P5 Report

Reimagining industrial heritage.

facilitating tomorrow's manufacturing industry towards a circular city

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MSc. Management in the Built Environment | 2022/2023

Preface

Acknowledgements

This thesis is the conclusion of my Master Management in the Built Environment, but also the result of the Master track Urbanism and Bachelor of Architecture and the Built Environment at Delft University of Technology. For now, this marks the end of my studies in Delft.

When starting this Masters, the aim was to broaden my knowledge from the design of the built environment to the development and realisation of these designs. I found out that this is the direction I want to develop myself in further and during the master programme my interest in the fields of area development and real estate management became prevalent. The aim of this thesis was to focus on a real MBE subject, starting with real estate management and adaptive reuse. I started with my personal interest in heritage, and the added value of unique real estate for companies. Gradually, the topic was linked to circular economy and became more linked to the spatial nature of my previous education. This again confirmed my personal interest, but also the need and value of an integral approach in practice as all these topics relate to each other. This has resulted in a research connecting the two fields and delivering products for assessment and development in the built environment. In this way I aimed to show the possibilities beyond the current practice, and I hope for it to be of inspiration for future urban developments and strategic reuse of industrial heritage.

I am happy that I got the opportunity to do another masters at our faculty, without the restrictions of the previous years and I have greatly enjoyed exploring the real estate sector with the community of MBE and BOSS over the last two years. I would like to thank all those who have contributed to the realisation of this thesis. Specifically, my parents and family for their ongoing support on my educational, personal and professional journey, my friends and other students at MBE for their support, the fun and inspiration. In addition, I want to thank my mentors at MBE, Hilde Remøy & Karel Van den Berghe, for their inspiration, guidance, support and challenging me to take the research to higher levels. Finally, I would like to mention and thank my mentors at my internship company Brink, Finn Vossen & Valérie van Lieshout. Your enthusiasm and involvement, knowledge and critical perspective has been of great value to my graduation process and project, but also the internship period which has made my graduation really enjoyable.

Abstract

For many years, the concept of adaptive reuse of buildings has been researched. A focus on heritage and specifically the implementation of circular economy frameworks is however relatively new. Adaptive reuse of heritage is often concerned a circular strategy for its material reuse. However, there are many more dimensions to circularity in adaptive reuse, ranging from socio-economic values in urban environments to buildings facilitating and stimulating the circular economy by their new functions. Urban manufacturing is one of the functions that can benefit of the added values of industrial heritage. In return, urban manufacturing can provide several values to its urban context and contribute to development of the circular city due to ongoing developments in this sector. The next generation of manufacturers can be well integrated in urban areas contribute to realising circular ambitions, but several principles should be applied to realise this and create balanced urban development. To date, integration of circular economy and adaptive reuse of heritage frameworks is limited and fragmented. An overarching conceptual framework for adaptive reuse in a multidimensional way is missing, and current research often avoids practical solutions and guidelines that can be used by developers and planners. This research aims to provide these frameworks to combine the potentials and values of both heritage and the urban manufacturing industry through adaptive reuse. The main research question: '*How can industrial heritage facilitate the developing urban manufacturing industry?*' is answered by executing a literature review, interviews, a questionnaire, studying different cases of heritage adaptive reuse, and providing a new framework for assessment and development of industrial heritage for facilitating the urban manufacturing industry.

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1.
Introduction
Context

In this section, the literature review on the context of adaptive reuse of heritage, urban manufacturing and the circular economy is introduced. This review is at the origin of defining the research questions and formulating the problem statement of the research proposal. It starts by explaining the concept of adaptive reuse and elaborating on the added values and need for adaptation of industrial heritage. This is followed by research on the relation between adaptive reuse and circularity. The concluding part consists of explorative research on the possibility to further enhance this relation by facilitating the (return) of the urban manufacturing industry.

1.1 Adaptive reuse of (industrial) heritage

Over the past few years the concept of adaptive reuse has increasingly been researched. Adaptive reuse can be defined as the reuse of a building by converting the function to something different than the original function (Arfa, Lubelli, et al., 2022). It is a strategy to improve the environmental, social and economic performance of a building or site, by transforming them to objects with a new purpose (Gaballo et al., 2021). Cultural heritage is one of the specific types of real estate where research on adaptive reuse has focused on. Heritage can be defined as an asset that embodies, stores or provides cultural or historic value in addition to possible economic values it possesses (Foster & Saleh, 2021a) and it can provide several socio-economic values to its surroundings (Arfa, Lubelli, et al., 2022; Dell'anna, 2022; Foster, 2020).

Specifically, industrial heritage can be defined as "the remains of industrial cultures which are of historical, technological, social, architectural, or scientific value. The remains consist of buildings and machinery, workshops, mills and factories, mines and sites for processing and refining, warehouses and stores, places where energy is generated, transmitted, and used, transportation and all its infrastructures, as well as places used for social activities related to the industry such as housing, religious worship or education" (ICOMOS, 2003, p. 2) (Figure 1.1). This shows industrial heritage contains both tangible and intangible values, which will be elaborated on later in this section.

Need for adaptation

Due to societal, economic and environmental changes, (performance) requirements of users and owners change and new standards are established, which increases the need for adaptation. When not adapted to the current needs, heritage buildings are at risk of vacancy and deterioration, risking the loss of their added values.

A large share of buildings in need of reuse is in urban areas (Foster, 2020). The number of sites recognised as cultural heritage is increasing and so are vacancy levels (Girard & Gravagnuolo, 2017), especially former industrial sites (de Jong & Boom, 2020). Many have lost their initial function and risk unwarranted use (Arbab & Alborzi, 2022) or decay when they remain vacant. At the same time costs

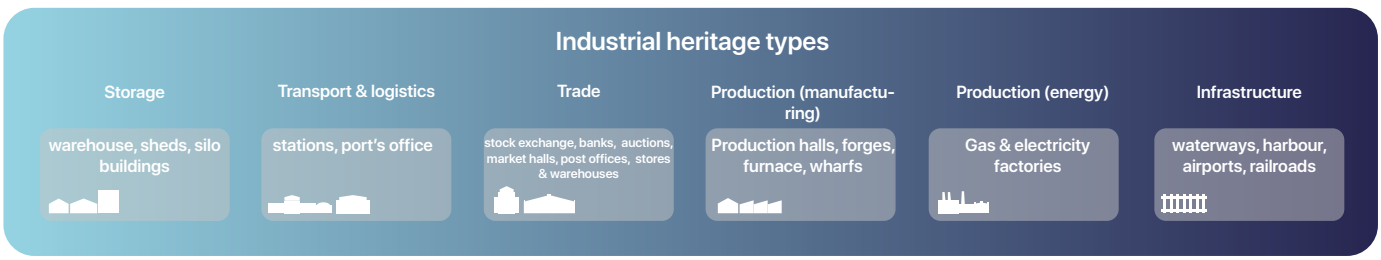


Figure 1.1 Industrial heritage types

Context

for functional maintenance are growing which increases this risk as these buildings can become too costly to run for users and owners (Girard & Gravagnuolo, 2017). This shows the need to turn heritage into a resource instead of a cost for the community (Saleh et al., 2020).

Benefits of reuse for the city – introduction to the values of adaptive reuse of heritage

Adaptive reuse of heritage can provide several social, but also economic values for the context such as increased real estate values in the surroundings (Arfa, Lubelli, et al., 2022; Dell'anna, 2022; Girard & Vecco, 2021). This originates from both cultural and architectural aspects of heritage (Arfa, Lubelli, et al., 2022). Heritage buildings can enhance urban liveability, human well-being and maintain and establish urban identity (Pintossi et al., 2021b). (Abastante, Corrente, et al., 2020; della Spina, 2019; Pintossi et al., 2021b, 2021a) describe the ability to be a main driver and enabler of sustainable development and urban regeneration. It is known for being an anchor to many social and economic hubs, ability to revitalise them through adaptive reuse (Foster & Saleh, 2021b), and being a keystone of unique urban neighbourhoods (Foster, 2020).

Perceiving adaptive reuse as just a strategy for economic regeneration can be problematic, but it has potential as alternative to deconstruction (Arbab & Alborzi, 2022). Only focusing on image for economic benefits can negatively impact the areas' physical, social and economic well-being (Niu et al., 2018 in Arbab & Alborzi, 2022). Current practices of reuse are often focused on commercial redevelopment, while the circular city requires a diversity of functions who can make good use of the former industrial structures, as will be discussed later. So, there is a need for a comprehensive and sustainable regeneration framework (Arbab & Alborzi, 2022). The challenge is to transform heritage from a costly asset to a valuable resource for urban development (Girard & Gravagnuolo, 2017). For this, a circular economy perspective could be valuable as presented in the following section.

1.2 Adaptive reuse as a circular strategy

The link between adaptive reuse of heritage and circularity has gained attention in research (Foster, 2020; Foster & Saleh, 2021a; Girard & Gravagnuolo, 2017; Gravagnuolo, de Angelis, et al., 2019; Ikiz Kaya et al., 2021; Vellecco & Martone, 2021). These studies show there is a need to develop the circular economy and implement circularity in adaptive reuse strategies and processes. Adaptive reuse is useful to connect circular relationships between more distant (industrial) heritage sites and historic centres (Gravagnuolo, Angrisano, et al., 2019). In addition, the heritage values can help activating circular processes of value creation, sharing and redistribution in abandoned urban sites (Gravagnuolo, Angrisano, et al., 2019), help generating new economic, cultural and social values such as job creation (Gravagnuolo et al., 2021) and stimulate innovative local developments that contribute to circularity (Della Spina, 2020).

The circular economy can be explained as closing loops by decoupling economic activity from finite resources, focusing on eliminating waste and pollution, circulating products and materials at their highest value and regenerating nature (Ellen MacArthur Foundation, 2013). It is a regenerative system in which resources, emissions, energy use and waste are reduced by slowing, closing and narrowing down material and energy loops. Long-lasting design, maintenance, but also the 10R's (refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle & recover) are ways to achieve this (Geissdoerfer et al., 2017; Platform CB'23, 2019).

Context

Adaptive reuse is often considered a circular practice in itself (Abastante, Corrente, et al., 2020; Gaballo et al., 2021; Gravagnuolo, de Angelis, et al., 2019). Although this is mostly a passive contribution to circularity, the use- and life of- materials, land and buildings is extended (Bosone et al., 2021), embodied energy is recovered and there is potential for using renewable energy sources and improve energy efficiency (Girard & Gravagnuolo, 2017). In addition, demolition often uses more energy than redevelopment (Girard & Gravagnuolo, 2017). Finally, both circular economy and adaptive reuse aim to prolong the use value and life-cycle of products. Extending the use value is not only physical, but also refers to the functions accommodated by these buildings, by adapting these to current and future societal needs (Girard & Nocca, 2019).

While reuse doesn't reduce the need for new construction completely (Foster, 2020), it is perceived more sustainable over conservation and restoration by the integration of a new function, so there is no waste of resources without providing added value, which is considered an effective circular strategy (Bosone et al., 2021; della Spina, 2021; Gaballo et al., 2021; Girard & Vecco, 2021; Pintossi et al., 2021a). Current adaptive reuse practices do not always activate new potentials in their surroundings (Foster & Saleh, 2021b), while this could add another layer to the value creation through heritage. The latter is more aligned with the definition of circular economy development as a regenerative practice: not only reducing the negative externalities of linear economies, but producing positive impacts as well (Girard & Gravagnuolo, 2017).

The adoption of a circular economy framework in adaptive reuse of heritage is still quite new, and there are many challenges concerning the stakeholders that are involved, besides regulatory and financial constraints (Kaya et al., 2021). Current assessment models are often focused on commercial or office reuse, not focusing on the heritage part and its added value (Yazdani Mehr & Wilkinson, 2021). In addition, interventions are often specific to the type of buildings and their context (Abastante, Lami, et al., 2020; Gravagnuolo, Angrisano, et al., 2019). In general, adaptive reuse of heritage is a well-known strategy, but less well understood and there is no systematic way to measure the investment opportunity at the city or regional level (Foster & Saleh, 2021b). There are existing frameworks for adaptive reuse assessment focusing on specific building types (Della Spina, 2020) but these are often not directly related to the circular economy and potential circular functions.

There are also several challenges related to adaptive reuse, such as the level of flexibility or adaptability of some types of heritage that should be included in new adaptive reuse processes to improve the level of circularity (Hamida et al., 2022; Rios et al., 2022), or the perceived additional costs (Bullen & Love, 2011; Yazdani Mehr & Wilkinson, 2020). Despite this, specifically industrial heritage often offers built in flexibility and modularity of structures or oversized building elements (Dell'anna, 2022; Tennekes et al., 2022). As the level of vacant industrial heritage is increasing, especially these sites may be suitable for facilitating the circular economy functions mentioned before (Arbab & Alborzi, 2022; de Jong & Boom, 2020; Girard & Gravagnuolo, 2017). The reintroduction of productive functions such as manufacturing is also aligned with the goals for sustainable development. It creates new job opportunities and can contribute to reduce the negative effects of vacant buildings on their surroundings. Incorporating the value of heritage in this process presents a research opportunity to investigate the possible synergies of this combination.

Context

1.3 Adaptive reuse for a circular city: facilitating circular development

While several contributions of adaptive reuse of heritage to circularity in cities are known, these are often limited to the reuse and sustainable or circular improvements of the building level, reduction of material use or to the socio-economic values that are related to sustainable urban development, but not circular economy development in particular (Coscia & Rubino, 2021; Foster & Saleh, 2021b; Girard & Vecco, 2021). The circular economy is emerging as a concept and a form of sustainable urban development (Gravagnuolo, Angrisano, et al., 2019). Many cities have been developing circular strategies focusing on new services, production, and the role of different stakeholders in this process (Girard & Gravagnuolo, 2017). A circular city can be defined as one that promotes the transition from a linear to a circular economy in an integrated way across all its functions in collaboration with citizens, businesses, and the research community (ICLEI Europe, 2020).

There is potential for cities to capitalise and use the potential synergies of integrating adaptive reuse of heritage with circular economy (Foster & Saleh, 2021a). For this, larger scale circular strategies need to be translated to a local level (Kaya et al., 2021). Circular economy development is also a regenerative practice, producing positive impact in addition to reducing negative externalities (Girard & Gravagnuolo, 2017). From this perspective, another dimension of circular economy could be added to adaptive reuse: focusing on the new functions of reused buildings. This relates to the circularity of outcomes of adaptive reuse (Gravagnuolo, de Angelis, et al., 2019). The following paragraphs will introduce one of the possible circular functions for reused industrial heritage.

Need for balanced urban redevelopment: the impact of current practices on the city

Over the years, existing industrial sites have been increasingly transformed into residential and commercial areas, while productive facilities have moved outside urban areas as part of processes and policies of offshoring, deindustrialisation, and globalisation (Grodach & Gibson, 2019; van den Berghe & Vos, 2019). This contrasts with the principles of a circular economy that aim to close loops at smaller scales where possible, to for instance reduce the environmental impacts of transport. Cities have planned for industrial decline and approached the former industrial sites as open for residential and other developments. Besides deindustrialisation, this has been part of the emerging knowledge- and digital economy with technology oriented urban developments such as innovation parks (Grodach & Gibson, 2019). Many industrial heritage sites have been redeveloped based on the desire to attract creative industries and knowledge workers. This is based on the expectation of socio-economic improvements, as in trickle-down economics. However, these developments have raised concerns about issues of commercialisation, marginalisation of certain communities and standardisation of developments which are all processes that are linked to gentrification (Arbab & Alborzi, 2022; A. V. Hill, 2020; Jansen et al., 2021). In addition, the processes of offshoring and replacement by service-oriented and more monofunctional spaces has resulted in a separation between places of production and consumption. This is part of a linear instead of a circular urban system (Hausleitner et al., 2022). Instead, former industrial areas can contribute to circular development by incorporating land-use functions like urban manufacturing, for more balanced urban development and closing resource loops (Tsui et al., 2021).

Context

Furthermore, some developers have exploited processes that are usually considered natural processes of gentrification, as a development model (Kohn, 2010). Revitalisation processes have in several cases resulted in increased land values, yet they are also linked to social issues like displacement (Jansen et al., 2021). Moreover, there are limits to the replication of these processes. Such redevelopments require the creation of a certain level of uniqueness and authenticity as part of their attractiveness, and due to standardisation and repetition in many cities this it at risk (Kohn, 2010; Mathews & Picton, 2014). Similar processes have resulted in industrial sites that lost their real identity and authenticity. Not only can large scale restructuring and alterations of industrial infrastructure take away potentials for hosting sectors like the manufacturing industry, it can also negatively impact the heritage values, and with that the authenticity and integrity of the buildings that refer to the industrial past (Wang & Wang, 2018).

Impact and challenges for manufacturing

The above does not align with the diversity of functions that urban manufacturers need, and it has impacted the availability of (affordable) space needed for urban manufacturing and development of the circular economy (A. V. Hill, 2020). This is problematic as urban manufacturing is crucial for achieving multiple circular economy ambitions by processing materials, providing skills and delivering innovative technology. It is challenged by more commercial redevelopments, but also the increasing demand for housing, resulting in increased land prices (Hausleitner et al., 2022). Planning strategies have increasingly been influenced by finance and real estate driven policies and have focused on 'place as a location' instead of being part of an (urban) ecosystem. As a result, many former manufacturing locations of manufacturing have become locations for high-end housing and commercial development, which further reduced space for manufacturing (Hausleitner et al., 2022; van den Berghe & Vos, 2019). Besides, manufacturing often requires more space per employee than other sectors. This can result in replacement by sectors that use less space, with more resources. Some cities are testing mixed-use developments in which new, cleaner forms of manufacturing are combined that were perceived incompatible before due to pollution, noise and other nuisance. Despite this, the protection of space for urban manufacturing remains challenging (Hausleitner et al., 2022; Ministerie van Economische Zaken en Klimaat, 2022). Also, this cannot be replicated for all types of manufacturing. Some mixed-use developments remain problematic due to inacceptable levels of nuisance for new inhabitants. Often this leads to relocation of productive facilities to place where the nuisance is not an issue, outside of urban areas (Hobma & Boeve, 2022).

Redeveloping the already transformed sites would not be feasible due to the alterations to buildings and infrastructure, increased land prices and urbanised context. However, the industrial heritage sites that are currently vacant or will be in the future, can still be a solution for accommodating the manufacturing industry. For instance, (Girard & Nocca, 2019) describe that many productive activities prefer historical areas for their localisation. In addition, there is an ongoing transformation in the industrial landscape. New industries have the potential for reintegrating manufacturing into cities, counteracting deindustrialisation and facilitating socially responsible production due to a change in production methods and impact on the surroundings (Busch et al., 2021). It is therefore interesting to consider reserving space for urban manufacturing in future planning, considering the added values presented earlier.

Context

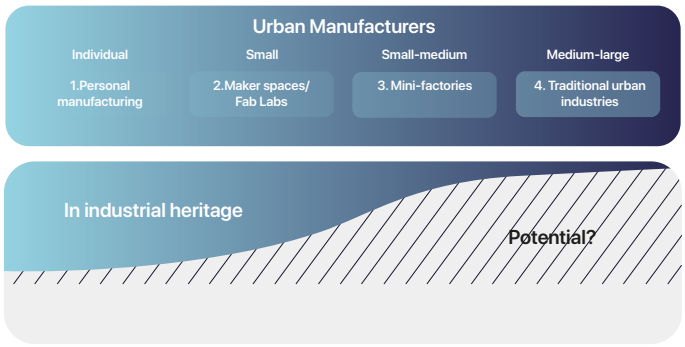


Figure 1.2 Hypothesis of potential for accomodation of urban manufacturing in industrial heritage: facilitating the development of the urban manufacturing industry on a scale from the traditional, commercial adaptive reuse functions to larger and mature urban industries. Chapter 4 of the literature review will elaborate on this categorisation of manufacturers.

1.4 Towards development and practice: the research gap

While the (re)introduction of manufacturing in urban areas clearly has potential, not all industrial heritage sites can facilitate such activities. It depends on the specific characteristics of the buildings and local circular economies whether the combination or adaptive reuse of heritage and circular economy functions such as urban manufacturing, are possible (Foster & Saleh, 2021b; Gravagnuolo, Angrisano, et al., 2019). However, as the number of buildings recognised as heritage and vacancies and need for adaptation are increasing, the issue becomes more relevant. Adaptive reuse for functions like urban manufacturing is needed to restore the balance and develop ahead of the circular city. Designing new uses while preserving the values is a complex issue which requires a methodological approach like the development of a model (Abastante, Corrente, et al., 2020). To assess built heritage and develop new proposals, frameworks need to be developed integrating adaptive reuse of heritage with circular economy development in the urban environment. Current frameworks often focus on executing a multi-criteria assessment to determine optimal design and development solutions for adaptive reuse (Abastante, Corrente, et al., 2020; della Spina, 2019, 2021), decision making and adaptive reuse processes (Bullen & Love, 2011; Della Spina, 2020; Kaya et al., 2021), the investment potential (Foster & Saleh, 2021b) and impact and performance (Girard & Gravagnuolo, 2017; Gravagnuolo, de Angelis, et al., 2019; Ikiz Kaya et al., 2021).

Still, there is a knowledge and implementation gap for adaptive reuse from a circular economy perspective in which heritage indicators linked to the intrinsic value, local circular economies, metabolism and smart specialisation strategies, can be developed (Bosone et al., 2021). An integrated perspective of the multidimensional benefits of adaptive reuse of heritage to circular economy is missing (Bosone et al., 2021). This includes the intangible and soft values, which are not always monetizable (Bosone et al., 2021). Many cities haven't recognised or capitalised the potential synergies of integrating adaptive reuse of heritage with circular economy and heritage is often not included in their circular policies (Foster & Saleh, 2021a). There are several driving factors for adaptive reuse of heritage, but the translation from the research results on an EU level to a national level and local level, and for local stakeholders to understand them is still a challenge (Kaya et al., 2021). (Foster & Saleh, 2021a) describe there is more a practice gap than a research gap. However, to date, academic literature avoids specific actions and activities that can be taken to implement circular economy, including manufacturing (Foster, 2020). Finally, the links between reuse of heritage, its values and regeneration of urban areas (della Spina, 2019; Gravagnuolo, Angrisano, et al., 2019), values and regeneration of circular economy functions are studied (Girard & Gravagnuolo, 2017; Tsui et al., 2021), but the direct relation between adaptive

reuse of heritage and urban manufacturing specifically is not widely studied. The following chapters will therefore further elaborate on this relation.

Conclusion of section

This section has aimed to show the context of research that led to the problematisation. It has elaborated on the values of adaptive reuse and industrial heritage, the existing relation between adaptive reuse and circularity, and the potential for circular economy development through urban manufacturing. Finally, it has showed the research gap that this research aims to reduce. The following chapters include the problem statement, methods, research questions and objectives, in-depth literature review, case studies and frameworks that have been developed.

2.
Problem statement

Over the last few years the concept of adaptive reuse of heritage has increasingly been researched. Adaptive reuse can be defined as the the reuse of a building by converting the function to something different than the original function (Arfa, Lubelli, et al., 2022). Built heritage can provide several socio-economic values to their surroundings (Arfa, Lubelli, et al., 2022; Dell'anna, 2022; Foster, 2020), which are at risk of loss. Due to societal, economic and environmental changes, the requirements of users and owners change and new standards are established, which increases the need for adaptation. Furthermore, the number of sites recognised as cultural heritage are increasing, while costs for functional maintenance are growing which results in risk of decay and vacancies (de Jong & Boom, 2020; Girard & Gravagnuolo, 2017). A large share of heritage in need of reuse is located in urban areas and vacancies and unwarranted use can negatively impact the surroundings (Arbab & Alborzi, 2022; Foster, 2020) so there is a need to turn heritage into a landscape of resource instead of a cost for the community (Saleh et al., 2020).

More recently, the link between adaptive reuse of heritage and circularity has gained attention in research (Foster, 2020; Foster & Saleh, 2021a; Girard & Gravagnuolo, 2017; Gravagnuolo, de Angelis, et al., 2019; Ikiz Kaya et al., 2021; Vellecco & Martone, 2021). This research shows a need to develop the circular economy and implement circularity in adaptive reuse strategies. Adaptive reuse is often considered a circular practice in itself (Abastante, Corrente, et al., 2020; Gaballo et al., 2021; Gravagnuolo, de Angelis, et al., 2019). However, reuse doesn't reduce the need for new construction completely (Foster, 2020). By integrating a new function that provides added value, adaptive reuse is also considered an effective circular city strategy (Bosone et al., 2021; della Spina, 2021; Gaballo et al., 2021; Girard & Vecco, 2021; Pintossi et al., 2021a). This is because enhancing the circular performance, a building could also actively benefit sustainable or circular developments in its surroundings on the social and economic level (Bosone et al., 2021; Foster & Saleh, 2021b).

Urban manufacturing has potential as one of these circular functions. Manufacturers can benefit from the values of industrial heritage and provide values to their urban surroundings and circular economy in return (Girard & Nocca, 2019). Yet, industrial heritage sites have increasingly been transformed for residential and commercial purposes, while productive facilities moved out of cities (Grodach & Gibson, 2019; van den Berghe & Vos, 2019). Over the years, deindustrialisation processes resulted in a separation between production and consumption and a transition to more linear economies (Hausleitner et al., 2022). This doesn't contribute to circularity, is linked to processes of gentrification and it is reaching the limits of replication (A. V. Hill, 2020; Jansen et al., 2021; Kohn, 2010; Mathews & Picton, 2014; Wang & Wang, 2018). Urban manufacturing is challenged by this, but also by increasing demand for housing (Hausleitner et al., 2022; Hobma & Boeve, 2022; Ministerie van Economische Zaken en Klimaat, 2022). Urban manufacturing is crucial for achieving circular economy ambitions by processing materials, providing skills and delivering innovative technology. It needs urban locations to find skilled workers, production resources, clients, knowledge and infrastructure. New forms of manufacturing have potential for integration into urban areas due to less impact on their direct surroundings and new business models. They can contribute to counteracting deindustrialisation, socially responsible production and facilitate circular material flows (Busch et al., 2021). Therefore, facilitating urban manufacturing by adaptive reuse of heritage locations is an interesting strategy towards circular city development.

Problem statement

The aim of this study is to further investigate this dimension of circularity. Current research is limited to either adaptive reuse of heritage and the contribution of reuse to circular economy and the urban surroundings, or implementation of the circular economy and the contributions to the urban surroundings. Especially adaptive reuse of heritage can facilitate circular economy, as it is able to connect circular relationships from these sites to the rest of the city due to the values of heritage (Gravagnuolo, Angrisano, et al., 2019).

An overarching framework for assessment and development of built heritage that integrates the potential for implementation of urban manufacturing is currently missing. Existing frameworks focus on assessment of specific aspects of adaptive reuse, such as development solutions (Abastante, Corrente, et al., 2020; della Spina, 2019, 2021), decision making and adaptive reuse processes (Bullen & Love, 2011; Della Spina, 2020; Kaya et al., 2021), the investment potential (Foster & Saleh, 2021b), impact and performance (Girard & Gravagnuolo, 2017; Gravagnuolo, de Angelis, et al., 2019; Ikiz Kaya et al., 2021). An integrated perspective of the multidimensional benefits of adaptive reuse of heritage to circular economy is missing and it is hard for local stakeholders to understand strategies for implementation (Bosone et al., 2021; Kaya et al., 2021). (Foster & Saleh, 2021a) describe there is more a practice gap than a research gap. However, to date, academic literature avoids specific actions and activities that project managers can take to implement circular economy (Foster, 2020).

Finally, the links between reuse of heritage, its values and urban regeneration (della Spina, 2019; Gravagnuolo, Angrisano, et al., 2019), and values of circular economy functions (Girard & Gravagnuolo, 2017; Tsui et al., 2021) are studied, but the direct relation between adaptive reuse of heritage and urban manufacturing specifically is not widely studied. The aim is to develop an assessment and development framework that integrates the different values and synergies of adaptive reuse of heritage and urban manufacturing, to contribute to a more balanced urban development, maximise the potential of adaptive reuse of industrial heritage and further develop the circular economy. Therefore, this research aims to answer the following research question: '*How can industrial heritage facilitate the developing urban manufacturing industry?*'.

3.
Research design
3.1 Research questions

3.1 Research questions

Main research question

How can industrial heritage facilitate the developing urban manufacturing industry?

Research subquestions

- **SQ1** What is the role of urban manufacturing towards the circular city?

- **SQ2** What functions does the urban manufacturing industry and its urban support network consist of and what are their requirements?

- **SQ3** What are the added (tangible and intangible) values and synergies of adaptive reuse of Industrial heritage for the urban manufacturing industry?
    - **3.a** What are the added values of industrial heritage?
    - **3.b** What are the synergies of combining adaptive reuse of industrial heritage and the manufacturing industry?

- **SQ4** How, and to what extent can these values strategically be used through adaptive reuse of heritage for the manufacturing industry? (development)
    - **4.a** What are the criteria for the suitability of industrial heritage for the urban manufacturing industry?
    - **4.b** What are success factors for adaptive reuse of industrial heritage for development of the urban manufacturing industry?

Conceptual framework

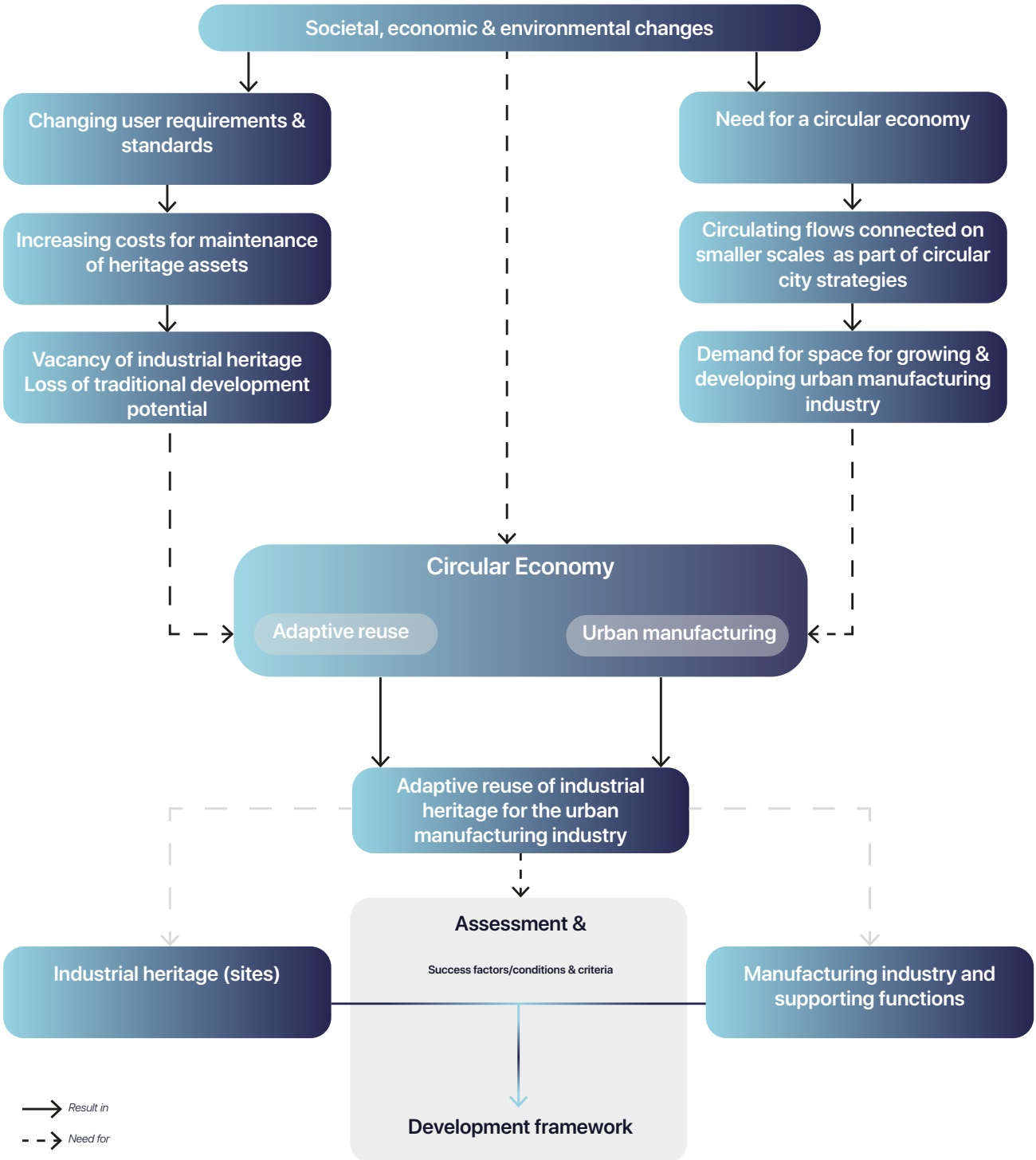


Figure 3.1. Conceptual framework based on the main concepts discussed in the context chapter.

Societal relevance

3.2 Societal relevance

As society, the economy and the environment are continuously developing, the built environment is under pressure to adapt to new requirements, users and new (building) standards. An increasing number of buildings and sites is recognised as cultural heritage. Many of these have lost their original functions (Arbab & Alborzi, 2022) and the number increasing in some areas (Provincie Zuid-Holland, 2020). As the costs for functional maintenance are increasing, these buildings are at risks of unwarranted use (Arbab & Alborzi, 2022), decay and vacancies which can negatively impact the surrounding urban environments, as a large share of buildings in need is located in urban areas (Foster, 2020; Girard & Gravagnuolo, 2017). Reuse of these buildings would be an opportunity, as heritage is known to provide several added social and economic values to their urban surroundings. These are for example related to the cultural and architectural aspects of these buildings (Arfa, Lubelli, et al., 2022), but also to the ability to revitalise urban districts (Foster & Saleh, 2021b), providing urban identity and liveability (Pintossi et al., 2021a) which is reflected in for example increased value of real estate (Dell'anna, 2022). Therefore, turning cultural heritage into a resource instead of a societal cost would be a relevant strategy to further research (Saleh et al., 2020).

The societal, economic and especially environmental developments require the transition to sustainable urban development and use of resources. The concept of circular economy is aimed to contribute to this by decoupling economic activity from finite resources, focusing on eliminating waste and pollution, circulate products and materials at their highest value and regenerating nature (Ellen MacArthur Foundation, 2013). Industrial heritage sites have been increasingly transformed into residential and commercial urban areas while production moved outside of urban areas (Grodach & Gibson, 2019; van den Berghe & Vos, 2019). This has resulted in decoupling of spaces of production and consumption, resulting in a more linear urban system (Hausleitner et al., 2022). In addition, such developments are often coupled with gentrification, displacement, standardisation, loss of heritage authenticity and irreversible alterations to industrial infrastructure (Arbab & Alborzi, 2022; A. V. Hill, 2020; Jansen et al., 2021; Kohn, 2010; Mathews & Picton, 2014; Wang & Wang, 2018). This is problematic from the perspective of heritage values, availability of space for the urban circular economy and sustainable urban development from a social, environmental and economic perspective.

Therefore, a shift towards more balanced urban development by implementation of circular economy practices such as manufacturing is societally relevant. This does not only benefit the environment by reducing use of finite resources and shortening resources loops, but can also positively impact their surrounding in social and economic terms (Della Spina, 2020; Gravagnuolo, Angrisano, et al., 2019; Gravagnuolo et al., 2021). This shift is increasingly visible in the outcomes of policies and the subject of discussion in society, asking to reserve and maintain space within the city for production (Jager, 2022; Ministerie van Economische Zaken en Klimaat, 2022; MKB Nederland Den Haag, 2022; PBL, 2023; Provincie Zuid-Holland, 2021). The outcomes of the research can be used in decision-making for adaptive reuse, for development of urban manufacturing and in circular urban development strategies. The combination of adaptive reuse of heritage and local circular economy development offers potential due to the mutual added values both concepts can provide (Gravagnuolo, Angrisano, et al., 2019; Tsui et al., 2021). Researching this combination can provide insight into the synergies that exist which can benefit society from multiple dimensions.

Scientific relevance

3.3 Scientific relevance

Currently, research on adaptive reuse of heritage is well established and the connection between adaptive reuse of heritage and circularity is increasingly being researched. A growing body of literature indicates the industrial transition that include processes and resource requirements that make integration of manufacturing in urban areas possible and even preferred in the light of circular economy development (Busch et al., 2021; Girard, 2013; Hausleitner et al., 2022; A. V. Hill, 2020). (Tsui et al., 2021) indicate that there is potential for research into the conditions to facilitate circular urban manufacturers. This research aims to look into the accommodation potential of industrial heritage and support networks and can therefore contribute to further research on these conditions. Finally, developing models for design, assessment and development is required because of the complexity of heritage and the multidimensional values of these buildings (Abastante, Corrente, et al., 2020).

Existing frameworks are based on indicators and assessment for design and development solutions (Abastante, Corrente, et al., 2020; della Spina, 2019, 2021), decision making and adaptive reuse processes (Bullen & Love, 2011; Della Spina, 2020; Kaya et al., 2021), the investment potential (Foster & Saleh, 2021b) and impact and performance of adaptive reuse (Girard & Gravagnuolo, 2017; Gravagnuolo, de Angelis, et al., 2019; Ikiz Kaya et al., 2021). However, an overarching framework to assess the multidimensional benefits of adaptive reuse is still missing (Bosone et al., 2021). In addition, the links between adaptive reuse of heritage and local circular economy development, focusing on mutual benefits of the circular function of the reused buildings, in particular urban manufacturing, has not been widely studied. There is both an academic and practice gap for the translation of large scale strategies to a local scale and locally understandable guidelines including specific actions or activities for practitioners (Foster, 2020; Foster & Saleh, 2021a; Kaya et al., 2021). This means the development of an overarching assessment and development framework could contribute to combining different fields of academic research on adaptive reuse of heritage and circular development, including manufacturing. It could also help in the translation to the scale of practice, which this research to contribute to with the proposed frameworks.

3.2 Research methods

3.4 Type of study

This research consists of mixed methods research to answer the research questions. Empirical research will consist of analysing case studies, a questionnaire and interviews within these cases, and expert reviews. The explorative and qualitative part of this study is to investigate the relations between adaptive reuse of industrial heritage, manufacturing and circularity, the added values of industrial heritage, and conditions and success factors for urban manufacturing in industrial heritage. Based on the preliminary literature review, possible relations and values are already identified based on the values for other sectors and research into the general values of (reused) heritage.

3.5 Methods and techniques to be used

Used methods are a literature review, case studies and framework development as shown in Figure 3.2. The case studies consist of analysing project documentation including literature, a questionnaire and interviews. First, a literature review is used to construct the conceptual and theoretical framework that are part of the research proposal. This is followed by literature review to study different types of heritage and the requirements of manufacturers. To find out what the added values are of each, the literature review is supported by a set of case studies and interviews with users reused industrial heritage buildings. This is therefore a mixed-method research, in which interviews are part of the case study research. The interviews aim to reveal the values of heritage accommodation for urban manufacturers. In addition, they reveal the decision-making criteria and success factors for accommodation of urban manufacturing in industrial heritage. Answering the 'what' is part of the exploratory research, for which interviews are held. (Yin, 2018) describes for answering 'what' questions a survey or interviews are most appropriate, while case studies in general are meant to answer 'how' and 'why'. Another reason for choosing this method is the novelty of the subject. Specifically relating to the new industries and forms of manufacturing, case studies can be an appropriate method for research as described by (Busch et al., 2021). The initial literature review that was done in the first part of the study, has resulted in several propositions that can be used to generalise the outcomes of the case studies and especially the interviews through verification, as described by Fowler & Lavrakas, 2014 in (Yin, 2018). This relation is shown in the research framework of Figure 3.2.

Theoretical research

An initial literature review was conducted to determine the main concepts that are part of the problematisation: these are the need for adaptive reuse of industrial heritage, the need for a circular economy and specific actions to realise circular economy. Urban manufacturing was selected as one of the new functions in reused heritage that can contribute to circular economy development on the city scale. This has resulted in the formulation of a main research question: '*How can industrial heritage facilitate the developing urban manufacturing industry?*'.

The main goal of this research is to show how reused industrial heritage can facilitate urban manufacturing. Several sub-questions were formulated to answer the main research question. First of all the aim is to elaborate on the role of manufacturing and industrial heritage adaptive reuse for the circular city, and to establish a definition of urban manufacturing (SQ1 & SQ2). After developing an understanding of manufacturers, their support networks and their demands, an initial literature review was conducted to reveal the potential added values of industrial heritage for this industry, showing how it can meet these demands (SQ3). Finally, the literature study aims to reveal what factors are of importance when redeveloping industrial heritage for urban manufacturing by showing several development principles and success factors (SQ4).

Methodological (research) framework

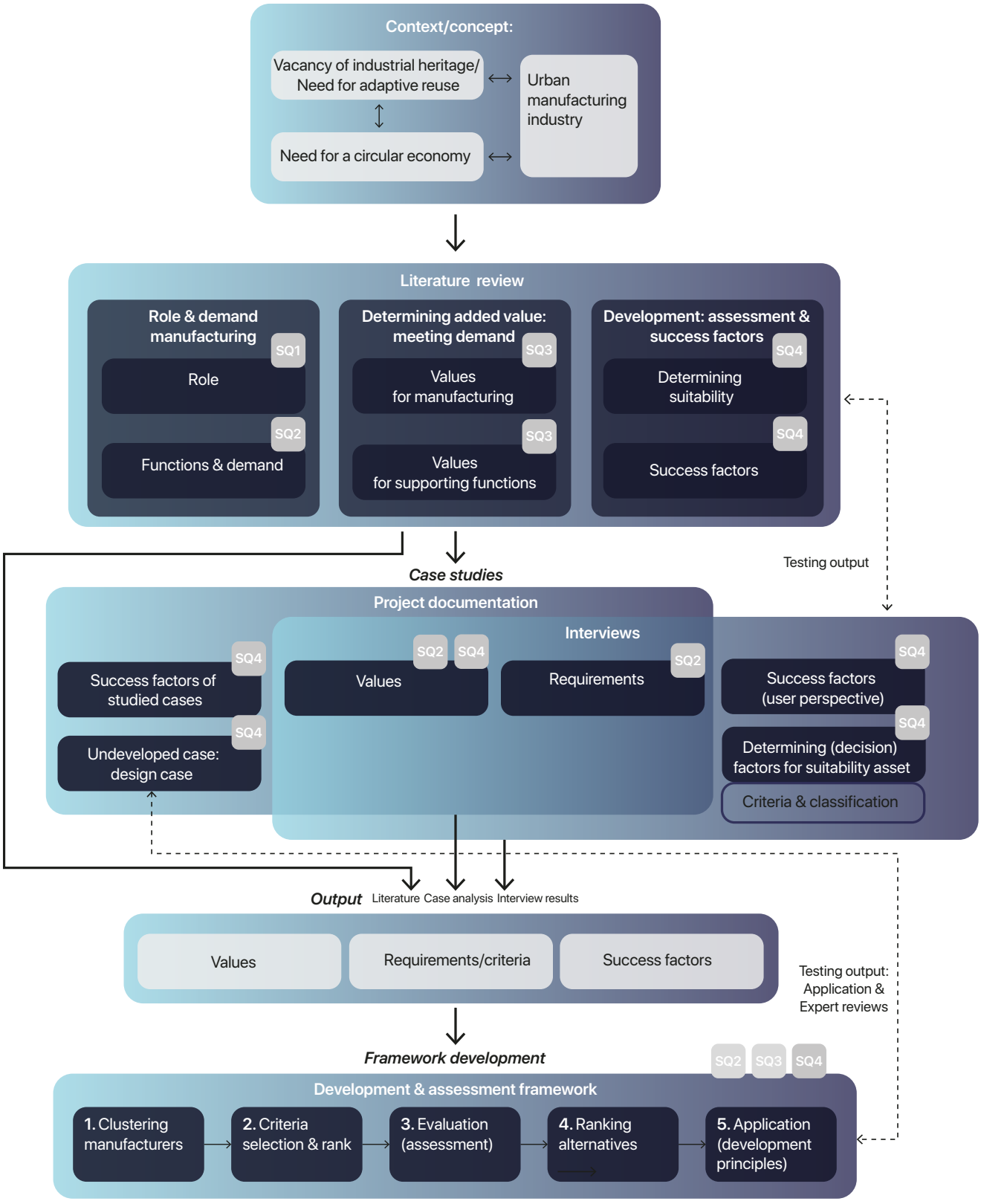


Figure 3.2 research framework

Research methods

Case studies

Multiple cases are selected for this study. They cover three manufacturing categories (Figure 3.3), which can be seen as three 'stages' of urban manufacturing development. These can reflect in the scale of manufacturing, but this is not always the case: mature, economically sustainable manufacturers can be small too. For the selection of cases, a difference in scale and type of manufacturers will be part of the criteria. It is possible that one case accommodates multiple types of manufacturers. The cases will be selected in two different contexts: the waterfront port environment and inland urban industrial locations within the Netherlands. The first type is the closest in relation to more commercial traditional forms of industrial heritage adaptive reuse such as creative industries. Often, this type consists of multiple companies in (shared) makerspaces or fablabs. Type 2: mini factories represents another form, which can be considered a next stage such as scale ups. This type small to medium-sized manufacturers that have developed production in batches: the mini factories. The third type is aimed to consist of manufacturers of different scales that have moved beyond the pilot phase, into economically sustainable and mature industries. Traditional urban industries are part of this too. However, many traditional industries are located in their original accommodation, and these are not considered projects of adaptive reuse. Only those accommodated in reused heritage assets are selected.

In this multiple case-study design, the aim is to reveal the similarities or contrasts in the decision-making and added values of heritage for the individual manufacturers to answer sub-questions 2,3 & 4. Different types of manufacturers are selected to interview within each of the cases. In addition, initiators or location managers and experts are interviewed for each case for a more comprehensive insight from their perspective. This contributes to validating whether the added values of industrial heritage from other sectors can be transferred to urban manufacturers. This is of interest, as earlier research shows that for example the

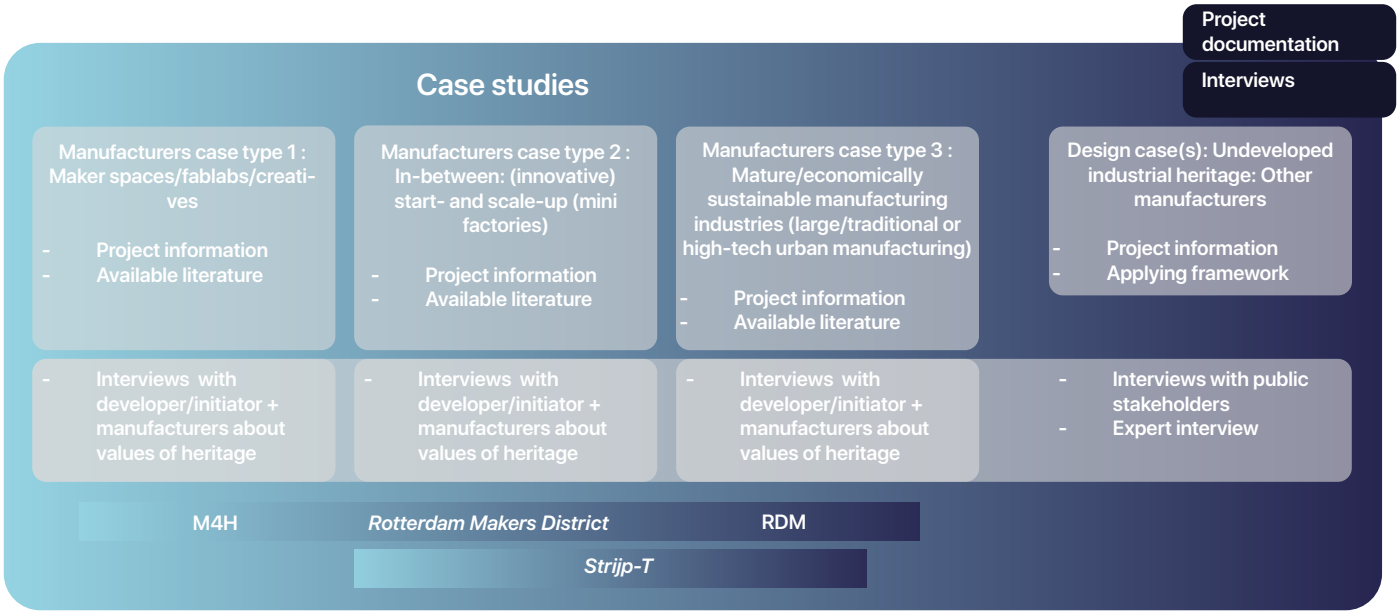


Figure 3.3 Case studies

Research methods

visual quality of the environment is valuable for creatives, while initial explorations show that other sectors, including manufacturing, have a different understanding of these values (Smit, 2011). The similarity between cases is the accommodation in industrial heritage. The differentiation comes from the different manufacturers they accommodate which is used for comparison.

The selection criteria for the cases are the following:

- Location: urban waterfront/port industrial heritage or urban industry
- Industrial heritage site providing space for urban manufacturing
- The case is an example of adaptive reuse
- The case facilitates one or multiple functions, of which at least 1 a manufacturer of category 2-4
- 1 Case with manufacturing in category 1: creative maker spaces/fablabs/start-up
- 1 of Mini-factories or small scale-up makers
- 1 of a mature, urban industry, scale up and traditional urban industries
- Design case examples in addition to the other case studies: undeveloped, vacant or in temporary use

The aim for the interviews is to validate and expand the requirements, decision-factors and added values of heritage locations for manufacturers that is found in the literature review. In addition, it aims to reveal possible similarities or differences between different types of manufacturers, types of heritage and urban contexts. The interviews are semi-structured, based on the outcomes of the already executed literature review and focus on qualitative aspects.

The interviews took approximately 45 minutes per interview. The first part consists of validating the added values of their location the heritage asset (SQ3). In addition, interviewees will be asked about their decision-making, such as location decision-factors and specific criteria for their business. These criteria are based on their requirements, but also the ability to make use of the values of heritage and success factors (Figures 3.2, 3.4, 4.2-4.5). New criteria were added to the ones found in literature and the interviewees were asked to rank them based on their importance in their business location decision-making (SQ2). Finally, they were asked to reflect on the success factors or limitations of the current configuration of companies and their location in the heritage asset (SQ4). This was validated by the other interviews and two expert reviews.

Selection criteria Interviewees:

- 1-3 Urban Manufacturers (of categories 2/3/4) per case (Figure 3.3 & 4.1)
- 1 Location manager/developer/initiator per case location (private/public)*
- (Professional) expert to validate outcomes & model

*A location manager can be referred to as the local contact point, responsible for managing the assets and companies, organising events and/or managing the professional network and public relations.

Framework development

The intended design output of this research is a framework for qualitative assessment and development of industrial heritage to answer sub-question 4. The types of manufacturers, their demand, heritage values and success factors found in the literature and empirical research (SQ1-4) aim to provide input for each step of the framework. The framework is visualised in Figure 3.4. The application aims to propose a suitable manufacturer or combination of manufacturing functions and support network to be facilitated in a specific asset. The framework is based on the framework presented by (Della Spina,

3.3 Research output

2020). This framework is developed as a Multi-Criteria-Decision Analysis tool and originally consists of several other frameworks that have been combined in multiple steps. It is a tool to support decision-making but it doesn't automatically offer a choice as it only focuses on the characteristics of the location and functions, and doesn't include contextual factors like policies or specific regulation. It is developed to rank several options for adaptive reuse and possible locations. Respectively, the adaptation in this research will rank several manufacturing scenarios with industrial heritage assets. It consists of both evaluation and design. A final step, application is added to show the development proposal based on the outcomes of the first steps of assessment. The steps are:

[1] Defining manufacturing types

[2] Ranking criteria & weight per combination, based on the outcomes of the interviews + questionnaire

[3] Evaluation matrix of criteria and proposed asset(s) or scenarios

[4] Ranking alternatives based on the outcomes of the evaluation (assessment)

[5] Application, combining the preferred alternative with the knowledge from literature & case studies: Making use of the added value, meeting criteria and consulting success factors to develop a proposal for the specific asset using development principles.

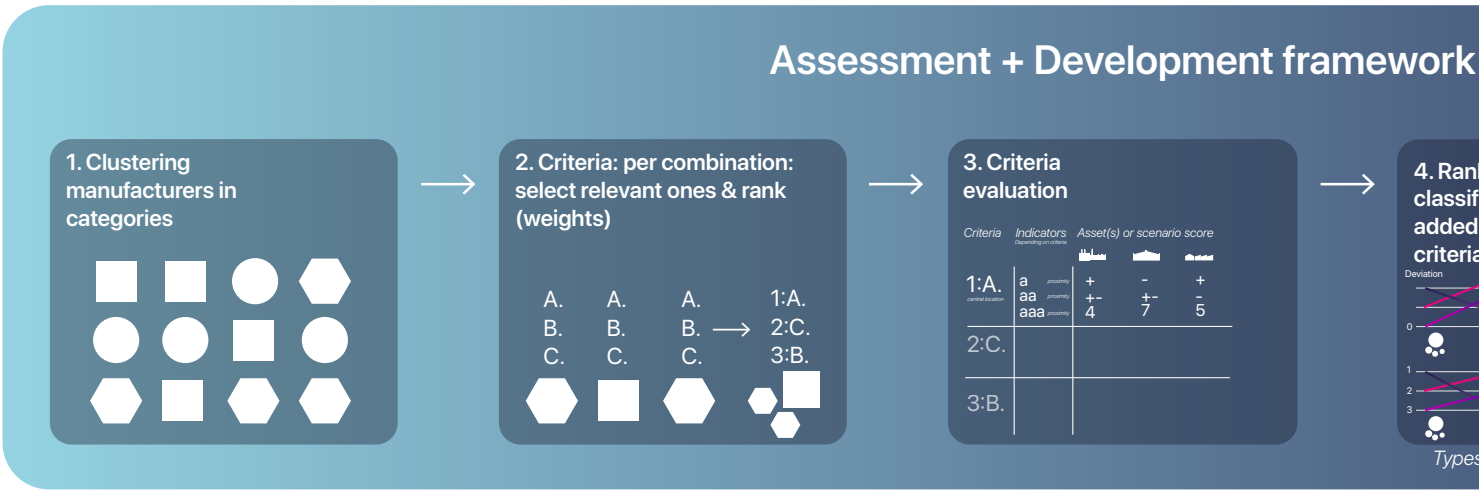
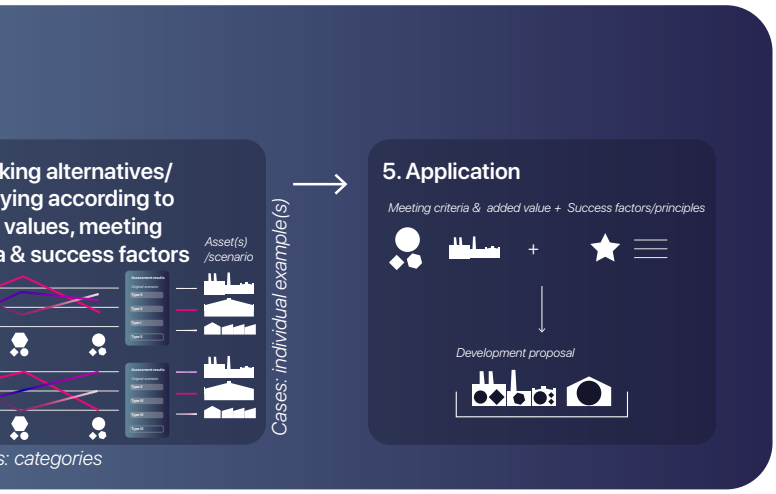


Figure 3.4 Framework development

Research output

3.5 Data collection

In this research, secondary data is collected by studying existing (professional) literature, and analysing project documentation. Information about the project is collected through available literature of cases, newspaper articles, project websites, and public documentation including policies or strategies. Primary data is collected through semi-structured interviews and in-person questionnaires in the first place. Interviewees are contacted directly, through the graduation organisation or the external graduation lab. At least two interviews are held with manufacturers or location managers/developers/initiators within each type to get information from different perspectives. In addition two experts were asked to reflect on the outcomes of the literature and empirical research and application of the framework.



3.6 Data analysis

The interviews are transcribed and analysed using AtlasTi. For doing so, specific codes were used referring to the [1] Background and development, [2] Requirements, [3] Values and [4] Success factors. The outcomes are processed in the assessment and development model. The ranked criteria were validated in a questionnaire and through expert reviews so see whether they apply to multiple manufacturers within the same category. The evaluation matrix combines the validated criteria with data about the characteristics of the design case to rank the alternatives and form a development proposal as can be seen in Figure 3.4.

Data plan

For this research a data management plan was made. This is required as it involves human research subjects. It also fits within the FAIR-data principles of Findable, Accessible. Interoperable & Reusable data (Wilkinson et al., 2016) that is required by the main research institute from which his thesis is executed. The set-up of the plan is included in Appendix I (DMP). This elaborates on the collection, management and final publication of the data. The methods used for analysis of the data are described in a chapter of the final report. As explained in the paragraph on data analysis, the data will be gathered in the form of a transcript and coding will be applied using AtlasTI software. This will be stored on a project cloud drive with a local back up. Finally, the anonymised data itself will be stored in a non-public repository. The outcomes of the research that are part of the research report will be published in a public repository. In addition, the ethical considerations part of the data plan are described in the following paragraphs. Finally, the participants are asked for informed consent before participating in the interviews.

Research output

Ethical considerations

Validity of questions and research approach
The responsibilities of the research concern not only integrity related to the participants, but also towards the scientific community as a researcher. This has been elaborated on in the societal and scientific relevance. The main research question aims to overcome the research gaps of understanding the added values of industrial heritage for the urban manufacturing sector specifically, and the translation to a model for assessment and development that can be used in practice.
The research approach contains multiple steps to validate the outcomes of the literature study. First, through the interviews themselves. These are aimed at providing a more complete overview of the possible values, requirements of manufacturers and success factors. The information is gathered from different perspectives as besides individuals, other stakeholders like location managers and involved (public) parties will be asked to reflect on the topics. (Yin, 2018) describes it is important to reflect on the outcomes during the phase of data collection because of possible bias. In this approach, two experts are consulted to review the initial outcomes of the interviews and translation into the framework. Finally, transparency of the research goals, methods and data collection and processing is ensured to avoid any harm to individuals and participants are asked to provide consent, which they can reconsider during the execution of the research, as reflected on previously.

Goals and objectives

The main aim of this research is to find an answer to the research question '*How industrial heritage facilitate the developing urban manufacturing industry?*'. In the research, the relation between adaptive reuse of industrial heritage and urban manufacturing is further explored. Existing assessment methods are researched to develop a comprehensive method for assessing configurations of manufacturing and matching them to industrial heritage. In addition, the aim is to find out how this can be done in the perspective of circular economy. This is used to develop an overarching assessment and development framework.

Deliverables (including data sets)

- Model for assessment and development showing adaptive reuse of industrial heritage's capacity and potential to facilitate urban manufacturing, to support decision making, including criteria based on literature and case study interviews and a questionnaire.
- Supporting literature review and case-study research including interview and expert review results.

Dissemination and audiences

The research is meant to support conservation and optimal reuse of heritage and circular city development through manufacturing. The assessment and development model is aimed at informing and helping the urban manufacturing industry, policy-makers, municipalities, developers, owners and planners in decision-making processes about industrial heritage assets.

Personal study targets

This research aims to contribute to several goals for personal development. One of the main goals is develop a feasible and relevant research proposal and execute this as an individual researcher. Relating to the theoretical research, the aim is to develop a better understanding towards facilitating and implementing circular economy through the built environment. Another goal is to translate

Research output

broad theoretical knowledge into development of specific guidelines and methods such as the proposed framework. Gaining insight into the reuse potential of heritage buildings, and being able to assess them as an individual researcher based on theoretical knowledge and examples from practice is another personal target. Another goal is being able to do research in a field that is currently underdeveloped, especially in the research of the values of reused heritage for other sectors, and development of urban manufacturing, by doing empirical research to add to-, and being able to validate-, existing theories and concepts. Finally, being able to create a well-defined and validated set of criteria, potential values and success factors for the concluding framework is one of the main targets, as this shows the research is representative and it can be shared with the proposed audience. In this way the research provides an answer to the described scientific and societal relevance.

Research plan

Main tasks

The planning for the research is visualised in Figure 3.5. It contains all the elements from the research framework including moments and relations of evaluation of the output from each task. The main tasks in the research are defining the context, executing a literature review, doing case study research including interviews and the development of a framework.

Main milestones (including deliverables)

The first main milestone is the development of the research proposal and finalising the main literature study at the moment of P2 in the form of the report and presentation. In the period between P2 and P3, main milestones are the decision for specific case studies and interviewees and the start of analysing the outcomes of these steps. Between P3 and P4, main milestones were the finalisation and testing of the framework that is developed. This step resulted in the conclusion of the research questions and presenting the final model in the report and presentation at P4. For P5 the results were further refined and prepared for the public presentation.

Interdependencies between tasks and milestones

The relations between different tasks are visualised Figure 3.2 and Figure 3.5. The definition of concepts and problematisation directed the literature study and in return the initial concepts have been further elaborated on through literature review before P2. The definitions and categorisation of manufacturing and industrial heritage are used for the case selection. The found values of industrial heritage, requirements (demand/criteria) and success factors in the literature study contribute to directing the analysis and developing the interview protocols. The outcomes of literature for direct input for the interview questions and are validated through the responses of the interviewees as presented in Figure 3.5. While the framework development is starting in parallel to the phase of interviews, the final outcomes of the case study (interviews & questionnaire) formed input for finalising the model. The model itself was tested on the design case which provided input for a final iteration of the model before P4.

Research output

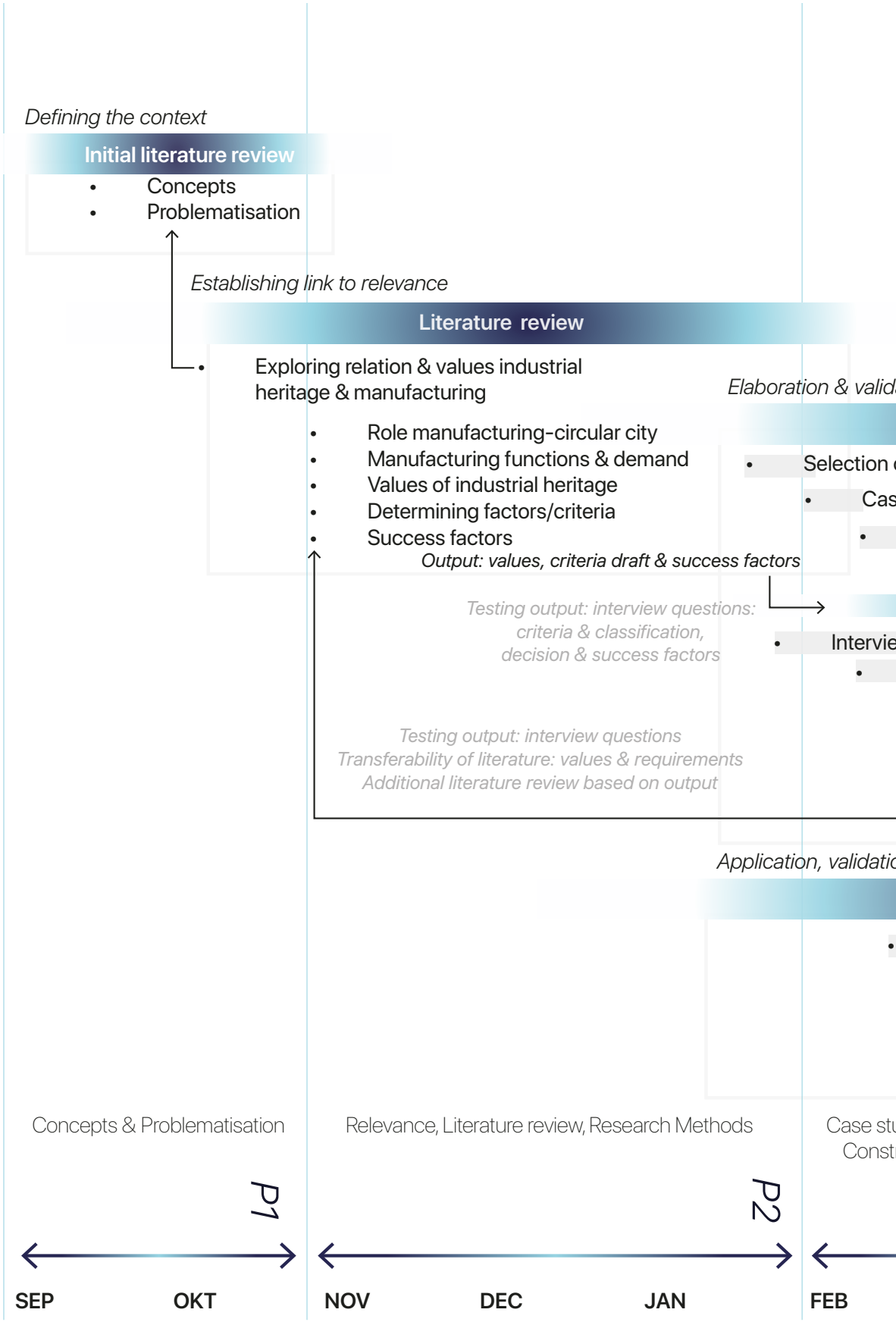
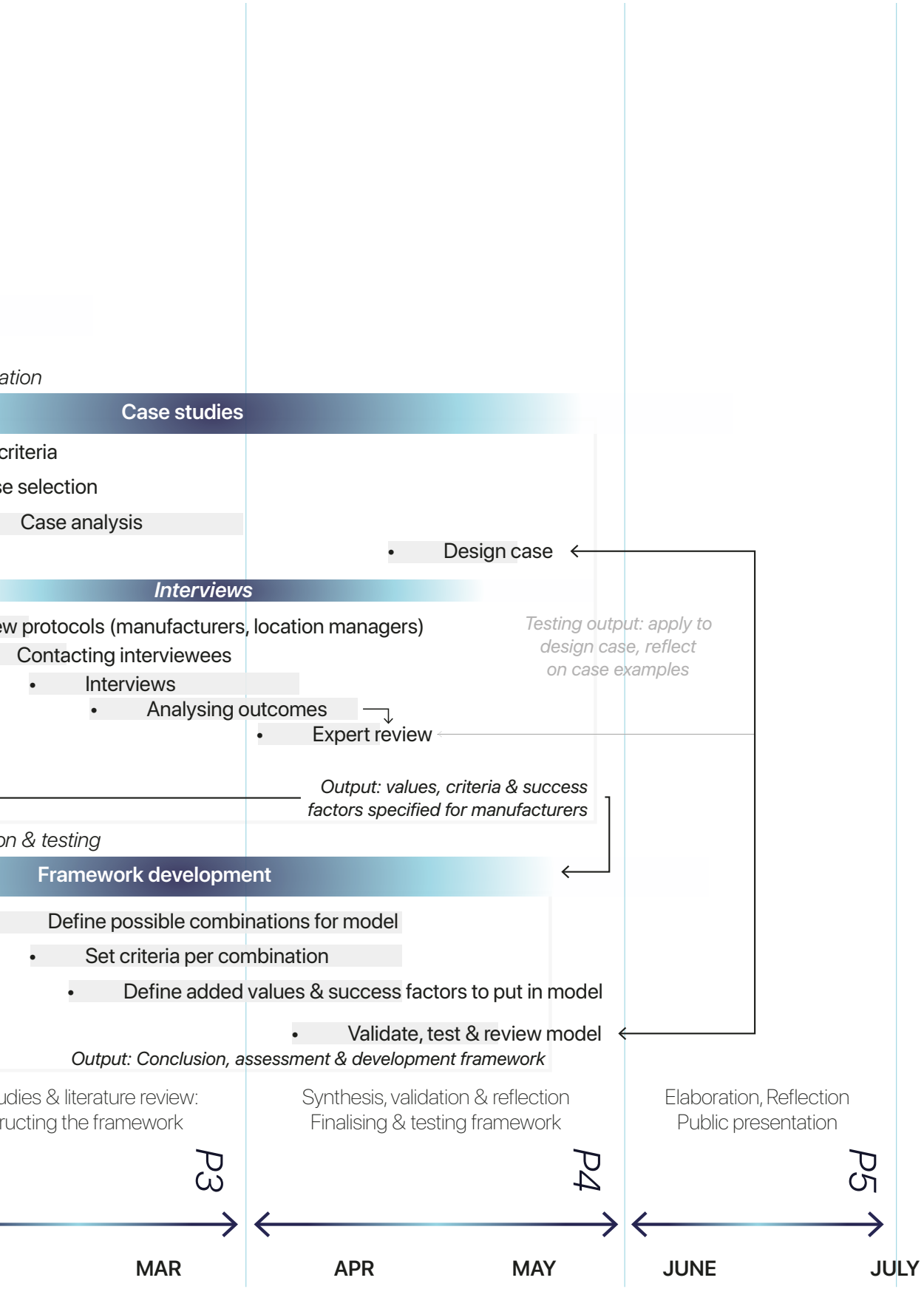


Figure 3.5 Planning

Research output



4.
Literature review
4.1 The role of urban manufacturing

In the introduction, the relation between adaptive reuse, urban manufacturing and circularity was introduced. This section will elaborate on this relation and discuss the relevance of industrial heritage for facilitating manufacturing in cities.

Circular city definitions often mention concepts like modular and flexible built environments, renewable energy systems, clean and accessible mobility systems and transforming waste into resources for production to encourage the closing of loops (Girard & Nocca, 2019). Urban industrial- and port areas face related economic challenges such as improving the sustainability and establishing circular resource flows (Prins, 2021). In addition, scaling down loops, which contributes to reduce transportation emissions and realising local resource flows, is mentioned (Girard & Nocca, 2019; A. Hill et al., 2018; Tsui et al., 2021). However, (Tsui et al., 2021) describe that more local manufacturing can also increase emissions in some cases, for instance due to less efficient energy resources and production possibilities in the local climate. Yet, others do show benefits in efficiency. For example, distributed manufacturing for consumers working with additive- and 3D printing processes are more energy efficient and use less materials. It can also result in less dependency on global supply chains which can make cities more resilient, even though some manufacturers do not aim to be local, as they have global clients and consumers (Tsui et al., 2021). In addition, when scaling up, the benefits of local production are at risk. Therefore, the following conditions apply for more circular urban manufacturing (Tsui et al., 2021):
[1] Manufacturers should use local supply chain sources and consumer bases,
[2] Transportation emissions should be a significant part of the total emissions, such as when using secondary materials as a resource,
[3] Local waste or secondary (raw) materials are used as resources,
[4] Scaling up is possible while staying within the city.

4.1.1 Urban manufacturing and circular potential

Urban manufacturing can contribute to meeting these ambitions and concepts by reusing local resources and production for their (direct) environments. Digitisation for example, allows for smaller production processes. It is not expected that all manufacturing will return from a global to urban scale, but when it does it is likely to benefit local innovation and product development linked to new industries (Industry 4.0). This is also called spatial recoupling of production and innovation and is expected to increasingly become part of the (circular) strategies of these manufacturers (Busch et al., 2021). This can be achieved by exploring new techniques and methods that are linked to innovation, but also, many smaller and middle-sized manufacturers are already working with circular flows (Prins, 2021). This can relate to materials, but also the use of (waste)energy (Girard & Nocca, 2019). Specifically, urban manufacturing can be used as an instrument for achieving a circular economy by enabling maintenance and repair activities (1), providing opportunities for remanufacturing and refurbishment of the built stock to extend the life and reduce the use of external resources (2) and transforming material waste into resources for the city (3) (Hausleitner et al., 2022).

Port areas in particular are of interest due to their development potential by combining port economy, industrial and logistic activities with cultural heritage regeneration. Here, synergies can be created between urban and industrial systems and their economies, cultural heritage and landscape conservation and economic development (Girard & Nocca, 2019). Ports are places where flows are maximised and where opportunities are present to make circular economy concrete by implementing circular processes such as recycling, reusing, up-cycling, sharing and design (Girard, 2013). Therefore, such industrial areas, at the intersection of different

(economic) systems, could be relevant places for the development of the urban manufacturing industry in the context of circular city development.

4.1.2 New forms of industries

In addition, more diverse developments are also beneficial for the economy of cities. It can help in creating a better balance of production and income, by not only focusing on one specific sector and type of urban development. This doesn't mean sectors such as the knowledge and creative industry should be excluded from these developments, but they should be used and become part of strategies to capitalise their innovation and technologic developments through implementation, in for example urban manufacturing (A. Hill et al., 2018). Especially the emergence of new industries that are described as part of Industry 4.0 (smart industry), offers opportunities to integrate multiple sectors in urban areas. (A. Hill et al., 2018) describes this will drastically change the way of production and consumption of goods. The previous industrial revolutions, of steam power, mass production and digitalisation of the industries, have all concentrated on standardised and centralised production, whereas Industry 4.0 allows for more decentralised production and goods that are highly customisable (Busch et al., 2021; A. Hill et al., 2018), all factors that support the argument for development of urban manufacturing in the light of circular economy. Also, in addition to the values mentioned in the context chapter, new forms of manufacturing can promote local economies, influence employment and provide more socially inclusive forms of development (Grodach & Gibson, 2019). As new forms of manufacturing are more suitable for localisation in urban areas, this can be beneficial for the direct surroundings and has potential to become part of circular urban development strategies.

4.2 The urban manufacturing industry

Urban manufacturing is a broad term for all kinds of manufacturing that can take place on the scale of cities. The circular economy objectives and industrial transition (industry 4.0) result in many different forms of manufacturing, that both need urban locations for their flows of resources, but also because of changing interaction with their clients and context and new forms of production. Urban manufacturing is often seen as very close to creative industries, producing (high-end) niche products such as design or art objects. However, Hausleitner in (Prins, 2021) describes not only traditional craftmanship, but also high-tech companies or more traditional industries, such as ship wharfs, are considered manufacturers. They all have different requirements that need to be considered when making an assessment and development framework. This section will therefore introduce the different manufacturers and their demands based on literature review to help answer the third research question.

4.2.1 Manufacturing and supportive activities and businesses

Manufacturing and supportive activities and businesses
(Tsui et al., 2021) describe four different types of manufacturing, as shown in Figure 4.1. These are:
[1] Personal fabricators (hobbyist makers) for personal use,
[2] Maker spaces or Fab labs,
[3] Mini-factories (small to medium sized) and,
[4] Traditional (upscale) urban industries that have decided to remain within cities instead of offshoring. This research will focus on the last three categories and scales of manufacturing.

The changes in the industrial sector, accelerated by circular economy objectives and part of Industry 4.0, results in a shift of focus and hybridisation. Bianchini et al. (2014) describe several forms of urban micro production. These are specialised artisan and customised production, advanced recycling and upcycling, service and repairs, creative self-production and experimental innovative production in collaboration with universities and research centres. Many urban manufacturers perform activities such as design, R&D, short-run, demand based production lines, distribution and even sales besides their 'core' activity of production, and sometimes depend on having a public façade for retail and commercial clients (A. V. Hill, 2020, p. 77). This is aligned with what was explained earlier: some manufacturers increasingly prefer functions such as services in their direct surroundings, run by external partners on in-house. In this way, they are associated with high levels of innovation, technologies linked to Internet of Things, smart factories, IT, Big Data and AI, focussing on serving specialised and customisable markets (A. V. Hill, 2020, p. 85). These processes require a combination of specialised knowledge, from different actors and fields to develop new production innovations and solutions (Grodach & Gibson, 2019). These supporting functions are important stakeholders in the network of manufacturers and can be categorised as the following (Tsui et al., 2021):

[1] Large scale traditional manufacturers, they collaborate with makers of industry 4.0 (Busch et al., 2021) for innovation and prototyping,
[2] Local production networks, including other small manufacturers maker spaces that provide access to technology and business partners,
[3] Skilled workers and professionals,
[4] Experts, consultants and universities,
[5] Marketing or business support.

The urban manufacturing industry

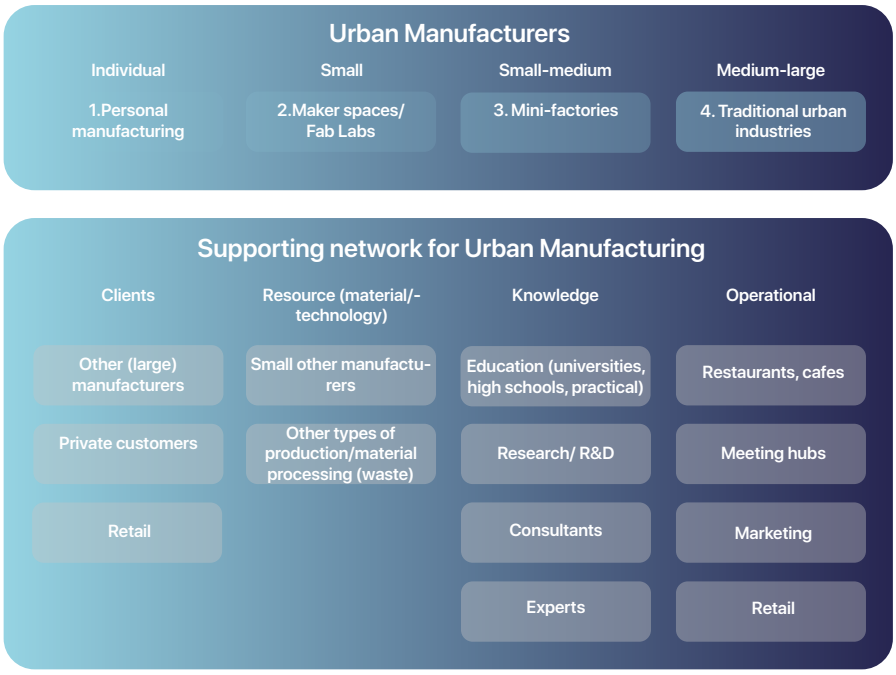


Figure 4.1 Types of manufacturing and functions in the support network

Location decision

Many of the more hybrid functions, especially high-tech and high-value services, can afford higher land costs and require good connectivity to the city and their partners (A. V. Hill, 2020). Traditional suburban industrial districts are therefore less suitable for some industries. (Hausleitner et al., 2022) describe different types of supporting businesses based on their relation to the city and manufacturing. The first category is those the city depends on: those for daily activities like bakeries, but also cement factories for construction in urban areas. In addition, there are the businesses that depend on the city. These businesses are attracted to the city and prepared to pay for higher land costs and rents because the benefits of being close to workers, knowledge and other services outweighs the extra costs. Examples of these are innovation- or high-value production manufactures who besides technology, need skilled workers, expert knowledge or proximity to customers. Both types are needed in balanced urban development and can be part of- and support urban manufacturers.

It is important to note that the demand for high-value urban services, technology and knowledge isn't required by all manufacturers, as not all producers rely on advanced processes. Many of them are low-tech and/or high-touch manufacturers who rely on designs instead of automation and digitalisation (Grodach & Martin, 2021). Examples are food and beverage producers or cultural manufacturers. They have smaller batches that run shorter and are able to respond to changing demands. While they don't require most high-value or high-tech functions, these often do rely on external companies for support. Low-tech supporting functions can be for example related to the machinery used, fabrication, marketing or retail (Grodach & Martin, 2021).

Other examples of urban manufacturing are food production, textile manufacturing, furniture making, construction material fabrication. (Domenech, 2020 in (Hausleitner et al., 2022). More high-tech, digitally enhanced functions are additive manufacturing, 3d printing and robots producing goods (Busch et al., 2021; Tsui et al., 2021). Some of them are highly specialised. They collaborate and deliver specialised knowledge and produce small series of customised products that can be directly tested by their clients (Busch et al., 2021). They can deliver to private customers looking for individualised products, or commercial clients such as other industrial manufacturers, design studios, and creatives like architects. Especially local

The urban manufacturing industry

companies like other manufacturers are important clients, as they can help them with maintenance, but also provide custom made spare parts, for repairs. This fits well within a circular economy perspective and therefore having these types in a mix of manufacturers could be valuable for making these areas function in a circular manner.

4.2.2 Space: flexibility

In addition to requirements for their context and support functions, there is a lot of demand for new locations for developing manufacturers. Growing urban manufacturers often need larger buildings to be able to grow, while (affordable) space for this is limited in urban areas and they are often 'stuck' in their own spaces that are shared with other manufacturers as described in the example by (Prins, 2021). Start-ups become scale-ups, but also need downscaling sometimes. These dynamics need to be facilitated by flexible accommodation. The example by (Groeneveld, 2016) shows this changing demand differs per type and level of maturity of the company, so providing flexible spaces is very important (Groeneveld, 2016).

4.2.3 Context: atmosphere, supporting activities, knowledge sharing and collaboration and location

Different types of urban manufacturers share similar demands. Many prefer locations where other manufacturers, customers or knowledge economies are nearby (Busch et al., 2021; Grodach & Gibson, 2019; Grodach & Martin, 2021). The right conditions for production, but also proximity to educational facilities, accessibility of (public) transport and attractive urban spaces are important for several manufacturers (Prins, 2021). In addition, the proximity to cities is important to find skilled employees. Some manufacturers don't require suburban large scale industrial parks, but prefer a mix of older buildings with flexible floorspaces, located in networks of knowledge and related industries. Such locations are more likely to be found in cities. In particular, specialised manufacturing, including Industry 4.0, often requires less space and may benefit from such central locations (Grodach & Martin, 2021). Together with more environmental-friendly production methods, it would be possible to accommodate them in urban locations. Cities are considered an important platform for these developing industries and innovation due to agglomeration benefits. Specialised labour, knowledge and services are combined, and it allows for urban diversity by integrating productive aspects in these locations (spatial recoupling). Due to the integration of concept design, research and development services and manufacturing, it creates conditions for local innovation, especially in an urban context where interaction with customers and knowledge services is possible (Busch et al., 2021).

The above describes the importance of urban locations due to the spatial proximity and agglomeration benefits. (Spalanzani et al., 2016) have described in detail all the locational decision factors for manufacturing companies. Factors for production are categorised in human resources, physical resources, knowledge resources, capital intensive resources and infrastructure. The most important for technology based (Industry 4.0) manufacturers, is still the cost/benefit of a location, followed by the presence of a university (knowledge), R&D facilities, the location, shared facilities (exchange), firm diversity and events in the surroundings. More high-tech companies especially value the possibility for networking opportunities and location in prestigious areas, so neighbourhood characteristics are of importance as well (Arauzo-Carod, 2021). The following section about values of heritage will further elaborate on the latter, as industrial heritage locations can provide some of these advantages.

The urban manufacturing industry

Conclusion

This section aimed to provide preliminary answers to the first two research questions: *'What is the role of urban manufacturing towards the circular city?'* and *'What functions does the urban manufacturing industry and its urban support network consist of and what are their requirements?.*

There are several categories of manufacturers, from small scale, low-tech, high touch to highly customised production using high-tech production techniques and expert knowledge. The scale goes from personal manufacturing, to start-ups in shared maker spaces, scale-ups at the size of mini-factories to traditional industrial production and grown-ups, located in cities. Flexible accommodation for scaling up is needed, to develop a mature and sustainable urban manufacturing industry. Manufacturers can contribute to circularity in cities by making use of local resources and supply chains, which many small and middle-sized manufacturers are already involved in, and by being able to scale up on the city scale. The industrial transition and circular economy development result in more hybrid forms of manufacturing, accelerated by innovation, automation and digitisation that are able to deliver highly customised, demand-based products using less resources and space which can also contribute to circularity in cities. Increasingly, urban manufacturers perform other tasks ranging from R&D to retail, and rely on a support network of other manufacturers and external providers of these services. This requires collaboration and good communication which is reflected in their requirements. Many manufacturers prefer urban locations due to the benefits of a central location close to skilled workers and infrastructure, but also because it allows for places of interaction and physical proximity to their support networks, material resources and client base. This does not only apply to high-tech manufacturers, more traditional producers can also benefit from these locations and support networks. This can benefit innovation and more circular manners of production. Reserving sufficient (affordable) spaces for urban manufacturers is therefore required in the implementation of circular city strategies and adaptive reuse of industrial heritage could be one of the strategies to achieve this, as will be explained in the following section.

4.3 The added values of industrial heritage

In preparation of the empirical research about the multidimensional values of industrial heritage for manufacturers, this section contains the results of the literature review relating to the third research question. Specifically, this section focuses on the socio-economic (soft) values of the reused buildings as 'heritage', and the benefits of the (hard) values of the location of industrial heritage sites, which contributes to answering research question 3: *'What are the added (tangible and intangible) values and synergies of adaptive reuse of industrial heritage for the urban manufacturing industry?'.*

4.3.1 Adaptive reuse of heritage and improving the urban context

Several values of heritage adaptive reuse were introduced in the context chapter. Multiple authors mention the capacity of adaptive reuse of heritage to revitalise urban areas and improve the quality of the surrounding environment and heritage itself (Arfa, Zijlstra, et al., 2022; Dell'anna, 2022; Girard & Vecco, 2021). (Girard, 2019, p.248) describes three values of heritage relating to this: the regenerative, generative and symbiotic capacity. Respectively, these are about (1) extending the lifespan and use value of the building which ends linear flows, (2) the capacity to produce positive cultural, economic and environmental externalities, and (3) the material and immaterial relations with the context and ability to stimulate synergies through circular relationships (Saleh, 2022).

Relating to the second capacity, in many (re)developments of urban areas, heritage is the anchor to many social and economic hubs (Foster & Saleh, 2021b) and main enabler of sustainable development and regeneration (Abastante, Corrente, et al., 2020; Arfa, Zijlstra, et al., 2022; della Spina, 2019; Pintossi et al., 2021a, 2021b). This originates from both cultural and architectural aspects (Arfa, Zijlstra, et al., 2022). The cultural relates to several socio-economic benefits such as enhanced liveability, social cohesion and relationships, increased real estate values and provision of jobs through regeneration and new functions. The architectural relates to contributing to establishing the identity of the neighbourhood and improving the aesthetic qualities.

In addition, adaptive reuse of heritage has multiple environmental and economic values relating to circularity, which relates to the regenerative and symbiotic capacities of Girard (2019, p.248). Besides adaptive reuse being a circular strategy itself, it can be a promoter and facilitator of circular development strategies by urban regeneration, avoiding over consumption of soil, materials and other resources and reducing emissions, which can result in cost benefits too (Bosone et al., 2021; Girard & Nocca, 2019). By facilitating functions such as manufacturing, adaptive reuse can also actively contribute to the circular economy. It produces external (economic) effects that partially impact the context, and partially are able to return as input to cultural heritage itself (Girard & Nocca, 2019). This shows there are mutual benefits of heritage adaptive reuse and circular outcomes like urban manufacturing. The following paragraphs will therefore elaborate on the added values of industrial heritage for urban manufacturing.

4.3.2 Benefits for manufacturers, supporting sectors and their users

Hard values

In the context, the argument for preserving industrial heritage sites for facilitating urban manufacturing was introduced. The following paragraphs will elaborate on why industrial heritage locations are relevant for developing the urban manufacturing industry based on the locational- and building values.

The added values of industrial heritage

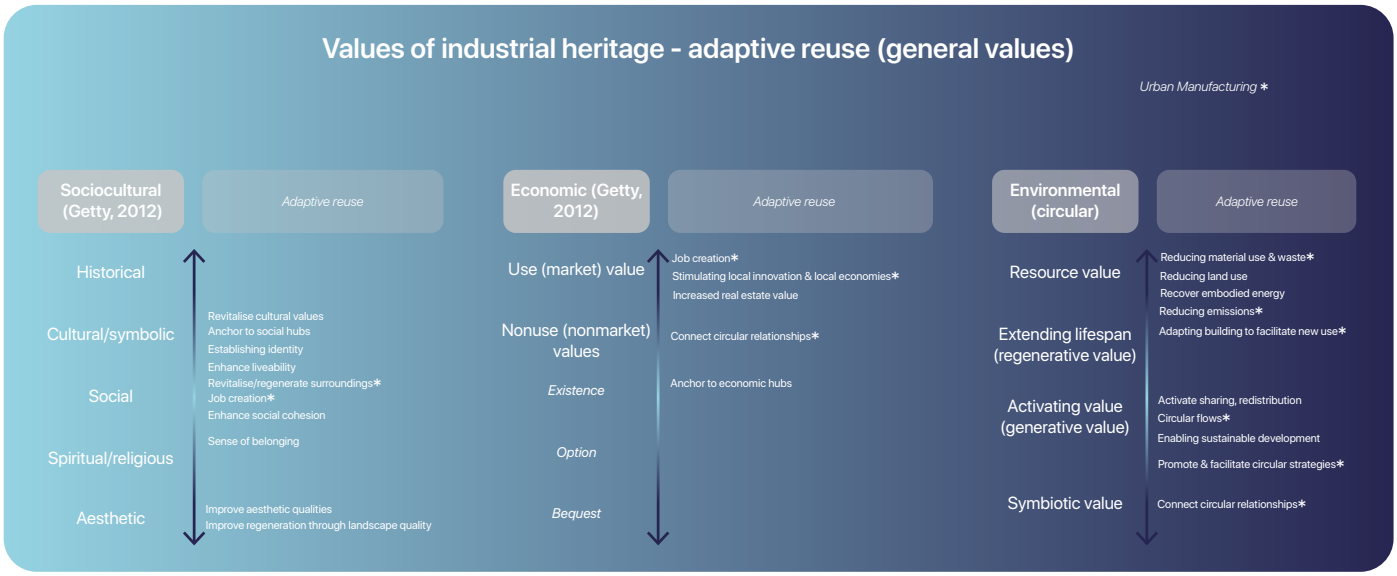


Figure 4.2 General values of industrial heritage adaptive reuse

Industrial heritage can be found in several contexts. Port-cities historically provide many industrial buildings due to trade and resource flows, but this is not exclusive to ports and large-scale production can, and has taken place in more inland locations as well. (Girard & Nocca, 2019) Describe port cities offer many opportunities to implement circular economy principles, relating to the resource flows and activities that take place. They also highlight the importance of industrial heritage in industrial cities. Industrial heritage can contribute to the beauty of a city landscape. The aesthetic quality of the landscape can be important for regeneration processes, but beyond aesthetics, the integration with the social and economic aspects of the city is also important to contribute to circularity (Girard & Nocca, 2019). The local cultural resources can help activation of the circular economy in a creative way, making use of the economic, logistic, and industrial activities in the area and through regeneration of cultural heritage.

Many industrial heritage locations are located on the edge of historical city centres and sometimes the landscapes themselves are recognised as heritage (Girard, 2013). Historically, many forms of manufacturing agglomerated in cities due to the availability of labour for specialised manufacturing. (A. V. Hill, 2020, p. 77) describes the new manufacturing industries can benefit from the established infrastructure and existing technical knowledge in these areas and build upon this.

It is often assumed that manufacturing needs suburban or large scale greenfield industrial areas and that urban industries have become obsolete (Grodach & Gibson, 2019). However, empirical research shows that urban manufacturing can profit from a location within cities with agglomeration economies. In places where functions of knowledge industries such as R&D and services are clustered, the dynamics and interactions between different businesses and sectors can facilitate urban manufacturers to grow. This is also based on the proximity to clients, labour and related manufacturing companies (Fox Miller, 2017 & Hakuta et al, 2017 in (Grodach & Gibson, 2019). This is why urban industrial heritage can be of value for urban manufacturing, situated on the edges of historical

The added values of industrial heritage

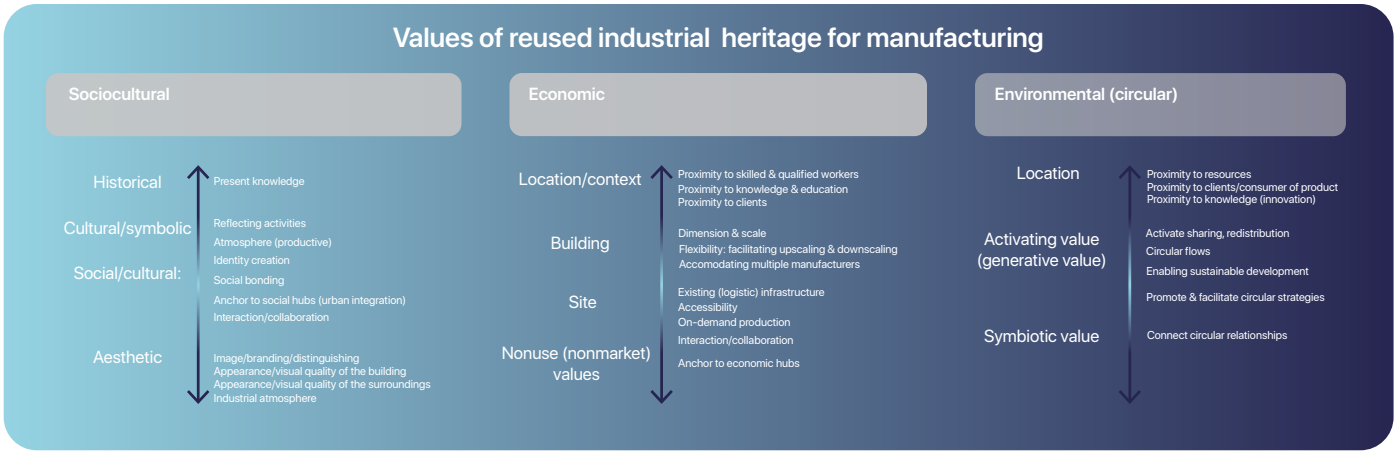


Figure 4.3 Values of industrial heritage for urban manufacturing

city centres and offering proximity to the centre, logistic infrastructure and a flexible layout which allows for a diversity of companies. These are also locations where manufacturing can still take place with limited risks of causing nuisance.

Similar factors are valued by new forms of manufacturing industries. For them, the physical factors of location often outweigh the power of digital tools, as their business model works with problem-based solutions, customised to their clients' needs. Urban areas are valuable for proximity to their customers, employees and knowledge (Busch et al., 2021). It can therefore be assumed that the importance of urban locations for manufacturing will increase with the transition to new industrial models and resulting smaller production scales as part of the circular economy transition, due to the presence of skills, knowledge and infrastructure.

Soft values

The values mentioned earlier in this section can contribute to the location decision of manufacturers to industrial heritage sites. However, contributing to the socio-economic urban context is maybe not at the core of their decision. Instead, reused heritage can have direct impact on manufacturers by proving a unique location, attracting supporting activities and employees. The attraction of heritage sites has much to do with the atmosphere. When heritage buildings are enhanced through adaptive reuse, the new users provide the space with a new purpose, but the heritage buildings are the factors connecting the old and new and support the users in creating the identity of the area (Jansen et al., 2021). This improves the attractiveness and contributes to the image of the local companies, which is also part of their marketing and positioning to distinguish themselves within the market. For instance, waterfront districts and harbour areas are particularly attractive for creative industries and knowledge workers. This is mainly about the look and feel of the neighbourhood. The historic and architectural appearance can contribute to the success of redevelopments of these areas (Saleh, 2022).

(Smit, 2011) describes in their research the influence of visual quality on location decisions of creative entrepreneurs. About forty percent of the creative entrepreneurs indicates that visual quality influenced their decision. The visual quality of the environment was rated second in importance, next to price, location and image of the building itself. The architecture and locations like waterfront areas were highly valued. The research also mentions it can encourage clients of these companies to pay a visit, which was not mentioned in earlier literature (Smit, 2011). In addition, elements in the urban space that contribute to a creative and reflective atmosphere influenced the location decision. The buildings should reflect their activity, in this case, creativity, to enhance the image of the company and their products (Smit, 2011). Industrial heritage can provide such locations, reflecting productive and industrial activities. The research above specifically focuses on creatives. However, other research shows that other sectors are willing to pay for unique locations as well as. The research by (Groeneveld, 2016) and (Bianchini et al., 2014) describes that historical and architectural heritage such as monumental wharf buildings are valued by manufacturers as it contributes to the (aesthetic) richness and industrial atmosphere of the area. The empirical part of this research will elaborate on the values for a broader range of urban manufacturers.

In addition to the heritage values, the location of many industrial heritage sites provides added values. As described in the previous section, urban manufacturers prefer areas where other manufacturers, supporting services and knowledge (institutes) are close. Many heritage locations have the potential to provide this environment, due to their location on the edges and presence of existing agglomeration economies from which new manufacturers can benefit (Girard, 2013). Urban locations are also beneficial due to the availability of all kinds of (specialised) skilled workers, which is preferred by many manufacturers as described earlier (Busch et al., 2021; Hausleitner et al., 2022; A. Hill et al., 2018). Finally, the proximity to cities is suitable for developing urban manufacturers that have just-in-time, demand-based production and short value chains, as they are close to resources and customers (Busch et al., 2021; A. V. Hill, 2020, p. 86).

Conclusion

To conclude, industrial heritage can provide both direct and indirect added values. Firstly, this relates to the location and scale of the building. Many are in proximity to urban centres, which provides access to resources, skills, clients and a support network. The scale of industrial heritage buildings and sites can accommodate multiple of these companies and provides potential for scaling up production to a certain extent. In addition, when facilitating a new function, the regeneration combined with the heritage values can provide value to the urban context by establishing a certain identity, providing jobs, interaction and improving the image of a neighbourhood. Finally, the (historical) appearance of industrial heritage can provide added values for increasingly hybrid-, but also traditional-manufacturers and their support network. The accommodation in heritage can contribute to the image, identity and atmosphere of the. It also influences the establishment of surrounding companies, attraction of employees and clients and is therefore able to create attractive conditions for relocating manufacturing in cities.

4.4 Determining suitability & success factors

The previous chapters have elaborated on the potential added values of industrial heritage and the requirements of urban manufacturers. Meeting the requirements of users is in first place one of the determining factors for the suitability of heritage. This has to do with the more technical factors such as the location and context, but also the way developments are organised in terms of their function and spatial plan. However, there are more integral principles that can be applied to create successful adaptive reuse and facilitate a sustainable and attractive environment for the manufacturing industry. For example, (Prins, 2021) shows different possible combinations of functions within a building. On the ground floor of a former warehouse, large spaces facilitate working spaces for urban manufacturers, while in the former offices, services are located that can support the manufacturing functions in some cases. Depending on the proposed use of the building, the suitability of industrial heritage can be assessed. Some factors are of importance to determine the suitability of heritage. In addition, there are several success factors that which will be described in the following paragraphs to answer *SQ4*.

4.4.1 Determining factors for suitability

To determine the suitability of buildings, some criteria for location-decision are of importance. (A. V. Hill, 2020) describe several of them. First of all they relate to the location in urban areas. Inner city mixed-use areas are relevant for especially small scale (high-tech) manufacturing, traditional crafts, design and workspaces. These are manufacturers with generally lower nuisance levels, which suits environmental regulation in inner cities. Transition areas in cities are valuable as accessibility remains good, but the buildings are often larger in their dimension. Here, hybrid businesses for development and production or collective workspaces could be accommodated. Finally, traditional business parks that fit larger manufacturers, such as scale-ups or traditional ones. These are under pressure of urban expansion by more commercial and housing-related functions. This can be problematic as these areas are well suited for larger scale manufacturing requiring heavy logistics and activities requiring special environmental zoning due to the potential nuisance and potentially harmful materials or production methods (A. V. Hill, 2020).

Besides the location, (A. V. Hill, 2020) describe other conditions which are important when selecting and developing accommodation:

- A range of available spaces, within a certain building or area to choose from to create diversity in terms of manufacturers, but also their support network.
- Visibility, so visitors and citizens can see and value their presence and work through for example a public façade or shared areas for display. This also helps to create the right image, as manufacturing is often considered with polluting and noisy environments, while a large share does not fit this image in reality.
- Transition zones, to reduce hard boundaries between residential and industrial functions causing nuisance, or to gradually increase environmental zoning for nuisance without hard boundaries
- Hybrid and mixed activities, to connect to the city and avoid monofunctional industrial zoning. These can be more urban (support) functions, but also other types of manufacturers supporting their activities.
- Sharing spaces, especially for smaller locations and manufacturers
- Flexible spaces with open layout, to facilitate rearrangements of companies and their process (e.g. scale-up/down)
- Linking place-dependent supply and demand for skills. This can be done in places where skills are

present and by selecting affordable or attractive spaces for motivating employees to move with the company
- Access to local, highly qualified labour (for some manufacturers)
- Potential for improving efficiency in the case of reshoring, through reduced lead times and reduced costs of unsold stock by local and on-demand based production
- Proximity or colocation with subcontractors
- A manager or agent to represent manufacturers and to create a strong identity and community
- A stable situation: clarity about ownership and contracts for tenants, while maintaining the possibility to choose. Stability of accommodation is crucial to take risks for investments in innovation and scaling-up for example.

Finally, (Spalanzani et al., 2016) describe the importance of:

- Access to natural resources
- Market access and business climate
- Local and urban externalities
- Regulations and government decisions
- A location that can favour the development of a special climate influencing human skills or innovation, based on the specific geographic area and conditions for viability (concept)
- Creating a certain territory, including the scientific and educational environment (concept)

As introduced in section 4.2, manufacturers, especially start-ups, scale-ups and those part of Industry 4.0, increasingly require flexible spaces for their demand-based production processes. However, commercial developers often tend to standardise spaces that are most suitable for manufacturing (A. V. Hill, 2020, p. 73). This doesn't favour manufacturers as they need a variety of space sizes to choose from. Depending on their requirements, demand and budget, this allows them to grow or downscale their production. A diversity of spaces also allows different complementary functions to be accommodated in the same environment, which can create synergies such as innovation and collaboration as described before.

4.4.2 Success factors and development principles

For successful adaptive reuse and facilitating the urban manufacturing industry, it is important to establish a good match between available buildings and the requirements of the future users. Not having access to the right facilities and services that support the business activities of manufacturers in the surroundings can be troublesome as it can negatively impact their performance (Ng et al., 2022). Several authors descripe principles for successful adaptive reuse. They refer to the autopoetic (regenerative), symbiotic and generative principles of heritage adaptive reuse, (Bosone & Ciampa, 2021; Girard, 2019; Girard & Nocca, 2019), principles of synergy, circularisation and creativity for sustainable urban development, and economic, social and ecological circular processes (Girard, 2013).

Based on the aforementioned principles by (Bosone et al., 2021; Girard, 2013, 2019; Girard & Nocca, 2019), some important factors for the success in the context of sustainable and circular development can be derived (Figure 4.4):

- Symbiotic: new developments should facilitate interaction and create synergies through combining different actors present in the development, in this case, manufacturers and other manufacturers or other functions that can support each other and lead to e.g. innovation.

Determining suitability & success factors

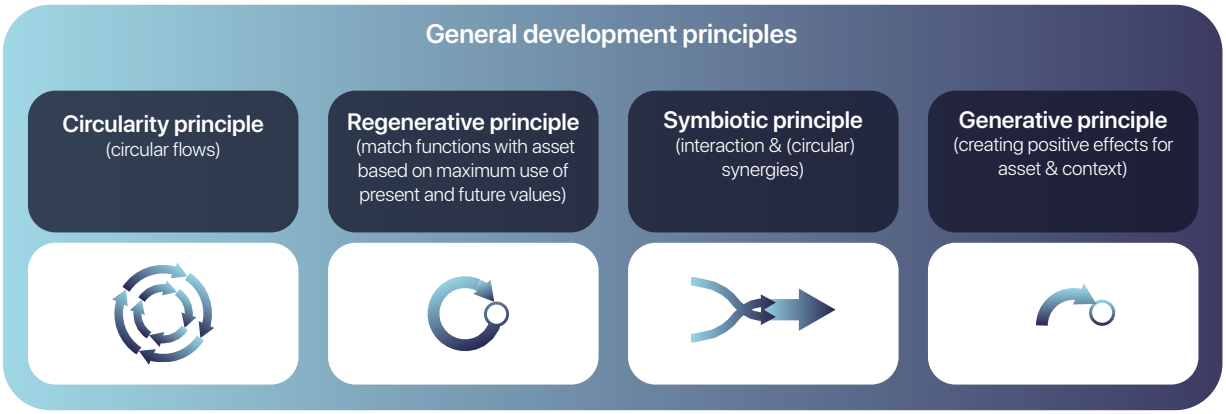


Figure 4.4 General development principles

- Generative: The new development should be able to create positive effects not only for the reused asset by its revitalisation, but also the surrounding environment and take this context into account when selecting the future use.
- Circular: New developments and proposed functions should make use of circular flows, either internally, or in relation to the surrounding city to meet the circular ambitions
- Regenerative: The proposed functions should be matched based on the ability to make use of the values of the heritage asset itself and the potentials coming from the urban context, considering both the hard and soft values.

In addition to fulfilling the requirements of individual manufacturers, different researchers describe important principles and considerations that could contribute to successfully facilitating urban manufacturing.

First of all this relates to the location and context. Many manufacturers depend on the availability of skilled and qualified workers. Locations for their business should therefore be selected in proximity to these. As described earlier, this is mostly in urban areas, with good quality of life and increasingly: creative environments (Hausleitner et al., 2022; A. V. Hill, 2020, p. 77; Spalanzani et al., 2016). Regarding the actual buildings, (A. Hill et al., 2018, p. 92) describe it is important to have shared spaces where employees from different organisations can come together for recreative activities, such as restaurants, cafes, and canteens. This can result in a connection between the employees of different companies but also a connection to the urban surroundings. Enhancing this relation by providing such facilities can improve the integration between them and the neighbourhood and improve the inter-company relations, which has many other benefits as described earlier.

Such facilities can also contribute to the creation of actual 'places' instead of only spaces of marketing. The character and atmosphere of the heritage assets should be preserved without replacing it for solely commercial, functional or economic needs. The (re)development should support real activities that take place on a daily basis, and not only accidental events. Facilitating communication and encounters between people by using symbolic (heritage) values, improving the sense of belonging and collective

Determining suitability & success factors

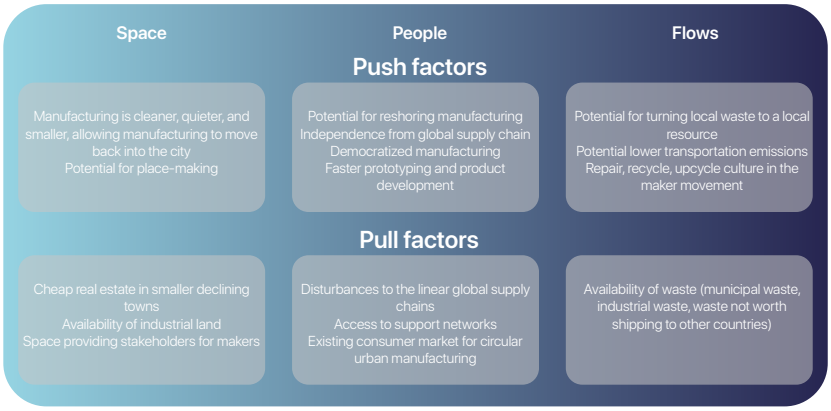


Figure 4.5 Factors for successful circular urban manufacturing (Based on Tsui et al., 2021)

identity are increasingly important for sustainable and circular city development (Girard, 2013).

Spatial clustering is a way to achieve knowledge exchange and facilitate trust and communication between companies by creating the right atmosphere or climate (Grodach & Martin, 2021; Spalanzani et al., 2016). This can be between manufacturers, but also material suppliers, designers and other related functions. It can also result in sharing resources such as machinery, space, skills and information (Grodach & Martin, 2021), which is beneficial from a circular perspective as well. Combining different functions in the developments such as services, that results in e.g. integrating conceptual design, research and the manufacturing itself, can stimulate local innovation, especially in an urban context (Busch et al., 2021). Examples are digital manufacturers who produce demand-based, highly customised products for clients that are made possible due to technological innovations such as 3D printing. Located in between services and actual manufacturing, they can contribute to the circularity of urban manufacturing. Such companies can provide space parts, custom made repair materials and therefore help prolonging the lifetime of products and production materials (Busch et al., 2021; Groeneveld, 2016). This not only happens on a small scale, but it can also be for large manufacturers (Busch et al., 2021). Furthermore, (Tsui et al., 2021) describe the following push and pull factors for successful urban manufacturing, specifically focusing on the circularity of outcomes (Figure 4.5):

The developing urban manufacturing industry requires a lot of skilled people who, especially in the light of the circular economy, also require a lot of new knowledge (Hausleitner et al., 2022). The demand- and problem-based production can benefit from an urban context wherein high schools, universities, research institutions or local design associations are located, who can provide input for creative ideas and innovation that is needed for this type of manufacturing (Busch et al., 2021; Spalanzani et al., 2016). Maintaining a good connection is crucial for existing and future knowledgeable staff. Accommodation in areas where education and research institutions are present can therefore also contribute to the success of development of a (circular) urban manufacturing industry.

Determining suitability & success factors

Conclusion

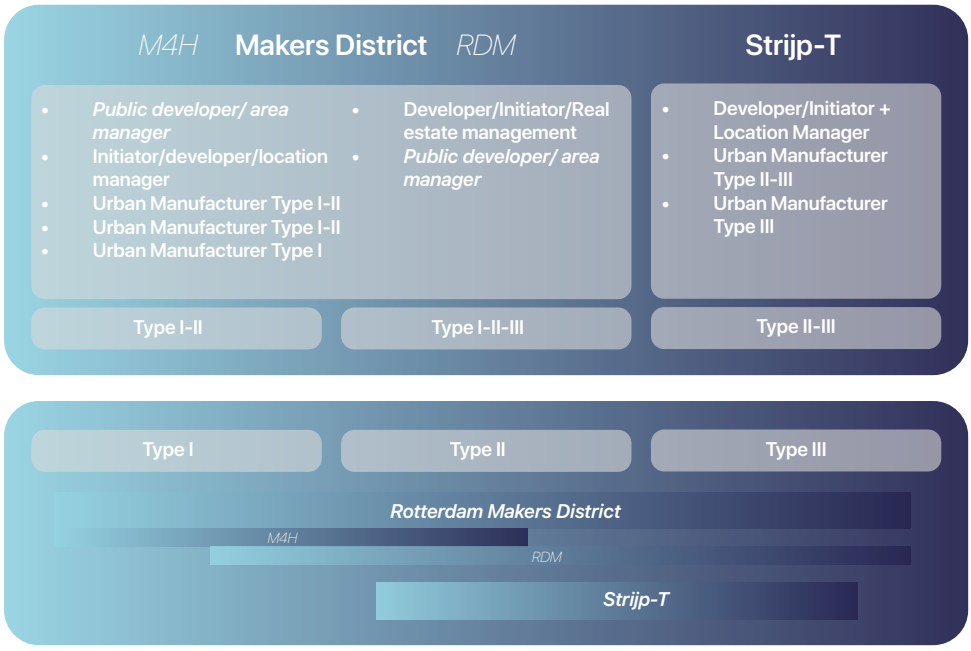
The previous paragraphs have shown several factors that can be used in the assessment of different industrial heritage sites and urban manufacturing (combinations). In addition, some of the success factors that can be used for development of urban manufacturing are presented. First of all, this relates to meeting urban manufacturers' demand. Building characteristics such as location, flexibility of spaces, facilitating growth and appearance are relevant. In addition, several principles apply for successful adaptive reuse of heritage for manufacturing in the context of the circular city, relating to the ability of facilitating new functions by regeneration, the (circular) relationship with its context, and the ability to generate positive externalities. Location close to the required material and knowledge resources, skills and supportive networks and activities contributes to the success of an environment for manufacturers. Creating spatial clusters where actual productive activities take place, that enhance the relationship between different companies and their urban surroundings, contributes to integration in the urban context and the sustainability of the development. The right environment and configuration of companies can also benefit the circularity of the outcome by accommodating innovation and research facilities and complementary functions, demand-based production and facilitating circular producers making use of local resources.

5. CASE STUDIES

5.
Case study research
5.1 Case introduction

5.1 Analysis locations and case-study selection

To select the case studies, several criteria were formulated as indicated in Chapter 3. Out of 37 Adaptive reuse projects of heritage in the Netherlands, 18 projects including a form of manufacturing were selected. When applying the criteria of industrial heritage and one of the three types of manufacturing defined in the methods, this resulted in 4 possible cases. The aim for this selection was to interview 2-3 manufacturers of each type in 2-3 cases, to cover the different types of manufacturing defined earlier. In addition, two expert interviews were held to reflect on the outcomes of the empirical research and final product. From possible cases, a selection has been made of cases where a diversity of manufacturers is located, to be able to analyse different stages in their development within the same context. This eventually led to the selection of two main cases, in which the three types of manufacturers are represented: The Rotterdam Makers District, consisting of M4H and the RDM Campus in the port of Rotterdam, and Strijp-T, a former Philips production district in Eindhoven that has been transformed for a new generation of manufacturers.



5.1 Selected case studies and interviews. The selection criteria are discussed in Chapter 2: Research Methods

ROTTERDAM MAKERS DISTRICT M4H RDM

Case descriptions

Rotterdam Makers District

Building	Innovation Dock (RDM Campus), Steurgebouw (M4H), Rotterdam
Site	M4H-RDM (Rotterdam Makers District)
Location	Merwevierhavens, Dokhaven, Port of Rotterdam, NL
Heritage types	Mix, Partly heritage: Wharfs, Port office, Warehouses
Manufacturing types	I-II-III
Building specific	Steurgebouw & RDM Campus
Interviews	Developer/Real Estate Manager: Port of Rotterdam (Interviewee RL1) Public developer/ Area management: (Interviewee RL2) Initiator/developer/location manager Steurgebouw M4H: (Interviewee RL3) Urban manufacturer: Type I-II (Interviewee RM1) Urban manufacturer: Type I-II (Interviewee RM2) Urban manufacturer: Type I (Interviewee RM3)

5.1.1 M4H-RDM: Rotterdam Makers District

Case introduction

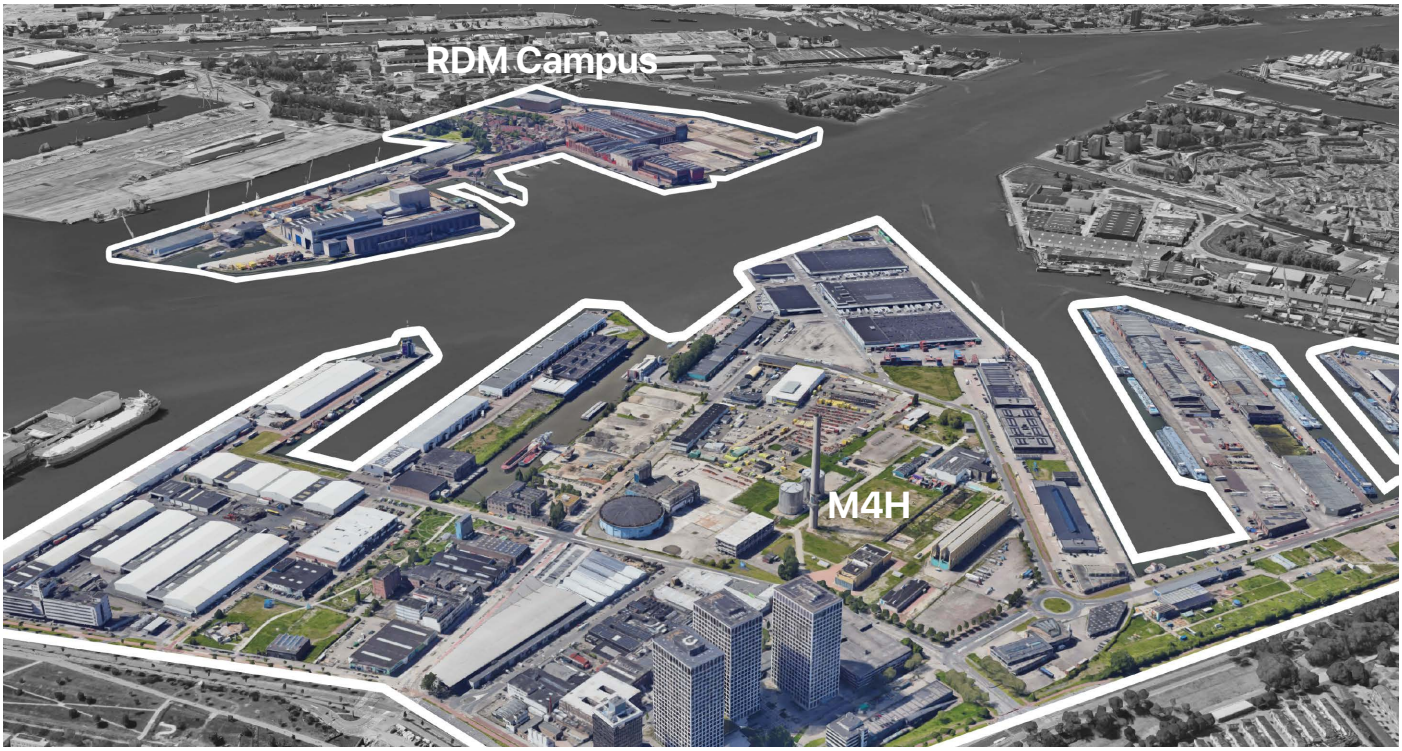
M4H (Merwe-Vierhavens) is a formed industrial port area in Rotterdam. Together with the RDM Campus, located at the river Meuse across of M4H, they form the Rotterdam Makers District (Figure 5.2).

In M4H, different forms of manufacturers and other companies are located, ranging from start-ups, creatives and design firms to multinational companies. The aim is to develop into a mixed-use area, including (innovative) production, housing, education, culture and other urban functions. Several buildings in the area are listed as municipal or national monuments and many have been transformed already, of which some for temporary use like event locations.

On the RDM Campus, the maritime industry is combined with several related companies and educational organisations. The majority of buildings is listed as (municipal) monument and is located in an area that is protected from visual alterations. RDM aims to focus on port-and maritime related manufacturing industries, but currently accommodates a large diversity of manufacturers, ranging from high tech scale-ups to mature manufacturing industries. The buildings accommodate several medium-to large scale manufacturers in individual buildings as well as shared buildings divided into several units. Manufacturing in this area differs from M4H as the environmental regulations allowing for production of higher levels of nuisance, while on M4H this is limited by the urban surroundings and future plans for mixed-use. In this way, spatially the manufacturers part of Type I & II are located in M4H, while RDM also accommodates large scale, mature industrial manufacturers of Type III.

The Makers district aims to become a regional hotspot for the innovative urban manufacturing industry. Start-ups can find accommodation for the first 5-7 years in the Innovation Dock multi-tenant building at RDM. They can experiment with new products and processes, such as digital and automated production and additive manufacturing. The aim of the district is to facilitate innovation and directly apply it by connections to other manufacturers (Rotterdam Makers District, n.d.). This is part of the transition of the

Case descriptions



5.2 Rotterdam Makers District. Based on Google (n.d.).

port to a new economy, with the return of (a new form of) manufacturing to the city (Rotterdam Makers District, 2017). For this development, the proximity of creatives, sales markets and knowledge is important. While presented as one district, the redevelopment and focus of both M4H and RDM differs. At RDM, all buildings and land are owned by the Port of Rotterdam. In contrast, at M4H, the plots and buildings have several owners and tenancy agreements, including the Municipality and Port of Rotterdam as main stakeholders. Together with the plans for other functions such as housing, this results in a more complex redevelopment processes in M4H (RL1, RL2).

STRIJP-T

Case descriptions

Strijp-T

District	Strijp, Eindhoven
Site	Strijp-T
Location	Strijp-T, Eindhoven , NL
Heritage types	Mix, heritage + newbuilt, listed monuments: Production halls, Power plant, Facility buildings
Manufacturing types	(II)-III
Interviews	Developer + Location Manager: (Interviewee SL1) Manufacturer Type II-III (location manager building) (Interviewee SM1) Manufacturer Type III (director/owner) (Interviewee SM2)

5.1.2 Strijp-T

Case introduction

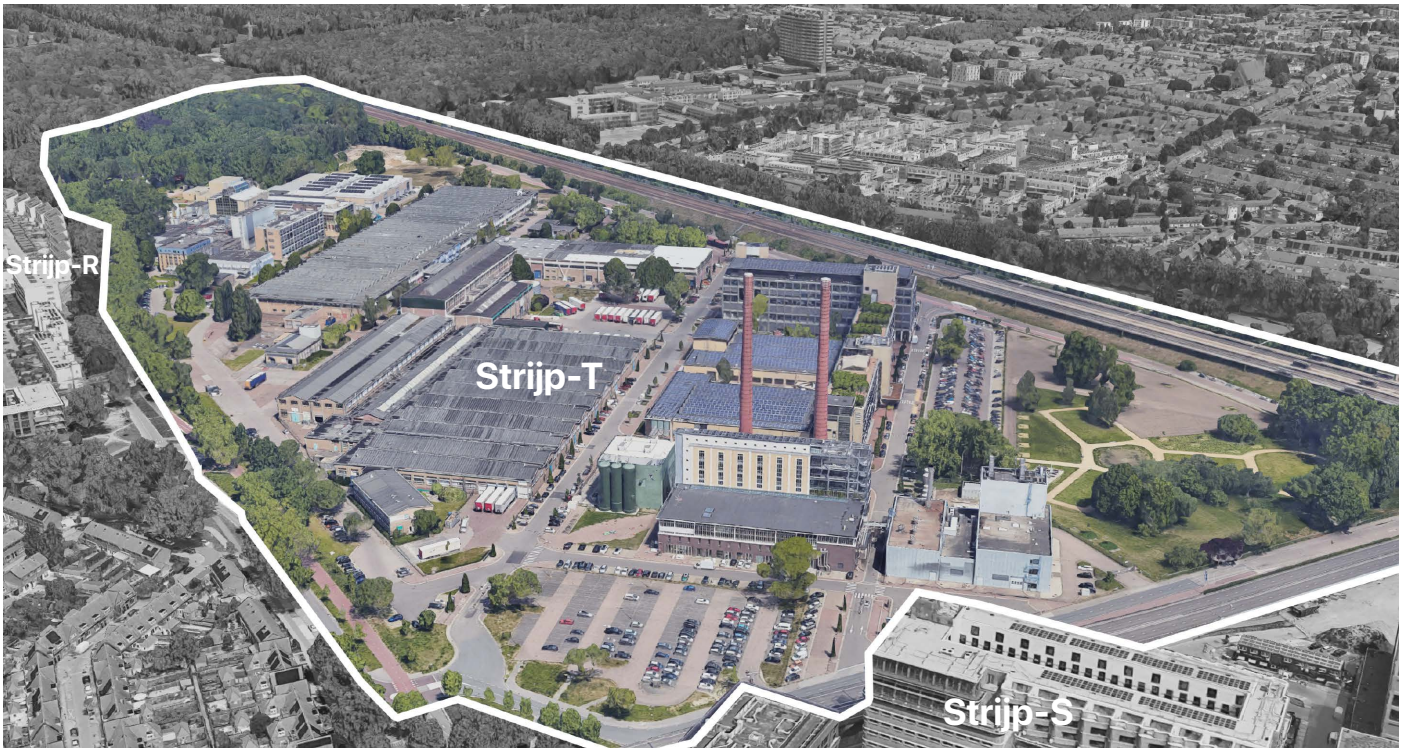
Strijp is a district in the Dutch city of Eindhoven which accommodated a large part of the former Philips factories and development locations. As the company was growing, it expanded from Strijp-S to the neighbouring areas of Strijp-R and Strijp-T (Strijp-S, n.d.) (Figure 5.3). In recent decades, parts of the area have been redeveloped into housing and mixed use neighbourhoods as part of Innovation District Strijp. Strijp-R became a new residential neighbourhood with little remains of the former productive facilities. In 2002, Strijp-S, the oldest part and closest to the city centre, was sold to commercial developer VolkerWessels and the municipality of Eindhoven. While plans were made to transform the area into a new mixed-use creative centre for the city, Philips remained the main tenant. Many of the buildings are listed by the municipality as monuments and are part of the redevelopment plans. Investments in public transport, and mobility were made to attract new users and external facilitate the future developments. Multiple events such as the Dutch Design week are organised that helped with the branding of the developments and establishing a creative community. The area accommodates housing, services, startups and several creatives such as media and design companies.

Strijp-T is a post-war part of the Strijp District. Redevelopment started in 2016 to accommodate the innovative high-tech manufacturing industry by developer GEVA Vastgoed. Over the last decade, developer GEVA strategically acquired several buildings in the area. In this specific case, the developer aimed to remain owner and manager of the area after the redevelopment and transformation of the buildings (SL1). Around 2018, the first major redevelopments were finished. Over the past few years, development has continued and it will do so in the future. Currently there are plans to expand the area further by adding new constructions to the parts of the site that remain vacant and on top of existing buildings.

The area consists of multiple industrial heritage assets that have been redeveloped into a diversity of buildings, ranging from production space in factory halls to workplaces in a former power plant. It aims to accommodate companies beyond the startup phase, that start production and testing on a small and medium scale (Strijp-T, 2020). On Strijp-T they can expand their business and move within the area due to the diversity of buildings. When they want to scale up even further, the companies can move to the Brainport Industries Campus outside the city or one of the future

Case descriptions

developments planned in Strijp-T. In this way this area aims to function as the intermediate step between startups who move from the University Campus to the Strijp-S district, and from there want to scale up when they start with actual production and testing of their products for consumers (Theeuwen, 2017). Within Strijp-T, a diversity of functions is located, including education relating to the high-tech industry, cafés, office spaces and meetings rooms, besides a majority of actual manufacturing locations. While the neighbouring area Strijp-S accommodates more urban functions and housing, Strijp-T is aimed to remain exclusively for manufacturing and functions directly related to manufacturing such as specialised services and education that fit within this concept.



5.3 Strijp.T. Based on Google (n.d.)

5.2 Interview results

In this section, the main findings of the interviews are discussed. Based on the predetermined values, requirements and success factors for the development, a set of questions are developed for urban manufacturer and location or area managers. In addition, the reflection of experts is included in these results. The interviews consist of four parts that indicate the structure of this section (Appendix II-III):

I Background & context
II Requirements
III Values of heritage
IV Success factors

The several cases aim to cover different types of manufacturers withing Type I, II, III and both low-and high-tech companies. The results of the interviews are used in the development and assessment framework presented in Chapter 6.

5.2.1 Requirements

The decision-making of the accommodation location is split into requirements relating to the building, and the requirements relating to the site and location. The requirements mentioned here are the result of the interviews, while those in the assessment form (Figure 6.4 & 6.10) are based on the combination of literature, interviews and reflections with experts.

Requirements building
A common theme among the interviewed manufacturers was the need for flexible accommodation. This relates to the growth of the company (SL1,SM1,RM2), but also the possibility to change the focus or the production methods during their development (SL1,SM1). Especially for the more traditional and creative companies that fit within Type I, the ability to make alterations to the buildings themselves is considered important (RM2,RM1,RM3). They often have equipment and skills to tailor the interior to their needs themselves and less financial means to hire externals. The functionality or shape is important here (RL1, RM1): by providing large open spaces, offering a diversity of workspace possibilities that can fit both office and workspaces rather than two disconnected ones (RM3). Visual quality of a building is rated high (Figure 6.10), but eventually the functionality remains more important, as one interviewee indicated: *'of course if the space is nice and you can see heritage, this is personally appealing, but not the most important factor. Eventually they make the decision based on whether they can do their thing here'*. (RL3). This is reflected in Figure 6.10, where factors like dimension and flexibility are rated higher than appearance.

Affordability is considered another important factor for manufacturers starting production (RL3,RM1,RM3,RM2, RL2). In the first phases, this is considered more important over other aspects such as visual quality, but it becomes relatively less important when companies develop (RM2). Multiple interviewees indicated that when moving to the phase of scale-up and beyond, the professional appearance and identity becomes more important to attract people that are needed for the company, such as employees and visiting clients, which results in different requirements (SL1, SM1 SM2, RM3). Together with extra services and facilities, manufacturers beyond the start-up phase are often prepared to pay extra as 'they look for more than just square metres of workspace' (SL1, SM1, RL1). This is also described in the literature (A. V. Hill, 2020): high-tech and higher-value companies can afford higher land costs and have additional requirements such as good accessibility. For them, traditional suburban industrial districts are less suitable. However, due to the scarcity of such places, affordability is not always the deciding factor, even for starting companies (RL1), who depend on these locations for their workforce and development of their company.

Interview results

Overall, there is high demand of manufacturing space. Especially for companies in-between the first steps and larger scaleups, suitable accommodation is scarce (RL3). Manufacturers are often 'stuck' in their accommodation (Prins, 2021), so being able to grow within the same place is valued a lot and one of the main requirements.

Relating to the technical requirements, large clear height, roof spans and high bearing load of the floors is important for all types of manufacturers. Infrastructure within the building, such as loading decks, logistic space, large openings and doors and high-power electricity are considered important. In many industrial heritage sites this is taken for granted, but it is often essential for their production process (RM3). Natural light (SM1, RM2, RM3) and windows in the workspaces (SM2) are other requirements mentioned. This also relates to the attractiveness of the workplace for potential employees becoming increasingly important, especially in the more competitive high-tech sector (SL1, SM2).

Requirements location/site

Relating to the location, accessibility for employees, through proximity of public transport and relatively central locations, is often the most important, especially for the next generation of employees: '*To find skilled workers, the right environment is important, many people want to work closer to their homes, which is not always possible, but then accessibility becomes really important*' (SM1). This counts for both the Type 1 companies, whose employees often live in the city and don't always have access to a car, as well as scaleups and high-tech mature companies that were interviewed. Also, a more central location often means access to a larger pool of workers (RM1). Both the literature (Grodach & Martin, 2021; Hausleitner et al., 2022) and criteria show the proximity is valued most by high-tech and higher-value companies (Type III, (Figure 6.10). For Type I and II manufacturers, a central location offers other benefits, such as relative proximity to other manufacturers and related companies. This is crucial for exchanging ideas, borrowing equipment and collaborations (RM3, RM2, SL1). This is aligned with the earlier literature, indicating benefits such as innovation as a result (Busch et al., 2021; Grodach & Gibson, 2019; A. V. Hill, 2020).

More creative Type I and II companies produced a lot on-demand. So, short delivery times are important (RM3, RM2, SM1). Preferences for colocation differ, but interviewees indicated they prefer similar, like-minded companies who have at least one step in their production process they can relate to, as this provides opportunities for collaboration and understanding (RM3, RL1,SL1). Proximity of material sources was also mentioned as important, at different scales. Some mentioned the city (RM3), others mentioned the scale of a region as close (SM1). Proximity of like-minded companies is also valued from this perspective, as they are often the suppliers of parts or other materials, or clients of these companies.

All manufacturers also indicated the importance of logistic accessibility. While present on most industrial heritage sites, it is crucial for deliveries and distribution, so a location within the city centre itself is not preferred. Type I and II manufacturers prefer relative centrality, but not urban, grade A locations to maintain a certain level of freedom. Related to this is the ability to produce a certain level of nuisance, which is required by especially the start-ups and scaleups who perform testing, and the more traditional manufacturers processing raw materials (RL1, RM2, RM1). Environmental zoning regulations are therefore important in their location decision-making. Multiple interviewees indicated that especially the edges of cities are suitable locations, as different (cultural) flows from the city come together here (RM3, RL3). In these edges, a certain level of freedom exists but they remain well accessible. For

Interview results

some manufacturers creative hubs in these cities are very important, such as cultural events and museums. For more high-tech companies, the high-tech hubs in the proximity are relevant for their own positioning and as a support network. All manufacturers indicated a related economic context, hub or culture in the proximity is important when locating their company.

Support functions/network

In addition to supporting companies, shared places for meeting clients and other companies are important, but interviewees also mentioned they would prefer this either in-house or at informal public places such as restaurants. Some manufacturers work with highly valuable or confidential information (SL1), so meetings in public places are only for network relations and less formal discussions. Shared spaces for working together were not valued by any of the manufacturers that were interviewed, indicating several limitations: *'we had to subsidise this, because it was commercially unviable'* and *'we noticed that without the makerspace, the concept still works'* (RL1). This would only work in demand-based, bottom-up developments like when shared makerspaces offer advantages of production scale and cost (ER1, SL1). This should be at own initiative, and not be imposed by externals. Interviewees preferred to be in the same buildings and areas, but sharing should not be forced. Multiple interviewees indicated this does not work due to specialised production methods, so they would prefer this in-house. They did not want to depend on the availability of the shared equipment and space. Sharing of materials or equipment or subcontracting did occur with Type I and more traditional Type II manufacturers, but informally, facilitated by being in proximity to each other and having common production methods. Nevertheless, also Type III manufacturers were part of the support network of other manufacturers, as they produced (spare) parts for production processes of companies within the region and city, which is a characteristic of the next generation of manufacturers (Busch et al., 2021).

In addition, multiple interviewees indicated that they value proximity to education, knowledge and R&D, but not necessarily at the same site. They often refer to proximity at the scale of the city, as also found in the literature (Busch et al., 2021; Grodach & Gibson, 2019).

Future requirements/developments

The aesthetics and atmosphere of workplaces become increasingly important to create inspiring workplaces (SL1, SM1, SM2), especially in more competitive markets. *'The next generation of employees still values salary, but many other factors too: a workplace should be nice, inspiring, sustainable, green, well accessible'* (SL1). One interviewee indicated *'If your building is underperforming compared to your competitors, you are done'* (SM1), referring to the competition in their sector. Good connectivity and more central locations near public infrastructure become more important. (Busch et al., 2021) agree on this, indicating that physical factors often outweigh digital possibilities for these manufacturers, due to their customised and problem-based products, that require proximity and accessibility for clients, but also skills and knowledge delivered by employees.

Companies in the first stages also require (future) space for growth of the company, testing and producing on a larger scale and integrating other functions, such as R&D and sales. Therefore, they often look for places where they can expand within the building or site. However, growth of the company doesn't always mean a growing need for space, as some interviewees indicated that more advanced, digital and more professional production processes sometimes require less space (RM2, RL2). There is also a difference in requirements of the building quality: *'At the start this building was cold in the winter, hot in summer, but when you have just started*

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you don't care, but at a certain moment you become professional. Then you don't want to receive clients who need to walk through halls where the paint is peeling off the walls or you are questioning whether the ceiling is going to stay in place' (RM1). When growing further towards maturity, they require more professional work environments for receiving clients and employees (RM3, RM2, RM1, SL1, SM2) and if possible, a space of their own. The latter also provides them with a certain level of freedom and independence that they require in a more mature phase (RL3).
Multiple interviewees also indicated they like the presence of shared facilities like café's, restaurants, sports and social events for the community, but as they were growing as a company, they start to build their own (in-house) community and facilities and don't always need this external support network anymore (SM1, SM2, RM1, RM3).

When introducing the transition towards a circular economy, sustainability measures to reduce energy use were often mentioned. This was also observed by location managers and developing parties that were interviewed: increasingly the tenants require (visible) sustainability measures in the building (SL1, RM2) and they want to know the sources of the energy they use (SL1). Circular production was often referred to as using local partners (SM1, RM3, RM1), recycling (RM2, RM1) and refurbishing (SM1) materials. One interviewee indicated that this could change when access to material resources becomes increasingly important and outweighs cost benefits (RL1). This would result in increased demand in accommodation in proximity to (secondary) material resources in for instance local ports and cities.

5.2.2 Values of heritage

General benefits
When referring to the values of industrial heritage, all interviewees mentioned the aesthetic expression, richness and atmosphere of the building and industrial sites which is also mentioned by (Bianchini et al., 2014; Groeneveld, 2016; Jansen et al., 2021; Saleh, 2022; Smit, 2011). This provides manufacturers and employees with an inspiring workplace (SL1, RM3, RM2, RM1, SM1, SM2). One interviewee mentioned: *'I also feel much more comfortable in a place that is kind of like filled with bricks, that looks like it has a history, and somebody has lived or worked there before. I find this much more attractive than a newly built kind of: you know, the average Dutch company that you see in the company parks somewhere with this typical bend sheet metals, very functional, which is also nice, but I like this more'* (RM3). It is also valuable for positioning and distinguishing their company (RM1,RM3,SM1,SM2,SL1). While (Smit, 2011) indicated that manufacturers likely value heritage for other reasons than visual quality as opposed to creatives, the interviewees indicated differently. One of the Type III manufacturers indicated that their company was taken much more seriously since they were in located in industrial heritage: *'this has so much effect on how people assess our company and what they think of us'* (SM2). Visitors and clients viewed the company differently because of the accommodation. However, it must be noted that these were more high-tech companies, who can have a different perspective than traditional large-scale manufacturers. One interviewee mentioned: *'if you are a traditional manufacturing company, it doesn't matter as long as you have space. But if you consider the designers, creatives and architects as makers, they really value heritage for its aesthetics specifically'*, referring to Type I companies as well (RL2). In addition, the interviewees indicated the requirements have changed as part of the 'war for talent' in this industry (SL1, SM1, SM2, RL1). (Smit, 2011) describes non-creative manufacturing industries value a visual appearance of

Interview results

'active firms on orderly lots, traffic on the roads, radiating the spirit that work gets done here'. This is aligned with the outcome of 'reflecting a productive atmosphere' which was most valued by Type III manufacturers, followed by Type II and Type I (Figure 6.10).

Some interviewees indicated that even without improvements in maintenance, they would still prefer it over a new building (RM3). Another manufacturer highlighted the quality of the workspace: *'even when a building is simple from the outside, the space for working is nice and that is really positive for the working experience'* (RM2). They mentioned the generous, high spaces, natural light, and aesthetic qualities can be used for their positioning, photo shoots and branding/ marketing for magazines (RM3). *'Spaces like this are barely built anymore and they can barely be found in the city centre'* (RM3). Also, the attention to details and craftsmanship in the materialisation and historical construction methods was mentioned as a value of industrial heritage over newbuilt accommodation (RM3, SM1). Another benefit of industrial heritage specifically is that it attracts like-minded people, especially in the case of start-ups and creatives within Type I (RL3, RL1, RM1, RM3, RL2). This in return is beneficial for these companies and the functioning of the area as they can help each other and organise social events to create their own community. Heritage is the connecting factor here (RM1), which is also described in the literature (Foster & Saleh, 2021b).

Some also refer to the history of the former activities. This can be expressed by storytelling, either relating to the former function, which is valuable for existing and older employees, (SL1, SM1), and the current story, which is valued by a new generation of employees (SL1). In addition, being in historical production sites where others have worked before can be more attractive than traditional company parks (RM2, RM3). Especially in places that have been vacant for some time, being able to contribute to the revitalisation of the place and neighbourhood was another value mentioned by an interviewee (RM2). This capacity of adaptive reuse of heritage was also found in the literature (section 4.3).

The industrial history also means environmental zoning regulations are often still tolerating higher levels of nuisance, which is unique for the relatively urban areas that some manufacturers require (RL3). However, the more high-tech companies indicated they didn't make use of this. It is something the traditional manufacturers and creative companies in especially the first phases of their company make use of, as they experiment with materials, test and process raw materials which can produce odour and noise (RM1, RM2, RL3). They also refer to the freedom in older buildings: *'you feel more freedom to experiment and figure out what you need, such as light or power or layout, and we are therefore less worried that we change something that we're not allowed to make adjustments to'* (RM2). Industrial heritage provides them with the freedom for experiment as opposed to clean production rooms, within the limitations of protecting heritage values.

Benefits of the building

When referring to the values of the building specifically, manufacturers mentioned the present equipment and infrastructure, such as cranes (RL1, SM1, RL3), (door) openings (RM3) and high-power electricity supply (SM1, RM2, RM1, RM3, RL3). Also the high bearing loads of floors, roof span, presence of natural light, height and ability to use heavy equipment were mentioned as values of the industrial heritage. One of the interviewees also mentioned the unique dimensions some buildings have, which almost don't exist anymore in productive spaces, especially on more urban locations (RL1), *'for the companies it creates their business'* (RL1) referring to the heights, present equipment and location of one of the heritage buildings.

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In addition, many buildings over dimensioning: *'for this building the original owner wasn't sure about the future purpose, so they made it really strong, resulting in industrial loads possible at even the 6th floor', 'the only limitation then is: do the machines fit in the elevators?'* (SL1).
In addition, many industrial heritage buildings have large open spaces that can accommodate a diversity of functions within the same building (SL1, RM3), and high levels of flexibility (RM1, SM1, SL1). In many new developments, this generosity type of flexibility is often not present because it is either tailor made to one company, standardised or unaffordable for new developments (SM2, SM1, RM3, RM1). Some interviewees also valued the ability to make alterations to their workspaces and tailor it to their own demand (RM2, RM1, RM3, SL1, SM1).

Benefits of the location
Many industrial heritage sites score well on traditional location criteria, because historically they were close to roads, railways or waterways (SL1, RL3, SM2). The studies cases were all located on the edges of city centres. This means it is close to potential employees who often live in the city (SM1, RM3, RM1, RL3, RM2). One interviewee indicated: '*the fact that you are in proximity of a city is important. Talking about startups or talking about young entrepreneurs or creatives, they live in a city. Many of them don't have access to a car and often public transport to other industrial sites is not really there. So if you are then in, or close to a city, we have access to a much larger pool of employees'*) (RM1). In addition, one interviewee indicated: '*the magic is in the city edges, which are most dynamic and functionally mixed' (RL3).* An urban location also means proximity to services like R&D (RL3, RM2), and accessibility for clients. Furthermore, this facilitates the combination of office space and support with the manufacturing workspaces (SM2, RL3). Others mentioned the value of proximity to the cultural melting pot of the city centres with cafes, museums, and galleries, especially for the design-related manufacturers. Here they can also meet informally with others working in different fields for example which is valuable for exchanging ideas and their network (RM3). The combination of finding an affordable workspace of this size and being next to a bigger city is perceived unique: *'I'm basically 15 minutes away from the city centre of Rotterdam, which is amazing, You have like a fantastic large workshop in the outskirts of the city. This is really, its kind of a dream'* (RM3).

The traditional and creative manufacturers within Type I also valued the spatial proximity to their colleagues and partners for material supply and production. Often collaborations in parts of the production process take place, and due to the short distances within the city, this suits their business model with short delivery times, which is also indicated by (Busch et al., 2021; A. V. Hill, 2020). Manufacturers also mentioned the value of proximity to urban infrastructure (SM2, SM1, SL1, RM3, RM2, RM1, RL3). Relating to logistics, the industrial-scale infrastructure is valued, as these manufacturers depended on large trucks for deliveries and distribution. These factors, including proximity to the city centre (hubs) and a support network in agglomeration economies, are aligned with the findings from the literature in Chapter 4 (Girard, 2013; Grodach & Gibson, 2019).

5.2.3 Success factors, development principles

Tailor-made and standing out
An important success factor is to focus on and listen to the requirements of the (future) employees who will work in the accommodation, to provide them with an attractive and inspiring workplace (SL1, SM2, SM1). Offering just a building at a nice location is not enough for most companies (SL1). Most important is to distinguish the company and accommodation from others (SM2, SM1),

Interview results

especially in competitive markets such as high-tech manufacturing, where access to local, highly qualified labour is crucial (A. V. Hill, 2020). There are multiple ways to achieve this. One way is by promoting the history through storytelling and branding focused on the historical value of the production sites for its surroundings and the atmosphere that remains (SL1, RL3). The selection of a site is also important, as it needs to be well accessible, preferably close to public transport for employees of all kinds of manufacturers. The building itself should also provide an attractive work environment by making use of the present heritage values. In addition, some of the interviewees highlighted the importance of an involved developer or owner, who can tailor the building to their needs, think along and is prepared and capable to invest in this for a long term (SL1, SM1, SM2, RL3, RM3, RL1). Multiple interviewees mentioned a guideline of 1000m2 units for middle-sized companies provides a good starting point (SM2,RL1,): *'for some companies it is just too large, for others just too small, but they will adjust to it'*. The extent to which developing parties can adapt their buildings according to the requirements of their clients, sometimes within a short term, can be part of the success (SM1). At, the same time, developers need to make sure they can still rent it to others in the future (SL1, SM1, SM2). This can be challenging, as one interviewee indicated: *'companies never know what type of accommodation they actually want, but at the same time it has to meet those requirements when they arrive'* (RL1). It remains important to look at the market to see what future companies can be accommodated. A certain proactive development is beneficial when attracting companies, but at the same time alterations can be made in a later stage. Multiple companies within the first phases indicated they would also prefer to make alterations themselves for reasons of affordability and prefer building owners that facilitate this (RM1, RM2, RM3, RL2). Therefore, it is also important to select companies carefully based on the potential of the building, as alterations are not always possible in heritage.

Flexibility

Another success factor from the cases is to maintain flexibility in different ways. Companies have different requirements in different phases resulting in uncertainties (RL1). *'Some companies grow so fast, so 1: they need to be able to grow easily, and 2: their requirements change sometimes'*, one interviewee indicated (SL1). It can be valuable to be able to respond to this demand quickly, by for example contracts with certain developers or construction companies (SM1,SL1).

Offering a flexible layout with room for growth at the building or site, is important and also described in literature (A. V. Hill, 2020) (SM1, SL1, RL1, RM1). Buildings should not always be filled completely for efficiency reasons, as growth potential is crucial for existing tenants: *'in another location we would have to sign a contract for 15 years, and you couldn't expand there, unless your neighbour was moving out'* (SM1). In addition, the contracts should also be flexible and not include too many restrictions (RM1, SL1), especially in the case of Type I & Type II manufacturers, who need freedom to experiment and for scaling-up or down: *'one should be able to put a screw in a wall or make some noise', 'without this flexibility I could never have done what I'm doing now. At first we rented a little space, then added something, then we broke down a wall and took the other side, which allowed us to keep growing. This was really important for us'* (RM1). Owners should therefore aim facilitate this process to make sure manufacturers are not limited by their initial space requirements and contracts (RM1, RL3, SL1).

Community: organic growth and self-organisation with a low threshold

A crucial success factor indicated by all interviewees is management of the community. It is important to have a local representative like a location manager to discuss accommodation, services and events, but also for commercial opportunities, finance, finding employees and other support functions (RL1). This person should be

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accessible and closely connected to companies (RM3, (A. V. Hill, 2020). The network is crucial for successful urban manufacturing and access to this network can be provided by this representative (RL1, RM3, RL3).

Events are one way to facilitate a community. However, the interviewees indicated these should be kept informal and simple to keep them accessible, even though this might impact their relevance for some manufacturers (SL1, ER1). In addition, some interviewees indicated that such events are most relevant in the initial phases, for building a network (SM1, SM2, RM1, RM2). When companies grow to maturity and are well known with their environment, these become less relevant: *'they have their own campus and community within their company'* (SL1). They like the presence of such events as part of the concept, but don't necessarily want to always participate (SM1, SM2) or that it could only work with related companies (RM3). One way to make it more relevant is to make companies responsible for organising community events themselves, with support of the owner/ managing party (SL1). However, several interviewees (Type I-II) also indicated that they would rather organise such events informally to avoid a formal character, which can be facilitated by allowing, but not forcing it (RL3, RM1, RM3, RM2). One interviewee indicated '*It shouldn't be too professional' 'if it is all in an area where nothing is allowed and with many restrictions, you lose the (informal) atmosphere'* (RM1), which is related to the classic story of gentrification: '*First the atmosphere is good, a community is established organically and informal drinks are organised, but then the building is redeveloped and improved and becomes too professional'* (RM1). This seems to be a characteristic of especially the creative manufacturers in Type I, who establish their own community informally and are in a more vulnerable position in the initial phase. Events like this are perceived as a first step in gentrification and too forced (RM1). This may be a characteristic of the specific case and type, as all interviewees within the case indicated this.

One expert indicated: *'everything related to the business, business-related tasks and activities or social activities, should be able to take place, but it should not be facilitated too much'* (ER1), which shows the difficulty of doing 'just enough' to stimulate a certain behaviour or location of a certain type of manufacturers, and the perception of being forced into a concept. Still, a developing party should offer the infrastructure to facilitate manufacturers. By this, a concept can be delivered informally through creating the right conditions (ER1), which was also indicated by other developing parties to still achieve the desired concept (SL1, RL1, RL3).
Another way is to facilitate interaction. This doesn't always have to be through facilities like restaurants or cafes, but can also be by creating an open character: *'making sure there is a culture where people can just walk in'* (RL3), or locating multiple manufacturers in a large space. All interviewees indicated such informal interactions are really appreciated. The following sections will elaborate on the principles to apply this.

Selection, positioning and concept

Creating a concept that fits within the economic context and selecting companies and support functions carefully is another crucial success factor for realising urban manufacturing. This can be based on the proximity of other economic functions, infrastructure like railways, airports, or waterways and public accessibility (SL1). Multiple interviewees mentioned the value of urban edges. According to one of the interviewees this is because they are the most dynamic, where different functions are mixed and come together (RL3). Here, creative or innovative hubs and potential employees are located, which is also described in the literature (Girard, 2013; Girard & Nocca, 2019; A. V. Hill, 2020; Spalanzani et al., 2016). These are therefore valuable locations to locate urban manufacturing.

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Nevertheless, a concept should be based on a certain theme (RL1, SL1, RL3). It should be relevant and fit within the region (context), be complementary or fill a certain gap: '*Everyone has a valley or something now, but it needs to be real*' (RS). It is important to select the companies carefully to maintain this concept (RL3, RM2, SL1, RM1). Criteria for selection can be based on their contribution to current manufacturers, complementarity, valuation of heritage and being committed to maintain it and participate in the community (SL1, RL3, RM1, RM2), but also having stable source of income and market potential of their products, to make a long-term contribution (RL3). Finally, the concept should clearly represent itself to externals. One manufacturer also highlighted the importance of creating a concept of the building itself (SM2). Avoiding a focus on space optimisation is important to maintain maximum heritage value, originality and identity of the building, branding and image of individual companies within the area. Furthermore, guidelines for signage, vacancies and furniture to maintain a clear concept and certain image can be important (SL1). Again, this is often the role of a location manager and owner. It is important they make sure the surroundings are kept well, plan for further developments and maintenance, as these are the elements that make it worth to stay (SM2).

Selecting companies within the concept doesn't mean they should all be the same, but putting together a group of people that match and understand each other is important to create understanding and avoid complaints (RM1): *'companies should differ sufficiently to keep inspiring each other, but still talk the same language'* (RL1). Another: *'what is interesting is that they try to fit many different kinds of parties and companies. But there are of course many different fields of work that I'm not as much connected to as when we're working in a similar field (...) and therefore, I'm also not very interested in getting to know them because the basis is not even given'* (RM3). One of the interviewees also mentioned it is important to keep the same level of rents, to avoid that the building becomes occupied with companies who want to pay a lot extra for the accommodation, so it becomes unaffordable for the other tenants (RM3). *'A place with like-minded people, with at least one similar step in the process'* (RM3), or *'running into the same problems'* (SL1) can be valuable (RM3, SL1). Especially for Type I and Type II manufacturers this is part of the success: a place where they can informally exchange equipment and ask their neighbours for advice (RM2, RM3, SL1).

Environment: cooperation

Finally, several factors in the context of the development can influence the success of realising and maintaining urban manufacturing in industrial heritage sites.

First of all this relates to cooperation and flexibility by municipalities (RL3, SL1, RL1, ER1). For example, in Strijp-T, the land-use plan was adjusted to one based on activities, instead of functions per building (SL1), which facilitates accommodating a diversity of functions. In more central urban locations, manufacturing using machines is often not allowed, but new production methods often produce less nuisance, and these manufacturers value such locations a lot as opposed to company parks. This requires municipalities to rethink their zoning as well by facilitating more fluent transitions in use (ER1). Maintaining a good relationship with a municipality is therefore also crucial (RL1). This can also be achieved by a reciprocal relationship, as often these developments are beneficial for the economy of a city or region. In addition, one expert indicated the importance of such a relationship with the surrounding neighbourhood. By delivering waste heat for housing or providing additional services in the surroundings, acceptance to urban manufacturing can be increased which contributes to the success or realising both urban manufacturing and creating circular relations.
Finally, the right conditions for production need to be

Interview results

present. Locations could be selected that receive too high noise levels for other functions (RL2). In all the studied cases, higher levels of noise could be produced due to environmental zoning. However, this was challenged by pressure from the surroundings, other tenants that were not manufacturers, and future developments such as housing (RL3, RM3, RM1, RL2). One way to overcome this is to focus on innovative production processes or digital, high-tech production in the most sensitive areas or apply zoning in which the maximum nuisance is reduced gradually towards more residential and noise-sensitive areas (RL2, RL1).

5.2.4 Circular development principles from interviews

When asking interviewees about circularity within their company or the factors to realise this, they often referred to sustainability measures to buildings. In addition, multiple interviewees mentioned this aspect is still under development and research and especially the use of renewable material resources is behind, compared to renewable energies (SL1, RSL1). They do mention the presence and possibilities for more local production (SM1, RL1) use and exchange of (waste) materials for production (RM3, RM1, RM2), or disassembling old parts to reuse in new projects, but do not always refer to it as part of the circular economy. Several events to share knowledge and case-studies and experiments took place in more innovative environments, but at a small scale (BH). In addition, there are some limitations related to infrastructure. For instance, when power supply for further electrification of the production process is present, but the contracts are not increased yet due to limitations to the capacity of the local and national network (SL1).
Nevertheless, one of the interviewees mentioned if (primary) resources become more expensive, this provides possibilities for reuse of waste flows from the industry, yet another factor will be even more important: *'Before the idea was always that cost efficiency will be most important in this, and this will be a game changer, but security of supply will become even more important'* (RL1). This means companies also need to rethink their (accommodation) strategies. A location near those resources could become more valuable. Providing this accommodation in locations with abundant resources, such as (port)cities, could play a role in realising a circular economy and manufacturing industry. Still, it requires a party to start this within the whole chain, as often parties assume they should not be the first to initiate this. Central organisations, focused on supply security could organise this, but this is a major challenge (RL1).

Another limitation is the efficiency of current waste processing in the Dutch context. According to one of the interviewees, this made it difficult to demand separation of specific materials by individuals (ER1). There is also uncertainty about where certain materials are available at a certain moment (ER1, RL1). One way to overcome this is by creating a critical mass: by clustering companies that produce similar materials and waste. Another company can then be added to reuse this waste for new products. A crucial factor is to reserve space for circular economy: for collection, storage and processing of these waste materials in manufacturing districts, which results in more efficient local processing (ER1). Creating internal waste flows are one possibility. For external waste (for example from the surrounding city, it remains important to separate waste. Systems that can separate this are crucial because people are not always capable to do it themselves. This is one of the limitations for upscaling circular economy as well.

Besides clustering similar companies, complementary functions can contribute to circularity. Traditional companies can realise this informally, by using each other's productive (repair) skills, while for high-tech companies, this can be achieved through collaborations resulting in

innovation as mentioned in chapter 4 (ER1). Finally, giving back something to the urban surroundings can contribute to realising circular urban manufacturing. This can be in the form of energy, but also facilities. Only if the relations and acceptance are good by creating a positive image, exchange of flows can work well. In this sense, mixed use cán be an opportunity.

5.2.5 Challenges

Challenges related to industrial heritage buildings

While the benefits outweigh the limitations of accommodation in heritage for most manufacturers, interviewees were also asked to reflect on these and how they impact their location decision. One interviewee mentioned the use of special building materials for the renovation process to meet regulations related to historical materials and appearance (SL1) like protected monuments (RL3, RM2). In addition, industrial heritage can contain hazardous materials from previous use, such as asbestos, oil or other chemical remains (RM2, RL1,SM1).

Multiple interviewees within Type I-II mentioned another limitation. The buildings in this case were less well maintained or not fully renovated, which provided benefits in terms of affordability and freedom to experiment '*this makes it easy to put a few creatives in*' but it doesn't always suit their next, more professional phase (RM1, RM2). Technical limitations are risks of leakages because of the age (RL1), low energy efficiency (SM1, RM2), temperature control resulting in less optimal working conditions (RM1) and meeting current (fire) safety regulations (RL1). One interviewee indicated: *'you can overcome these, but at what cost? It sometimes just becomes too expensive to meet current requirements'* (SM1). Safety regulations can also reduce the flexibility of new functions. Especially in large open spaces, companies sometimes need to be protected from each other by individual safety measures, so not all types of manufacturing can be located there. In new buildings manufacturers can tailor the spaces to their own demand (SM1), but this means the flexibility of larger and shared accommodation is lost (RL1). Finally, some interviewees mentioned that although general accessibility is well for an industrial location, it is still less accessible than a city centre in terms of public transport in some cases (RL1).

Development: shared vs individual space

Other challenges are related to the concept and configuration that limit the success of the case-studies. One interviewee mentioned a conflict between creating an open atmosphere and displaying production to visitors, and protecting the privacy of manufacturers and their process (RL1). This also applies to shared facilities that are often not used for formal meetings. Shared workspaces like a makerspace or labs were referred to as unsuccessful and undesired by most interviewees. Many didn't want to depend on others for their production process and sharing can cause friction (RM3). The production processes of multiple companies were also too specific or even confidential, which requires special equipment and protected environments that makes sharing difficult. In the Netherlands, small (creative) manufacturers are often innovative companies who do prototyping, value privacy and have specific production processes and uncertainty of when they need specific equipment, so planning makes shared use difficult (ER1). However, informal sharing does take place. Especially Type I and Type II companies mentioned they share equipment occasionally or produce certain parts for each other, but at their own initiative (RM2, RM1, RM3, RL3).

Interview results

Heritage and urban development processes

There are some challenges related to the heritage specifically. First, an official monumental status can limit the development potential due to regulations (RL3, RM1). Related to this, is the inefficiency of some spaces that cannot be changed to maintain the heritage values (SM2). In addition, the municipality is often not the developing party. They want to protect heritage, but there are limits to providing individual parties the rights to develop in complex area developments, as developers often need to include it in larger plans to make it financially feasible, so individual heritage adaptive reuse for manufacturing is difficult to realise. At this moment a lot of financial support is needed to get middle-sized companies in developments like M4H, as the societal added values cannot be capitalised yet (RL2). Municipalities can include special programmes like urban manufacturing in tender requirements, but this often excludes affordability (RL2), as many subsidies are for housing, and not for commercial developments. In this way, many heritage redevelopments become so expensive that they can only be rented to high-end or office functions (RL2).

When parties manage to realise urban manufacturing in such developments, some challenges remain, especially relating to the process of gentrification. Manufacturing functions are often temporary, while plans for redevelopment are made (RM1, RM2, RL2). This also puts less financially capable manufacturers in a difficult position. One of the examples also showed that even when a building is meant to be for manufacturers permanently, a change in ownership can still influence this. Many creative manufacturing environments eventually attract more commercial companies that aren't involved in manufacturing themselves. If a building owner doesn't select new companies based on a desired profile for manufacturing, or if ownership changes, this can result in increased rents, less possibilities for experimenting and changing regulations. As a result, an owner or developer can force manufacturers to leave in exchange for companies with more financial power (RM3, RM1). Another limitation of the temporary character are the limited investments in sustainability measures: *'while the aim of this kind of places is to generate innovation, or at least facilitate it, this should be part of it, you cant skip this'* (RM2). In addition, more traditional small-scale manufacturers are viewed as a marginal group, while more 'digital' producers are often perceived as the future of urban manufacturing as they fit better in more urban environments (RL2). This also causes a preference for this type of manufacturers in new developments by developers and municipalities on the long term. City edges are valuable locations, but as one interviewee indicated: *'they are disappearing as cities grow towards each other'* (RL3). The pressure on these urban areas was also indicated in the literature (A. V. Hill, 2020), as they are valuable for other functions as well.

5.2.6 Development principles

Concept

Development of a concept based on the economic and urban context is important. It can be crucial for the success, as by a good analysis and proactive development, the spaces are available at the moment of demand (RL1). The creation of a campus-like environment around a certain theme can work out well (RL1, SL1, RL3), if it is 'real', based on the local and regional context, current or future demand and suits the possibilities of the (heritage) assets (RL1, SL1). It can be relevant to give back something to the surroundings to foster (circular) relationships (ER2, RL3, ER1 SL1). Furthermore, it is relevant to display the innovative, sustainable or creative character of these areas, based on the concept (SL1). Still, such interventions should be proven, substantial and 'real' and not just a label (RM3). Finally, managing and maintaining the concept is important. The criteria and guidelines should be followed for selection but can be adjusted according to

Interview results

developments in the context or development of the present manufacturers. Interviewees indicated that changing requirements also part of the process to grow to maturity (RL3, SM1, RL1): *'it is also a phase, there is impermanence to it, and if you come out of this phase as a healthy company and are able to grow your business, you will notice it will just become a different company'* (RL3). A decision needs to be made between facilitating companies in their growth and development within the possibilities of the site and building, or staying close to the concept and only keeping companies within a certain phase, type or scale.

Company selection and support network

Selection of the right companies is considered important by all interviewees. It can be valuable to have a mix in companies, who can surprise or inspire each other, but still talk in the same language or share pars of their process (RL1, RM3). Multiple interviewees mentioned that at some point, some manufacturers liked to be associated with a more professional environment, including more professional companies that produce the same quality of products (SL1, RM3). This is another important factor to consider in the selection.

Companies can also fit the concept by providing related ecosystem services like finance, legal- or design support (SL1), which can be valuable for developing their network too (RL1). This should only be allowed if they improve the character or atmosphere and it is important to be strict in maintaining the concept in different ways, including guidelines for e.g. appearance in the concept, according to (SL1). It is important that companies support the concept and vision (SM1, SL1), and value the heritage and desired type of environment (RL3). Staying close to the concept is important for multiple reasons: to keep supporting each other and collaborate (RM1), and to distinguish the concept and site, which contributes to the success (SL1).
Placemaking support facilities can be restaurants or cafes, organised events for developing the community or attracting externals, but also shared meeting spaces (SL1). According to most interviewees, the use of such facilities should not be forced. It remains important to make sure companies are not dependent on shared facilities or other manufacturers for their essential processes. Nevertheless, companies often tend to turn back to their own 'islands' of their own company and community. One way to overcome this issue is to direct the use of shared facilities by restricting the development of their own. For example, a limit can be set to the size or number of meeting rooms or hospitality facilities. One of the experts indicated this is often used in campus-like development for this reason, as it is most effective (ER2). However, this also excludes the companies that object to this, as one interviewee mentioned: *'you need to provide this is a more soft way, you shouldn't facilitate this as 'hard' regulations, as this is bound to go wrong'* (RL3). In addition, encounters can be facilitated by creating an open design and shared areas, but a location manager should not act in-between as a facilitator (RL3). They should be able to encounter others themselves, based on a careful selection of tenants' compatibility in advance (RL3).

Design and future use (building)

It is important to tailor the buildings to user requirements, but the future use should also be considered, as companies change their accommodation or move to other buildings at the site. Therefore, modularity and creating multiple entrances to maintain flexibility can be an option (SL1). In addition, multiple interviewees mentioned dimensions of 1000m2 as suitable for scale-ups, but also for grown-up companies who want to add additional space (RL1, SM2). From the interviews it appears that more mature companies know their requirements better, and therefore can afford more tailor-made solutions and accommodation. For Type I and Type II companies however, it remains important to maintain flexibility, by providing just the basic infrastructure to leave room for experiment (RL1, RL3).

Interview results

A principle related to the design and urban planning of these sites is to make sure logistic infrastructure doesn't cross neighbourhoods (ER1). This may seem obvious, but in practice the direct environment is not always considered (ER1). As a result, manufacturers must leave due to the impact on (traffic) safety and other nuisance for residential areas. Besides, manufacturers value logistic accessibility high (Figure 6.10). Transition zones are also mentioned by multiple interviewees (ER1, RL1). This means gradually reducing the nuisance-intensive activities towards other urban areas and facilitating this by both functional transition as well as a built transition.

Making use of heritage values is increasingly important as mentioned earlier. This can be achieved by creating desirability (RL3), promoting the soft values of heritage, like storytelling (SL1, SM1), or the hard values by making the industrial appearance, specific infrastructure and other added values (Chapter 4) part of the concept.

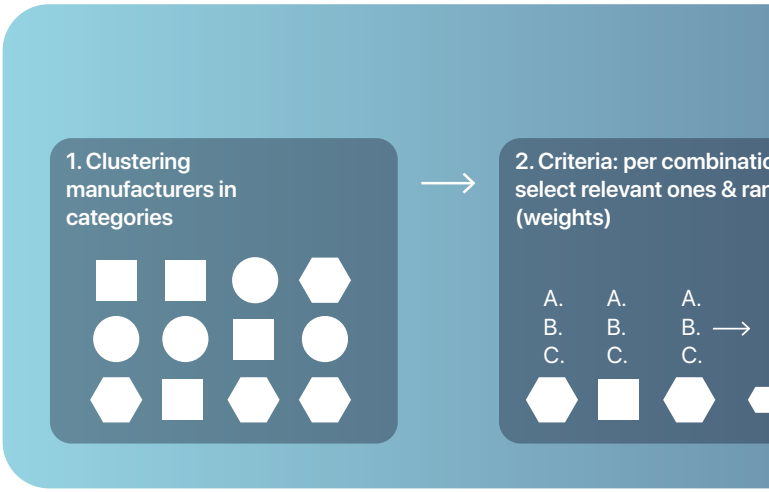
Flexibility
Flexibility does not only relate to the buildings by facilitating growth, but also the relation with the owner or property manager, and the contract. According to multiple interviewees, flexible contracts were important in combination with a location manager who is thinking along. Flexibility can be achieved in duration, which is beneficial for companies with uncertainties in their first phases. It can also be about the accommodation itself, by facilitating movement within a building, scaling up-or down or movement to another accommodation at the same site. Certainty is needed for both the owner and tenant as they invest a lot in the accommodation (SL1).

Conclusion of chapter

This chapter introduced the studied cases and interview results to show the requirements, values of heritage for manufacturers, success factors and development principles for realising (circular) urban manufacturing in industrial heritage. In addition, the outcomes have been linked to previous literature and a first expert review was conducted to reflect on these results. The results show that these vary between types, and sometimes result in opposing preferences and principles based on individual preferences besides other challenges related to heritage. Factors such as flexibility, accessibility and appearance are valued, but opinions about shared facilities differ between many interviewees and provide another perspective on the outcomes of the literature review. Increasingly, attraction of employees becomes important, resulting in the need to select distinct accommodation that provides inspiring workplaces. Interviewees indicated this is one of the largest values of industrial heritage, besides more technical values. Related to this is the need to focus on the employees' requirements, develop tailor-made solutions and promote the concept as some of the success factors. At the same time, keeping sufficient flexibility is important to facilitate the development of manufacturers. Other development principles are providing the basic conditions to facilitate community development, and carefully selecting companies based on a well-founded concept. For realising circularity, several options exist, from facilitating innovation and clustering similar companies to creating internal circulation of flows and investing in relations with the surroundings to foster circular relationships. In the following chapter, the assessment and development framework is presented. Based on the weights provided in the questionnaire, the interviews and expert review, a final set of assessment criteria is developed. Next to this, the development principles based on the success factors, development principles, values and requirements from the interviews and expert reviews are presented.

6.
Assessment & Development framework
6.1 Framework components & design

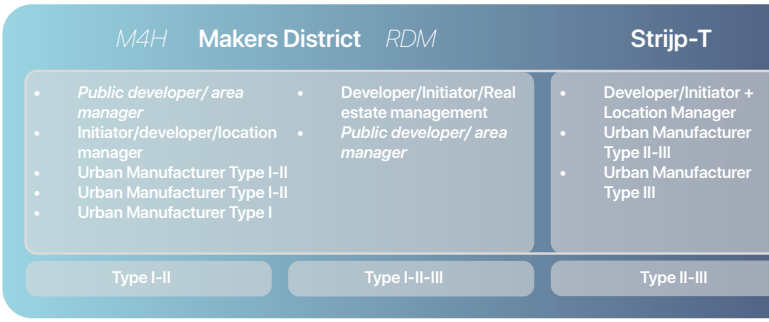
The interview results from Chapter 5 have been used to construct the assessment and development framework presented in this chapter. The following sections will elaborate on the different components, design, use and application of the framework on the case-studies and a new 'design' case. This consists of a reflection on the existing cases to validate and compare the outcome to the actual situation, and to reflect on the applicability for other cases through a design case. This case will also be analysed and reflected on through two expert reviews: One academic expert to reflect on the outcomes of the empirical research and comparison, and one expert from practice to reflect on the model and comparison with the design case.



6.1 Framework design and use

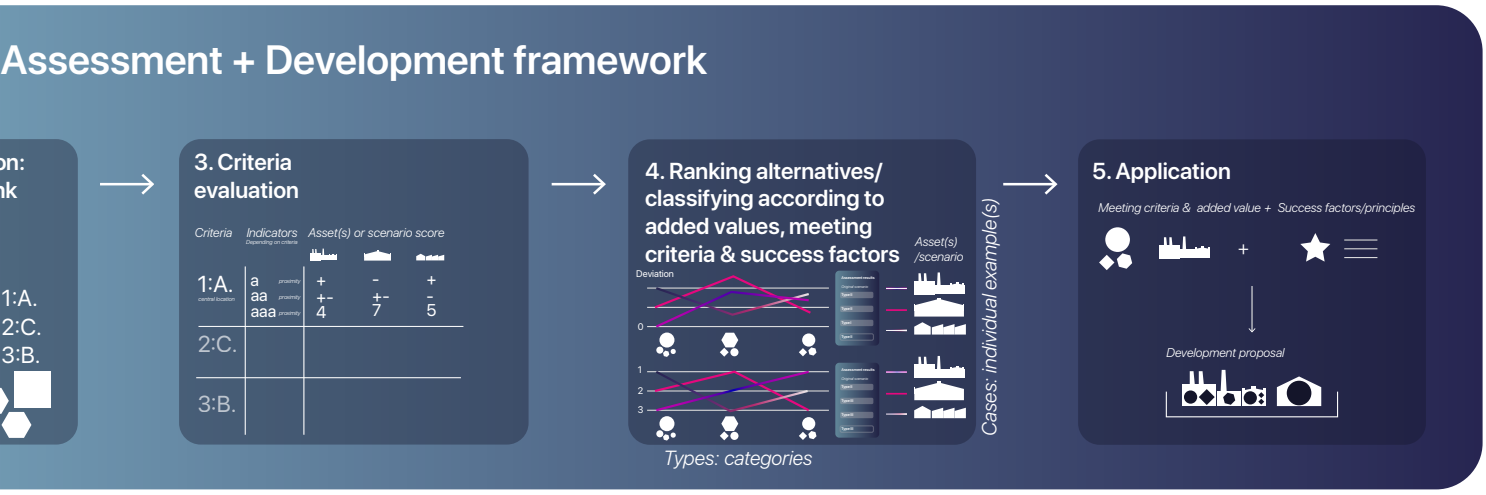
6.1.1 Components & design

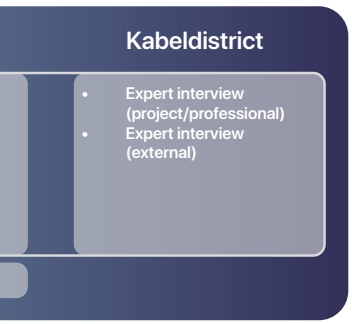
As introduced in Chapter 3, the framework consists of different elements. The first step is to develop several groups or individual functions to compare. Based on the literature review and interviews, these have been categorised as Type I, Type II and Type III manufacturers (Figure 6.2). The next step is to develop a set of criteria per type. Based on the interviews and a questionnaire, a set of criteria is developed including weights to indicate the importance and relevance for each type of manufacturer. This is used to construct the assessment matrix (Figure 6.10). Using this matrix, different potential buildings or different scenarios for the same building can be assessed. Based on a selection of the most important criteria and points of assessment (Figures 6.12-6.16), the preferred alternative per scenario can be selected. Together with the development principles (Figure 6.11), based on the literature, requirements, success factors and development principles from the interviews, a proposal can be made to facilitate a specific type of manufacturing in industrial heritage.

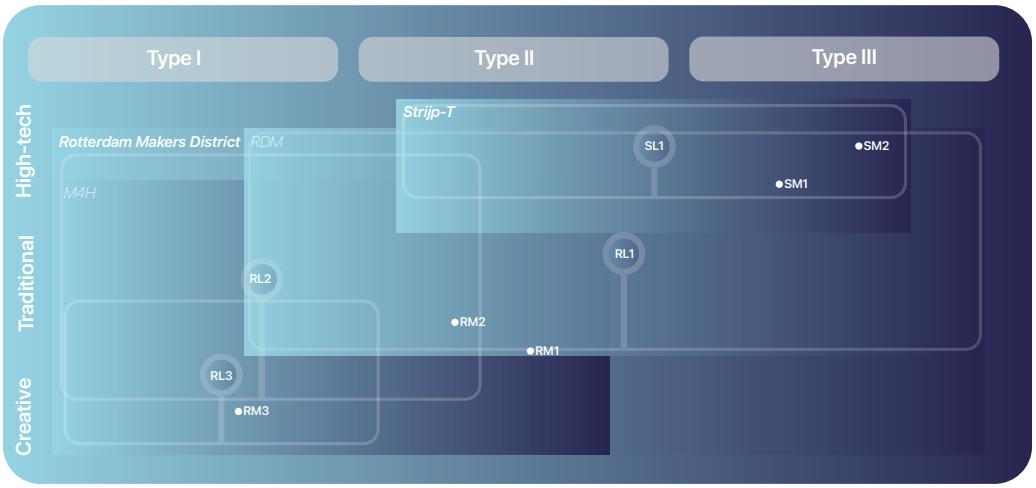


6.2 Manufacturing types and case-studies

Framework components & design







6.3 Interviews indicated in type and sector. Individuals are indicated as points. Representatives of larger areas are indicated with lines.

Framework components & design

3. Criteria evaluation | Resulting weights

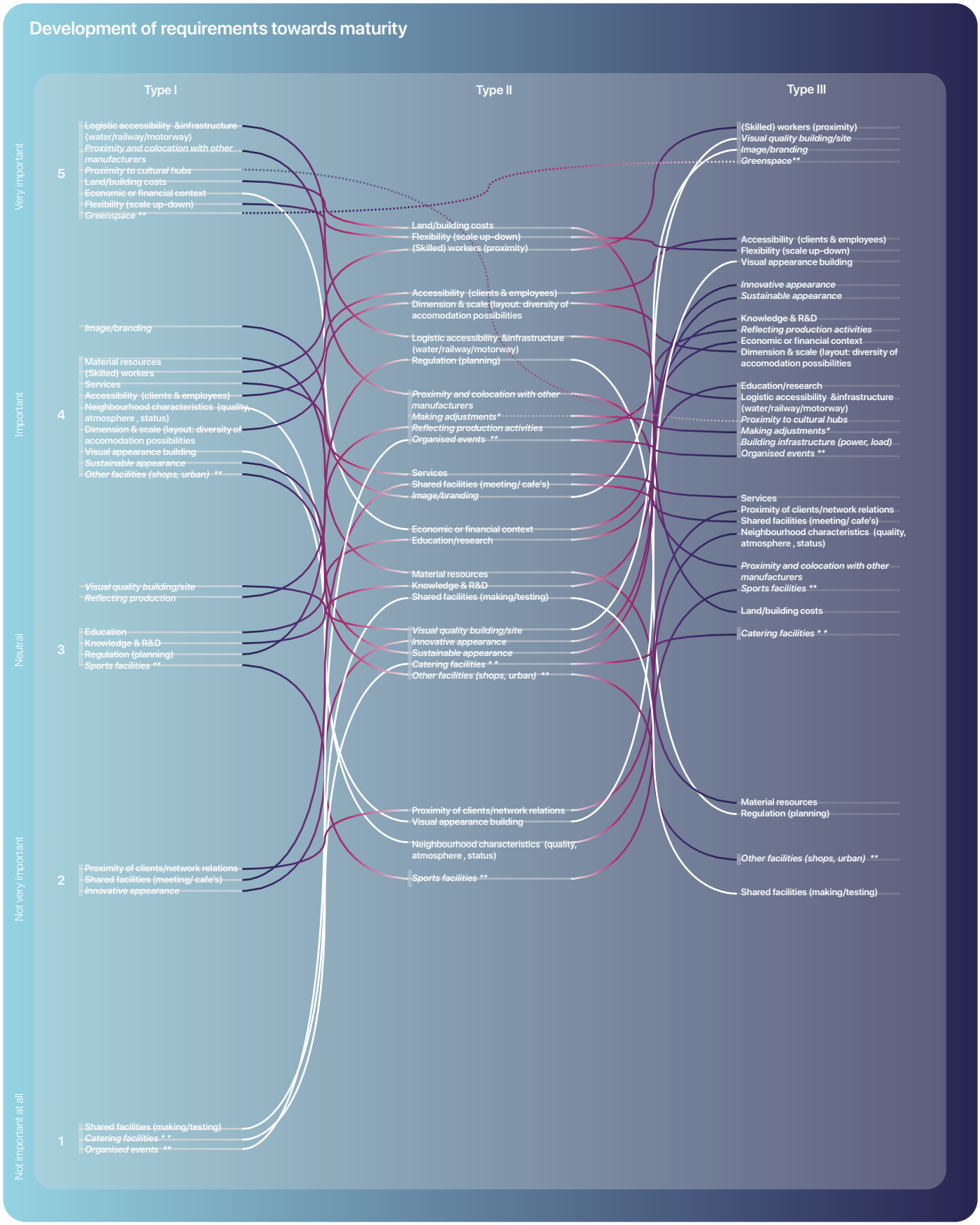
Criteria	*Indicator explanation/assessment guideline*	*Weight Type I*	*Weight Type II*	*Weight Type III*
Urban/ central location, Proximity to:				
Material resources	Proximity of primary or secondary resources (materials, parts) for the specific company at the location, city or region	4	3,25	2,66
(Skilled) workers	Based on the economic context: education and similar companies within the sector	4	4,75	5
Education	In the surroundings or at the location of accomodation (city)	3	3,33	4
Knowledge & R&D	In the surroundings or at the location of accomodation (city/region)	3	3,25	4,33
Services	In the surroundings or at the location of accomodation (city)	4	3,75	3,66
Clients	In the (urban) surroundings or city/region	2	2,66	3,66
Accessibility (clients & employees)	Accessibility by car, bike, public transport opportunities or proximity of an airport (clients)	4	4,5	4,66
Logistic accessibility &infrastructure (water/railway/motorway)	Proximity to waterways, highways, railways and suitable logistic infrastructure at the site	5	4,25	4
Shared facilities (making/testing)	Current presence or potential	1	3,25	1,66
Shared facilities (meeting/ cafe's)	Current presence or potential	2	3,75	3,66
Catering facilities	Offering cafe/restaurant services at the site	1	3	3
Sports facilities	Offering sports facilities at the site	3	2	3,5
Organised events	Organised events (organised by developer/owner or location manager)	1	4	4
Other facilities (shops, urban)	Presence of urban facilities such as shops, cafes or retail at the site or direct surroundings	4	3	2
Proximity and colocation with other manufacturers	Current presence or potential	5	4	3,5
Proximity to cultural hubs	In the urban surroundings, city or region (e.g. High tech companies and universities, musea and ateliers, or a port area) which can suit a specific concept	5		4
Greenspace	Presence of greenspace in the direct surroundings of the building	5		5
Making adjustments	Based on the monumental status and resulting regulation, concept from building owner/manager and type of companies present: the facilitation of adjustments		4	4
Building infrastructure (power, bearing load)	Present electricity infrastructure and contracts, large roof heights or load bearing capacities based on the preferences of the companies that are assessed			4
Atmosphere:				
Visual quality	Spatial & aesthetic qualities of building/site	3,5	2,66	5
Image/branding	Use of atmosphere for image/branding of companies or the concept	4,5	3,66	5
Reflecting production	Based on other companies, industrial appearance and activities taking place at the site or building	3,5	4	4,33
Neighbourhood characteristics	Based on the spatial quality, appearance and socio-economic status of the neighbourhood	4	1,5	3,66
Land/building costs	Higher costs assessed with a lower score	5	4,66	3,33
Regulation (planning)	More/ more strict regulations assessed with a lower score = less options for companies	3	4	2,66
Economic or financial context	Based on the economic context: similar companies within the sector, ecosystem/concept and the potential gap (business case) suiting the company or concept	5	2,33	4,33
Dimension & scale (layout: diversity of accomodation possibilities	Based on the scale, layout and physical form of the building and spaces	4	4,66	4,33
Flexibility (scale up-down)	Based on the scale, layout and physical form of the building and spaces including the current use and future (expansion) potential	5	5	4,66
Visual appearance building	Aesthetic qualities & professional appearance of building	4	2	4,66
Sustainable appearance	Sustainable appearance (visible measures)	2	3	4,5
Innovative appearance	Innovative appearance (visible: e.g. spaces of display, exhibition windows)	4	2,33	4,5

6.4 Weights and elaboration

6.1.2 Criteria and weights

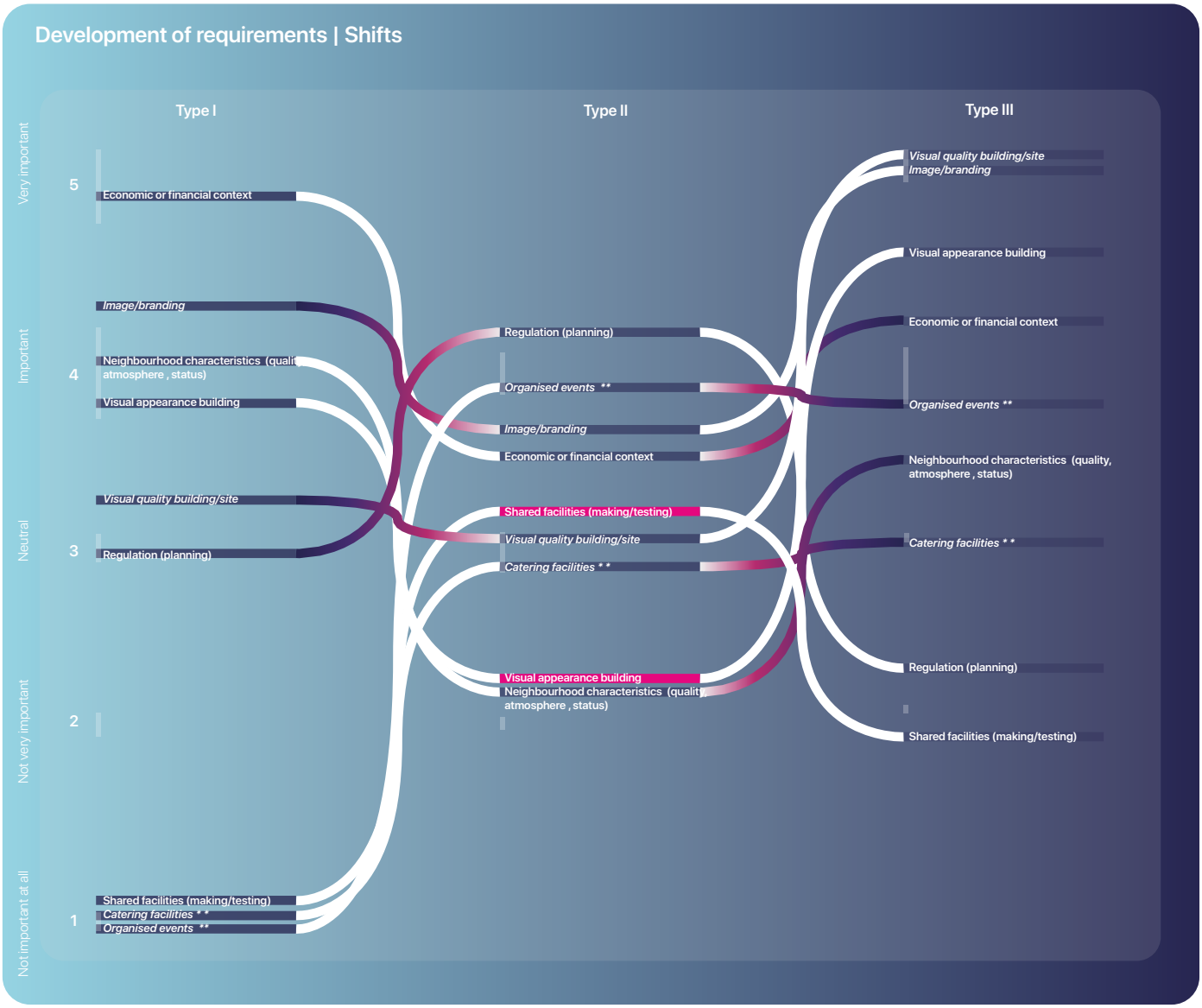
The resulting weights based on the 9 interviews (Figure 5.1), including a short elaboration are presented in Figure 6.4. These are based on the questionnaire where interviewees had to indicate the importance of several criteria for their accommodation (Appendix II-III). The development of importance of all requirements are visualised in Figure 6.5. These are based on the average weights per type in Figure 6.4. In the figure, the largest shifts are indicated with white lines. To analyse these outcomes, large shifts, upward developments and downward developments of weights in each phase are visualised in Figures 6.6-6.8.

Framework components & design



6.5 Development of requirements between types (phases)

Framework components & design

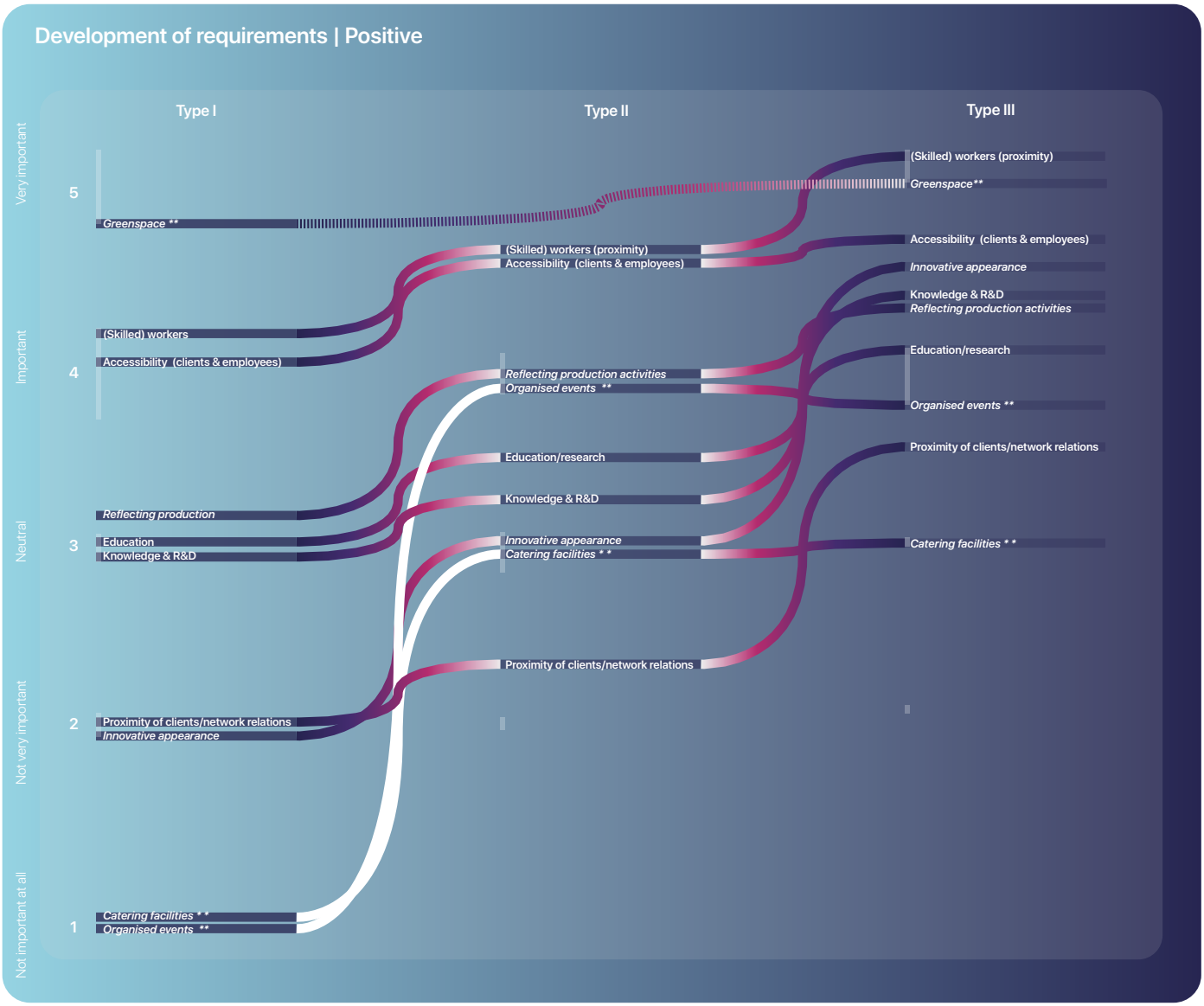


6.6 Shifts in development of requirements between types (phases)

Shifts between requirements per type

One of the largest differences can be seen in the weight of organised events. As mentioned earlier, this is likely specific to the type of creative manufacturers that were interviewed, who indicated they value to organise their own events. Also, shared facilities were valued low for this type, as part of the same tendency to not depend on others. Type II manufacturers valued this when present, but they were relatively neutral about the necessity. Type III preferred their own facilities due to their tailored and specific processes. Regulations are rated highest for Type II, mainly due to their need for space to experiment and testing which requires less strict regulations. Finally, the visual appearance of both the building shift between the Types. For Type II, this is valued less, as they focus on growth and development of their company. The importance of visual quality of the building is less in this phase as the focus is on scaling-up and investments in the production process. At Type III this is valued highest again. These indicated this is a crucial factor for positioning their company and attracting employees.

Framework components & design

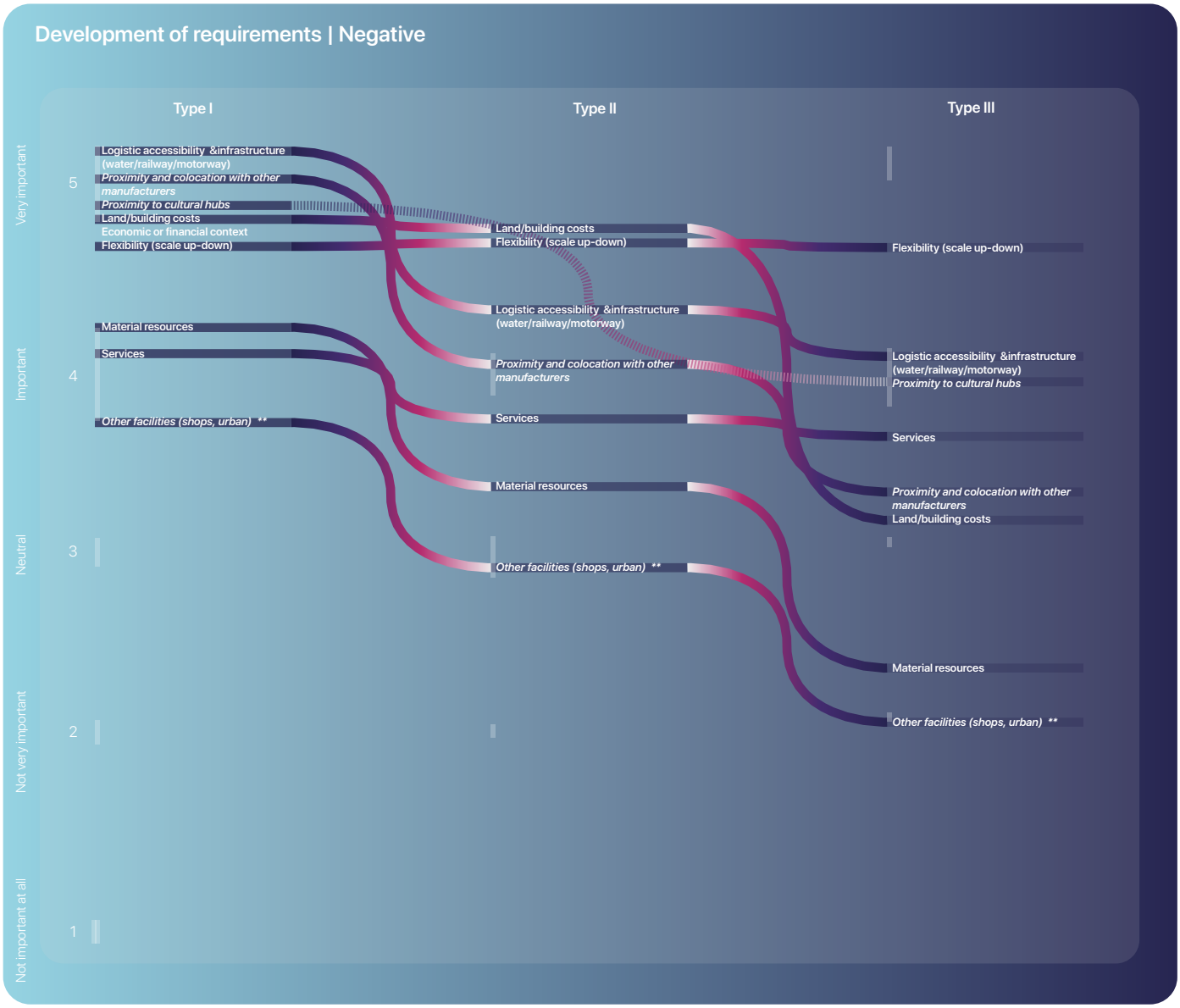


6.7 Positive development of requirements between types (phases)

Positive developments from Type I towards Type III

Interviewees indicated increasing importance of proximity of skilled workers, clients, their network and the accessibility for clients & employees. Support functions such as education, research, knowledge and R&D were also increasingly valued in their proximity. This is surprising, as during the interviews, interviewees indicated they value such functions more in-house as they became more mature. Based on this, one would expect it to be higher for Type II, who value this in their process of innovation and scaling-up. It is possible that this is more to fit the concept which is beneficial for their image, than for actual use. Finally, an innovative appearance and productive atmosphere were valued higher towards Type III. This is likely linked to the increased value of a more professional environment and branding as indicated in the interviews.

Framework components & design



6.8 Negative development of requirements between types (phases)

Negative developments from Type I towards Type III

The factors that become less relevant when companies develop are visualised in Figure 6.8. The decreasing importance of accommodation costs, colocation with others, services and other facilities is aligned with the expectations based on the literature and interviews, as companies grow to maturity and have more support functions in-house and more financial means. What stands out is the decreasing relative importance of logistic accessibility and infrastructure, as larger companies often produce larger batches and need more traffic movements of products and materials. However, it remains relatively important with a score above 4 (important-very important) for all manufacturers. This could be due to differences in interpretation. The negative development of materials resources is also significant between each Type. This can be a result of both the interviewee-specific and type-specific characteristics. For example, the manufacturers within Type I used relatively more local materials and parts from other manufacturers than Type II and Type III, which can explain the different weights that were given.

6.2 Use of the framework

3. Criteria evaluation | Assessment Matrix

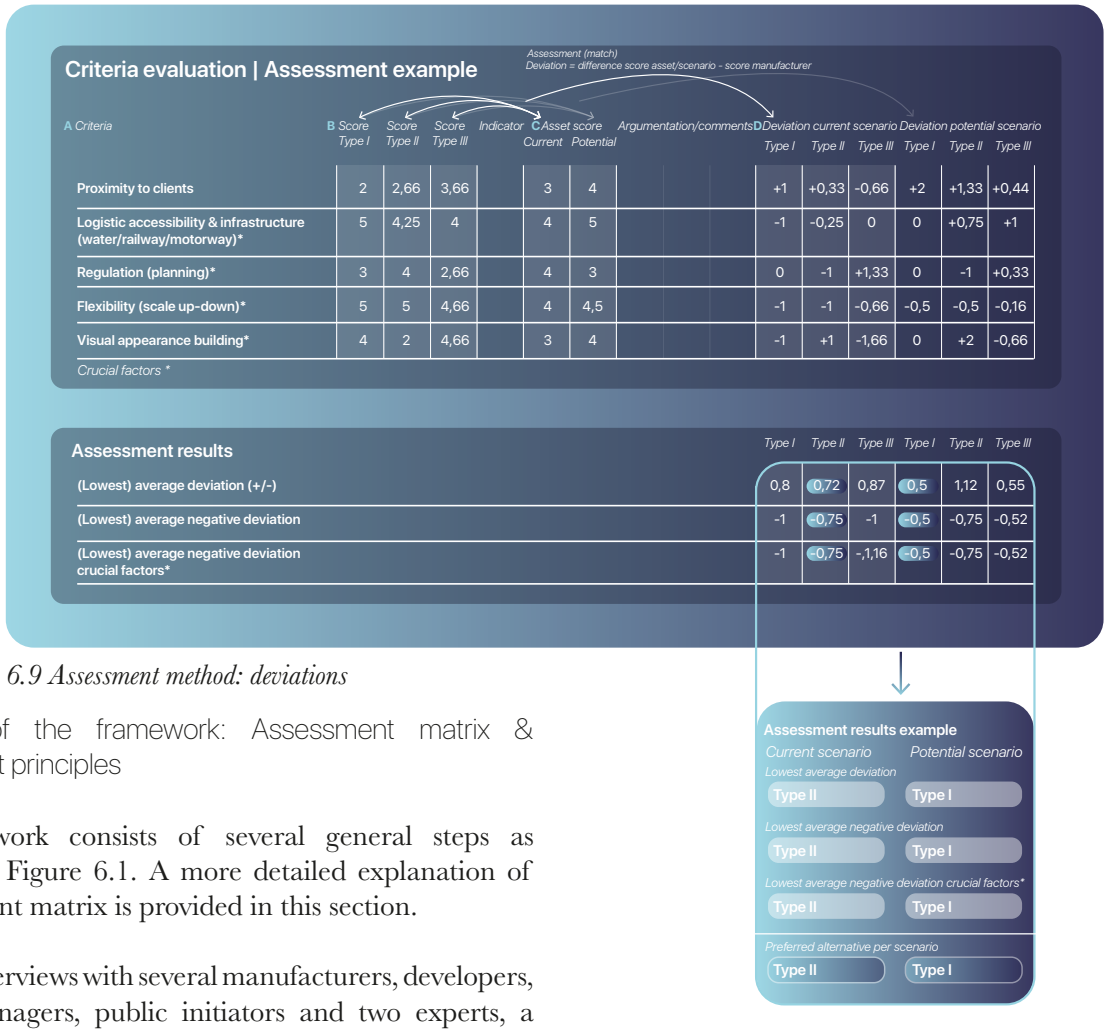
Assessment (match)
Deviation = difference score asset/scenario - score manufacturer

A *Criteria*	B *Score Type I*	*Score Type II*	*Score Type III*	*Indicator*	C *Asset score Current*	*Potential*	*Argumentation/comments*	D *Deviation current scenario Type I*	*Type II*	*Type III*	*Deviation potential scenario Type I*	*Type II*	*Type III*
Urban/ central location, Proximity to:													
Material resources	4	3,25	2,66										
(Skilled) workers*	4	4,75	5										
Education	3	3,33	4										
Knowledge & R&D	3	3,25	4,33										
Services	4	3,75	3,66										
Clients	2	2,66	3,66										
Accessibility (clients & employees)*	4	4,5	4,66										
Logistic accessibility &infrastructure (water/railway/motorway)*	5	4,25	4										
Shared facilities (making/testing)	1	3,25	1,66										
Shared facilities (meeting/ cafe's)	2	3,75	3,66										
*Catering facilities ** *	1	3	3										
*Sports facilities ** *	3	2	3,5										
*Organised events ** *	1	4	4										
*Other facilities (shops, urban) ** *	4	3	2										
*Proximity and colocation with other manufacturers**	5	4	3,5										
Proximity to cultural hubs	5		4										
*Greenspace ** *	5		5										
Making adjustments		4	4										
Building infrastructure (power, bearing load)			4										
Atmosphere:													
*Visual quality**	3,5	2,66	5										
Image/branding	4,5	3,66	5										
Reflecting production	3,5	4	4,33										
Neighbourhood characteristics	4	1,5	3,66										
Land/building costs*	5	4,66	3,33										
Regulation (planning)*	3	4	2,66										
Economic or financial context*	5	2,33	4,33										
Dimension & scale (layout: diversity of accomodation possibilities *	4	4,66	4,33										
Flexibility (scale up-down)*	5	5	4,66										
Visual appearance building*	4	2	4,66										
Sustainable appearance	2	3	4,5										
Innovative appearance	4	2,33	4,5										

*Crucial factors **
*Nice to haves ***

6.10 Complete assessment matrix

Use of the framework



6.9 Assessment method: deviations

6.2 Use of the framework: Assessment matrix & development principles

The framework consists of several general steps as indicated in Figure 6.1. A more detailed explanation of the assessment matrix is provided in this section.

Based on interviews with several manufacturers, developers, location managers, public initiators and two experts, a set of criteria has been established, including an average weight of importance, indicated per manufacturing Type (steps 1 & 2, Figure 6.1). The next step is to assess one or several buildings, or scenarios of the same building by using the same criteria and indicators in Figure 6.1 & 6.4. For this, a score between 1 (low) to 5 (high) can be given.

After this first step of assessment, the scores of the building and the scores given by manufacturers can be compared (Figure 6.9). This comparison results in the deviations between the scores of the building (in a specific) scenario, and the scores given by manufacturers of each type. It can for instance reveal a mismatch on a certain criteria, for example if one is really important, but not present in building. It gives an indication of the match with each type. A negative deviation, meaning the building scores less than the score given by manufacturers, can indicate underperformance when this deviation is large (<2). This results in a possible need for additional investments to make it suitable for this type of manufacturer. A positive deviation indicates the building offers something that is not considered very important, which may not be the most efficient if the building suits another type better (indicated by a deviation closer to 0).

Negative deviations are considered relatively more important as this for example requires additional investments, while this is mostly not the case for positive deviations. Also, the importance of assessment of deviations is higher for more crucial factors, as indicated in Figures 6.12-6.16. Furthermore, while averages are used for the assessment, exceptions such as an excessive deviation or a limited number included in the average should be taken into account. Therefore, the results of the complete model, such as the sum of negative deviations indicating the significance of the negative results, must still be analysed to reflect on any excesses before deciding on a preferred alternative. The final step is to apply the development principles, indicated in Figure 6.11.

Use of the framework

Development principles

Start development phase

Development | building & site

Tailor buildings to company requirements
Provide basics of accomodation initially (structure)
Thinking along, listen to manufacturing needs,
Developer prepared to invest (long-term)

Focus on the requirements of main user: current & future employees
Create attractive work environment: natural light, aesthetic appearance & concept + relevant facilities

Make use of the values of heritage
Highlight & enhance aesthetic + technical qualities (in concept) + storytelling of history
Avoid focus on space efficiency at cost of heritage value
Continue spatial quality in the surroundings of the accomodation, at the scale of the site

Select a well accessible location
For purpose employees/clients/logistics
Close to public transport, motorways, waterways
On the edges of cities

Create flexibility
Create built-in flexibility: flexible layout, larger units of 1000m2, modular workspaces for multiple companies and room for growth and reconfiguration to facilitate scaling up-down
High demand for companies in between first steps and larger scale-ups
Avoid focus on only efficiency to maintain flexibility
Move along with the changing requirements of users

Select & design locations for production
Select locations for producing higher levels of nuisance for companies who need this
Avoid logistic infrastructure crossing residential neighbourhoods
Apply environmental zoning for nuisance / fading towards the (noise-sensitive/residential) city:
A transition in building types to facilitate a transition in functions

Circularity

Clustering complementary companies for innovation
Complementary companies + support network.
Exchange of ideas, sharing processes to change > towards circularity

Clustering similar companies for circular flows
Gather & process waste locally / create a critical mass (resource)
Add complementary company to reuse waste (complete circle)

Invest in relations with surroundings
Giving something back to the surroundings for acceptance of urban manufacturing. This can foster collaboration and better relationships, which is required for potential circular networks
In this way, mixed use developments cán be successful and become circular

Concept

Select companies within concept
Based on being complementary / like-minded / valueing heritage and concept / commitment to maintain heritage and concept and participation in community / (stable) source of income & market potential for a long-term contribution / similar steps in production process / similar financial means or types to avoid competition for space: commercial gentrification

Embed development and concept in (future) economic context
Analyse economic gaps, future developments, proactive development

Create concept & facilitate this
Embedded in (economic) context,it should be 'real'
Basic placemaking
Based on a theme/ campus concept
Based on complementary economic functions, accessibility and present infrastructure
Maintain this concept
Provide the basics (accomodation, infrastructure & space) so it can be tailored to, and by-companies

Facilitate a network & community
Appoint a location/network manager to create a community, select companies and establish a network on different scales

Development | general

Look for ownership & long-term commitment
A developing party with experience, long term involvement perspective / investment capacity (resources) + network of experienced contractors / maintenance etc.

Cooperation & flexibility of public parties
Allowing flexible land-use & zoning: based on actual nuisance levels
Maintaining a close relation during development & use phase

6.11 Development principles - development phase

Use of the framework

6.11 Development principles - use phase

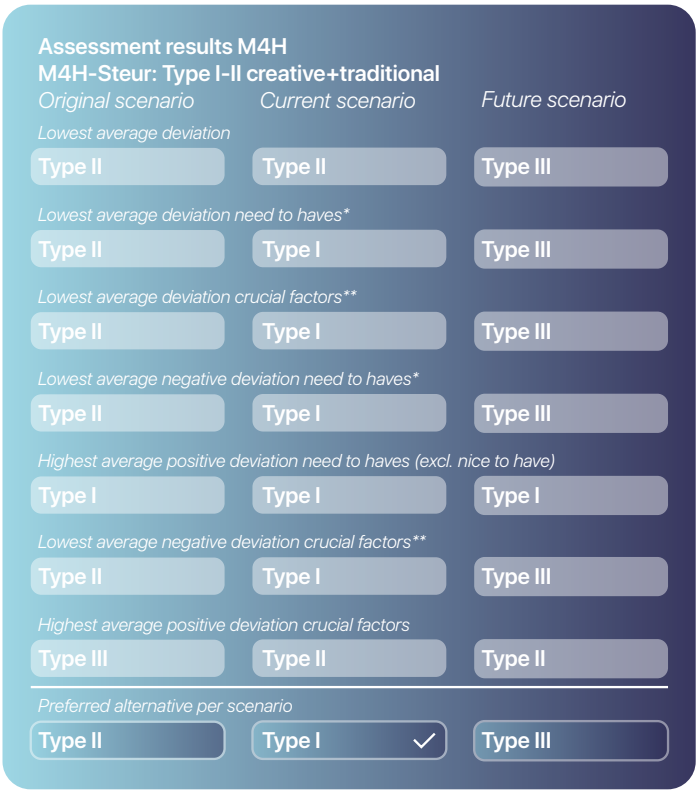
6.3 Testing the framework: Case-study reflection

To validate the applicability of the model, it is applied to the cases that were analysed in Chapter 5 to test the use and applicability of the model. This section also includes the application on the design case and the results of the expert reviews. The complete assessment matrixes are included in Appendix I, while the results of this assessment are shown Figures 6.12-6.15.

Case: Rotterdam Makers District

M4H-Steur

In the original situation, this case was mainly suitable for manufacturers who value costs above appearance and their surroundings, which is why Type II manufacturers are preferred. Gradually, the concept was established, other manufacturers moved in and the appearance and atmosphere improved, which indicates a shift towards Type I manufacturers for the most important factors. However, the average deviations were close to Type II manufacturers and they also remained as tenants. In the future scenarios however, the area could become suitable for more mature companies. Costs, but also regulations due to the mix with housing are more suitable for Type III manufacturers and on the most crucial factors this type shows to be a better fit, with the least total deviations and negative deviations. This matches the interview result that indicated that at first, the focus was on cost, but as their companies were growing and a community was established, the building professionalised and in the future scenario, there would be no place for them, as one interviewee indicated *'the classic story of gentrification' (RM1)*.

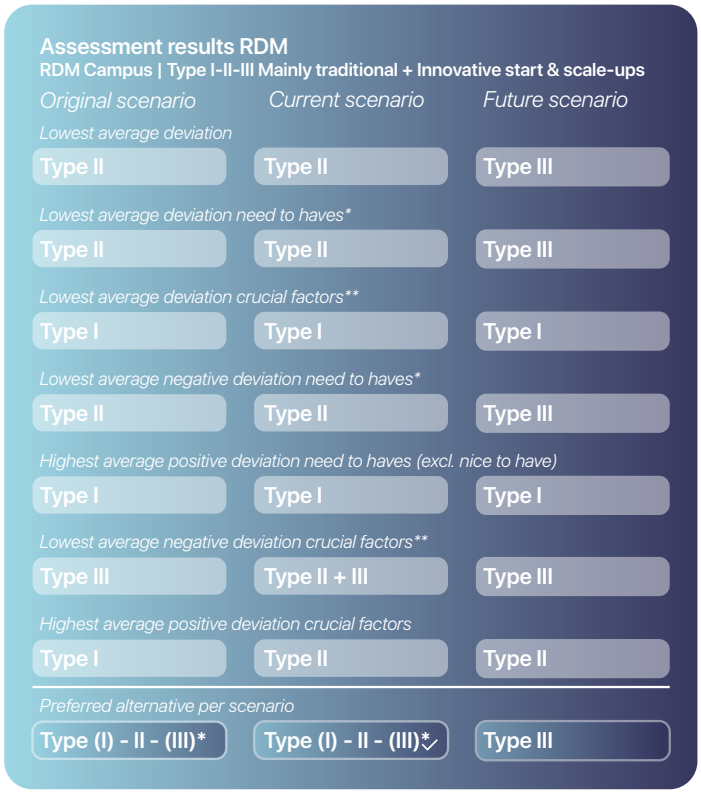


6.12 Assessment results per scenario M4H. The outcomes of the assessment for the current scenario match the present manufacturers.

Testing the framework | reflection on case studies

RDM

In the current scenario, the deviations for the RDM campus are relatively comparable for each manufacturer. This is reflected in Figure 6.13, showing a diverse outcome of preferred manufacturers. When assessing only the total deviations for crucial factors, Type I is the preferred alternative, relatively close to Type III in this scenario. However, when analysing further analysis shows that the average positive and negative deviations in crucial factors are relatively high compared to Type II and Type III manufacturers. Type III scores significantly lower on the negative deviations in the future scenarios, while Type II scores better in positive terms. This shows the current situation is relatively suitable for all types of manufacturers. The future scenario will overall improve the suitability for all types. The model shows a spread of positive and reduced negative deviations for the future scenario, indicating the differences are little between types. The average negative deviations decrease and the positive increase in general in the future scenario for all types. It is therefore likely that the RDM Campus will be able to accommodate a diversity of companies like it does in the current situation.

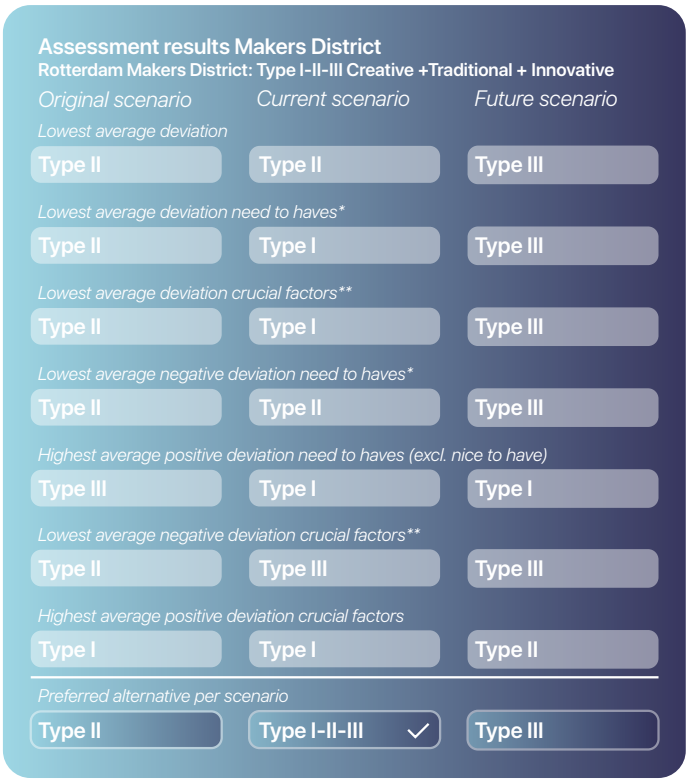


6.13 Assessment results per scenario RDM

Testing the framework | reflection on case studies

M4H+RDM- Makers district

The combined district should facilitate all kinds of manufacturing. The analysis shows relatively low deviations for all types of manufacturers in different scenarios, especially when compared to the individual cases, which confirms the suitability of all types in the combined district. The most suitable Type shifts in the different scenarios, but differences are relatively small. The main changes are caused by the most crucial factors, as seen in Figure 6.14. In the original situation, the deviations are lowest for Type II manufacturers. The average negative deviations are lowest for Type II and Type II shows relatively more positive deviations compared to Type I. Also on crucial factors, the negative deviations are lowest both in sum and average for Type II. This changes to Type I in the current situation, but Type II is comparable. Type II also shows the highest sum of positive deviations in the current situation. However, considering only the most crucial factors, the deviations for Type I are lowest and this shows it is a better match. Finally, in the future scenario, the best match is Type III. They show relatively low deviations, and negative deviations for both need to haves and crucial factors are the lowest. Mainly the factors of cost and regulation result in lower suitability for the other types in the future scenario.



6.14 Assessment results per scenario Rotterdam Makers District

Testing the framework | reflection on case studies

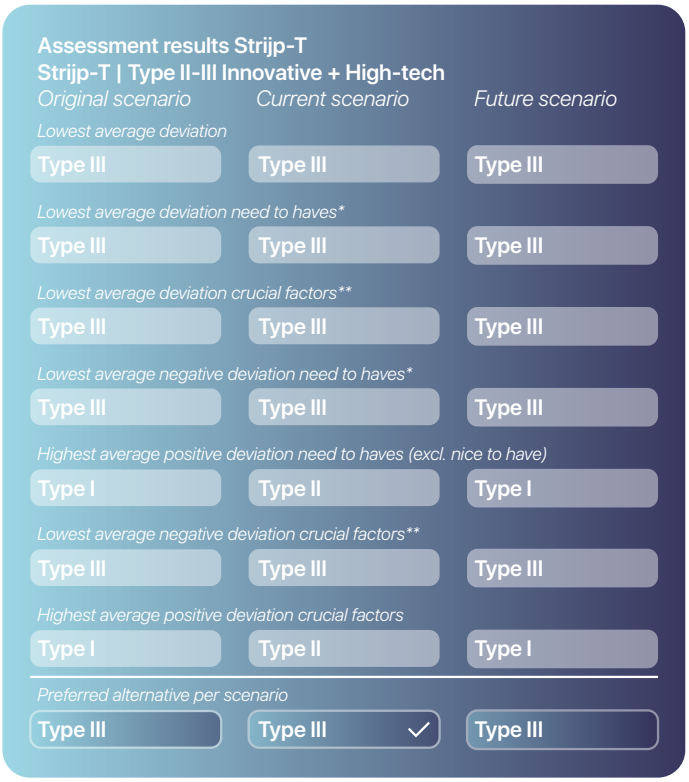
Case: Strijp-T

Strijp-T

Based on the average deviations, Type III manufacturers are most suitable for Strijp-T. This matches the manufacturers that are currently present. The original situation is also relatively suitable for Type I when looking at the average deviations. Type I scores relatively high on positive deviation. However, the negative deviations are the lowest for Type III in all scenarios, which indicates a better match. In addition, the average deviations remain lowest for Type III for the most crucial factors. This indicates Type III is the best match according to the model, which matches the current and expected future use.

Conclusion

The application shows the assessment of an asset using these criteria can give a right indication of the suitability for different manufacturers. All cases have evolved and show increasing potential for more mature types of companies (III) in later scenarios. The preferred manufacturing types per point of assessment indicate the largest deviations, but not the relative differences between types. Therefore, the outcome of the qualitative interviews and literature and the complete assessment matrix should still be consulted when drawing conclusions. The discussion will further elaborate on these implications for the application of the model in practice.



6.15 Assessment results per scenario Strijp-T

6.4 Testing the framework: Design case

Kabeldistrict

Building	Former cable factory
Site	Kabeldistrict (KD Lab, Makerspace Delft)
Location	Schieoevers, Delft, NL
Heritage types	Production halls (factory) & office
Manufacturing types	(I)-II , innovative start & scaleups
Interviews	Expert review 1 (Academic: literature & interview results & framework) (ER1) Expert review 2 (Professional: kabeldistrict & framework) (ER2)

Design case analysis

The case that will be studied is the Kabeldistrict, the site of a former cable factory in Delft (Figure 6.16). The site is located next to a main transport and leisure canal connecting the cities of Rotterdam and Delft and the railway between Rotterdam and Delft on the other side. The surrounding plots along the canal in the Schieoevers district, are mainly used by other manufacturers, construction companies and interior-and construction markets. In addition, there is a train station, event space and student (sports) associations in the direct surroundings. On the other side of the canal, Delft University of Technology is located. Currently, the area is being redeveloped to become a mixed-use urban neighbourhood. A part of the site is already redeveloped for temporary use, as will be reflected on in the following sections. The assessment framework is applied to the original situation, the current temporary redevelopment and the potential situation, to reflect on the decisions made in the redevelopment and the validity of the framework, before further analysing the existing research on the Kabeldistrict. The results are presented in this section.

Original scenario

The outcomes of the assessment are displayed in Figure 6.17. It shows that based on the original scenario, Type II manufacturers are most suitable to be accommodated in Kabeldistrict. The deviations are low when it comes to a central and urban locations, as employees, education, knowledge and potential clients are close. In addition, the average negative deviations are significantly lower for both the need to haves and crucial factors. Positive deviations are high for proximity of education, knowledge and employees. This is mainly because of the direct proximity of the university campus and related companies. In addition, the location of Kabeldistrict is assessed positively, due to the present infrastructure and location near highways, waterways, and a train station, which results in good scores for both logistic accessibility and accessibility for employees and clients. As Type II manufacturers indicated, they value visual quality less in the first stages of development, which matches well with the original situation in the Kabeldistrict. Regulatory restrictions in the urban area were relatively low, which is beneficial for Type II companies who want to experiment, as indicated in the interviews. Other good matches are discovered in the flexibility of the building. A downside of the original situation is the innovative and sustainable expression, which is not present and causes a mismatch with Type II companies. As shown in the table, this has changed in the current situation which can be considered part of the development principles.

Testing the framework | Design case

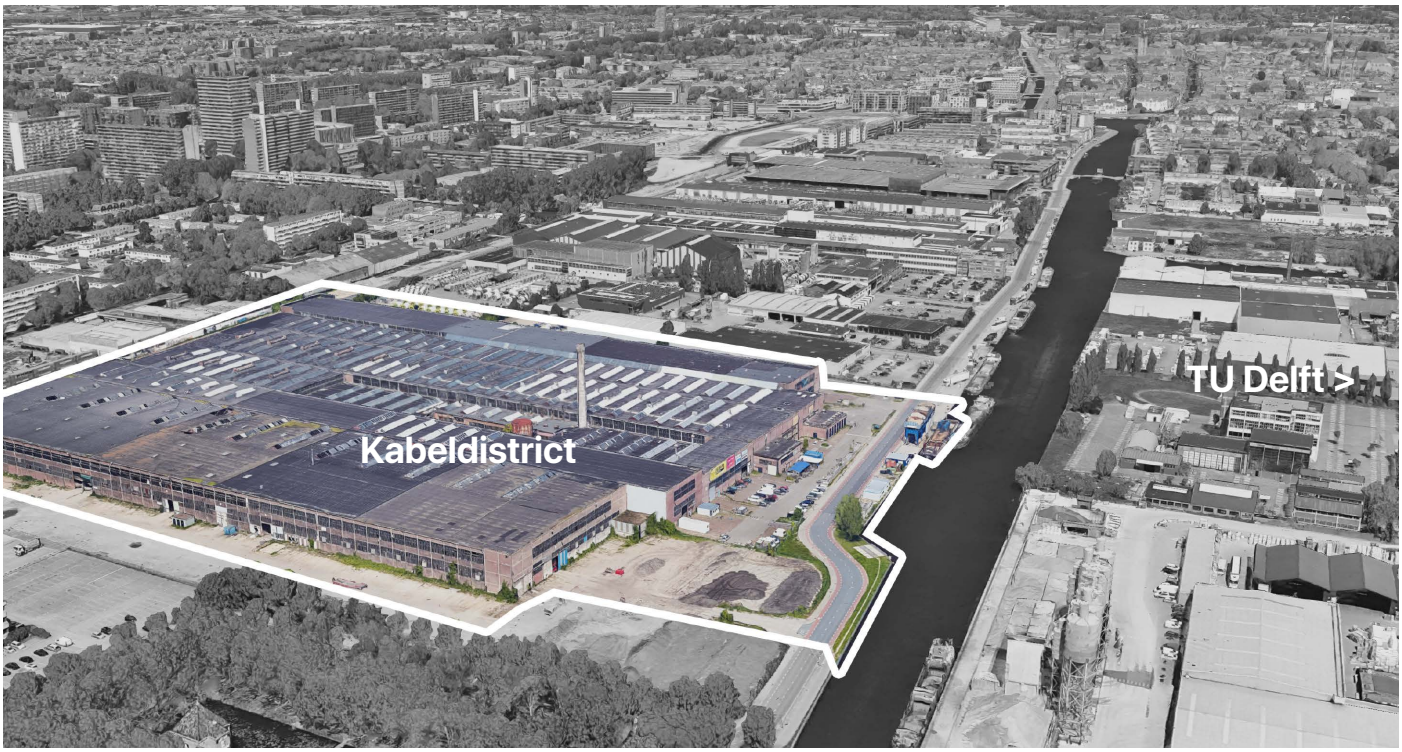
Current scenario: KD Lab

The preferred types of manufacturers in the future developments differ from the original and current situation. As mentioned before, the developers created an intermediate plan, the current situation, to accommodate innovative start-ups and scale-ups. As shown in Figure 6.17 & Appendix I.5, this matches with Type II companies. The resulting deviations for each type have moved a little closer to each other in the assessment of the current situation, but the negative remain lowest for Type II. This makes the accommodation increasingly suitable for the other manufacturers as well, while the suitability for Type II has slightly reduced. This is mostly due to reduced flexibility by installing fixed modules in the Lab area, and addition of other functions which increases total occupation.

The improved character, shared spaces and other urban (support) functions, spaces that have been added as part of the innovation concept, are beneficial for Type II manufacturers. These manufacturers often want to take their own image to a next level when developing (SM1, SL1). The improved visual appearance moved closer to the weights of the other manufacturers. In the current situation, some facilities and functions are added which are valued by all manufacturers, resulting in a lower average score. Together, these are the main reasons for the smaller differences between the companies.

Future scenario: Kabeldistrict urban neighbourhood

A final assessment was made to reflect on the plans to further develop the area towards a mixed-use neighbourhood, including housing and more commercial functions, In this scenario, the preferred manufacturer moves to Type III (mature, high-tech). The total- and negative deviations overall are significantly lower for Type III. The concept



6.16 Kabeldistrict in Delft. Based on Google (n.d.)

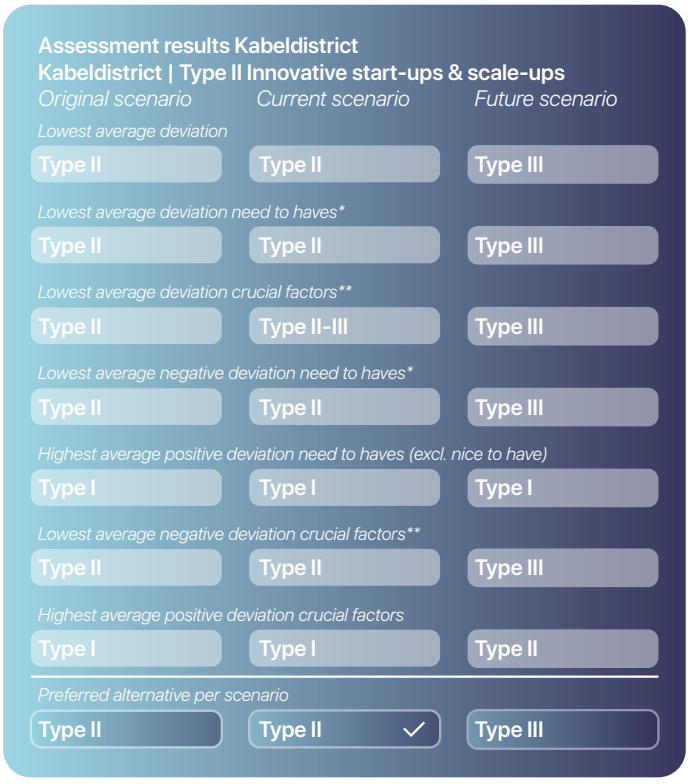
Testing the framework | Design case

and further improvements in the visual and innovative appearance of the neighbourhood and buildings result in a better position for Type III manufacturers. In addition, the development of housing and commercial functions impacts the tolerated nuisance levels, which limits the potential for Type II. Finally, the developments of the (residential) surroundings and increased costs increase the deviation for Type II, while this is less problematic for Type III manufacturers. As mentioned in the discussion, it is important to consider this is based on high-tech manufacturing. Mature traditional manufacturing of Type III would be less suitable if it requires higher standards for nuisance levels and logistic accessibility, as this can cause friction with other functions as described in Chapter 4 (Hobma & Boeve, 2022).

Reflection on development principles

The principles used to develop the Kabeldistrict match the majority of development principles in the framework. Currently, the basic accommodation (structure) is provided, as well as a shared makerspace (KD Lab). In addition, a separate makerspace facilitates startups. Here, an even more basic accommodation is provided, which allows these companies to expand and make alterations themselves. This is not the case in the KD Lab, where more mature, high-tech companies are located. This suits high-tech companies better, but also limits the flexibility which is often needed in this stage.

The concept was well established based on the context and matches the current companies, and the area is currently supported by multiple shared facilities with attention to enhancing the visual quality of the buildings. The concept and theme fit well within the economic context. In this case this is because of the other manufacturers and the university campus, where many other innovative companies of all types are located. This location provides the room to experiment for Type I and Type II companies. Many of them cannot find suitable accommodation at the campus itself, so the concept is a feasible answer to their demand. Because of the university, the focus on innovation and high-tech is also relevant.



6.17 Assessment results per scenario Kabeldistrict.

Nevertheless, the long-term commitment and temporary character of especially the makerspace is suboptimal for this type of companies. In addition, the future developments require a reduction of the nuisance produced by companies in the direct surroundings, which limits the potential for the current manufacturers. Also, separate logistic infrastructure is difficult to realise and in the future plans, the Kabeldistrict will mainly become a residential and commercial area. This can limit the possibilities for logistic transport for many potential companies. The latter two are the main challenges for maintaining manufacturers in the future development.

Testing the framework | Design case

Comparison plans (review 1 & document analysis)

After the initial application of the framework, the results were validated through an expert review on the framework and first results. In addition, the results have been compared with the interview results and development proposal that was made by (Brink, 2022) for the Municipality of Delft and Kabeldistrict developers Amvest and KondorWessels Vastgoed. These results are used to reflect on the outcomes of the assessment framework and provides input for discussion in the expert review that was used to improve the framework.

Comparison interview results Kabeldistrict with literature and earlier case-study interviews

The most important requirements of the companies were space for their office, R&D and manufacturing. The flexibility of this space for scaling up or down and a professional appearance were considered most important by this group.

While reflecting on the current situation, the interviewees indicated the added value of the proximity of the university, public transport, the possibility for interaction between companies, students, and other sectors were valued about the concept. In addition, they (Type II) valued additional urban functions, such as sports facilities and were willing to pay extra for this. Also, they didn't perceive the addition of housing as problematic. Instead, this was valued for added social safety and a livelier neighbourhood.

Also, the flexibility was valued a lot. The KD Lab and Makerspace offer places for students, start-ups, scale-ups and grown-ups (to a limited extent). The Kabeldistrict was perceived as a large, more professional version of a student/ startup district nearby by interviewees, which confirms the classification of Type II manufacturers. This flexibility supported the concept of facilitating different phases, as companies indicated they want to use new equipment and spaces directly when they are able to grow. '*Office space can be found everywhere, but the factory hall is unique, the combination of the two in such an ecosystem is a great added value'.* The freedom for experimenting at the site was valued, but interviewees also indicated this should not be unlimited and suit the environment. In addition, the current tenants valued like-minded companies who work in a professional, innovative and future-oriented way. However, they also mentioned the desire for a larger diversity. The concept and ecosystem include basic facilities like shared office spaces and cafes, but events are organised at the initiative of companies themselves. These events were perceived valuable for their network and informal collaborations. In addition, they mentioned a place to display their work would be valuable, which is also mentioned by the interviewees in the other case studies (SL1, RM2).

They also concluded that it is important to maintain relative freedom by avoiding obligations like events or many restrictions for tenants, which is aligned with the other case-studies. At the same time, tailoring the accommodation based on the specific demands of individual companies was mentioned, either at the selection of tenants or in advance by offering a diversity of accommodation. In this specific example, security was valued a lot, as the place shouldn't become too public, especially considering other functions such as housing in the surroundings. This also relates to the challenge of privacy presented earlier (RL1). In addition, maintaining flexibility and avoiding fragmentation when scaling-up or -down was considered important. Selecting companies carefully, and for example providing housing to the tenants of the district in the direct surroundings were options mentioned to reduce nuisance and create more acceptance. Finally, shared makerspaces were valued most by the smaller companies: start-ups and scale-ups. Larger companies indicated they prefer to use their own machines and network, which is also mentioned in the previous case-

studies. Interviewees indicated that this would only work when organised in a professional way, and by pay-per use so it only involves the costs for those who make use of it as they have less financial means. This differs from the interview results in Chapter 5, as those indicate shared makerspaces are unviable for multiple reasons. Overall, the interview results summarised above indicate relatively similar results as the interviews from the cases in Chapter 5 and the literature. The following section will elaborate on the expert review and discuss the differences more in-depth.

Proposal: recommendations

The expected future scenario results in a shift in the most suitable manufacturer as seen in the assessment (Figure 6.17 & Appendix I.5), which means the Kabeldistrict can become less suitable for the current manufacturers. Still, the current manufacturers score relatively well, with a positive average assessment of the crucial factors. The following recommendations can be made based on the development principles and assessment (Figure 6.18).

Expert review 2

In the expert review, the outcomes of the assessment and the method itself were presented to an expert in accommodation strategies to improve the framework. This interviewee was involved in the development of the documents used for the previous analysis. Reflecting on the model, they indicated that multiple criteria can also be added later or adjusted. In the assessment table itself a clearer distinction was made between this, categorising these in nice to haves, need to haves and crucial factors. In addition, some factors are broader than others. For example, they mentioned manufacturers often value the height in industrial heritage, in the model, this is part of the category of 'building infrastructure'. This will be discussed further in Chapter 7. In addition, average weights are based on a relatively small number of interviews, which should be indicated as this does not cover the whole range of manufacturers. In addition, due to the limited number of assessment criteria, averages and average deviations can be made, but conclusions should not only be based on these numbers and take the total deviations and nuances, like those found in the interviews, into account when drawing conclusions.

The review of the model was followed by a reflection on the comparison with earlier interviews and the development principles. One of the main differences was the preference for a shared makerspace by the companies in Kabeldistrict as opposed to the other case-studies. The expert indicated this difference is based on the preference of scale-ups, who do not always know what equipment they need yet. For them a shared space could be valuable to test and experiment, without the risks of buying their own equipment. This was based on their desire and not their experience with an existing situation and its financial challenges.

In addition to this, the development of shared spaces was discussed. The manufacturers of the earlier cases indicated they did not prefer- or make use of this. The experience of the expert with campus developments indicated that these are necessary for facilitating interaction and collaborations. Informal meetings rarely take place unless they are forced to meet each other by creating the conditions. One way to facilitate this is to set restrictions in the size of private meeting rooms or hospitality facilities such as a restaurant and maintain this concept strictly. In this way, tenants are more inclined to make use of shared facilities to benefit interaction between companies. A downside of this is that it also excludes certain companies, for example those who work with confidential information or larger companies who prefer to have their own facilities.

Testing the framework | Design case

Recommendations Kabeldistrict

Recommendations

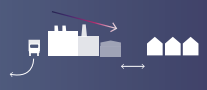
Selected development principles

Option 1

Decide between maintaining the current concept and adjusting the plans to suit the requirements, spatial design should accommodate the diversity in this case:

- Applying zoning (increasing nuisance levels towards edges) or vice versa
- Logistic infrastructure organised outside of residential area: access to manufacturers should be maintained (as opposed to the central location in the current plans) to maintain logistic accessibility
- Maintaining lower costs for lower-value manufacturers. Less investments in visual quality and upgrade of the existing buildings are necessary to keep this concept.
- If these principles are applied to suit Type II, the preferred alternative of the assessment moves back to Type II manufacturers in the future scenario

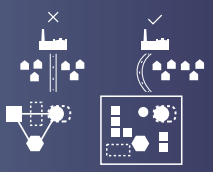
Select & design locations for production
Select locations for producing higher levels of nuisance for companies who need this
Avoid logistic infrastructure crossing residential neighbourhoods
Apply environmental zoning for nuisance / fading towards the (noise-sensitive/residential) city:
A transition in building types to facilitate a transition in functions



Safeguard space for manufacturing: public parties & developers
Be critical on urban developments near logistic network
Take the context of new urban developments into account when redeveloping near manufacturing sites

Maintain (logistic) accessibility
Avoid isolation within residential neighbourhoods: agreements & planning
Maintain accessibility by not planning infrastructure through residential neighbourhoods

Maintain & develop concept
Make sure to have room for reconfiguration of tenants / buffer
Offer flexible contracts for future changes in (space) requirements



Option 2

Facilitate growth of a selection of companies (more high-tech, lower requirements) based on a stronger selection within the concept to maintain accommodation possibilities in the proposed developments

- Makerspaces in the current form are less suitable in the new development, change of accomodation and concept required
- Increase the flexibility, especially for the more professional KD-lab if growth and development of the current companies isvalued

Adjust buildings to developing requirements
Owner remains involved for changes
Allow & facilitate alterations of the buildings along the way

Create flexibility
Create built-in flexibility: flexible layout, larger units of 1000m2, modular workspaces for multiple companies and room for growth and reconfiguration to facilitate scaling up-down
High demand for companies in between first steps and larger scale-ups
Avoid focus on only efficiency to maintain flexibility
Move along with the changing requirements of users

Safeguard selection of companies within concept
Based on being complementary / like-minded / valueing heritage and concept / commitment to maintain heritage and concept and participation in community / (stable) source of income & market potential for a long-term contribution / similar steps in production process / similar financial means or types to avoid competition for space: gentrification

General recommendations

- Invest in relation with surroundings to increase acceptance and foster (future) circular relations (giving back something: (facilities, events, energy etc.)
- Create space for circular economy functions for (urban) repairs & maintenance, spaces for storage & processing of (waste)materials.

Invest in relations with surroundings
Giving something back to the surroundings for acceptance of urban manufacturing. This can foster collaboration and better relationships, which is required for potential circular networks
In this way, mixed use developments cán be successful and become circular

Create space for circular economy
Site specific: proximity to water, accessibility, sharing materials, repairers, maintainers, caretakers, cleaners (For CE) materials flows. Space for storage, distribution, logistic, demolition halls,

6.18 Recommendations Kabeldistrict presented to expert

Testing the framework | Design case

In an ideal situation, accommodation can facilitate all phases of a company, scaling up and -down. However, not all phases are suitable in a certain environment, such as large scale production requiring better logistic infrastructure and large amounts of material resources. Therefore, in the Kabeldistrict the decision was made to only allow for a certain type of companies, which partly explains the limited flexibility currently present. The proposed advice was to narrow this down even further, so only innovative scale-ups that fit within the limited urban context are located in the area in the future development.

In relation to this, the model shows Type III would be preferred in the future situation. However, there are many side notes to this. First of all, it is mainly based on costs and requirements. Secondly, the scale of production and logistic movements are not taken into account. The expert indicated that actual (large scale) production, beyond the experimenting phase of scale-ups was not preferred. This is aligned with the second option (Figure 6.18) based on the assessment and also part of the advice of the expert in their consult.

7.
Discussion
Limitations & recommendations

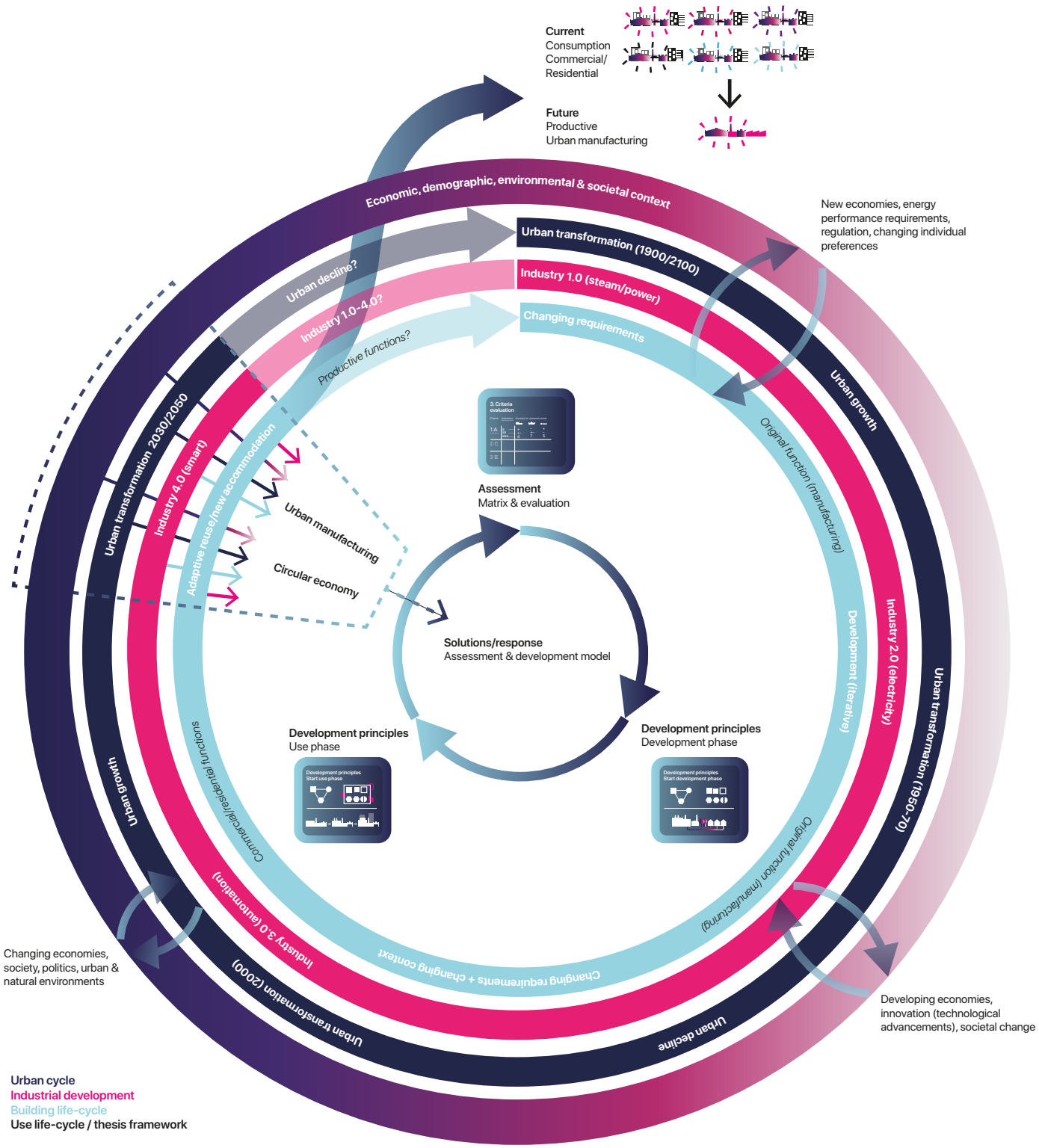
This research has shown that industrial heritage offers several added values for urban manufacturers. It also aims to show the options for (circular) redevelopment by introducing a set of assessment criteria and development principles based on the success factors found in the literature and case-studies. This section includes the findings, comparison with literature, discussion of limitations and the relation and implications of the findings to the larger societal and academic context.

7.1 Identifying the role of urban manufacturing for the circular city

The literature indicates several ways in which urban manufacturing can contribute to the realisation of circular cities. They refer to the use of urban and industrial (waste) resources and establishing more local, circular resource flows (Girard & Nocca, 2019; A. Hill et al., 2018; Prins, 2021; Tsui et al., 2021). In addition, it can help creating a better balance of production and consumption and benefit the resilience of cities by introducing a more diverse economy (Figure 7.1). (Tsui et al., 2021) describe several conditions for successful circular urban manufacturing. These are making use of local supply chains and resources, significant potential to reduce transport emissions, use of local waste or secondary materials as resources and possibilities to scale up within the city, facilitated by innovative production methods and changing urban development as shown in the alignment of cycles in Figure 7.1. Others mention manufacturers can contribute by remanufacturing, repairing or refurbishing products, and transforming waste into resources for the city (Hausleitner et al., 2022). While some sources mention this is already applied by especially smaller and middle-sized manufacturers (Prins, 2021), the case-studies show this is not (yet) the case on a large scale. Interviewees often refer to sustainability measures to reduce non-renewable energy use, rather than reusing material flows. They indicated this is still under development and research and a future perspective (SL1, RL1). One of the interviewees also indicated the Dutch waste processing system makes it difficult to demand specific materials by individuals, which is why secondary materials are often imported (ER1).

However, some of the manufacturers in the case studies did already make use of waste resources (RM1, RM2), either as part of their core business model or to reduce their waste production. Others indicated they refurbished old products and resold them for use elsewhere (SM1). These were both traditional, small scale creative manufacturers as well as larger high-tech manufacturers. Yet, scaling up of these circular principles is still limited. Interviewees indicated a lacking demand from clients (SL1, SM2) or the current processes and financial systems that are not ready to facilitate this on a larger scale (ER1, RL1, RL2). One of the interviewees mentioned this is always a challenge, as other parties are expected to start circularity (RL1). Nevertheless, they did expect that locations closer to material resources will become more attractive for manufacturers (RL1), which can contribute to the scaling down of resource loops. Clustering similar manufacturers to create one type of waste, or clustering complementary functions to facilitate innovation were also mentioned by the interviewees. Still, planning for the use of resources from the city remains challenging, as it is uncertain what, and when, waste flows are available. Recently, the National planning agency of the Netherlands published a several spatial scenarios for 2050 (PBL, 2023). They indicate that for a circular economy, material processing can take place on several scales, ranging from the region to cities and neighbourhoods, depending on the policies that are applied. Based on the outcomes of the empirical research, creating urban environments that stimulate innovation and the reuse of local resources within industrial clusters currently seem the most realistic circular strategies to make impact on the short term.

Discussion



7.1 The thesis outcomes in their context. At the intersection of different changes in (life) cycles and developments in the context, the thesis proposes a tool for the smallest scale: accommodation for the user.

Discussion

7.2 Categorising urban manufacturers and their requirements

In Chapter 4, manufacturing activities were categorised in four categories: personal manufacturers, maker spaces or fab labs, mini-factories and traditional upscale urban industries (Tsui et al., 2021). The case-study analysis focused on the last three categories based on the hypothesis that they have the most potential to be accommodated by industrial heritage (Figure 1.2). For the research they were translated into three types of manufacturers. It can be challenging to put manufacturers within each of these categories, which was also indicated by interviewees. Some of them identify themselves as scale-ups, while according to the categorisation they are part of mature industries or creatives in maker spaces. In addition, this categorisation does not include specific definitions about the scale or focus. Manufacturers can be start-ups, scale-ups, or mature grown-ups and within this, the scales can differ as well. In addition, the focus of their production differs. Creative manufacturers were found, but also traditional (such as woodworkers or producers of steel beams), and high-tech companies were identified in the empirical research. Manufacturers could often be identified with multiple of them, indicating there are more variations that can be covered as shown in Figure 6.3.

The requirements for the support network of urban manufacturers from literature were generally aligned with the findings from literature. Interviewees indicated they preferred flexible accommodation, especially in the first phases due to uncertainties. In addition, the literature describes lower-tech, traditional companies value functions such as R&D less than high-tech companies (Grodach & Martin, 2021). The weights given by the interviewees also indicate a stronger preference for R&D, knowledge industries and education in the surroundings by high-tech manufacturers. Lower-tech manufacturers valued support functions like marketing, retail or provision of machinery or fabrication. While the weights given by interviewees indicate a preference for services and other facilities, including shows by Type I manufacturers, shared places such as makerspaces are negatively assessed. This could be because the results are based on a limited number of interviewees from one case, but the interviewees from both cases (Strijp-T and RMD) indicated that shared makerspaces were unsuccessful. Interviews from the Kabeldistrict document analysis show a different perspective, but in this case, such spaces were never realised which might explain the differences. Nevertheless, while formal sharing was not preferred by the interviewees from the other cases, informal collaborations in production and sharing of equipment did take place and was valued by especially Type I manufacturers. Further research should indicate whether this relates to a specific type of manufacturers or whether this is the result of other factors.

Finally, the literature indicated central urban locations are especially suitable for specialised, high-tech or digital makers to facilitate innovation (Busch et al., 2021; Grodach & Martin, 2021). This is validated by the high-tech manufacturers, but also other manufacturers indicated the relevance of these locations. They referred to values like the proximity of 'cultural hubs' that are valuable for their network and collaborations. These can be areas with other creatives, museums, and ateliers, but also other high-tech industries, (technical) universities and related functions. However, the suitability of spaces also depends on other aspects such as the tolerated nuisance levels in environmental zoning. Both the literature and case-analysis indicate that more digital-high tech and innovative makers are eventually most suitable in the most urban locations. One of the scenarios by (PBL, 2023) indicates that digital space can become more important than physical space in a high-tech economy, resulting in less dependence on location, but the research shows that physical spaces are especially demanded by this sector due

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to the competition and attracting employees. While they are place-independent regarding the production process, the competition and dependency on employees currently remains to result in high demand for physical urban locations.

7.3 Values of heritage

In the literature, the multidimensional values of adaptive reuse of heritage for the urban surroundings, circular economy and manufacturers are introduced. While most interviewees agree to these benefits, direct benefits for the surroundings, besides revitalisation and improvements in spatial quality, were not clearly identified. Nevertheless, one interviewee indicated they really valued being able to be part of the revitalisation of a former vacant area, which allowed them to give something back to the urban surroundings (RM2). Values for circular economy are the proximity other material suppliers, reduction of transport & construction emissions and material use, which were mentioned in both literature and interviews. In addition, the research does show that by developing good relations with the surroundings, the conditions for circular relationships are created, as will be discussed in the next section. This research has focussed on identifying more direct values of heritage for manufacturers, but future research could also include the indirect values to-and from the surroundings.

The interview results also show values relating to the location of industrial heritage, such as proximity of support functions, present infrastructure and accessibility are aligned with what is indicated in the literature. Besides present infrastructure at the site, interviewees also specifically referred to the infrastructure and capacities of industrial buildings that were present, which allowed them to work with large machinery and materials. Increasingly, manufacturers value the aesthetic appearance and visual quality of their work environment to attract employees and distinguish their company. While (Smit, 2011) indicated in their research that visual qualities are mostly valued by creatives and design companies and manufacturers likely value a more productive appearance, the results of the case studies and interviews show that manufacturers also highly value the aesthetic appearance. This applies to especially creative and high-tech manufacturers that were interviewed. The more traditional manufacturers (Type II) valued visual quality less and values the productive atmosphere more, which is aligned with the expectations of (Smit, 2011). While visual quality is important, the relative importance differs per manufacturer. Creatives and start-ups often have fewer financial means and a different focus at this stage, while companies in the high-tech or high-end design sector are often willing to pay extra for an attractive workspace for their employees. Still, both the literature by Smit (2011) and interview results show cost and functionality of accommodation remain the most important in their location decision. Yet, the interviews also show that one of the largest values of industrial heritage is that multiple of these factors can be present. Industrial heritage can provide affordable workspaces, but also provide aesthetic qualities and a functional workspace where office functions and manufacturing of the same company can be combined, which was perceived a unique quality.

7.4 Success factors, selection criteria and development principles : the assessment & development framework

Based on the literature, interviewees were asked to indicate the importance of several accommodation-decision criteria. The literature mentioned inner-city mixed-use areas can be valuable for small scale high-tech manufacturing, traditional crafts, design and workspace. However, the interview results show that especially traditional crafts and

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workspaces often produce too much nuisance to be in highly urban areas. Instead, transition areas on the edges of cities were valued the most. The literature also indicates these are suitable locations for a large range of manufacturers due to relatively good accessibility and accommodation that can better facilitate production activities. Yet, in many urban areas, these are under pressure of urban expansion (A. V. Hill, 2020; PBL, 2023). This also applied to M4H. One interviewee indicated this is part of urban development process, where the edges disappear as cities grow towards each other (RL3). This could indicate that some locations for manufacturing are more prone to disappear, for example when they are in-between two highly urban areas. One of the experts therefore emphasised the importance of proactively reserving space for manufacturing, processing of waste flows and safeguarding logistic accessibility to safeguard the realisation of (circular) urban manufacturing (ER1). In practice, this remains challenging due to the pressure on these areas for other functions. Furthermore, one interviewee indicated that it is not the core task of a municipality to develop commercial areas, while for other functions such as housing, subsidies are available (RL2). As they depend on collaborations with private developers, the ambition to realise manufacturing space is often lost as it is financially unfeasible or perceived incompatible with residential functions. The cases show that often only larger financially capable organisations, such as port companies or major industrial parties could be able to develop such areas for other functions than residential. Policies that steer towards more balanced urban development can stimulate this as well.

Nevertheless, a transition in policy is visible. A letter from the Dutch Ministry of Economic affairs (Ministerie van Economische Zaken en Klimaat, 2022), indicates the need to reserve spaces for industries and middle-sized companies, especially with high environmental (nuisance) contours. These are crucial to maintain local employment opportunities, but also for the transition to a circular economy, despite the pressure from housing. They also indicate the need to reserve spaces near campuses where start- and scale-ups can start local production, which shows a change in urban development strategies that is also visualised in Figure 7.1. In addition, the report by (PBL, 2023) indicates reserving space for the circular economy is important in all scenarios. However, as one interviewee indicated, it is important to that the (long-term) societal economic benefits can be capitalised in a way, as otherwise it will remain challenging to realise this as a developer or municipality (RL2). Finally, the increasing relevance and suitability of urban areas for manufacturers due to innovative production methods, dependence on (human) resource availability and competitive advantages of being in the city could also contribute to the feasibility, as this attracts new types of urban manufacturers, who are prepared to invest in these locations as they benefit from the advantages on the long term.

For the development of the assessment criteria, the conditions and requirements of manufacturers that were found in the literature are used as a basis. Interviewees were given the opportunity to reflect on these and indicate new requirements and criteria. A discussion of the development of the final criteria is included in the limitations. As mentioned in the previous section about requirements, shared makerspaces were assessed low, in contrast to the literature which can be caused by individual experiences, but also the aversion for being forced into a certain concept. As some of the experts indicated, it is important to create the conditions for collaboration and sharing spaces, but the social and business-related activities should eventually be organised by companies themselves (SL1, ER1). Factors such as flexibility and certainty of accommodation, regulation, costs, accessibility and a concept matching a good business case were important criteria mentioned in both the literature and case-studies.

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Important success factors refer to the creation, development and maintenance of a concept and good relations between the developer, municipality, location manager and manufacturers. It should be well embedded in its economic and urban context and selection of companies should be done carefully. The basic conditions for interaction between manufacturers should be provided and facilitated, but the use should not be forced and it should keep a low threshold. Spatial clustering is a way to facilitate this and facilitate trust and communication (Grodach & Martin, 2021; Spalanzani et al., 2016). However, the interviewees indicated it is important to select like-minded companies that have something in common, as otherwise interaction does not take place. When it does, it can result in collaborations, innovation and sharing of knowledge or equipment, which was acknowledged by the interviewees.

Maintaining a certain concept is mentioned as a success factor in the interviews. However, manufacturers also demand flexibility as their company develops, which means the concept should also keep evolving to suit the demand of the companies that are present. This could imply that on the long-term, the focus of a concept can change, for example from start- to scale-ups. A decision can be made to focus on a certain phase and stay to this, requiring manufacturers to locate elsewhere when they do not suit this concept anymore, or moving along with their development, which can be challenging as companies develop in different ways and at different speeds. In addition, the case-studies show differences in the permanence of manufacturers. Especially lower-end accommodation for start-ups and creatives, is often temporary which allows for keeping the costs low. This also puts them in a vulnerable position, as redevelopments often result in higher-end accommodation that doesn't match their needs and financial capabilities. If those manufacturers are able to develop their business to a mature stage, they can often find longer-term accommodation elsewhere, while for some, the uncertainty of accommodation remains. Therefore, the accommodation for this type of manufacturers is also part of a cycle, as indicated by one of the interviewees 'the classic story of gentrification'. The interviewees were also not able to provide solutions to this, as they accepted it as a characteristic of this type of accommodation and manufacturers. Certainty of space is important, as indicated by (A. V. Hill, 2020). Future research could investigate the possibilities to create this certainty for this type of manufacturers as well.

For realising circular manufacturing multiple strategies can be applied. In addition, the literature indicate the capacity to create circular relationships by adaptive reuse of heritage (Bosone et al., 2021; Girard, 2019; Gravagnuolo, Angrisano, et al., 2019; Saleh, 2022). However, they do not refer to specific strategies. The interviews and expert reviews have elaborated on this. For example, by improving the relations to the surroundings by providing facilities or services, it can create acceptance (ER1, RM2) and result in more circular relationships such as the sharing of waste heat (ER1). The literature indicates clustering can result in innovation for circularity, but also making use of waste flows from the city by manufacturers. However, the expert review showed the latter is difficult to plan on a larger scale, as the availability of such flows is uncertain (ER1), while availability is a success factor (Tsui et al., 2021) . It would be more feasible to create such a system within manufacturing areas, by clustering companies that produce similar waste flows.

Finally, flexibility and cooperation of public parties is required, by designating spaces for manufacturing, which can be challenging as described earlier, but also by allowing for a flexible land-use plan. This allows developers to mix manufacturers with support functions within the same buildings. In addition, both the literature and interviewees indicate the design of manufacturing areas should take into account possible nuisance, by avoiding infrastructure through neighbourhoods and reducing nuisance production towards residential areas.

Limitations & recommendations

7.5 Assessment & Development framework: discussion, limitations & recommendations

The results from the literature and empirical research have been translated into assessment criteria and development principles for realising urban manufacturing in industrial heritage. The assessment framework is based on several other frameworks including criteria (Della Spina, 2020; Spalanzani et al., 2016). These frameworks include criteria based on a large amount of respondents, and quantified the specific indicators belonging to the criteria. The research of this thesis has a more qualitative nature, as the empirical research consists of a limited number of respondents that were willing to participate, which can influence the results. However, the aim of this research was to generalise the outcomes to create a comprehensive assessment model. Therefore, averages of weights were assigned do different types of manufacturers, based on whether they fit in the definition of a certain type. It is important to acknowledge that the given weights of criteria are [1] based on a limited number of respondents, which has implications for the generalisation, due to differences in interpretation and individual preferences, [2] they include a given weight ranging from not important to very important, but this does not give a detailed indication of the relative ranking of certain criteria and [3] the limited number of case-studies and interviewees means not all different types of manufacturers are covered. A detailed ranking of all criteria could elaborate on their relative importance to help indicate whether certain positive deviations outweigh negative deviations. Moreover, there are also differences in development, size, and focus (traditional, creative, high-tech). Therefore, the model can only draw conclusions for the suitability of heritage for manufacturers that were found in the case-studies. Further research is needed to cover all types of manufacturing to be able to generalise the outcomes for use in practice.

Furthermore, because of the limitations regarding generalisation, the current assessment model requires background knowledge to be able to nuance the outcomes and decide on a preferred alternative. The application on the studies cases and design case shows this version of the model can give a good indication of the suitability for these specific manufacturers, by using the indicated points of assessment. However, the differences can be small, and individual preferences of manufacturers are not included as this model aims to generalise a type of manufacturers, based on the score of an asset, instead of selecting an asset based on the preferences of individual manufacturers. Therefore, despite the positive results when testing the model, the assessment results for all criteria should still be taken into account, besides only looking at the average deviations to reflect on the suitability for a specific type of manufacturers.

In addition, the scores of a building or scenario are interpreted by the assessor based on existing development plans. This means the current version of the model remains a qualitative assessment method. Further research could therefore also investigate the quantification of indicators. For instance, this could increase the applicability of the model for assessors with less knowledge about urban manufacturers and their requirements.

7.6 Research limitations and recommendations

At the start of this research, the hypothesis was that there is increasing potential for towards more mature industries to be located in industrial heritage, as often small scale individual producers and creatives are already located in industrial heritage (Figure 1.2). The results from the empirical research and literature review show this can only be partly validated. It especially applies to creatives and digital, high-tech manufacturers, ranging from start-ups to

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mature companies, while the outcomes for more traditional manufacturers indicate different a potential based on their valuation of heritage. This potential is based several requirements, values and success factors found in the case studies. As mentioned earlier, further research could indicate the potential for a wider range of manufacturers, including variables like scale, production methods and levels of maturity to create a more comprehensive framework.

As discussed in the previous section, the assessment framework can be used to execute a qualitative assessment of a certain (heritage) building and indicate a preferred alternative for three specific categories of manufacturers. Examples form literature show this can be a feasible way of assessment if based on a large set of data from respondents (Bottom et al., 1997, 1998; Della Spina, 2020; Spalanzani et al., 2016). In addition, the literature study, empirical research and development principles are of a qualitative nature. For instance, they do not involve quantitative data or advice for financial feasibility of plans. In practice, these are factors that should also be considered in the redevelopment strategies of industrial heritage.

The scope of this research is limited to looking into the potential of heritage for urban manufacturers. However, the research does not indicate whether this is the most optimal use for industrial heritage in general, nor does it imply that this type of function is the most optimal to preserve heritage or heritage values. While the initial problematisation indicated urban manufacturing can be a valuable alternative to more commercial functions to create more balanced urban development and develop a basis for the urban circular economy, there might be other suitable uses for reused heritage. Further research could look into most suitable match based on several variables, include different types of heritage and indicate what types of (manufacturing) functions contribute the most to circularity in each phase.

8. Conclusion

At the start of this thesis, two main concepts were introduced: adaptive reuse of industrial heritage, and development of the circular economy. Industrial heritage can provide several added values to its surroundings. However, due to continuously changing requirements, many industrial heritage buildings are in need of adaptive reuse to avoid negative impact on heritage values and their urban surroundings. There are several existing transformation strategies for heritage, but there are limits to their application and they do not always benefit sustainable urban development.

By accommodating urban manufacturing, industrial heritage can actively contribute to realising circular economy strategies in cities. It can contribute to realising circular ambitions by processing (waste) materials, providing skills and delivering innovative technologies to realise a more circular urban economy. New forms of manufacturing also have the potential to be located in more urban areas, due to new forms of production and less impact on their urban surroundings. However, many existing manufacturing areas are challenged by more commercial and residential urban developments that results in less balanced urban development and urban resilience. Research shows the mutual benefits of combining industrial heritage and urban manufacturing for circular cities, but specific strategies and frameworks that combine heritage and urban manufacturing are currently missing. Therefore, the following research question was formulated: '*How can industrial heritage facilitate the developing urban manufacturing industry?*'.

This resulted in four sub-questions concerning the role of urban manufacturing for the circular city, the requirements of manufacturers, the added values and possible synergies in relation to industrial heritage, and the use of these values for an assessment and development strategy.

Urban manufacturing consists of several categories and scales, ranging from start-ups, low-tech mini factories to high-tech mature industries. Besides circular use of resources, manufacturing can contribute to innovation to stimulate circular city development. They are increasingly hybrid, also including other functions such as R&D and innovative production methods increase the suitability of location in urban areas. Their support network can exist of other manufactures, services and facilities for business support such as marketing, professionals and skilled workers, networks of R&D and education, experts and consultants. Increasingly, manufacturers value central or urban locations as this provides access to a larger pool of workers. The interviews show this is partly due to the competition in the sector, referred to as the 'war for talent'. This requires not only relatively central locations and good accessibility, but also a unique, attractive and inspiring work environment to attract potential employees and distinguish the company. Both the literature and interviews show this becomes increasingly important for the next generation of manufacturers and employees.

Besides this, flexible accommodation that facilitates their development and the presence and proximity of several support functions, other manufacturers and facilities is important. Shared use should be facilitated by providing basic conditions, but not be forced. When this support network is used optimally, it can foster innovative collaborations, but also informally support manufacturers by providing space to exchange ideas and sharing materials and equipment.

Among the most important values of industrial heritage are the aesthetic qualities and industrial, productive atmosphere. Companies can use this for their image, branding, creating attractive workplaces and to distinguish themselves from others. This is important to keep attracting employees, clients and like-minded companies. In addition, adaptive reuse of heritage can extend the

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lifespan and use value of buildings, but also positively impact its surroundings by the revitalization. This can result in socio-economic benefits, but also provide the basis for creating circular relationships.

Manufacturers can also benefit from the location of industrial heritage on the edges of city centres, at the intersection of different flows between businesses and sectors. Physical values of the accommodation are important for new forms of manufacturing, but also more traditional manufacturers benefit from it. This includes existing equipment and infrastructure in the buildings, dimensions and physical capacities and flexibility. Relating to the location, logistic accessibility, proximity to clients, skills and knowledge and economic hubs are some of the main values. Together with the aesthetic qualities and atmosphere, industrial heritage can create attractive conditions for relocating manufacturing in cities.

Challenges and limitations of heritage are potentially hazardous materials and regulations for safety and monument protection that can limit flexibility, possible alterations and (sustainability) improvements. Finally, accessibility can still be challenging. While many sites are better accessible than traditional suburban company parks, access by public transport is (historically) not always optimal within these sites and logistic accessibility remains under pressure by urban developments in the surroundings.

The suitability of heritage for manufacturing can be determined based on several criteria relating to the building, site and context of the location. The assessment framework and interviews show these differ per type of manufacturer, but the framework can provide an indication of the suitability of industrial heritage for different manufacturers. Important criteria for the building relate to the functionality and diversity of spaces, flexibility and present infrastructure, accessibility, appearance, regulation, but also the costs of accommodation, which is relatively more important for smaller and more traditional manufacturers or companies within their first development phases.

Relevant success factors are the creation of a concept that is well embedded in the economic and urban context, realising flexibility, carefully selecting companies and tailoring buildings to their requirements, creating the conditions for the development of a community and interaction, and fostering good relations for cooperation with the urban, social and political context. Flexibility is important as many manufacturers are uncertain of their future demands. It is also important to carefully select companies that fit within and can contribute to- a certain concept and value the heritage and community. Matching like-minded manufacturers that for example share a part of a production process and creating an open character is important to create the conditions for collaboration or innovation and avoid friction. Shared facilities and events can facilitate interaction but the use of these shouldn't be too forced. A focus on only space efficiency should be avoided to maintain the heritage values, originality and identity of the site and concept which is valued by manufacturers, clients and (future) employees. A long-term investment perspective and local point of contact that is willing to think along is also part of the success according to the case-studies. In this way, manufacturers can develop their accommodation along the development of their company.

In addition to this, cooperation of public parties and the surroundings is important, especially for creating circular relationships. A flexible land-use plan can facilitate a mix of manufacturers and support functions which can benefit local innovation and the use of local resources. By giving back something to the surroundings, for example facilities or services, acceptance and collaboration can be stimulated which facilitates circular relationships such as exchange of

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waste heat. Other circular principles are clustering similar manufacturers to create a critical mass of materials which can be locally processed, or clustering complementary functions to facilitate local circular relations, innovation and knowledge development to contribute to scaling-up circularity. Finally, designing redevelopments in a way that logistic accessibility is safeguarded and creating space for circular economy processes are important development principles to realise a circular urban manufacturing industry.

This returns us to the main research question. First of all, industrial heritage provides several added values that the current and next generation of urban manufacturers can make use of. This relates to the location benefits due to present infrastructure, the urban context which provides access to human-material- and knowledge resources that are increasingly demanded by urban manufacturers. In addition, heritage itself provides these companies with flexible accommodation with a diversity of possibilities and an appearance that is valuable for their positioning, image and provision of inspiring work environments that they need to attract employees and welcome clients as they professionalise. The combination of suitable spaces for manufacturing with the levels of spatial quality and atmosphere is unique to industrial heritage. Heritage accommodation is capable of developing along with the development in requirements of manufacturers, if flexibility is also facilitated in space and contract by owners and developers. When carefully maintaining and developing a concept that is well embedded in its context, industrial heritage can accommodate manufacturers for a long term, create conditions for circular relations, innovation and implementation of circular strategies and be prepared to facilitate the next generation of manufacturers that are part of the developing urban manufacturing industry.

9. Reflection

This chapter is aimed to reflect on the preliminary results of the research and design and refers to the product, process and planning during the graduation phase. The following paragraphs includes a reflection on the graduation process, methods, results and relations to the master programme and larger societal and scientific context. The final paragraphs include a personal reflection on the graduation process and outcomes.

1. Relation project and master programme

Adaptive reuse of heritage and urban manufacturing, referring to a new use, both fit well within the studio theme of circular adaptable real estate reuse. In addition, both adaptive reuse and urban manufacturing are part of several circular economy strategies. The master track MBE is operating between different scales and with stakeholders from all master tracks and different fields in practice. This research operates within this perspective by combining MBE-related fields like Real Estate Management and Urban Development Management in its selection of methods and literature. The research and assessment model include methods derived from these academic fields, and propose solultions that can be applied in the practice of developing the built environment, which connects to the purpose of Management in the Built Environment. In addition, this integrated perspective relates to the master programme of Architecture, Urbanism and Building Sciences, where spatial planning (urban development), social, economic and environmental values and sciences are combined in the different professions within the built environment to make societal impact.

2. Relationship between research and design

The research has provided the basic structure of the design, in this case the assessment and development model. The literature review has provided the initial assessment criteria and development principles that were later validated by researching case study documents, executing interviews, expert reviews and application of the framework to several cases. This sequence facilitated the validation after each phase. The design process of the framework has been a useful tool to guide the reflection and validation of the applicability on the outcomes of the literature during the interviews. It has been a guiding element during the comparison of literature and empirical research, as the results of each step in the validation process were included in the framework. This allowed me to continuously compare new results to the previous findings. In addition, the design products were applied to the case-studies and a new 'design case' that was not studied for the development of the model. This was used to validate and compare the findings from the empirical research and indicate the applicability and transferability of the model in practice. This informed the discussion of the results that were compared to the earlier findings from literature and new literature related to the main findings.

3. Approach and methods

The sequence of the process, starting with the literature review, has been very valuable in the project. The literature review and introduction provided a rich amount of information that could be validated through the interviews at a later moment through an iterative process. However, a decision to focus on a certain aspect could have been beneficial for the planning of the project, especially the selection of cases and defining on the final products. As a result, the empirical research, specifically referring to the interviews, still contained a broad range of information. While it had been structured to match the required information for the products, it has been challenging to process all information into a set of criteria and development principles. Therefore, background knowledge of urban manufacturing, either from the literature review or empirical research is required to apply the model. Furthermore, the interviewees that responded to the request were often interested in the

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subject, as they for instance could identify the added value of their (heritage) accommodation, while many invitations remained unanswered or were rejected because potential respondents indicated they were not able to say anything valuable about the subject, which can influence the results and contributes to the limitations in generalisation. In addition, the model is based on a combination of assessment methods from practice and models and methods found in academic literature. There are limitations to this approach, as the models from literature are based on a large amount of data from respondents, which increases the validity of the used criteria and assessment results, while this model is based on a limited number of respondents. As a result, the generalisation and drawing conclusions from the application is limited to the specific categories of manufacturers in which the respondents can be placed. However, the results of the application to the case studies and design case and expert reviews indicate that the method of assessment itself can provide a good indication of a preferred alternative and that the development principles can be relevant in similar developments.

4. Values and implications

As indicated in the section on societal and scientific relevance, the research in valuable in multiple ways. The development of a framework was based on a research gap found in literature. Through this research, the basic structure of a of a comprehensive framework for assessing industrial heritage for urban manufacturers has been made. It has also aimed to identify the relations of combining adaptive reuse of industrial heritage and urban manufacturing for development of the circular economy. Finally, the research has contributed to translating circular strategies to a local level, that can be applied on the scale of urban area development. Referring to the societal value, during the research process, the urgency of reserving space for urban manufacturing has been discussed in society, by a letter indicating this need from the minister of economic affairs, but also the national planning agency who presented several scenarios for the future planning of the Netherlands that include potentials for developing a circular economy. In addition, the built environment is continuously under pressure to adapt to new requirements, users and building standards. This requires buildings to adapt to new functions and the design strategies for sustainable urban developments. This research presents one way to contribute to this ambition to achieve more balanced urban development that can increase the future resilience of cities and create the conditions for realising a circular economy.

5. Transferability

The transferability of the results for future academic research has been guaranteed by explaining the development of the methodology and the development process, input and implications of the assessment and development framework. In addition, the method included several moments of validation: by interviews, expert reviews and applying the model to existing and new case studies to reflect on the applicability. However, there are limitations to the generalisation of the outcomes, as currently it is based on a limited number of respondents. While the reflection by experts and testing of the model shows the method of assessment can give a good indication of one of the suitability for the manufacturers that were studies in the empirical research, more research is needed to create a comprehensive model that includes criteria and weights for a wider range of urban manufacturers.

Personal reflection on the process and outcomes

From the start of the graduation process the aim was to research added values of buildings for organisations. In the first weeks the concepts ranged from the values iconic architecture, representativeness of corporate real estate, to maintaining the cultural values of heritage in for example disposal strategies and the values for new users.

Reflection

Gradually my interest in accommodation strategies and urban development were combined with my interest for heritage in the built environment. The different studios helped narrowing this down and adaptive reuse seemed fit for combination with heritage, as many heritage assets are converted to facilitate other functions to provide new use-value. Research on circular adaptive reuse often refers to the values of revitalising areas and being able to connect circular relationships, which resulted in the proposal to make this specific by integrating the aim to include circular economy functions in heritage adaptive reuse. A broad theoretical background of adaptive reuse and circular strategies was found and this made narrowing down the concepts a challenge.

Towards P2, I decided to focus on urban manufacturing as a circular economy function and industrial heritage as the specific type of heritage based on examples found in literature and practice. The discussions within the graduation lab, external supervisors from the internship organisation Brink and my mentors helped to focus on making research results explicit and match formal requirements, but also positioning it in a larger context. During this period, the research methods course has helped structuring the research and introduced the methods for the empirical part. Determining definitions for manufacturing and industrial heritage was one of the main success factors to narrow down the main research objectives and limit the number of subquestions. However, the challenge to narrow down the research remained after P2.

Between P2 and P3 The selection of cases and interviewees took place. While the case-study selection was straightforward due to the set criteria, selecting interviewees within these cases remained challenging. Initially, several categories of manufacturers were defined. However, it has been challenging to contact a large diversity of manufacturers, as often only the more mature, well-known companies within these sites were willing to respond. Eventually, I managed to contact manufacturers within each of the predetermined categories and add to that by interviewing (public) developers, area and location managers that were always open to talk about the cases. The information coming from these interviews was plenty and broad, which was also a result of the starting point at P2. I learned that empirical research is a really valuable, but also enjoyable part of the research. The interviewees provided really interesting insights and could further specify the findings form literature.

After the empirical research, the frameworks were further specified. As they were based on existing frameworks from literature, but a different research approach was used, the translation of my own results to a practical framework was challenging at first. However, help from my mentors at MBE and brainstorming about the design of the framework with my supervisors from Brink has been really valuable and resulted in a method of assessment that could be applicable in practice, despite the limitations in data. The expert reviews have also proved to be valuable, especially as they were held with experts in different fields: focusing on the content, and on the product of the research. This allowed me to draw conclusions from the comparison of literature and empirical research and to further enhance the assessment method and design principles.

In the final part of the graduation period I have continued to narrow down the outcomes of the empirical research and reflect on the implications of the framework in the larger context. In addition, I aimed to visualise the positioning of the research and simplify and clarify the framework. Finally, this period was used to translate the final products and presentation to one that is accessible for a broader audience, including the internship organisation, attendants at the final presentation and practitioners.

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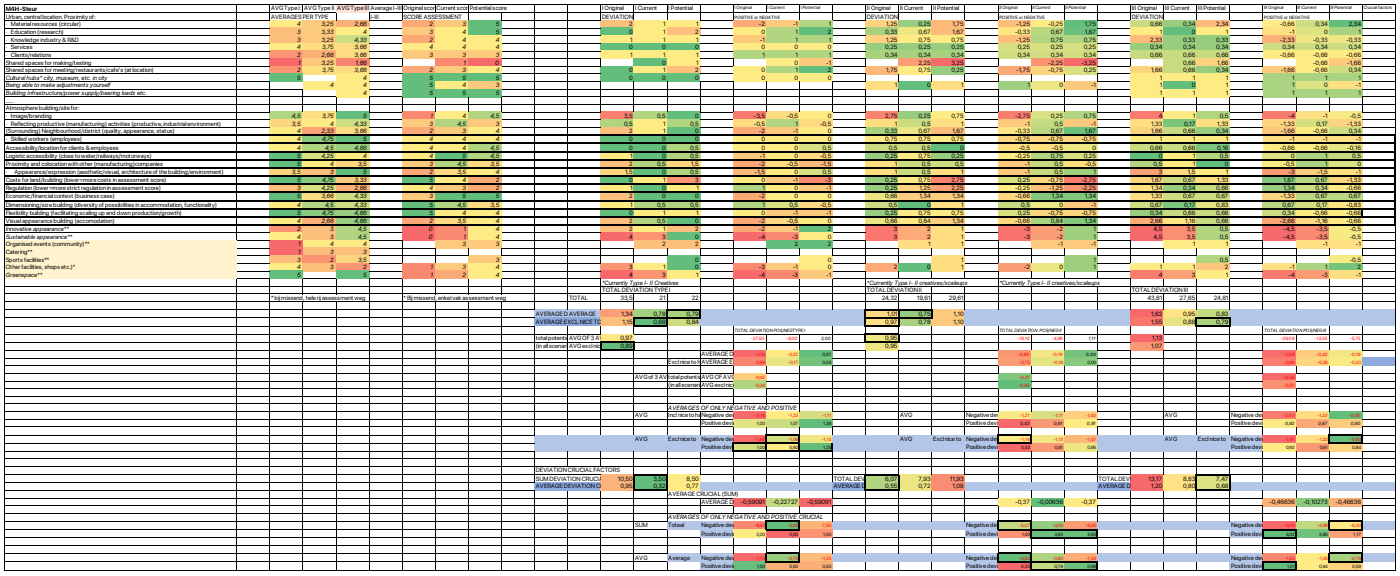
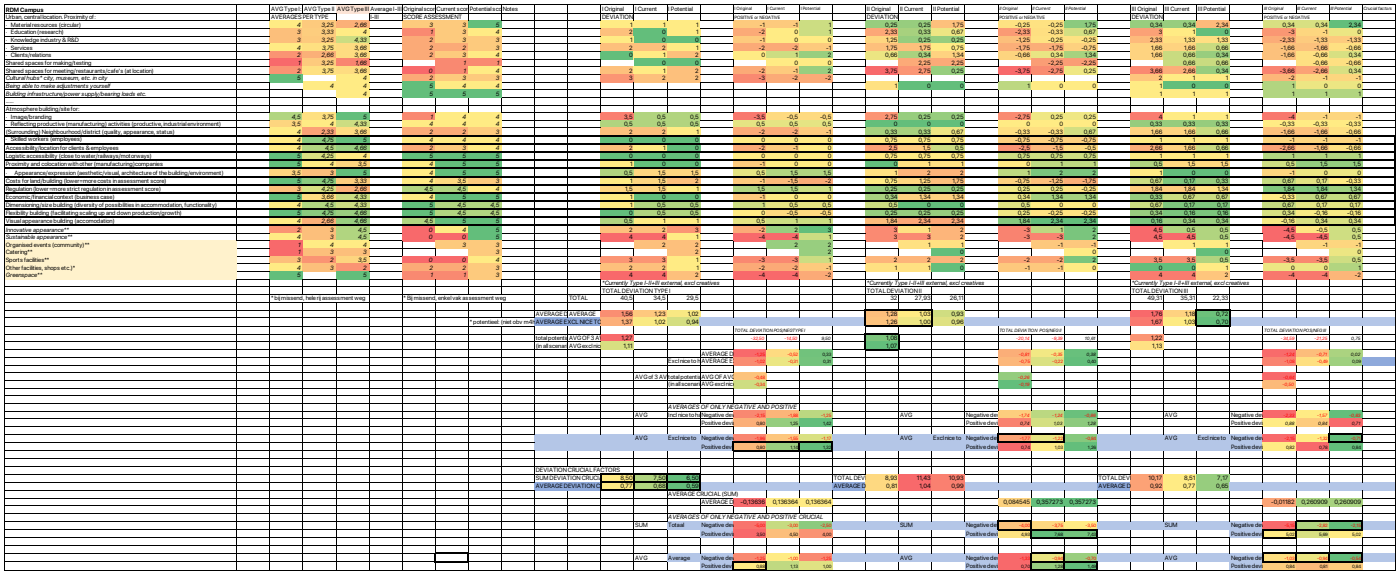
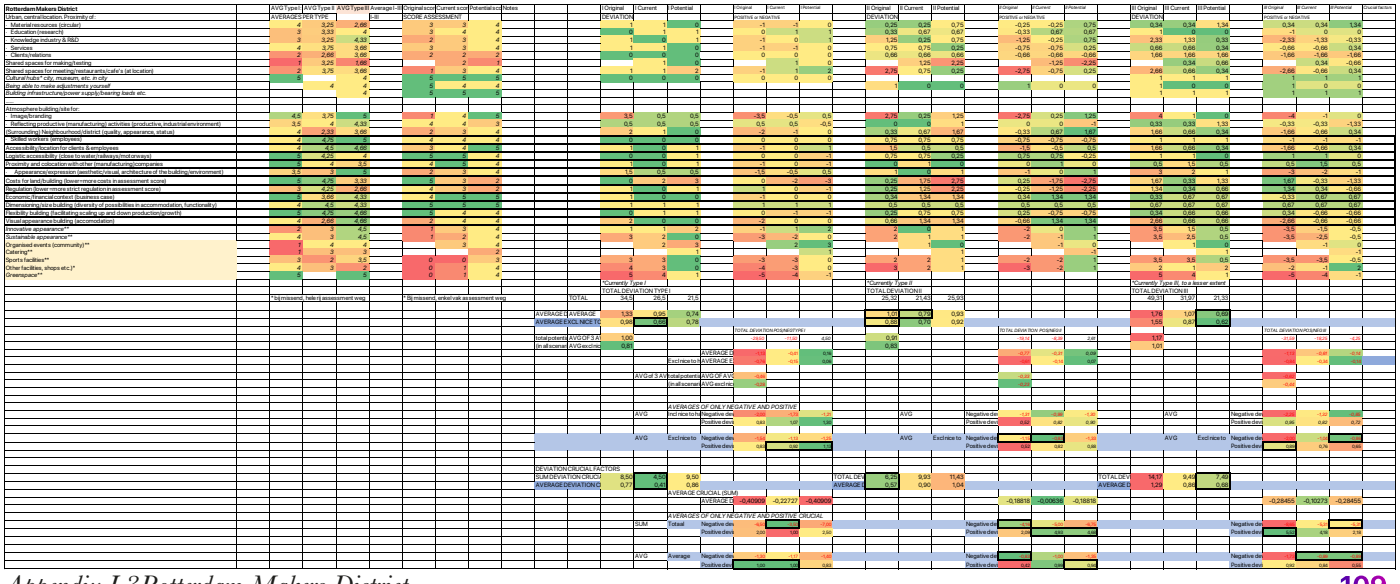
APPENDIX I Assessment matrixes (for digital use)



Appendix I.1 M4H

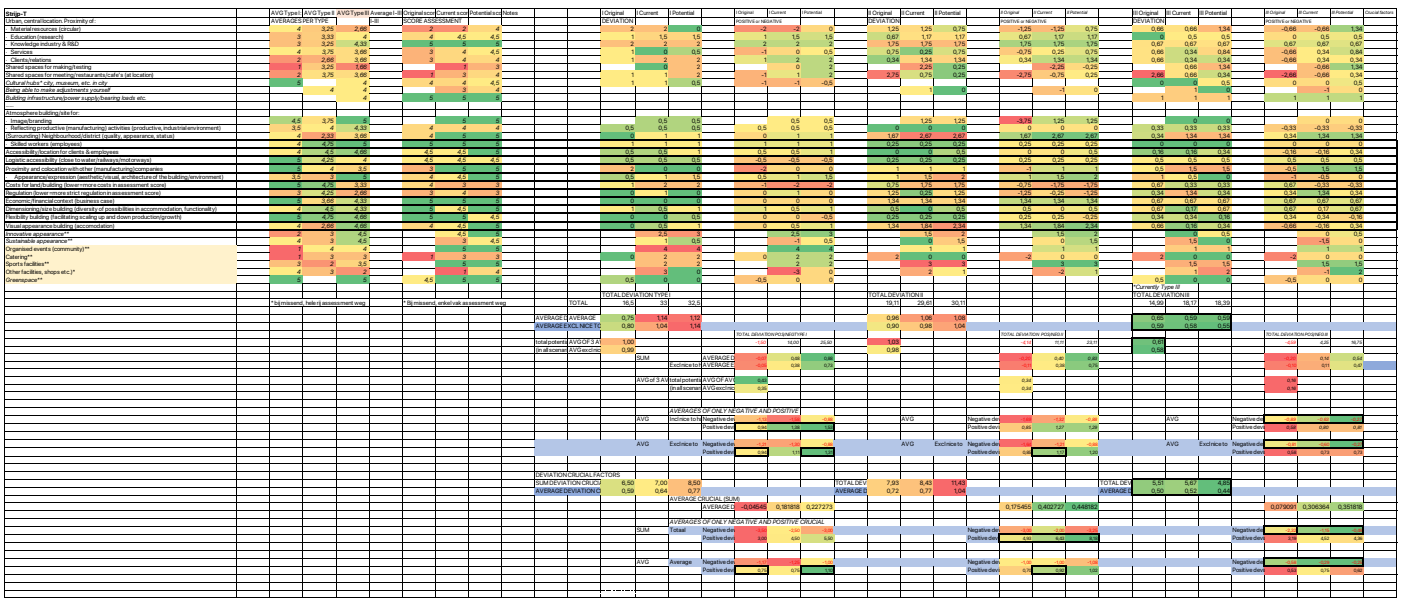


Appendix I.2 RDM Campus

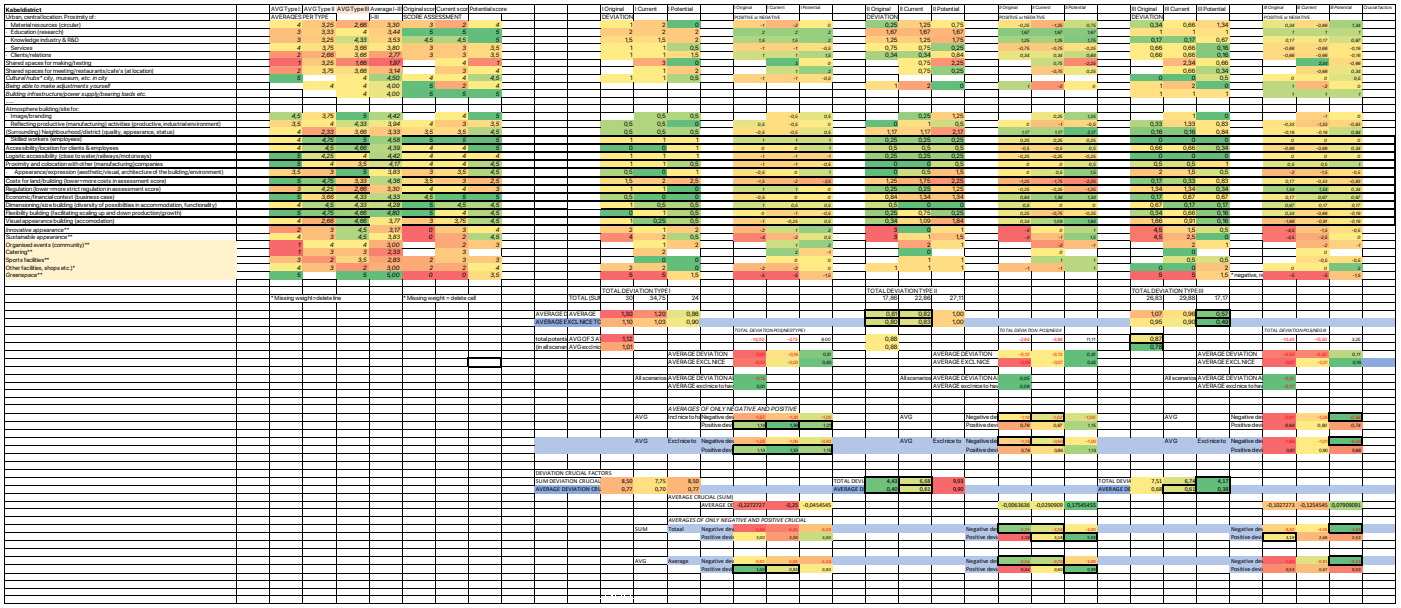


Appendix I.3Rotterdam Makers District

APPENDIX I Assessment matrixes (for digital use)



Appendix I.4 Strijp-T



Appendix I.5 Kabeldistrict

INTERVIEW PROTOCOL

APPENDIX II Interview protocol Urban Manufacturer

Institutions: Delft University of Technology

Interviewee (Title and Name): ___

Interviewer: Christiaan Hanse

Survey Section Used:

_____ A: Background & Context

_____ B: Requirements (demands)

_____ C: Values of heritage

_____ D: Success factors

Checklist

- Ondertekende informed consent
- Start opname (dubbel)
- Introductie: herhalen informed consent en algemene informatie

Instructions

Om straks de resultaten van de interviews te verwerken en te kunnen coderen, zou ik graag ons gesprek opnemen. Eerder heeft u het formulier ondertekend, gaat u hiermee nog steeds akkoord? U mag ook nu zeggen dat u liever niet mee doet. Ook op een later moment kunt u zich nog bedenken en uw deelname intrekken zonder opgave van reden. U bent vrij om elke vraag die wordt gesteld te weigeren te beantwoorden.

U bent gevraagd om mee te doen aan dit onderzoek omdat u bij een organisatie werkt die gerelateerd is aan de stedelijke maakindustrie. Het afstudeeronderzoek gaat over hoe industrieel erfgoed de maakindustrie kan facilitieren. Dit bestaat zowel uit onderzoek naar de eisen en vestigingsfactoren van maakbedrijven, maar ook de waarden en succesfactoren van de erfgoedlocaties voor deze bedrijven en ondersteunende functies. Het onderzoek zal beginnen met een aantal vragen over het bedrijf en de context, waarna we ingaan op de vereisten en wensen van maakbedrijven in relatie tot de huisvesting, de mogelijk toegevoegde waarden van het erfgoed en succesfactoren voor het realiseren van een stedelijke maakindustrie (in industrieel erfgoed).

Interview protocol

Question/theme

'How can adaptive reuse of industrial heritage facilitate the developing urban manufacturing industry to contribute to the circular city?'

Hoe kan transformatie van industrieel erfgoed de ontwikkelende stedelijke maakindustrie faciliteren om zo bij te dragen aan de circulaire stad?

YES NO OPTIONS

Interview questions : MANUFACTURERS

Het eerste deel van dit interview gaat over de achtergrond van het bedrijf: welk soort maakbedrijf, hoe is het bedrijf ontstaan, is het nog aan het ontwikkelen en heeft het altijd op deze locatie gezeten? Zijn vragen over de context om deze straks goed te kunnen vergelijken.

Part A Introduction

A1 Wat voor soort bedrijf is X? Kunt u kort beschrijven wat uw bedrijf precies doet?

Probe: wat maakt/produceert dit bedrijf?
Probe: zou u dit bedrijf beschouwen al seen creatief/startup maakbedrijf, scale-up maakbedrijf of volwassen maakbedrijf?
Probe: past dit bedrijf binnen de smart industry/ Industry 4.0?
Probe: maakt dit bedrijf gebruik van circulaire stromen/is het bedrijf onderdeel van de circulaire economie?

A2 Heeft uw bedrijf altijd op deze locatie gezeten?

Probe: Was het bedrijf eerst elders gehuisvest?
Probe: Waarom? (Hoe) zag uw bedrijf er toen uit? Verschilt dit van nu?

A3 Kunt u kort iets vertellen over de andere (soorten) maakbedrijven die op deze locatie zijn gehuisvest?

In het volgende deel van het onderzoek gaan we in op de wensen en vereisten vanuit makers bij het kiezen voor een accommodatie en locatie en specifiek de belangrijkste vestigingsfactoren.

Part B Requirements, decision-making + ranking

B1? Waarom heeft u voor deze locatie of gebouw gekozen?

B2 What are the benefits for choosing this location? Wat zijn de voordelen van deze keuze (huidige huisvesting)?

Heeft dit specifiek te maken met de erfgoedwaarden van het gebouw?

B3 What are the barriers/limitations for choosing this location? Wat zijn de beperkingen van deze accomodatie?

Heeft dit specifiek te maken met de erfgoedwaarden van het gebouw?

B4 Wat zou er nog meer bijdragen aan de huisvesting op deze locatie/wat mist er nog vanuit uww (bedrijf) perspectief?

B5 Do you think this building/area can accommodate your business in the future (e.g. when you expand or have less need of space)? Denkt u dat dit gebouw en de locatie uw bedrijf ook in de toekomst goed kan huisvesten?

Probe: Hoe? Waarom?
Probe: Heeft dit te maken met het gebouw specifiek, of het hele gebied/cluster?
Probe: Heeft dit te maken met bijvoorbeeld de flexibiliteit van het gebouw?
Probe: Is dit omdat het wellicht enkel een bepaalde fase van het bedrijf/de maakindustrie kan faciliteren?
Probe: Is dit gerelateerd aan de transitie naar een circulaire economie?

B6 Wat zijn de vereisten, wensen en vestigingsfactoren voor een locatie en accommodatie van uw bedrijf?

Probe: aan welke voorwaarden moet een gebouw voldoen?
Probe: zoals nabijheid van materiaalbronnen, werknemers, toegankelijkheid etc.
Probe: Hoe maakt(e) u zelf deze beslissing?

B7 Onderstaand zijn een aantal vestigingsfactoren gebaseerd op de literatuur weergegeven. Kunt u aangeven welke van deze voor uw bedrijf van toepassing zijn en de lijst eventueel aanvullen?

	1 Helemaal niet belangrijk	2 Niet erg belangrijk	3 Neutraal/ gedeeltelijk van belang	4 Belangrijk	5 Zeer belangrijk
Stedelijke, centrale locatie, nabijheid van:					
• Materiaalbronnen (circulair)					
• Vaardig personeel					
• Onderwijs (onderzoek)					
• Kennisindustrie & R&D					
• Diensten					
• Klanten/relaties					
Bereikbaarheid/locatie voor klanten & werknemers					
Logistieke bereikbaarheid (nabij water/spoor/snelwegen)					
Gedeelde ruimtes voor maken/testen					
Gedeelde ruimtes voor ontmoeten/restaurants & cafe's					
Catering					
Sportfaciliteiten					
Georganiseerde evenementen (community)					
Overige faciliteiten: winkels etc.)					
Nabijheid en colocatie met andere (maak)bedrijven:					
……					
……					
……					
Sfeer gebouw/terrein					
• Uitstraling (esthetisch/visueel, architectuur van het gebouw/omgeving)					
• Beeldvorming/branding					
• Reflecteren van (maak) activiteiten die plaatsvinden (productieve, industriële omgeving)					
Omgeving/buurt/wijk (kwaliteit, uitstraling)					
Kosten voor land/gebouw					
Regelgeving					
Economische/financiële context (business case)					
Afmetingen/maatvoering gebouw (diversiteit aan huisvestingsmogelijkheden)					
Flexibiliteit gebouw					

(faciliteren opschalen en terugschalen productie)					
Visuele uitstraling gebouw					
Innovatieve uitstraling					
Duurzame uitstraling					
…..					
…..					

Probe: Denkt u dat deze in het algemeen gelden voor dit type maakindustrie?

B8 Denkt u dat er ontwikkelingen zijn (in de toekomst) van deze factoren en zo ja, welke?
Probe: denk aan bijvoorbeeld de circulaire economie of Industrie 4.0

B9 Welke andere functies waarderen maakbedrijven in hun omgeving?
Probe: zoals: klanten, bronnen (material of andere makers), kennisbedrijven (onderwijs en R&D) of dagelijkse voorzieningen (ontmoetingsplekken, retail)
Probe: Hoe ondersteunen deze uw bedrijf?
Probe: Weet u iets over de wensen en Eisen van deze (ondersteunende) bedrijven?
Probe: Denkt u dat er hier in de toekomst nog ontwikkelingen in zijn?

Het volgende deel van het onderzoek gaat over de waarden van industrieel erfgoed voor de maakindustrie.

Part C Values

C1 Wat is de toegevoegde waarde voor makers om in industrieel erfgoed gehuisvest te zijn?
Probe: Denkt u dat het een bepaalde sfeer creert, of visuele kwaliteit, of bijdraagt aan de marketing of beeldvorming en positionering van het bedrijf?
Probe: heeft dit te maken met het gebouw of de locatie? (afmetingen, schaal)
Probe: Heeft dit te maken met fysieke waarden zoals locatie, werkaanbod, infrastructuur of meer met de beeldvorming en sfeer?

C2 Wat is de toegevoegde waarde van het gebouw als erfgoed specifiek?

C3.L Heeft dit vooral te maken met de locatie of ook het gebouw?

Part D Success factors

D1 Wat zijn volgens u de succesfactoren voor het huisvesten en ontwikkeling van maakindustrie en het creëren van dit soort omgevingen?
Probe: denkend aan regelgeving, financiele voordelen, optimale configuraties, ontwerp, het gebruik, etc.

D2 Wat zijn de succesfactoren voor specifiek het huisvesten van maakindustrie in industrieel erfgoed(locaties)?

D3 Wat zijn volgens u de succesfactoren voor het realiseren van een circulaire stedelijke maakindustrie?

Probe: gebaseerd op de voorgaande vragen.

D4 Wat waren de uitdagingen in deze ontwikkeling/realisatie?
Probe: denkend aan industrieel erfgoed, de maakbedrijven of de omgeving.

D5 Is er volgens u een specifieke relatie tussen de activiteiten die plaatsvinden en het erfgoed?
Probe: thinking of the activities suiting the building bijvoorbeeld bepaalde activiteiten die goed bij het gebouw passen
D6 Is er een relatie tussen de verschillende bedrijven en de omgeving in deze case?
Probe: thinking of the activities, etc.

D7 Zijn er door deze ontwikkeling enkele positieve externe effecten ontstaan?
Probe: e.g. on the surrounding neighbourhood and back Hebben deze de ontwikkeling zelf beinvloed? Bijvoorbeeld meer acceptatie/integratie?

D8 Is er een circulaire relatie tussen uw bedrijf, andere bedrijven of de omgeving, bijvoorbeeld in materiaalstromen?
Probe: denkt u dat dit in de toekomst verandert?

D9 Is er verder nog iets dat u graag zou willen delen over de ontwikkeling van de maakindustrie of huisvesting in industrieel erfgoed?

Comments/notes during interview/additional information

….

Reflective notes

….

Afronding

Checklist:

- Signed inform consent by interviewee
- Minutes
- Finish recording & transcript
- Interviewee would like to receive the results?

INTERVIEW PROTOCOL

APPENDIX III Interview protocol Location manager/Developer/(public) Initiator

Institutions: Delft University of Technology,

Interviewee (Title and Name): ___

Interviewer: Christiaan Hanse

Survey Section Used:

_____ A: Background & Context

_____ B: Requirements (demands)

_____ C: Values of heritage

_____ D: Success factors

Checklist

- Ondertekende informed consent
- Start opname (dubbel)
- Introductie: herhalen informed consent en algemene informatie

Instructions

Om straks de resultaten van de interviews te verwerken en te kunnen coderen, zou ik graag ons gesprek opnemen. Eerder heeft u het formulier ondertekend, gaat u hiermee nog steeds akkoord? U mag ook nu zeggen dat u liever niet mee doet. Ook op een later moment kunt u zich nog bedenken en uw deelname intrekken zonder opgave van reden. U bent vrij om elke vraag die wordt gesteld te weigeren te beantwoorden.

U bent gevraagd om mee te doen aan dit onderzoek omdat u bij een organisatie werkt die gerelateerd is aan de stedelijke maakindustrie. Het afstudeeronderzoek gaat over hoe industrieel erfgoed de maakindustrie kan facilitieren. Dit bestaat zowel uit onderzoek naar de eisen en vestigingsfactoren van maakbedrijven, maar ook de waarden en succesfactoren van de erfgoedlocaties voor deze bedrijven en ondersteunende functies. Het onderzoek zal beginnen met een aantal vragen over het bedrijf en de context, waarna we ingaan op de vereisten en wensen van maakbedrijven in relatie tot de huisvesting, de mogelijk toegevoegde waarden van het erfgoed en succesfactoren voor het realiseren van een stedelijke maakindustrie (in industrieel erfgoed).

Interview protocol

Question/theme

'How can adaptive reuse of industrial heritage facilitate the developing urban manufacturing industry to contribute to the circular city?'

Hoe kan transformatie van industrieel erfgoed de ontwikkelende stedelijke maakindustrie faciliteren om zo bij te dragen aan de circulaire stad?

YES NO OPTIONS

Interview questions : MANUFACTURERS

Het eerste deel van dit interview gaat over de achtergrond van het bedrijf: welk soort maakbedrijf, hoe is het bedrijf ontstaan, is het nog aan het ontwikkelen en heeft het altijd op deze locatie gezeten? Zijn vragen over de context om deze straks goed te kunnen vergelijken.

Part A Introduction

A1 Wat voor soort (maak)bedrijven zijn er op deze locatie gehuisvest?
Probe: wat maakt/produceert dit bedrijf?
Probe: zou u dit bedrijf beschouwen al seen creatief/startup maakbedrijf, scale-up maakbedrijf of volwassen maakbedrijf?
Probe: past dit bedrijf binnen de smart industry/ Industry 4.0?
Probe: maakt dit bedrijf gebruik van circulaire stromen/is het bedrijf onderdeel van de circulaire economie?

A2.L Wat is uw rol op deze locatie?

A3.L Kunt u wat vertellen over het ontstaan van deze locatie?

In het volgende deel van het onderzoek gaan we in op de wensen en vereisten vanuit makers bij het kiezen voor een accommodatie en locatie en specifiek de belangrijkste vestigingsfactoren.

Part B Requirements, decision-making + ranking

B2.L Wat zijn de voordelen van deze locatie voor deze bedrijven? (huidige huisvesting)?
Heeft dit specifiek te maken met de erfgoedwaarden van het gebouw?

B3.L Wat zijn de beperkingen van deze accommodatie/locatie?
Heeft dit specifiek te maken met de erfgoedwaarden van het gebouw?

B4.L Wat zou er nog meer bijdragen aan de huisvesting op deze locatie/wat mist er nog vanuit uww (bedrijf) perspectief?

B5.L Denkt u dat dit gebouw en de locatie deze bedrijven ook in de toekomst goed kan huisvesten?

Probe: Hoe? Waarom?
Probe: Heeft dit te maken met het gebouw specifiek of het hele gebied/cluster?
Probe: Heeft dit te maken met bijvoorbeeld de flexibiliteit van het gebouw?
Probe: Is dit omdat het wellicht enkel een bepaalde fase van het bedrijf/de maakindustrie kan faciliteren?
Probe: Is dit gerelateerd aan de transitie naar een circulaire economie?

B6 Wat zijn de vereisten, wensen en vestigingsfactoren voor maakbedrijven?

Probe: aan welke voorwaarden moet een gebouw voldoen?
Probe: zoals nabijheid van materiaalbronnen, werknemers, toegankelijkheid etc.
Probe: Hoe maakt(e) u zelf deze beslissing?

B7 Onderstaand zijn een aantal vestigingsfactoren gebaseerd op de literatuur weergegeven. Kunt u aangeven welke van deze voor maakbedrijven van toepassing zijn en de lijst eventueel aanvullen?

	1 Helemaal niet belangrijk	2 Niet erg belangrijk	3 Neutraal/ gedeeltelijk van belang	4 Belangrijk	5 Zeer belangrijk
Stedelijke, centrale locatie, nabijheid van:					
• Materiaalbronnen (circulair)					
• Vaardig personeel					
• Onderwijs (onderzoek)					
• Kennisindustrie & R&D					
• Diensten					
• Klanten/relaties					
Bereikbaarheid/locatie voor klanten & werknemers					
Logistieke bereikbaarheid (nabij water/spoor/snelwegen)					
Gedeelde ruimtes voor maken/testen					
Gedeelde ruimtes voor ontmoeten/restaurants & cafe's					
Catering					
Sportfaciliteiten					
Georganiseerde evenementen (community)					
Overige faciliteiten: winkels etc.)					
Nabijheid en colocatie met andere (maak)bedrijven:					
……					
……					
……					
Sfeer gebouw/terrein					
• Uitstraling (esthetisch/visueel, architectuur van het gebouw/omgeving)					
• Beeldvorming/branding					
• Reflecteren van (maak) activiteiten die plaatsvinden (productieve, industriële omgeving)					
Omgeving/buurt/wijk (kwaliteit, uitstraling)					
Kosten voor land/gebouw					
Regelgeving					
Economische/financiële context (business case)					
Afmetingen/maatvoering gebouw (diversiteit aan huisvestingsmogelijkheden)					
Flexibiliteit gebouw (faciliteren opschalen en terugschalen productie)					

Visuele uitstraling gebouw					
Innovatieve uitstraling					
Duurzame uitstraling					
…..					
…..					

Probe: Denkt u dat deze in het algemeen gelden voor dit type maakindustrie?

B8 What do you think are current & future developments in these factors? Denkt u dat er ontwikkelingen zijn (in de toekomst) van deze factoren en zo ja, welke?

Probe: denk aan bijvoorbeeld de circulaire economie of Industrie 4.0

B9 What other (support) functions or manufacturers do you value in your surroundings? Welke andere functies waardeert u in uw omgeving?

Probe: zoals: klanten, bronnen (material of andere makers), kennisbedrijven (onderwijs en R&D) of dagelijkse voorzieningen (ontmoetingsplekken, retail)
Probe: Hoe ondersteunen deze uw bedrijf?
~~*(Probe: do you know about their requirements?: this question is more for the expert & location manager)*~~
Probe: Denkt u dat er hier in de toekomst nog ontwikkelingen in zijn?

Het volgende deel van het onderzoek gaat over de waarden van industrieel erfgoed voor de maakindustrie.

Part C Values

C1 Wat is de toegevoegde waarde voor u als maker om in industrieel erfgoed gehuisvest te zijn?

Probe: Denkt u dat het een bepaalde sfeer creert, of visuele kwaliteit, of bijdraagt aan de marketing of beeldvorming en positionering van het bedrijf?
Probe: heeft dit te maken met het gebouw of de locatie? (afmetingen, schaal)
Probe: Heeft dit te maken met fysieke waarden zoals locatie, werkaanbod, infrastructuur of meer met de beeldvorming en sfeer?

C2 Wat is de toegevoegde waarde van het gebouw als erfgoed specifiek?

C3.1 Zou u overwegen om op deze locatie in een ander (nieuw) gebouw gehuisvest te zijn?

C3.2 Andersom, zou u overwegen om op een andere locatie in hetzelfde gebouw gehuistvest te zijn (bijvoorbeeld een minder stedelijke locatie), waarom wel/niet?

Part D Success factors

D1 Wat zijn volgens u de succesfactoren voor het huisvesten en ontwikkeling van maakindustrie en het creëren van dit soort omgevingen?

Probe: denkend aan regelgeving, financiele voordelen, optimale configuraties, ontwerp, het gebruik, etc.

D2 Wat zijn de succesfactoren voor specifiek het huisvesten van maakindustrie in industrieel erfgoed(locaties)?

D3 Wat zijn volgens u de succesfactoren voor het realiseren van een circulaire stedelijke maakindustrie?
Probe: gebaseerd op de voorgaande vragen.

D4 Wat waren de uitdagingen in deze ontwikkeling/realisatie?
Probe: denkend aan industrieel erfgoed, de maakbedrijven of de omgeving.

D5 Is er volgens u een specifieke relatie tussen de activiteiten die plaatsvinden en het erfgoed?
Probe: thinking of the activities suiting the building bijvoorbeeld bepaalde activiteiten die goed bij het gebouw passen

D6 Is er een relatie tussen de verschillende bedrijven en de omgeving in deze case?
Probe: thinking of the activities, etc.

D7 Zijn er door deze ontwikkeling enkele positieve externe effecten ontstaan?
Probe: e.g. on the surrounding neighbourhood and back Hebben deze de ontwikkeling zelf beinvloed? Bijvoorbeeld meer acceptatie/integratie?

D8 Is er een circulaire relatie tussen uw bedrijf, andere bedrijven of de omgeving, bijvoorbeeld in materiaalstromen?
Probe: denkt u dat dit in de toekomst verandert?

D9 Is er verder nog iets dat u graag zou willen delen over de ontwikkeling van de maakindustrie of huisvesting in industrieel erfgoed?

Comments/notes during interview/additional information

….

Reflective notes

….

Afronding

Checklist:

- Signed inform consent by interviewee

Reimagining industrial heritage.

Christiaan Hanse
MSc. Management in the Built Environment | 2022/2023
Delft University of Technology