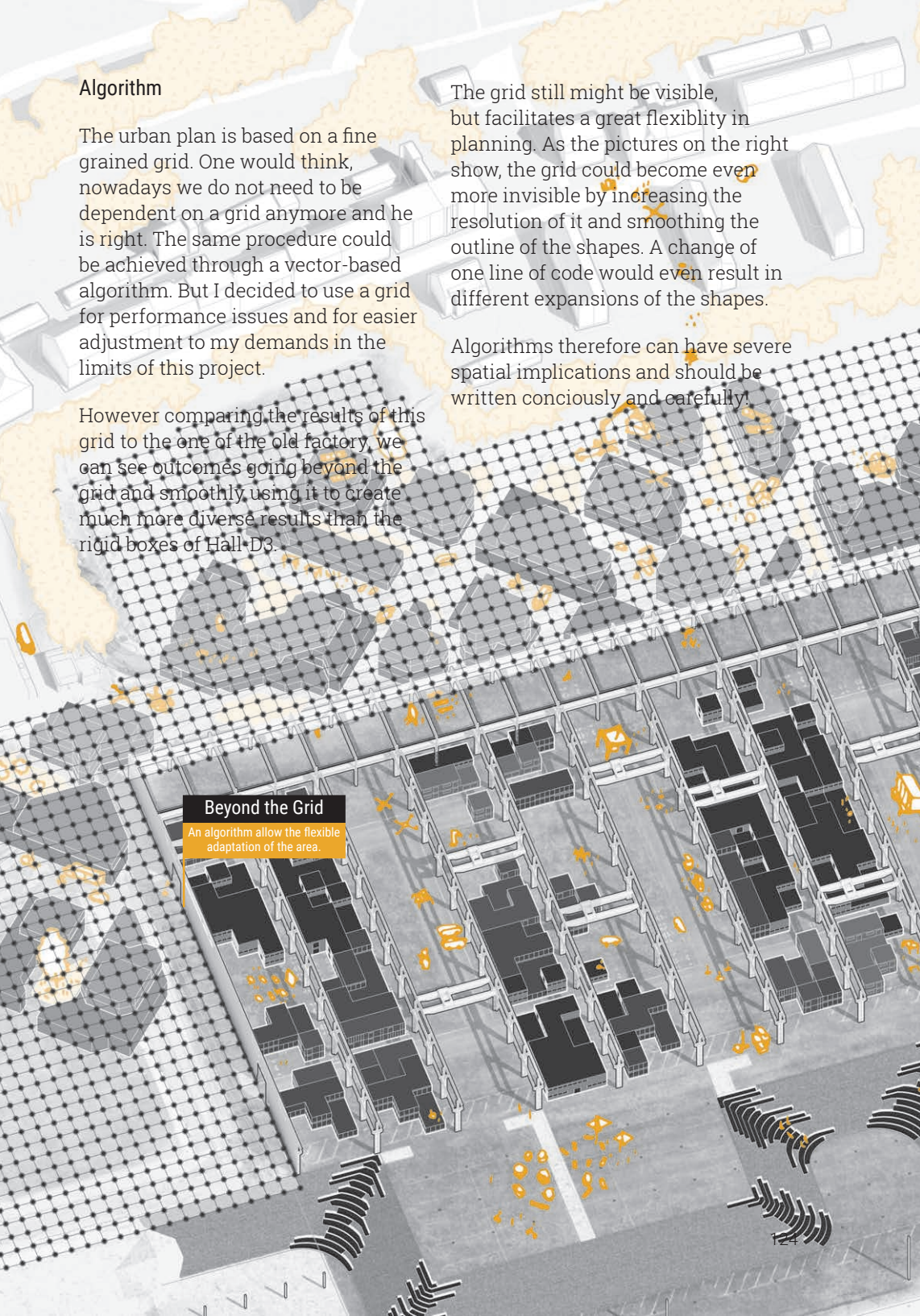
Algorithm

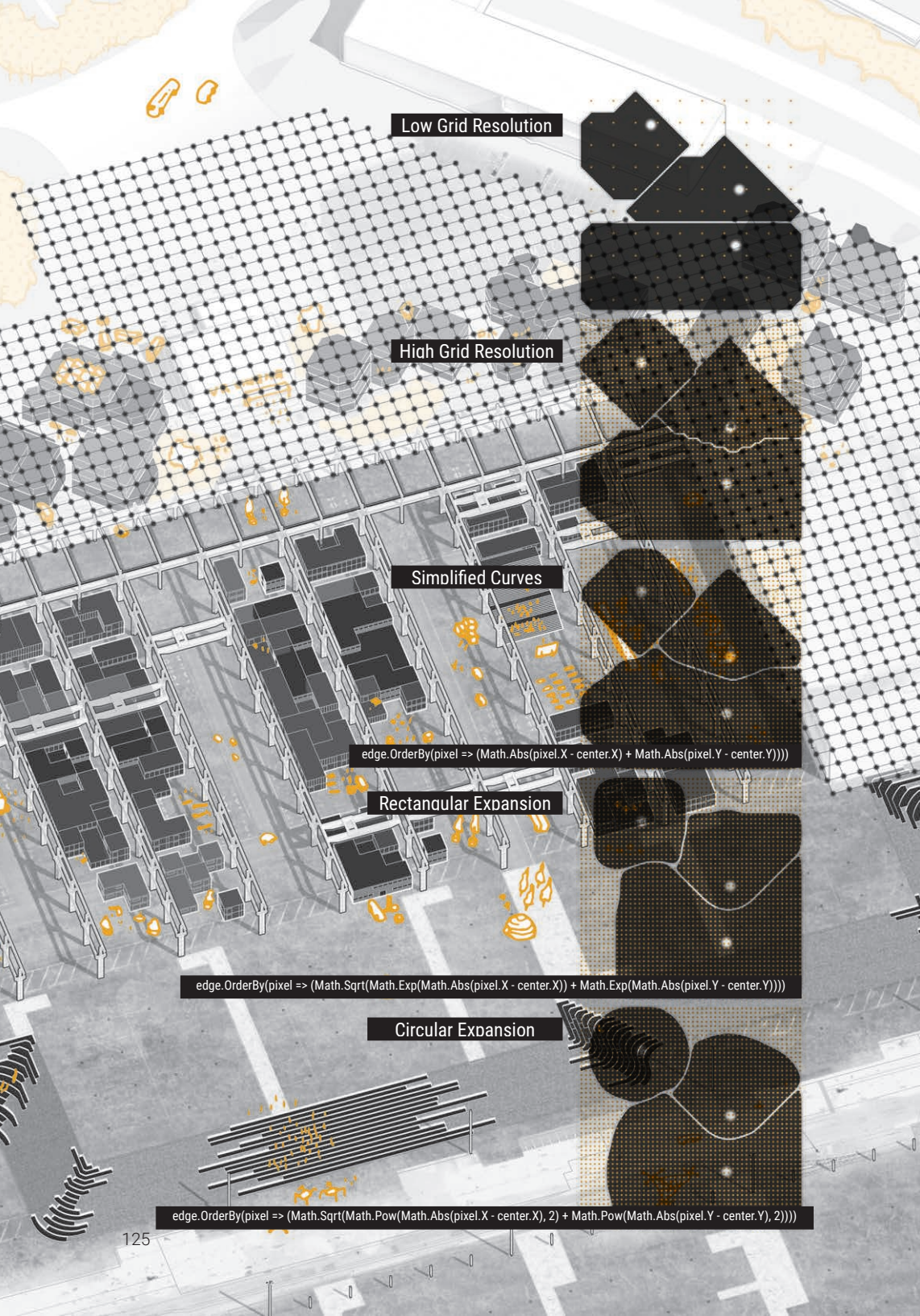
The urban plan is based on a fine grained grid. One would think, nowadays we do not need to be dependent on a grid anymore and he is right. The same procedure could be achieved through a vector-based algorithm. But I decided to use a grid for performance issues and for easier adjustment to my demands in the limits of this project.

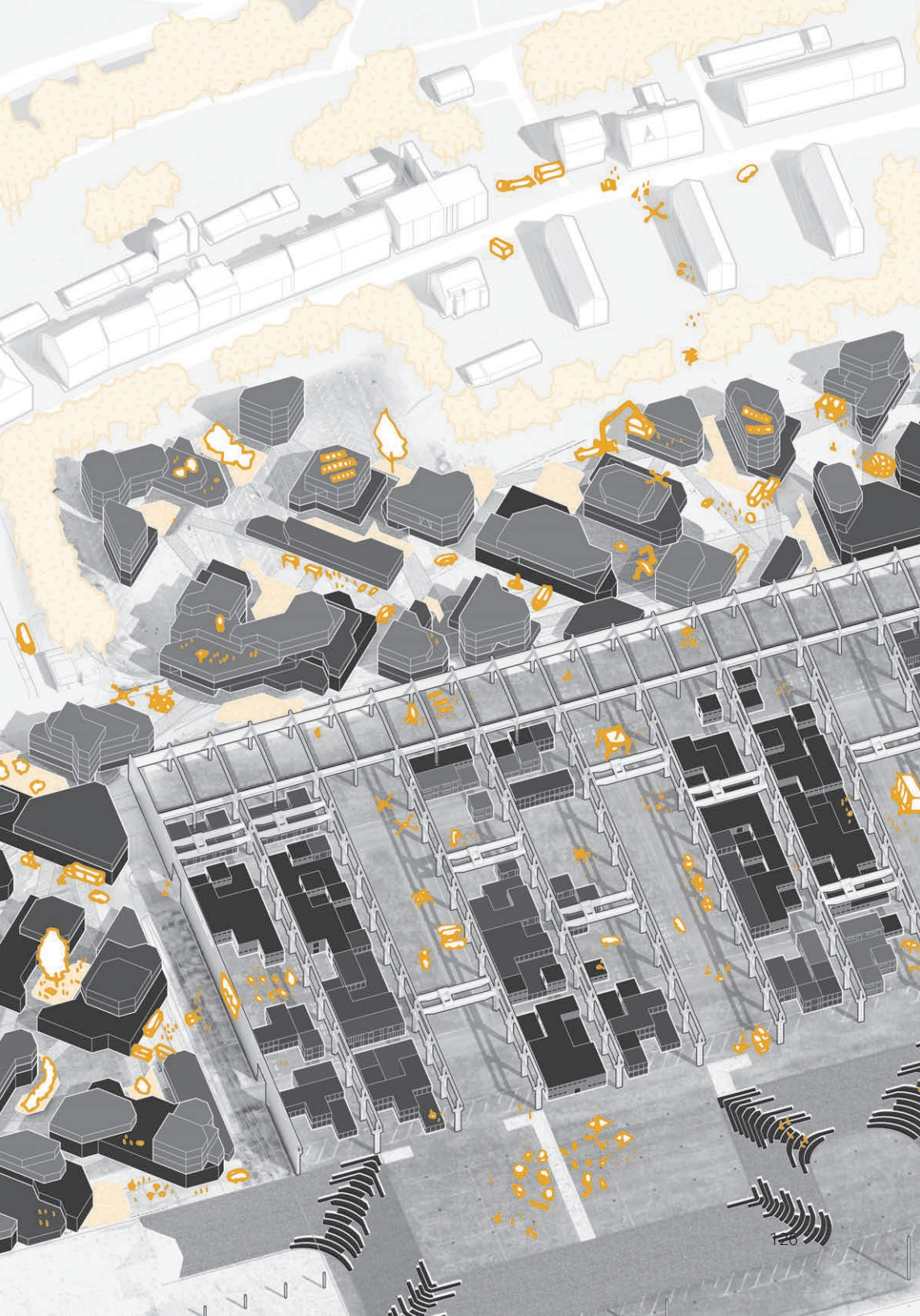
However comparing the results of this grid to the one of the old factory, we can see outcomes going beyond the grid and smoothly using it to create much more diverse results than the rigid boxes of Hall-D3.

The grid still might be visible, but facilitates a great flexiblity in planning. As the pictures on the right show, the grid could become even more invisible by increasing the resolution of it and smoothing the outline of the shapes. A change of one line of code would even result in different expansions of the shapes.

Algorithms therefore can have severe spatial implications and should be written conciously and carefully!




Low Grid Resolution
High Grid Resolution
Simplified Curves
edge.OrderBy(pixel => (Math.Abs(pixel.X - center.X) + Math.Abs(pixel.Y - center.Y)))
Rectangular Expansion
edge.OrderBy(pixel => (Math.Sqrt(Math.Exp(Math.Abs(pixel.X - center.X)) + Math.Exp(Math.Abs(pixel.Y - center.Y))))
Circular Expansion
edge.OrderBy(pixel => (Math.Sqrt(Math.Pow(Math.Abs(pixel.X - center.X), 2) + Math.Pow(Math.Abs(pixel.Y - center.Y), 2))))




VR CINEMA

Fig. 67: First temporary project on the open field.


43

Fig. 68: First permanent projects and new temporary projects.


INFO-CAFÉ
43

Fig. 69: More developments and agents (humans or vehicles) scanning and analysing their environment.


BEER
INFO-CAFÉ
43

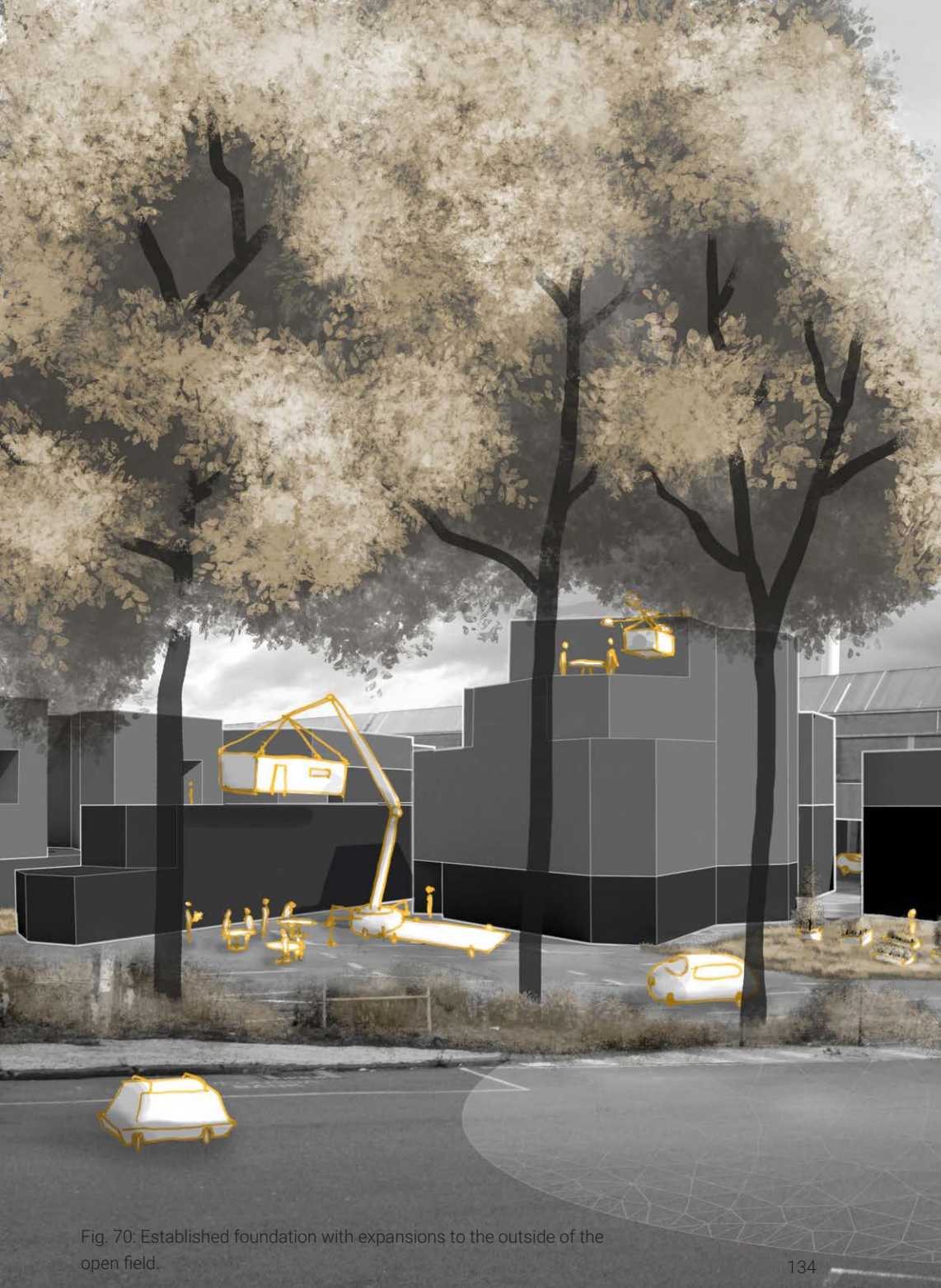


Fig. 70: Established foundation with expansions to the outside of the open field.


INFO-CAFÉ
43

Fig. 71: Possible physical representation of the topologial zoning plan.


INFO-CAFÉ
43

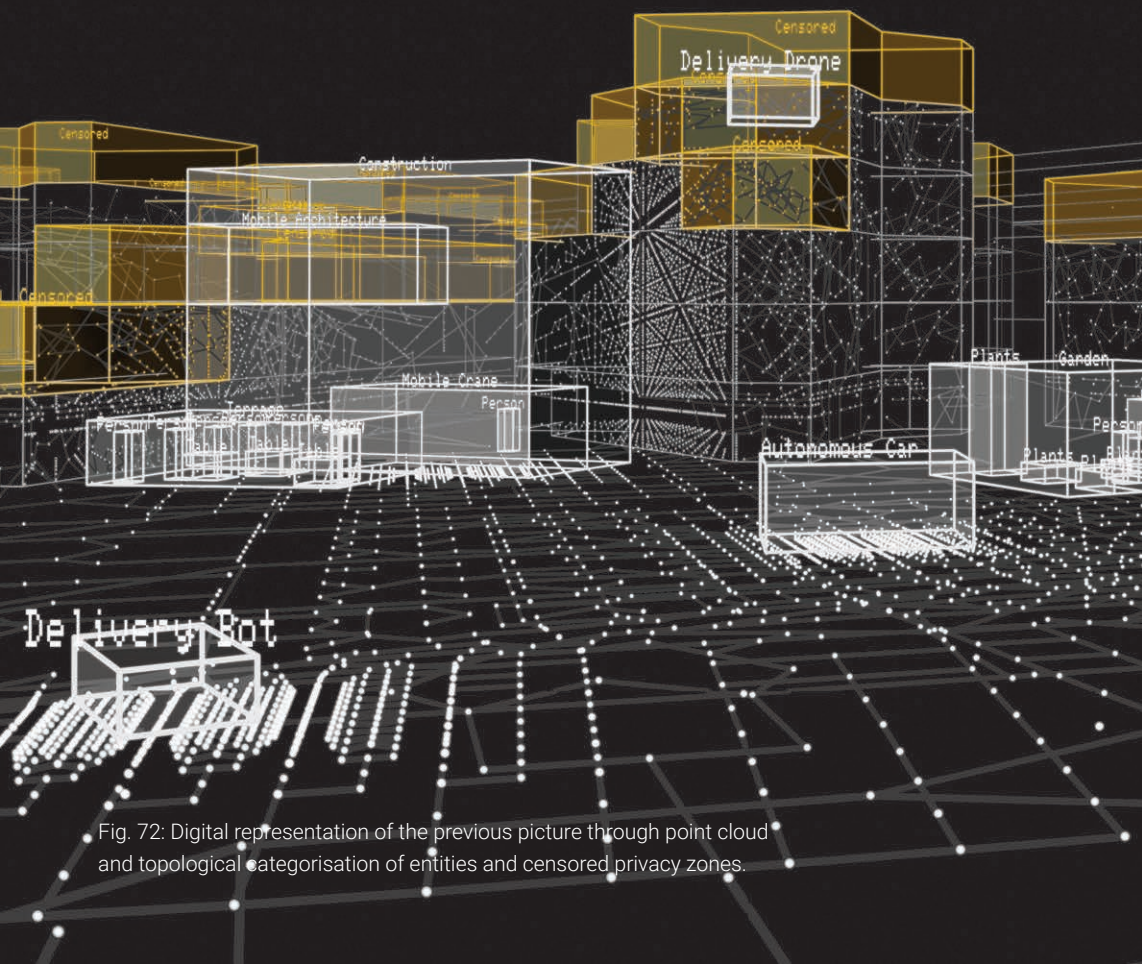
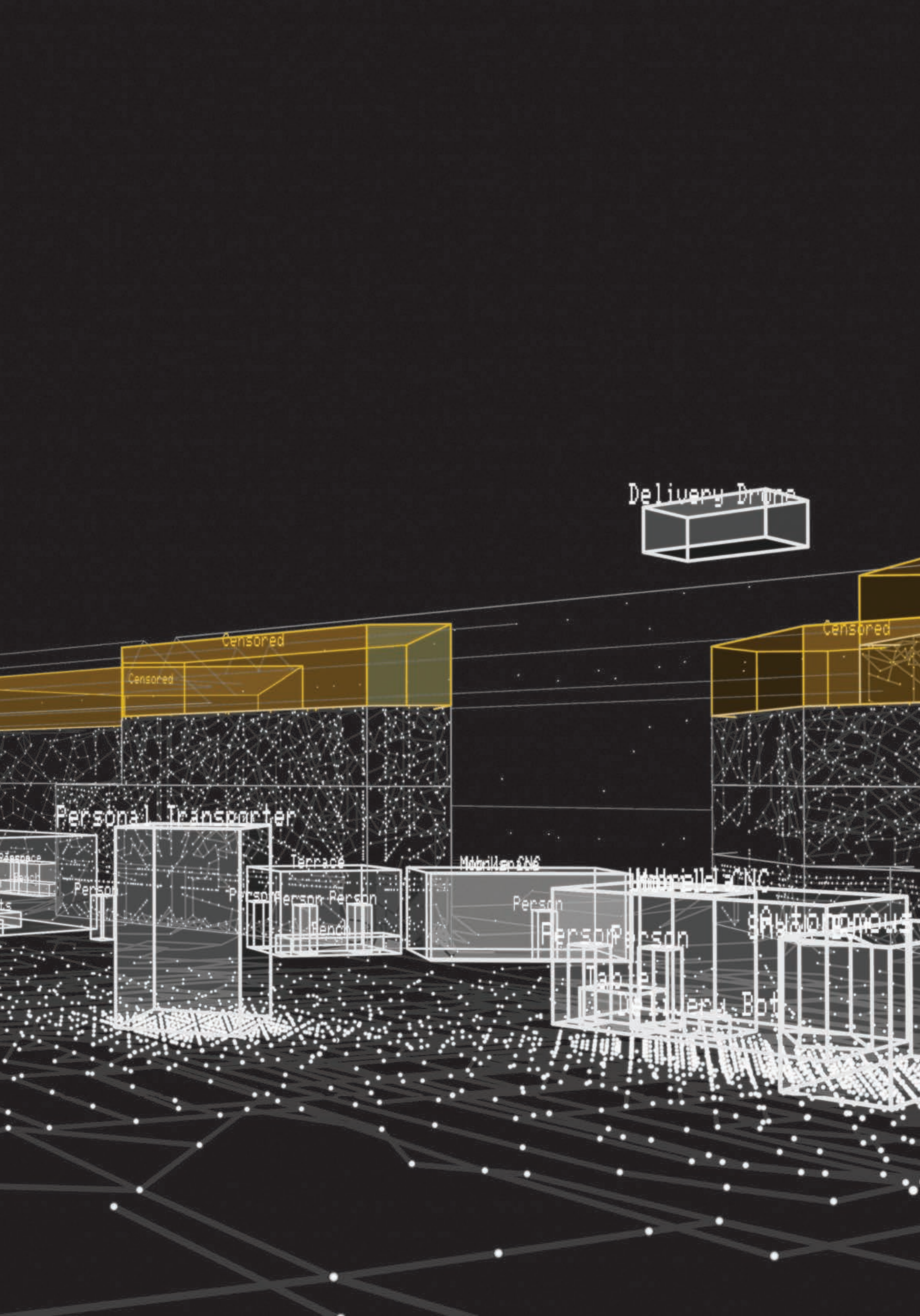


Fig. 72: Digital representation of the previous picture through point cloud and topological categorisation of entities and censored privacy zones.


Delivery Drone
Censored
Censored
Censored
Personal Transporter
Terrace
Person
Bench
Table
Delivery Bot

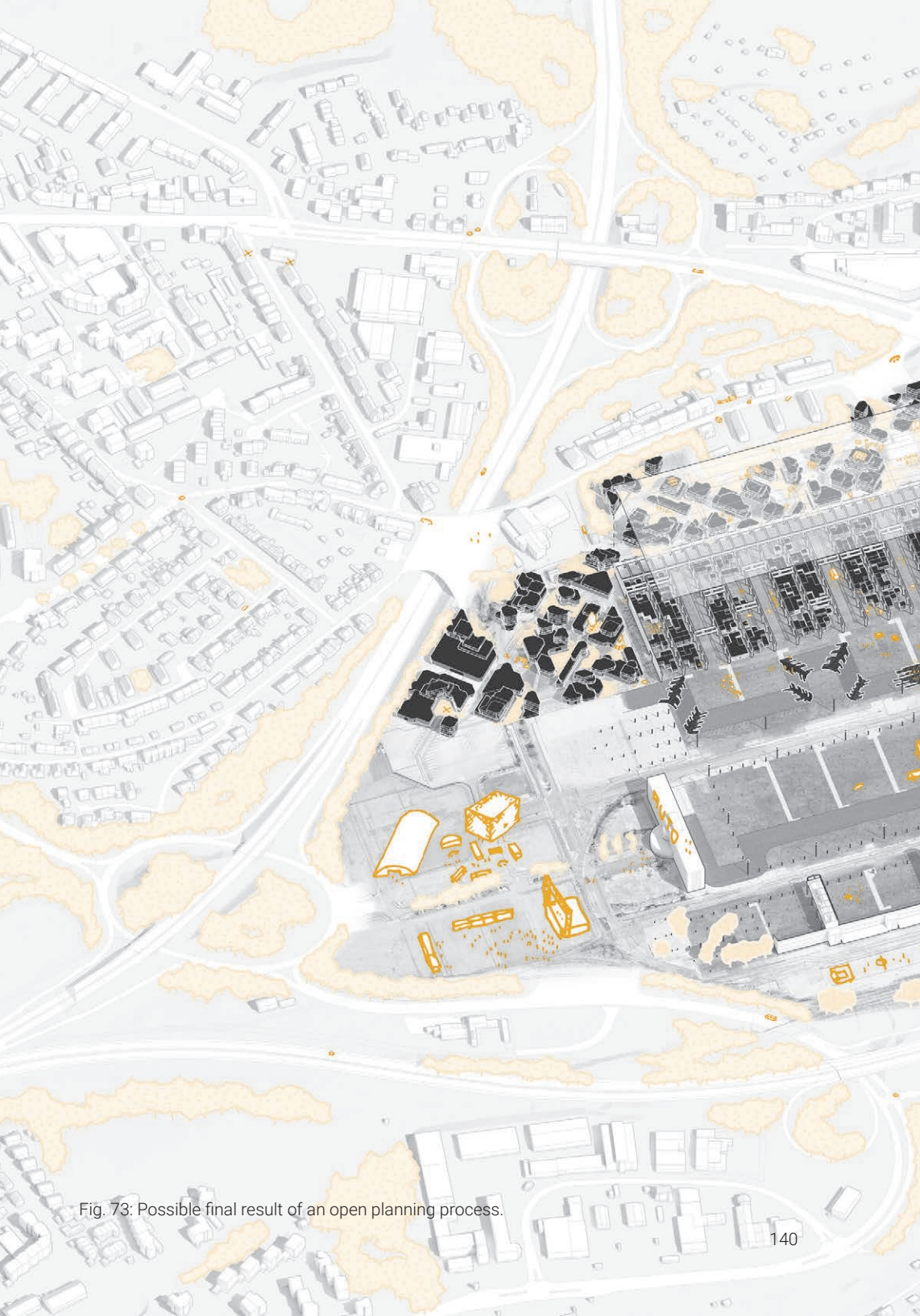
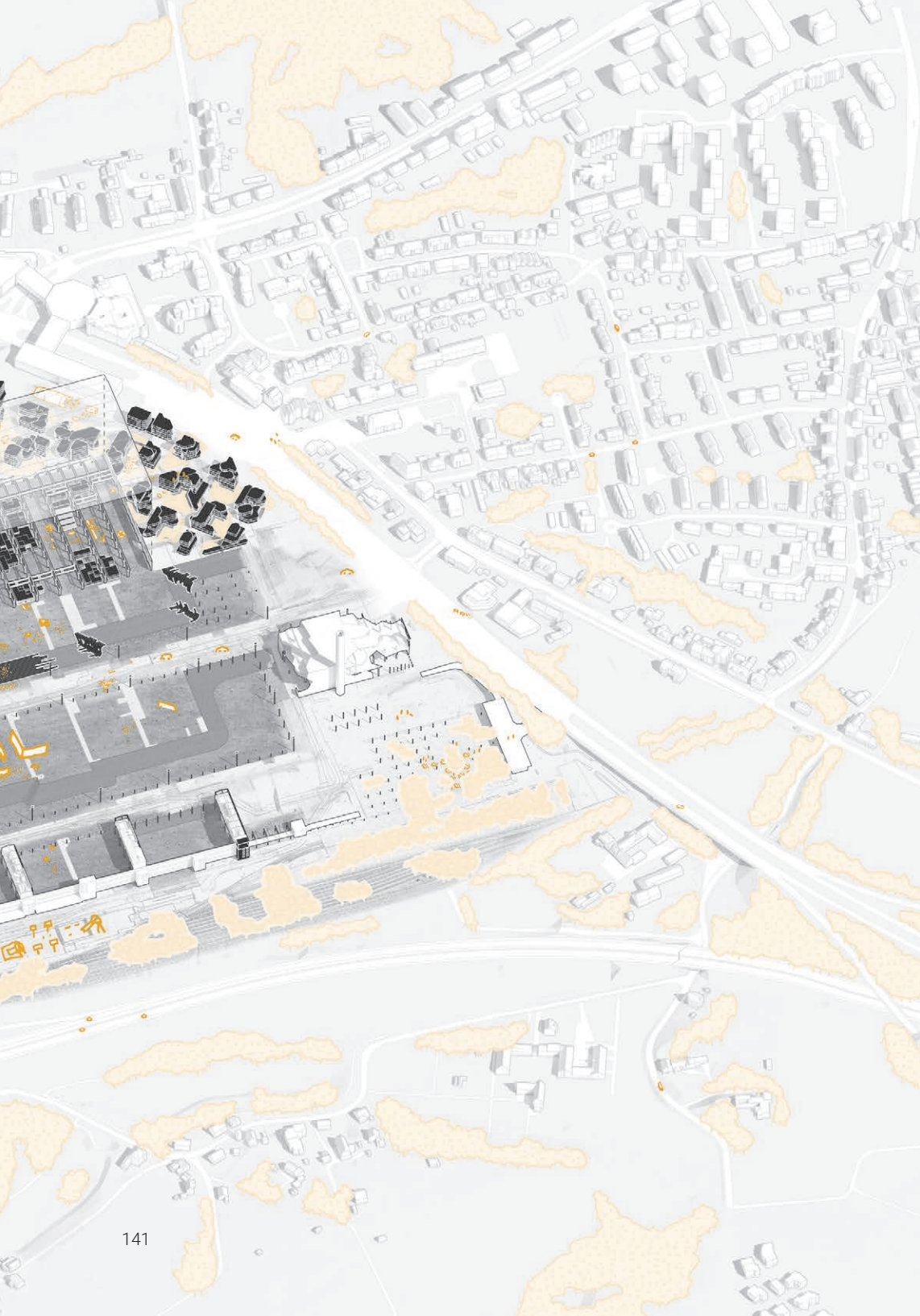
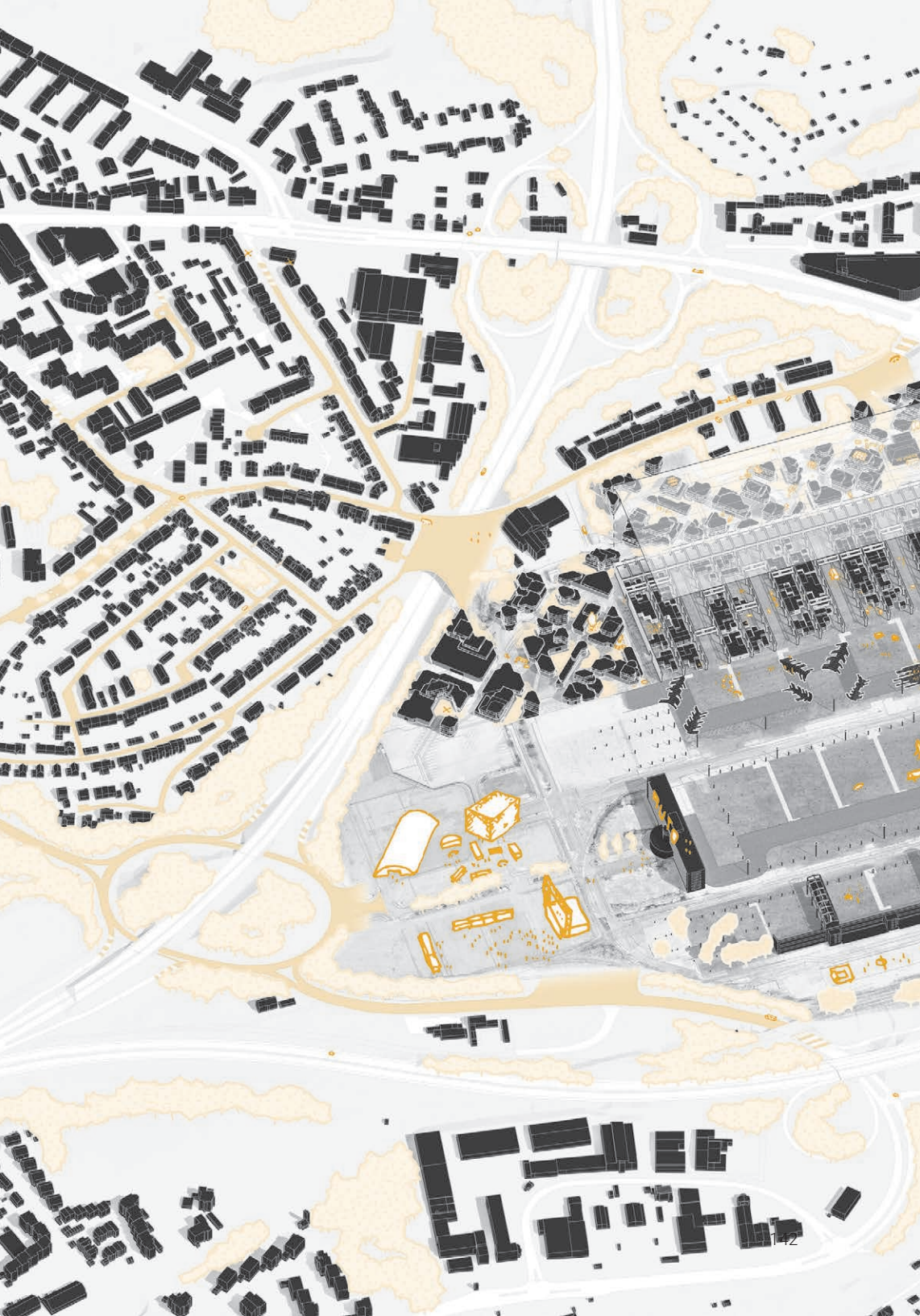


Fig. 73: Possible final result of an open planning process.





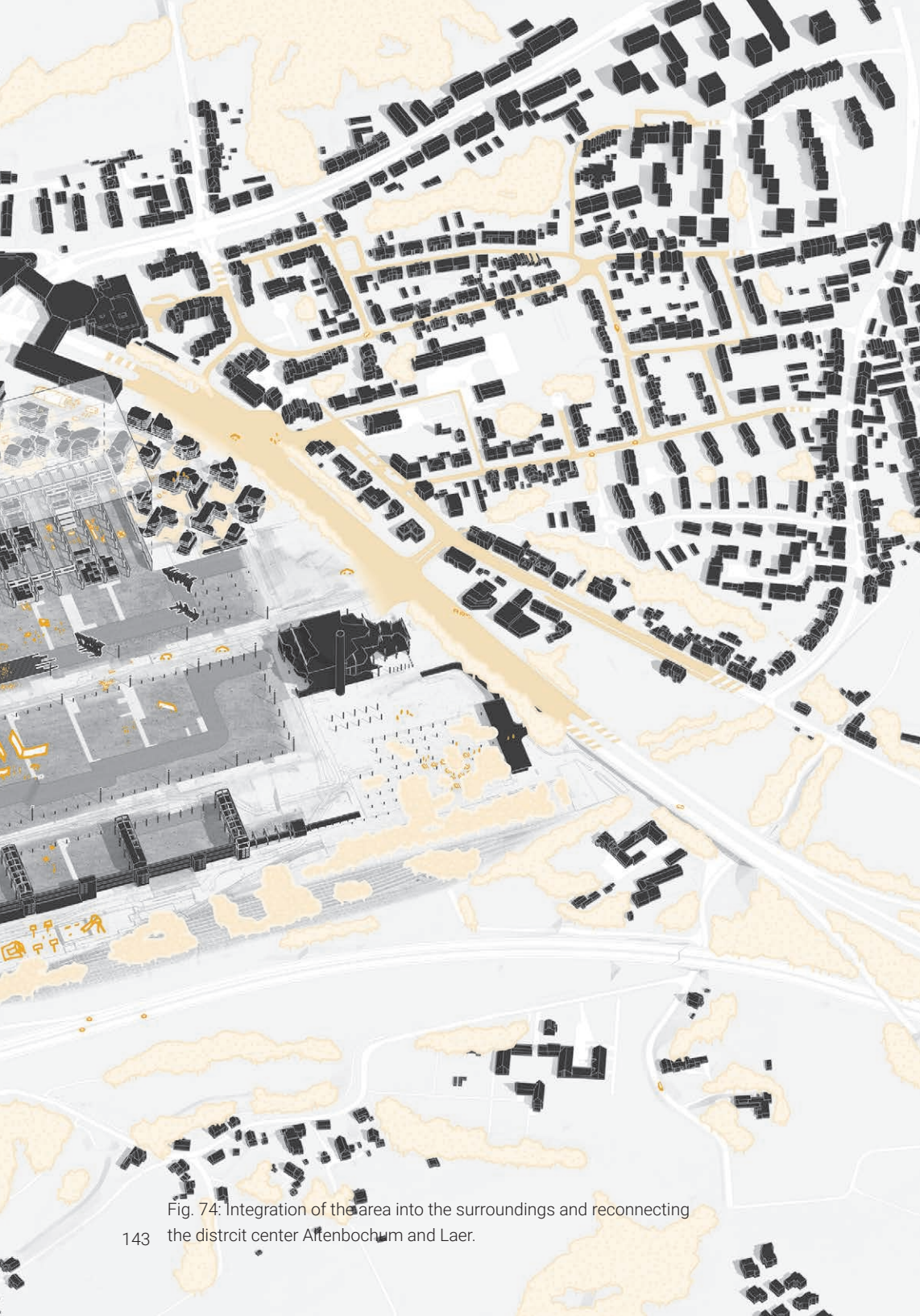


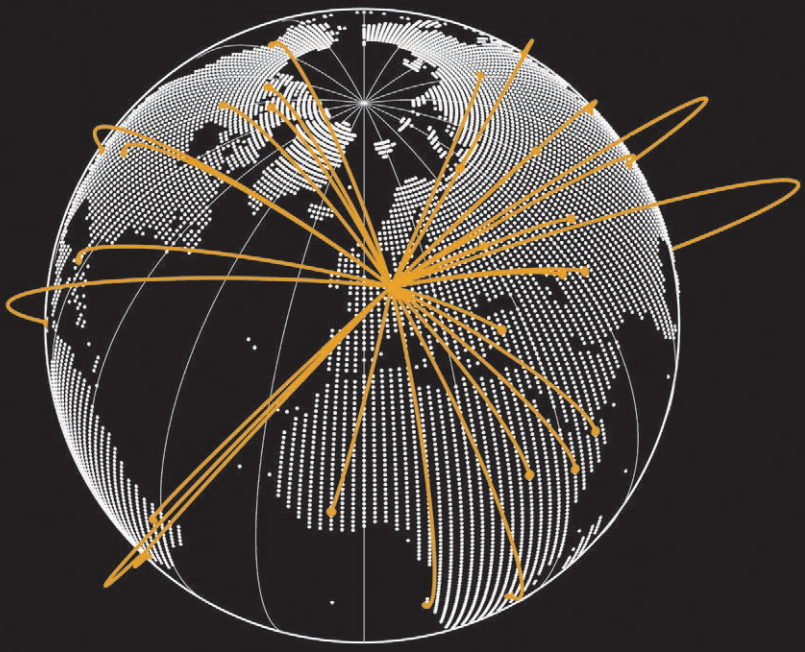
Fig. 74: Integration of the area into the surroundings and reconnecting the distrcit center Altenbochum and Laer.

Local nodes in a global community

The commons approach creates a pool of resources openly accessible for everyone who wants to contribute and use them. The only constraint is the legal framework of its foundation, that should allow this openness through copyleft licensing protecting the pool of resources from misuse and exploitation (see chapter Theory Paper).

With everyone having access to all new contributions to the commons, everyone can profit from them. In this way innovation will happen locally and globally in a much more gradual and faster way than the big leaps forward that we know from existing copyright innovations. Leaps will be unexpected, coming out of a problem-solving and problem-finding routine and invention will happen out of necessity.

Through the accessibility and openness not only the local industry can make use of the knowledge and resouces, but furthermore global actors. This global community that will be attracted will generate a much greater and diverse contribution to the commons than the local network could ever do. It will be a network of local nodes, who join the foundation or establish their own. They will come up with improved or better planning concepts than the one presented in this thesis. Together the local nodes will not be dependent on only one other actor anymore, but many and therefore they overcome the danger of disruption that harmed the local economy of Bochum in the past.



Reflection

Since the beginning of my graduation I have been in search of an open approach to design. Within the studio topic "Let's work" we have explored trends in the way we work today and one very promising part was the open source culture trough which I got to know more about peer-to-peer production and the commons. They show us alternative models to closed hierarchical systems to which we are used to in capitalism by having open and flat organisations. They often try to be more inclusive and therefore can introduce social values in our economy.

In architecture and urbanism this trend is also very present. People like Christopher Alexander, Lucien Kroll or Giancarlo de Carlo have spoken about open processes already within the 60s and 70s criticizing the modernist planning paradigm with a few people deciding on behalf of the mass. Nowadays similar opinions are recognizable in texts of Richard Sennett, Patsy Healey, Stephen Graham or Nikos A. Salingaros, who talk about open cities, peer-to-peer urbanism and collaborative planning. Participation is always part in their texts. But not in a romanticized way that we can fulfil everyone's needs and find a consensus, but rather as a way to negotiate demands and also embrace and solve conflicts between different stakeholders. Inclusion in the shaping of our environment is important and the change of rules that govern it needs to be allowed. Nobel-Prize winner Elinor Ostrom was explaining this also in her eight principles of designing commons.

The site of the Opel factory in Bochum, where my project is situated, turned out to be a very interesting case for a commons-driven industry. Its history has shown Bochum's suffering from centralized economic dependency and it would be a chance now to approach the future with an open, social, inviting economy. Creating an open design process for this site should further on be an opportunity for me to overcome my older structuralistic projects. In these I tried to create participatory, inclusionary processes. But at the end one could criticise it in the same way as Colin Rowe did on structuralism in his famous book Collage City by saying that "total design [extended] into total management".

Therefore I started to oppose my own projects and all modernistic and post-modernistic planning in the search for something post-structuralistic, inclusionary. It went so far, that I was not able to set up a rule or draw a line to define the spatial qualities, since it would be a centralized design made by me and not involving others.

Listening to an interview with Richard Sennett at the Constructing the Commons Conference organized by the Methods and Analysis chair of TU Delft, my view was encouraged through him. The conference was in search of an answer how design could create the commons, but Sennett

had to disappoint the audience by saying that the commons leave the physical space on a certain scale. Furthermore one person alone cannot create and have a c ommon resource. It needs to be in common with more persons. The organisation and community behind the resource is essential to create commons. This is something a designer cannot do through design. People may think if they plan i.e. a science park, high-tech companies will come by themselves or if they draw urban gardening on a plan, it will happen. No, it needs to be initiated by political will and influence. Considering the title of the studio Design as Politics, I believe the designer himself cannot do politics with only design, but if he positions himself and initiates or joins a discourse he will become a politician and design will become his tool to persuade others.

Having these two roles of a designer and politician in one person it is not the designer who creates a process of commoning, but the politician. It is his choice and responsibility to be inclusive and open or the opposite. The designer however is just a translator of the demands that come out of this process.

Now in relation to my project I have to accept that I cannot initiate an open negotiation to shape the site in Bochum. But I have a position how the economy should develop. The design is not created through commoning itself, but becomes a vision of how it could look like. It is a leap into the future of a commons-based society with the focus on transportation. It is an alternative to the mass-manufacturing of Opel that took place on site before and an alternative to the future of transportation that is being developed right now with autonomous cars and drones. If the underlying functions and algorithms of these are not open, we cannot develop trust in these technologies. Cars could bring us anywhere to manipulate our behaviour and track our habits. It is the same discussion which was started by Edward Snowden on how we communicate. Safe communication through encryption is only trustworthy, if it is open source and double-checked by others. A commons-based industry which shares its knowledge with the world can achieve this trust. Its local production would then become more collaborative than competitive, which would influence the way we shape our cities.

Besides the aspect of collaboration I also had to reflect on the impacts of autonomous driving on our cities. Diving into design I rediscovered the importance of symbolism and through the discussions in the studio I realised that my thinking is constrained by conventional design methods and references. However exploring the symbols of our existing built environment and how it was shaped through technologies, I tried to stimulate my own thinking. Exploring and using similar algorithms as autonomous cars and analysing existing common spaces I started shaping the context of my project. The development of a

narrative generated interesting new ideas that changed for example the shape of my test-site. Instead of using a net-structure I thought, with the internet of things drones could teach other drones and keep them inside the area.

Now my project is divided into three chapters, each symbolising an important phase of Bochum's past, present and future. The first deals with the site as industrial heritage in the shape of a ruin. It is a clear critique on the powers of capitalism. The second transforms a part of the old factory into an incubator for the future. Three industrial revolutions are fostering a fourth. The last gives a glimpse into the future of autonomous transportation and its collaborative development, represented by a process that creates an open urban environment through self-organisation.

I was not sure if I could achieve it, but I was able to create this process of the last chapter. With a bit of help of Pirouz Nourian, PhD-candidate at the Urbanism department, I programmed a software, which allows an intuitive interaction and shaping of a part of the project. After using it myself, I realised that I always come up with similar solutions, since my thinking is constrained by my experience and knowledge. What I did was therefore asking friends to participate. Each of them had to create one plot of the design. This experience was the most fulfilling part of my whole project! Besides very surprising and serious spatial thinking of even those who don't have an architectural background all aspects of the negotiation of space that I was looking for took place. The site developed slowly over time, each time bringing new information into the project. Rules were changed on demand depending on the context. In one case two persons even negotiated about sightlines, in a real situation this issue might have developed into a conflict. But as I said, participation is not always convenient and nice. A society based on the commons thrives from this engagement and needs transparent and trustworthy processes.

I am happy to say that I finally overcame my structuralistic traits of my older projects. I still designed the main structure of the design, but it was able to adapt to most of the individual wishes. I thought it would need a real project and years to come to see how rules change. But in this little simulation of participation with my friends, I saw these changes happening right in front of me. I hope to explore this in the future in more depth to find new ways how to negotiate our built environment.

Further Research

The presented thesis does not present a finished planning principle. It only gives a direction of aspects that are important to look at and shows a possible new flexible and collaborative planning method. It will hopefully be a start of an ongoing process of improving and adapting of new planning tools for very different demands and context. and therefore has to be open source.

The first important aspects to look at for the further development are the topological and structural perspective on spatial development. Geometrical aspects and the designed form are nowadays, provocatively said, arbitrary. At least architecture is struggling with finding a universal style or identity and it probably won't be able to do so, which is good. Design rather shows a diverse representation of identity that an entity like a community or developer wants to express. Looking into a future of virtual reality, everyone could even overlay their own favourite design on the existing physical world.

I do not see this development negative, but it shows the topological importance of planning, because it allows for a great diversity of physical design, for which we will still need educated experts. Urban planners however who are used to zoning plans that work in essence also with a topological layer of functions, should perceive their environment similar to a self-driving car or even better language, categorizing its environment. The color and shape of a car does not matter, but it is important to categorize and measure it as a moving vehicle. But this abstract layer will have to be flexible like language adapting to new cultural contexts to be able to evolve and not get stuck in a rigid structure, which can only be achieved through an open and transparent planning process. Therefore I also want to speak out a warning, since this way of planning can be easily misused as a very profitable, pseudo-participative tool protected under copyright law, making everyone who uses it dependent on the person owning it!

Besides the topological aspect the other important part is still the geometrical representation. I developed an algorithm that translates the topological nodes and connections into spatial design. It constrains the form of the architecture and layout of infrastructure. There can be many more ways explored to do this and also the feedback aspects of the program like greenness, density, openness, illumination and privacy could be extended or interpreted in very different ways. The person programming the algorithm needs to be aware of the impacts. We need to ask the right questions to the data and create a spatially useful design. For example in my case the light conditions inside the buildings were not considered. The classic thumb-rule of a 12 to 16m wide building, dependent on the direction, does not apply here. It could be implemented in the algorithm that would lead to very

different shapes. Another interesting critique to my algorithm was the apparently visible grid, although it should go beyond it. Increasing the resolution of it, changing the expansion or outlines of buildings or using a vector-based expansion i.e. would create very different outcomes, partly already by changing only one line of code. I believe these aspects should not be decided only by the "urban programmer", but should be negotiated by the parties involved in the development of a site.

Concluding these remarks, I would like to stress again the importance of opening the development and therefore I will open the knowledge as much as possible by even making the underlying algorithm open source.

Social and scientific relevance

"Instead of accepting the waves of deindustrialization that seem to sweep over us, can we not learn from other shores how to achieve new forms of craft, creativity, manufacturing and cities that both think, talk, consume and make? The focus of this studio is not just the workplace, but the place of work, the position of industry, manufacturing, production in the wider context of our urban communities. We are looking for new perspectives, new solutions, new utopias or new research into this topic."

Abstract of the brief of the Design as Politics Graduation Studio Let's Work

My project lies in between the specific challenges, faced by the closing of the Adam Opel factory, and general trends of work that are discussed in my studio Design as Politics with the topic Let's Work – Industry, Architecture and the City.

The history of the Opel site reveals three phases of industrial revolutions that gave new economic development in times of structural change. They were necessary, since the local industry was strongly dependent on one economy-branch. With the Opel factory the city of Bochum is facing a similar problem again. The transnational company GM, Opel's parent company, decided to close the factory in Bochum and leaves behind a disrupted car-industry. At Opel 3,200 jobs are directly affected and 45,000 regionally, causing social and economic downturns.

With my theory paper I am positioning the project in a scientific discussion on how a local industry can compete in a globalising world. Out of the studio discussions and literature, the commons proved to be valuable. They cannot only position a local network in the world economy, but also introduce social values in capitalism. Specifically for Bochum these values could be achieved by integrating a diverse population in the development and establishing an innovative and collaborative instead of competing industry. Small- and large-scale examples show successful applications, however there is yet no similar development of a commons-based industry in the scale of my site – only rather small initiatives like Fab-Labs who have a world-wide community. Since my project cannot be tested, it will only contribute a proposal to the scientific field.

Besides the general topic of the commons, more specific site aspects address social challenges. A redevelopment of the area can integrate the surroundings better in the urban fabric and re-establish a flourishing city district. Further on novel techniques for transportation can reconnect the disrupted car-manufacturing network. With an already existing R&D network and political initiatives in the region, it becomes a very specific solution for the site. It has the chance to give back jobs to those who are now unemployed and create new businesses.

The project itself is very idealistic in its roots, but I hope to give inspiration for others and contribute new knowledge to fruitful discussions.

Methodology

The scheme on the right shows the methodology for my project to progress from the studio topic through problem analysis and research towards a final design.

It is influenced by the studio itself, which offers lectures, workshops and an excursion to Shenzhen as the most-known place for manufacturing these days. It is then refined through my own initiative and the proposals of my mentors.

Site visit, local interviews and a symposium on city development in Bochum give specific knowledge as well as desk analysis. And general knowledge especially about the fourth industrial revolution, collaborative economy and the commons help framing the project.

The research afterwards informs the design process and structures it to create the final results.

Fig. 40: Scheme of methodology

STUDIO TOPIC

Design as Politics: Let's Work - Industry Architecture and the City

Location: Adam Opel Werk I in Bochum, Germany

PROBLEM ANALYSIS

Site specific		General discussion
Closing of Adam Opel Werk I		Fourth industrial revolution
Reports Newspapers Statistics Lectures Mapping	Interviews 3D-Model Drawings Historical and new Maps and Photos	Literature Diagrams Drawings Images Interviews
Site Visit "1. Hochschultag vor Ort" Symposium Studio Meetings		Shenzhen Excursion Workshops Lectures

CHALLENGE

Motivation ▶ **Structural Change** ◀ Relevance

RESEARCH QUESTIONS

Establishing a social, stable and strong economy

Bochum's competitiveness	Spatial and organisational structure	Local context	Involved actors

THEORETICAL FRAMEWORK

Disrupted Car Industry	Missing Competitiveness	Economic Dependency	Unconsidered Stakeholders
Novel Transport		**Commons**	
Interviews Reports Drawings	Literature Case Studies Computational Analysis	Literature Diagrams	Computational Analysis Graphical Analysis
		Theory Paper Institution - Community - Resources	

RESEARCH BY DESIGN

Design Process

Ruins of Capitalism	Incubator of a Revolution	Foundation for Transportation

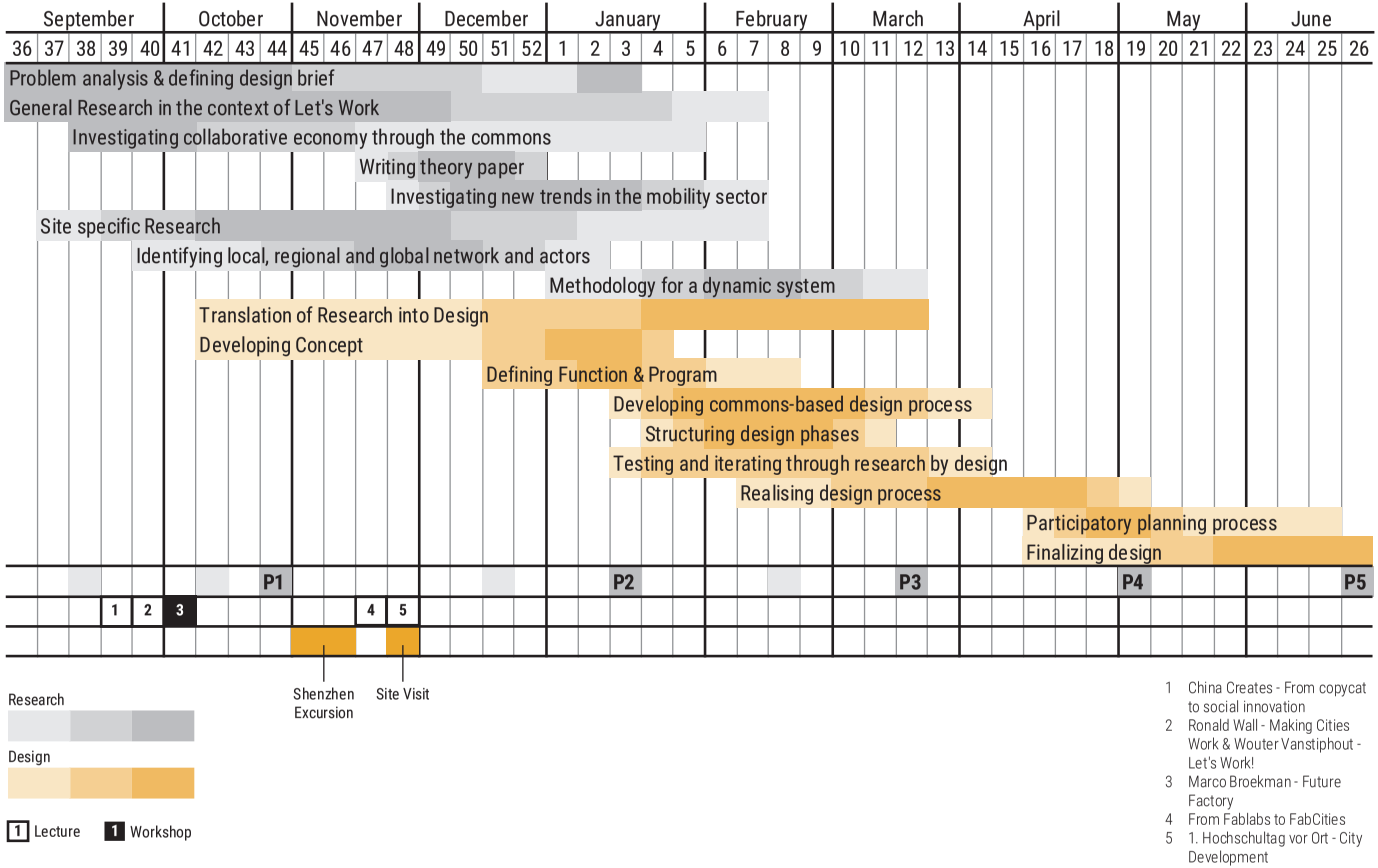
Iteration, Testing & Evaluation

Institution

Community **Resources**

Participatory Process & Design

Timeline


September
October
November
December
January
February
March
April
May
June
36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Problem analysis & defining design brief
General Research in the context of Let's Work
Investigating collaborative economy through the commons
Writing theory paper
Investigating new trends in the mobility sector
Site specific Research
Identifying local, regional and global network and actors
Methodology for a dynamic system
Translation of Research into Design
Developing Concept
Defining Function & Program
Developing commons-based design process
Structuring design phases
Testing and iterating through research by design
Realising design process
Participatory planning process
Finalizing design
P1
P2
P3
P4
P5
1
2
3
4
5
Shenzhen Excursion
Site Visit
Research
Design
1 Lecture
1 Workshop
1 China Creates - From copycat to social innovation
2 Ronald Wall - Making Cities Work & Wouter Vanstiphout - Let's Work!
3 Marco Broekman - Future Factory
4 From Fablabs to FabCities
5 1. Hochschultag vor Ort - City Development

Shenzhen - an inspiration

Shanzhai and the commons

Within the Design as Politics studio an excursion to the factory of the world Shenzhen was organised, the city where most of our smartphones are produced. We got to know the local culture of living and working and tried to grasp the Shanzhai culture which works rather collaboratively and open. People who are participating in Shanzhai adapt to new technology fast, have an open culture of sharing knowledge and act agile in a decentralized network. It has great similarities to the commons.

Knowledge and know-how innovation

In a lecture Tat Lam, an urban researcher, told us the difference between innovation through know-how and knowledge. Silicon Valley is a place were innvation happens in big leaps through high educated people with knowledge. Shenzhen however is a place were people often learn by doing - they know how to do things and then they adapt it to different demands. This innovation does not happen in leaps but step by step. Commons could allow both ways to happen depending on the project.

Small-scale urban mobility

Fascinating for me was also the logistic that happened in this place. Many small vehicles like simple carts, scooters or even trendy one-wheelers can be seen there. They act very efficiently and demand oriented in a distributed network. Although it looks chaotic at first hand patterns are observable. Through technological innovation, countries in Europe could adapt to this, too, making their transportation more efficient.

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List of figures

Fig. 1: Own work based on graphic by dpa infografik http://img.welt.de/img/wirtschaft/crop134739681/2210198819-ci3x2l-w780/DWO-WI-Opel-Bochum-js-Aufm.jpg and statistic of Gebhard, G. (1957) Geschichte, Aufbau und Verflechtung seiner Gesellschaften und Organisationen. Ruhrbergbau. Glückauf GmbH, Essen 1957, S. 580.

Fig. 2: In the public domain via https://de.wikipedia.org/wiki/Geschichte_des_Ruhrgebiets#/media/File:Lange_diercke_sachsen_deutschland_ruhrgebiet_1830.jpg

Fig. 3: In the public domain via https://de.wikipedia.org/wiki/Geschichte_des_Ruhrgebiets#/media/File:Lange_diercke_sachsen_deutschland_ruhrgebiet_1930.jpg

Fig. 4: Own photo

Fig. 5: Regionalverband Ruhr licensed under CC-BY-NC-SA 4.0

Fig. 6-9: Own work based on old maps of Bochum http://geoportal.bochum.de/mapapps/resources/apps/Stadtplan_historisch/index.html?lang=de and http://www.ruhrzechenaus.de/bochum/bo-dannenbaum.html

Fig. 10: Own work based on Bing Maps

Fig. 11 to 13: Stadt Bochum - Presseamt https://www.bochum.de/C125708500379A31/vwContentByKey/W28YXFD5282BOCMDE/nav/start

Fig. 14: Photo by Ute Grabowsky © Presse- und Informationsamt der Bundesregierung

Fig. 15-18: Own photos

Fig. 19: Own work

Fig: 20: Network graphs by Paige Peterson CC BY-SA 4.0 https://github.com/ioptio/design/tree/master/networks

Fig. 21: Own work

Fig. 22: In the public domain via https://3.bp.blogspot.com/-iqlkjypV_Q0/UY2bvpq7-aI/AAAAAAAAB5k/niW32wymV04/s1600/Haussmann-paris-avenue.jpg

Fig. 23 & 60: In the public domain via http://www.remixtheschoolhouse.com/sites/default/files/lc.JPG

Fig. 24: Cedric Price Archives, Canadian Centre for Architecture, Montrea

Fig. 26 & 27: Own work

Fig. 29: Own drawing and image by Die Auslöer - http://www.psd-zukunftspreis.de/files/2015/09/www.dieausloeser.net-Garten-von-oben-2-1024x607.jpg

Fig. 30: Prinzessinengarten http://

prinzessinnengarten.net/wp-content/uploads/2009/07/18bildpg_01.jpg

Fig. 31: Andrew Alberts - http://heidevonbeckerath.com/hvb/poster/current/20151210_r50.html

Fig. 32: Eric Tschernow - http://www.archdaily.com/587590/coop-housing-project-at-the-river-spreefeld-carpaneto-architekten-fatkoehl-architekten-bararchitekten/54b731fae58ece61b900001f-02_coop_sfb_36_view2_across_river_a4-jpg

Fig. 33: Photo by Rob de Voogd - https://farm6.staticflickr.com/5208/52777762276_92c934c002_z.jpg

Fig. 34: Holzmarkt 25 AG - http://www.holzmarkt.com/downloads/140411_Holzmarkt_Broschuere.pdf

Fig. 35: http://www.energienieuws.info/2013/04/innovatiecentrum-duurzaam-bouwen.html

Fig. 36: https://admin.stedenintransitie.nl/wp-content/uploads/2015/04/YESDelft.jpg

Fig. 37: Own graphic based on https://guides.github.com/introduction/flow/

Fig. 38: Andreas Lundqvist and Muhammad Herdiansyah - https://en.wikipedia.org/wiki/File:Linux_Distribution_Timeline.svg

Fig. 39: Own work

Fig. 40: Own work based on map of Autocluster.NRW

Fig. 41 & 42: Own work based on OpenStreetMaps

Fig. 43 & 44: Own work

Fig. 45: Own work based on graphic by S. Thiemermann (Thiemermann, 2005)

Fig. 46 & 47: Video snapshots of a video by Ford Motor Company 2015 https://media.ford.com/content/fordmedia/fna/us/en/asset.html/content/dam/fordmedia/North America/US/2015/11/12/3D-Map-of-Fusion-Hybrid-Autonomous-Research-Vehicle-driving-at-Mcity.mp4.html

Fig. 48 & 49: (Lupashin et al., 2014)

Fig. 50: (Fehrenbacher, 2015)

Fig. 51: Own work based on Google Maps 2015

Fig. 52 Own work

Fig. 53 & 54: Photos by Dieter Link-Stern who documents the demolition of the Opel factories on www.rottenplaces.de

Fig. 55-58: Own photos and collages

Fig. 59: Still of the movie Ghost in the Shell by director Marmoru Oshii. Production I.G, 1995.

Fig. 61-64, 67-70: Own work

Fig. 65, 66, 71: Own collage with graphics from
http://gramaziokohler.arch.ethz.ch/web/e/forschung/index.html
http://icd.uni-stuttgart.de/?cat=6
http://modulorbeat.de/
http://www.pretaloger.nl/press/

Fig. 72-74: Own work

Additional material

junctions per km

I	⯐⯐	▽▽▽▽	●
II	⯐	▽▽▽▽	●
III	⯐	▽▽▽▽	●◖
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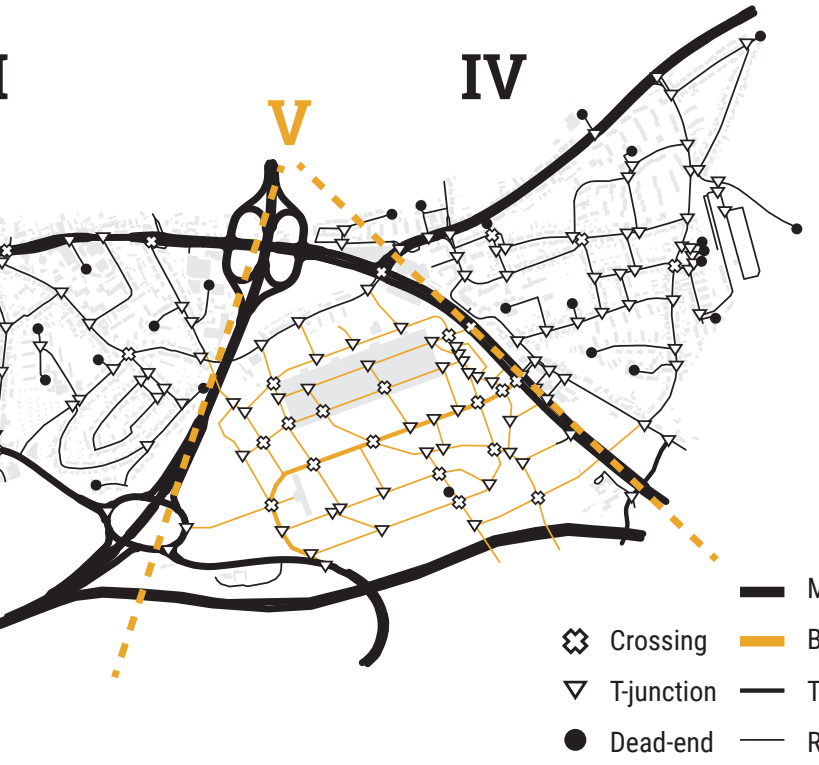

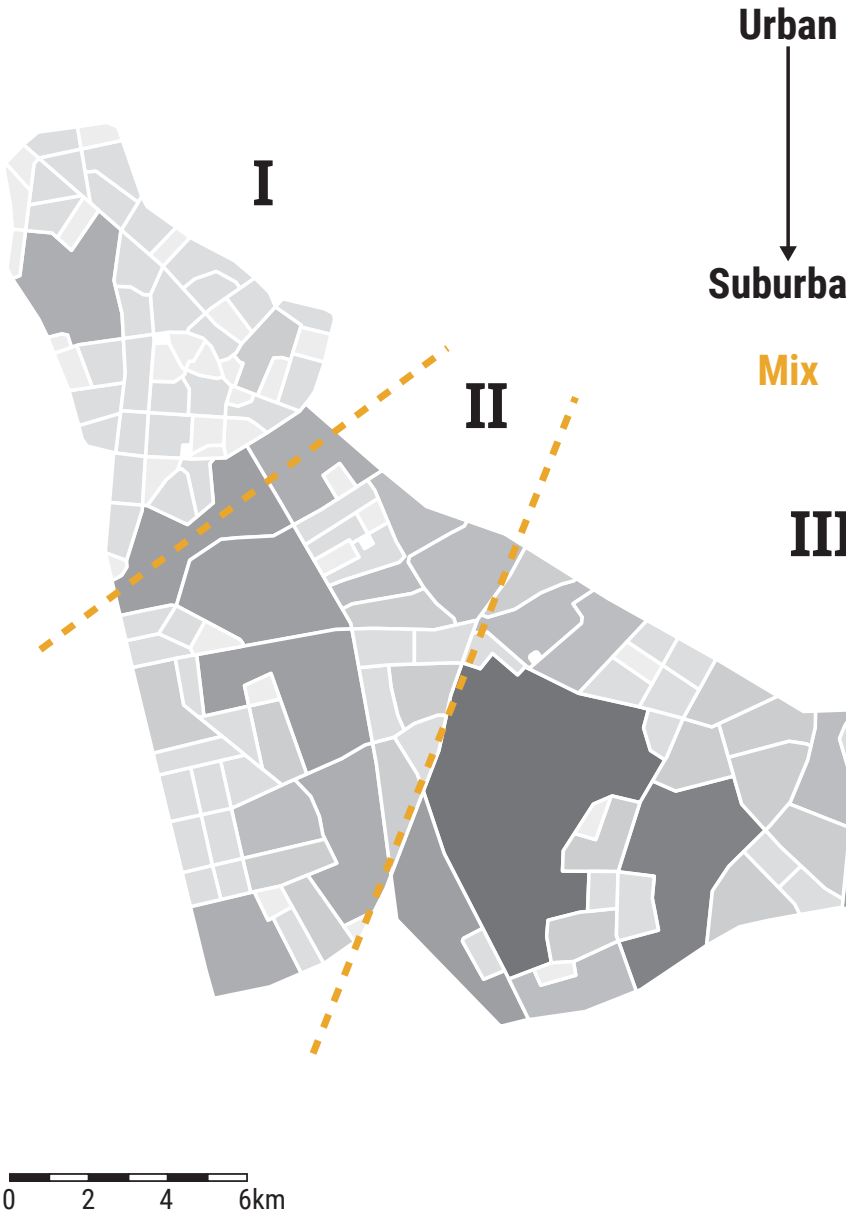
Urban
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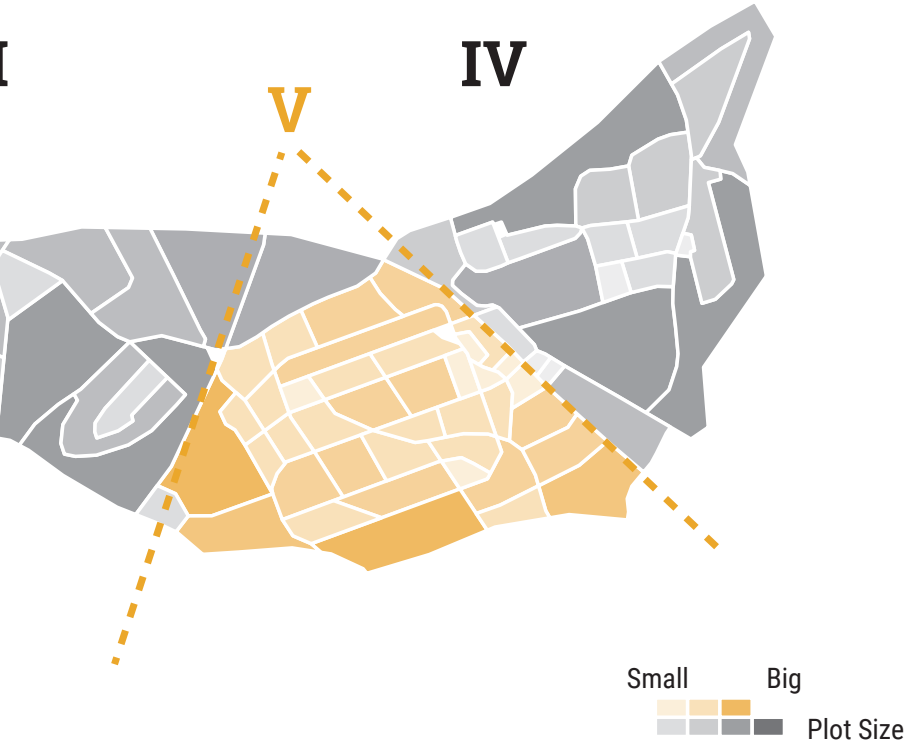
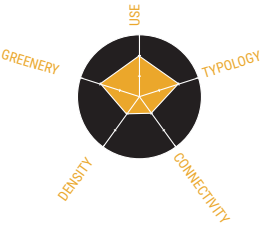
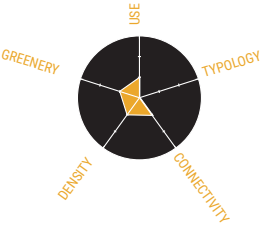
	Øm² of plot	Ø FAR
I	13.600	2.35
II	26.800	1.15
III	42.700	0.60
IV	35.100	0.55
V	19.100	1.10



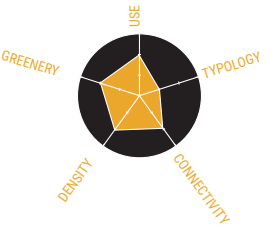
Analysis Science Parks



Stockholm - Hammarby Sjöstad

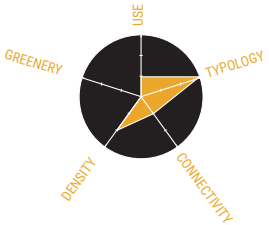


Silicon Valley - Google Campus

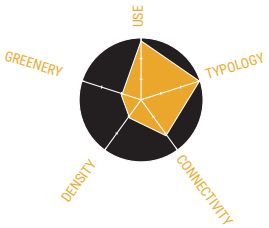


Copenhagen - Science City

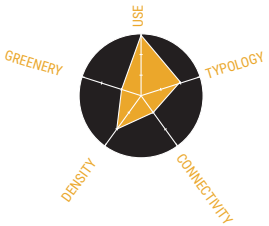
Analysis Redevelopment Projects



Boston - Innovation City



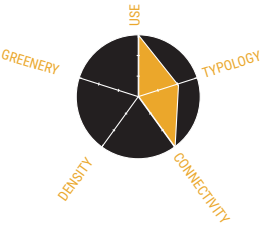
Barcelona - 22@



Amsterdam - NSDM Amsterdam Noord

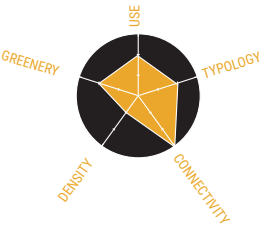
Fig. 23: Case study analysis

Analysis Inner City Developments



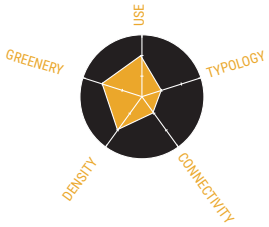
Shenzhen - Electronics Market

New York - Silicon Alley

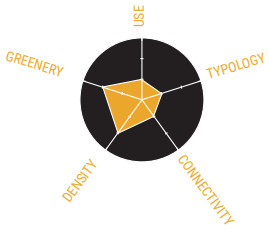


Berlin - Moritzplatz

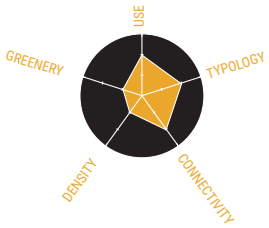
Analysis Anchor Development



St. Louis - Cortex Innovation Community



Dortmund - Technologiezentrum TU Nord



Massachusetts - Kandell Square Area

Fig. 23: Case-study analysis

Theory Paper

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Commons for local industries

Competing globally while collaborating socially and locally

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Abstract – The profit-oriented industry neglects often local and social responsibility. A globally operating company i.e. wants to improve its value-chain to stay competitive. By changing the location of production it accepts the risk that the local supplier-network may collapse. These suppliers, who are often small and medium sized companies, do not have a huge flexibility to change their field of work. However innovations in their products and processes could make them more attractive for investors and clients again. But the risk of failure, expensive investments and intellectual property can hinder individual companies from innovating. With the introduction of commons this could get a lot easier. Looking at open-source software production a culture of sharing and caring of common goods can create ties and stronger networks. Profit is not the main purpose of production; it is about reciprocity in contribution. A peer-to-peer like community builds up rather social than economic values and cares for the local conditions. Together it is easier to invest in innovation and stay competitive. Based on the generally accepted model of categorising the commons into resource, community and institution (Dellenbaugh et al., 2015), this paper will question the role of intellectual property and limited access and investigate possible spatial and organisational structures of a commons-based industry.

Key words – commons; industry; local; global; resource; community; institution; manufacturing

1 Challenge for local industries

Our economy is going through rapid changes. Technology has interconnected our whole world and has immense effects on our way of living and working. Not only money travels through space and time in an immense speed, also products will be on their way to us, before we even ordered them. Manuel Castells describes it with the terms "space of flows" and "timeless time" (2004, p. 37/8), which represents a global world in a fast movement losing its local roots and long-term responsibilities.

In this world influence and power are not generated through money but mainly information. Its "recombination is the source of innovation, and innovation is at the root of economic productivity, cultural creativity and political power-making" (Castells, 2004, p. 11). Those who can process it and gain knowledge the fastest are also the greatest global actors. Most of them keep their knowledge and intellectual property for themselves protecting it with patents and copyright (Bollier, 2001). They have the money and resources to fund innovation and integrate it in their own companies. The organisation structure is often closed, hierarchical and non-transparent and their local responsibility rather low. Currently the Volkswagen affair, in which engineers manipulated the exhaust of diesel-cars, shows this very well. They optimized their environmental footprint on paper for short-term profits but ignored the long-term environmental and economic impact. The German government, which should be a counterbalance to strong global actors, even knew about this issue of German's biggest corporation, but did not investigate (Gude, Hawranek, Traufetter, & Wüst, 2015).

However big companies realised that keeping intellectual property only for themselves is slowing down innovation (Castells, 2004). Some already started to open up and work with others, even competitors, on innovations. One reason is a necessity for standards in i.e. communication infrastructure (Himanen, 2004). Another is the need to gain a more diverse user-base and with it more innovation. This goes even so far that companies like Google do not get the trust of their users, so that they assign non-profit organisations to maintain and work on open-sourced products (Finley, 2015).

Of course these companies also see profits in paying less for basic innovations. The costs for innovation are often very high and make it especially for SMC's difficult to compete. Seat-Suppliers i.e. were forced to continuously update their products, but those who were not fast and financially strong enough had to close their business. To escape their precarious situation, they slowly started to incorporate and share open innovation, making themselves and the other suppliers in the network more resilient (de Ugarte, 2014).

Although global actors are dominant, the Seat example shows that small and local actors can have an influence if they connect in a network. But how do they need to connect in organisationally and spatially, how can competitors work together and trust each other? The model I want to present does not see them as competitors but rather as collaborators. As Manuel Castells puts it: "Since innovation is the source of productivity, wealth and power, there is a direct relationship between the power of sharing and the sharing of power" (2004, p. 40).

The idea of collaboration is often connected to the commons. In the next paragraphs I will introduce this term and a widely accepted division of its structure into resources, communities and institutions (Dellenbaugh, Kip, Bieniok, Müller, & Schwegmann, 2015). By looking at existing commons like open source projects I will show the relevance of the organisational and spatial structure and its advantage for an innovative and resilient local industry.

2 Commons

Michel Bauwens founder of the Peer-to-Peer Foundation and theorist working on peer-production and the commons gives the following explanation for the commons:

So what is the existing commons economy? … It consists of productive communities of contributors, paid or unpaid, who are contributing, not to privatized knowledge, but to common pools of knowledge, code and design, which fuels a new commons-oriented economy. It's the economy of open knowledge, free software, open design, and open hardware, more and more connected to practices of open and distributed manufacturing. (2014)

He uses often the words 'open', 'free' or 'unpaid', which are not characteristically for the vocabulary of the traditional capitalistic market. Commons actually exist besides it. They do not try to create value for the market but for themselves and make it accessible to their community (Bollier, 2005). Speaking of value-systems and power-making, commons give social-values a higher attention and therefore compete with capitalistic value-systems like the currently most-successful information-system. If information is becoming more and more open and accessible for everyone information-based companies will lose their influence. The internet as a common resource shows this at its best, being the source of many new models of peer production (Bollier, 2005). Its spatial influence can be the organisation of flashmobs, guerrilla-gardening or crowdfunded facilities, working besides profit-oriented real-estate developments. But the internet can also be exploited by actors gathering even more data and information for their own purposes. Common resources therefore need to be protected by well organised institutions and communities.

Their organisation and thematic fields can look very different (Hess, 2008); sometimes they even allow for illegal actions consciously or unconsciously, i.e. through ignoring copyrights by sharing files via a p2p file distribution system. But they allow individuals to connect to broader networks and together they have a stake in the global economy. As an example the Fab Lab Movement, starting in 2001, nowadays exists of 584 Fab Labs over the whole world (The Fab Foundation, 2015). Their intention: make the innovation process as cheap as possible by giving people access to tools to manufacture their own products in local workshops, which they normally could not afford. People who want to produce at these places do not only join a local, but also global community of tinkerers and makers, sharing experience, knowledge and ideas. Some of the prototypes developed in these Fab Labs, like open-source 3D-Printer, can even reshape and disrupt industries which were led by few major companies (Biggs, 2014).

If a local industry wants to act in a network to become more resilient in the global economy, it is important to find out what kind of resources should be managed commonly and how. Noble Prize winner Elinor Ostrom gave eight points on how to do this:

1. Define clear group boundaries.

2. Match rules governing use of common goods to local needs and conditions.

3. Ensure that those affected by the rules can participate in modifying the rules.

4. Make sure the rule-making rights of community members are respected by outside authorities.

5. Develop a system, carried out by community members, for monitoring members' behaviour.

6. Use graduated sanctions for rule violators.

7. Provide accessible, low-cost means for dispute resolution.

8. Build responsibility for governing the common resource in nested tiers from the lowest level up to the entire interconnected system. (Walljasper, 2013)

These points are a general outline to manage the commons. The next sections will loosely relate to them and the importance for local manufacturing.

3 Resources

It is not necessary to share everything, if the local industry wants to work collaboratively. Participants have their own interests and reasons why they want to contribute to a common resource and should have freedom in their own projects, since it leads to more diversity. But the actors of the network may share certain basic needs for their business. These could become a commonly managed organisation or space (Juris, 2004).

Looking at the manufacturing value-chain there are several themes that could partly be organised commonly, especially expensive tasks like research & development or tasks that are often outsourced, so that a company can specialise on its core business and be more profitable. This can even be a small thing like co-working spaces or renting a room on demand for interviews and meetings, which can be helpful for small entrepreneurs (Hatch, 2013). The shanzhai culture, meaning imitation culture, which is quite common in China and especially Shenzhen, may represent this in a very good way. Although being criticised as not respecting intellectual properties it is able to openly share knowledge and innovation and manufacture in a distributive way (Menchinelli, 2011). The actors in the manufacturing network do not try to have all expertise in house, but make use of outsourcing tasks to several partners and producing fast on demand (Tseng, 2010). Some concentrate on logistics, some on production and others on selling and overviewing the market demands. If companies have similar repeating tasks then there could be potential for a commonly managed resource. The earlier mentioned network of Seat-suppliers is an example. It shows that especially innovation is a basic need to sustain a business. Although in traditional models intellectual property should help protecting products and technologies it becomes a threat, since the development costs are too high for individual suppliers. But by not closing themselves off they get a stronger local economy through collaboration. For this reason local industry can profit from commonly managed facilities that favour diversity and innovation.

Fab Labs or maker- and hackerspaces are facilities that foster innovation. They give access to tools and knowledge which is normally rather expensive to achieve and hence they allow a broad diversity of people to realise their ideas. They may need some hundred square meters or even a few thousand. Mark Hatch CEO of Techshop, a commercial makerspace, even believes it is possible to create an innovation hub of some hectares, which needs to be placed in a local and global network (Hatch, 2013). This would also favour proximity of companies and exchange of knowledge. If the collaborative economy grows, this can be quite realistic. One of his makerspaces is even co-funded by Ford with the intention to get more innovative technologies. Similarly local actors could invest together in a campus where they can develop technologies collaboratively. Not only do they share the spaces but also the innovations.

To attract new actors to the local network and strengthen the local economy with new businesses other supplementing services can be integrated. The Silicon-Valley model works for one reason so well, because companies with different expertise help to push new start-ups (Himanen & Castells, 2004). Young entrepreneurs can get a lot of support through

finance and sharing of expertise by angel investors and accelerators, organisers of start-up and networking events with municipalities and local companies, or marketing agencies who help i.e. with crowdfunding campaigns (Hatch, 2013). The existing local actors can assist with their expertise and can help to grow a business fast. For a common innovation campus an advantage is therefore to offer not only working spaces but gather different professions who support each other (The Economist, 2012).

But why would someone contribute and invest in this place, knowing that others may profit more from the investments than oneself? The collaborative economy needs a different economic thinking, which will be discussed in the following two sections.

4 Communities

Communities that produce and preserve the commons are often part of the creative class, they like to work in a network of people who share the same interests. They appreciate the work of each other and like to have freedom and flexibility in their lifestyle and project-oriented work (Himanen, 2004). Formal and informal ways of networking can bring them together. Proximity is not necessarily needed. People can meet accidently or consciously around the world or they find each other on the web. But having spaces for networking events or bars, cafés, parks or similar places for random meetings can favour unexpected chats. Face-to-face meetings still have an advantage to digital communication, because of the flexible use of media. Local communities should make use of it.

The motivation of individuals to contribute to the commons is rather different to companies. They both may need it for their own purposes, but individuals often participate in the creation of commons for the sake of joy, reputation or doing something good for the community (Lakhani & Von Hippel, 2003). Organisations however have economic interests and get advantages by using certain resources for free or they even want to influence the development for their own interests (Germonprez & Brian, 2015). By giving away some of their knowledge, expertise or money to the commons, they may disrupt their traditional business model of selling their manufactured products, since they are suddenly available for everyone. But by opening up, their products can be used by a much more diverse user-base, which will create more innovation than in a closed system and will attract even more participants and broaden the network. Newer business models that concentrate on supplementing services and tools around the technologies or the enhancement of basic products can become the main part of the revenue. The Arduino-Board is an example of a product, which is open and can be produced and developed by everyone. It's community is thriving and the brand strong enough that the inventors can

live from trademarking the name (Menchinelli, 2011). Therefore an open company, which is part of a community and contributing to it, has several options of using the common resources for its own wealth.

The user-base, that the local industry should attract, are people who are often called hackers, tinkerers or makers and who invest their free time and equity capital to design prototypes and products. They should have a low threshold to access the commons, since an increased user-base gives higher chances for innovative ideas. A better and equal accessibility can even challenge social issues. Makerspaces i.e. often face the problem of not having a diverse user-base ethnicity- or educational-wise (OSHW, 2013), but they want to be more accessible to change this. Guy Standing sees it also as a way to help people in precarious situations, who may need space and education. They can find this in the commons (Standing, 2014). It is another important factor which strengthens the local economy.

With more people being attracted, the organisation of the commons is getting more difficult. Studies show that a group with a maximum of 150 people is manageable since everyone still knows each other.. But an increasing group has the effect that people feel less responsible and the cooperation decreases. Individuals become anonymous and lose influence (Bieniok, 2015). Commons need daily maintenance and need to get attention from their community, but if the community is not communicating well, it may not survive (Iaione, 2012). Therefore the role of institutions becomes important to structure resources and community and form a healthy environment.

5 Institutions

The management of a small group of people is rather easy. Face-to-face contact happens often and people know each other, there is trust and roles are determined. With a growing network this organisation gets more difficult. Traditional industrial companies therefore have a hierarchical structure with defined positions. They are observable and manageable from the inside, but since their structure is rather closed and many tasks happen inside the company, they struggle with their networking ability and not being innovative enough. Commons-based organisations however are more open and flexible to allow for more innovation. Sharing and fast communication are key for this (Castells, 2004).

These organisations often constitute as foundations like the P2P-, Wikimedia-, Fab- or Mozilla-Foundation. Each foundation has its own structure, but the analysis of the Mozilla Foundation by David Booth will show already general struggles a commons-based industry has to face (2010). The foundation is a successful brand of open source software products. It has a huge user-base and

its management shall show a way on how a greater group of people can collaborate.

The Mozilla project already has a lot of contributors, but only a small part of it is really active. They work together in modules on projects, which is a decentralized way of working. Everyone is free to join and can choose a project. If someone wants to contribute he has no time- and quality-constrains. Ones work will be reviewed by a peer and if it is good enough it will be integrated in the project. Failing is allowed and therefore people can try out several solutions, train and get better. As the Mozilla network is already big, it still needs a hierarchical organisation, which is done in a meritocracy. With good contributions a member will get reputation and with it more influence in the development (Booth, 2010).

This decentralised working on projects, the problem-solving and problem-finding procedure in a flexible environment and the acknowledgment of achievements are deeply rooted in the programming culture (Himanen, 2004; Sennett, 2008) and as mentioned in the former section, it helps to be creative and innovative. Commons-based institutions need to create these conditions with their organisation if they want to create social values and innovation. As said before, the resources need to be accessible and they also need to be cheap to allow for experimentation (Lakhani & Von Hippel, 2003). This is easy for software resources, manufacturing however is more expensive. Hence tinkerers and makers claim that money should not be a constraint for accessing resources (Hatch, 2013; Himanen, 2004).

But besides allowing free access Booth gives some more advices on how the software peer-production could influence the governance of commons. In a society, where many people live and work in precarious and uncertain conditions, where labour is divided into categories of creative, self-progressive workers and those who are exchangeable, since they only do simple, generic tasks (Castells, 2004), access should not only be free to everyone but also the threshold to join should be lowered by allowing a broader audience to educate themselves, collaborate and see personal advantage in the contribution. They should work in the same places and inspire each other. In this way the commons can introduce social stability and diversity in the local industry. Companies do not necessarily need to pay for the education, but give their workers free time to develop their skills. They need to be aware that they need to gain knowledge to have a good position on the market and they should be given easy access to education. It can be an advantage for everyone (Benner, 2004). Similarly they can give their workers time to work on innovation or their might be ways to attract innovators to a project by giving them rewards. The high-speed train project Hyperloop was initiated like this by making engineers shareholders if they invest their free time in the

development (Davies, 2015).

A broad user-base however needs enough space and not everything can be afforded. Furthermore if innovations are produced commonly, is everyone allowed to use it? Even those who do not contribute?

The commons can be easily exploited, if there is not a legal framework. Therefore licensing evolved in the open source culture as a way to protect intellectual property more openly than traditional methods like patents (Booth, 2010). Reaching a reciprocity which sustains the commons is one of the goals. Creative Commons, GPL or Apache License 2.0 are licenses which allow the use, modification or sharing of property under certain conditions like acknowledging the author. It is not a copyright, but a copyleft approach. The license allows the use of intellectual property, but the user has to contribute back to the community or mention it. The Arduino-board i.e. grew in this way, since every invention has to be documented and made public with the same license (Hatch, 2013). The P2P-foundation went one step further with a copyfarleft Peer Production License, which distinguishes proprietary use from personal use. If the property is used commercially, there needs to be at least a monetary contribution. The license tries to increase reciprocity and avoids exploitation (Vieira & De Filippi, 2014). Summed up, an institution needs to have a legal concept which protects the innovation that is commonly created as well as its use of facilities – the digital and physical common resources. It should make the use reciprocal and if necessary sanction those who do not obey the rules.

A last important point is the openness and transparency of the commons and its institutions. Not only David Booth, but also Elinor Ostrom says that it is most important for the commons to be flexible and adaptable. They need to reflect the needs of the local users. The community needs to understand changes and has to be able to influence them, so that the commons can evolve over time. But with it every user should have accountability for the maintenance and progress of them (Dellenbaugh et al., 2015).

6 Conclusions

Commons are representatives of a growing collaborative economy. In a society, where our "social structure is global, but most human experience is local" (Castells, 2004, p. 22/3) they allow to sustain this experience by giving it a better position in the global network and by introducing social values.

The paper shows with its examples the advantages of collaboratively owned resources for the manufacturing industry, but it does not want to give a clear answer on how to achieve this. Ostrom's eight points and the division in resources, community and institutions help building up a commons-based

industry, but each local community should find its own ways on doing this! Innovation through access to spaces, tools, education or time is very helpful. But there should not be one answer to its spatial and organisational manifestation. "The most familiar and most magnificent open system familiar to all of us is Charles Darwin's version of evolution" (Sennett, 2006, p. 6). Booth's and Ostrom's guidelines favour exactly this evolution, an evolution of the commons so that they can grow stronger and adapt to changing demands over time.

Commons for manufacturing may fail several times, but there will be successful cases, too. Organisationally and spatially they can learn a lot from open source software production. Richard Sennett already uses similar terms like problem solving and finding in his article The Open City for a proposed open city planning as well as in The Craftman concerning Linux programmers (Sennett, 2006, 2008). Similarly architects and urban planners have talked about openness for a long time since the 60s with upcoming structuralistic and participatory movements. For example Christopher Alexander who promoted a more holistic and networked approach on the build environment (Alexander, 1968) and actually influenced object-oriented programming (Salingaros, 1997). His former collaborator, Nikos Salingaros, is also working on a P2P-Urbanism and writing articles for the P2P Foundation (P2P Foundation, 2015). All three and other persons dealing with bottom-up, participatory, networked approaches to city design are very close to the open source culture.

The commons for industries therefore may look closer at the structure of resources, community and institutions from existing common platforms and adapt it for their own manifestation. The organisational and spatial structure has structural similarities and if realised well, it will allow progress, innovation and a better social and local integration in both domains for a resilient, globally acting industry.

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