



Delft University of Technology

Foundries of the Future

A Guide for 21st Century Cities of Making

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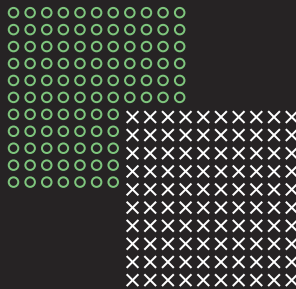
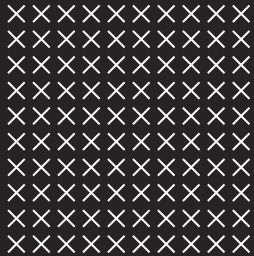
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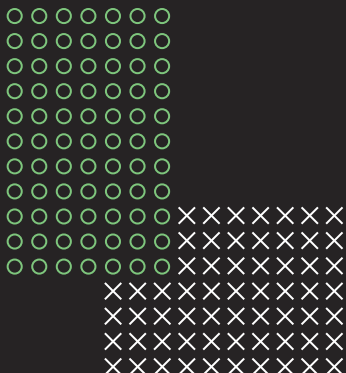
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FOUNDRIES OF THE FUTURE



A Guide for 21st Century
Cities of Making



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This book was produced by the Cities of Making project team consisting of Latitude Platform for Urban Research and Design, Brussels Enterprises Commerce and Industry (BECI), Technical University of Delft (TU Delft), The Royal Society for the Encouragement of the Arts, Manufacturing and Science (The RSA), l'Université libre de Bruxelles (ULB), University College London (UCL), Vrije Universiteit Brussel (VUB).

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FOUNDRIES OF THE FUTURE

A Guide for 21st Century
Cities of Making

"The hand is the cutting edge of the mind. Civilisation is not a collection of finished artefacts, it is the elaboration of processes. In the end, the march of the man is the refinement of the hand in action."

“Head and hands need
a mediator. The mediator
between head and hands
must be the heart!”

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Most large European cities grew remarkably in the late 19th and 20th century, riding on the back of manufacturing. But by the 1960's, planners found that the manufacturing industry did not fit into their vision of a modern metropolis within a global economy. Why would any city want dirty factories, tough jobs and poor air quality when far cleaner and more prosperous sources of income were available? As a consequence, many Western cities have again changed dramatically, shifting away from making things, to providing services while importing goods and resources from across the globe. Very little effort has since been invested into understanding why cities need manufacturing now and what value it can provide.

As described in this book, cities have much to gain from urban manufacturing. Firstly, they need skilled makers to help solve a vast range of challenges requiring technical solutions. Manufacturers bring a 'material intelligence' which, when linked to that of designers, engineers and scientists, can be leveraged to build new products to solve local problems. Manufacturing is highly competitive and risk taking, which offers a context for innovation. Secondly, urban manufacturing often involves a vast number of SMEs that are highly integrated into the local economy. Some of these businesses are city focused and cannot be easily relocated. They provide foundational goods such as bread, construction materials and waste treatment. Other businesses depend on supporting services located in cities to develop their products for the local or export market, requiring a close interaction between both. Thirdly, manufacturers can help turn waste into a feedstock for new products and therefore close resource cycles. Finally, urban manufacturing offers important entry points for work, to gain skills and to diversify the labour market.

Despite the radical transformation of cities away from manufacturing, the sector remains vibrant even in cities like London, Brussels and Rotterdam. However, more than ever the sector requires strong leadership to protect land zoned for manufacturing from being used for housing, to provide necessary services and to ensure that manufacturing actually contributes value to their host city. Entrepreneurial public authorities have much to gain from adopting this leadership position and playing a stronger role in the local economy.

Manufacturing can be mission oriented and help prototype and develop cutting edge technology to solve pressing urban challenges. Such technical breakthroughs can then be exported, and the profits can be channelled back into the local economy. Manufacturing can have tangible results. Unlike the services sector, products can be touched and seen while showing evidence of successful policy. Public authorities can act as curators, identifying collective challenges, setting ambitions, defining long-term planning, developing brave projects, connecting partners, funding pathways for innovation and capturing the benefits of keeping manufacturers in cities. Finally, locally produced goods are important vectors to communicate culture, create a sense of place and community.

I hope this book helps shed some light on this highly complex sector, that could hold the key for dealing with key 21st century urban challenges, and working as a guide towards those aiming to produce Cities of Making.



CUREGHEM, AN INCREDIBLY VIBRANT AND MIXED USE AREA MINUTES FROM THE CITY CENTRE (BRUSSELS) / © D PIRES - R.4, C.5, C.6, C.7, C.10 & N.3





A MESSY FOREGROUND IS PROVIDING THE CONSTRUCTION MATERIALS FOR THE CITY BEYOND (LONDON) / © T DOMENECH - R.8, R.9, C.7 & C.9











THIS BOOK AT A GLANCE

This book is intended as a manual to accompany anyone interested in exploring or working with urban manufacturing. The book is split into two parts. The first part of the book should be read sequentially. We first cover an abridged history of the late nineteenth and early twentieth centuries, noting how European cities evolved rapidly by harnessing manufacturing, and then how the late twentieth century led to a radical shift in how cities work and think. We're now at a crossroads between actors that do not see the need for manufacturing in cities and those that consider it vital for a prosperous urban future. Part of the tension comes from the fact that manufacturing is considered a 'weak land use' compared to activities such as real-estate development, which has been considered more financially attractive by many actors in the private and public sector. This real estate oriented development narrative is increasingly regarded as short-sighted, but will not change without an alternative vision. We have therefore elaborated a narrative on how urban manufacturing responds to four specific challenges facing cities and how in turn manufacturing needs cities. In practice, planning and design for a topic like this is highly challenging. The second part of the book is therefore intended as a handbook. By synthesising our research and fieldwork conducted in a number of cities, we have encountered many similarities in terms of problems, challenges and solutions for urban manufacturing. Inspired by the seminal 1977 book, 'A Pattern Language' we have translated our findings into fifty patterns which help render the diversity of issues concerning manufacturing more tangible. As both teamwork and negotiation are necessary, exercises and methods are provided to use the patterns. Finally, we have set out twelve key action areas as possible starting points for supporting urban manufacturing.

MOTIVATION

The motivation for this book emerged from the confluence of various trends and initiatives in 2015. Ideas of '**reshoring**' industry and '**re-industrialisation**'¹ had raised interest as data was emerging that one in four businesses that had left Europe, were actually returning their production units back to Europe.² In 2014, the European Commission had set ambitions to raise the share of Europe's GDP coming from industry from 17.1% to 20% by 2020.³ This came in part due to the role that European industry plays in the economy, which accounted for 80% of exports and was attributed to some 80% of European research and development investment. Europe was also keenly aware of the fact that it was a world leader in research but struggled to offer conditions to commercialise and spin-out knowledge in the face of more attractive business conditions in the US and more competitive industrial infrastructure in China. *Fablabs* and the **maker movement** were captivating both grassroots interest and government enthusiasm but it was unclear how they would evolve or affect cities in the long-term. The **circular economy** was also emerging as a mainstream talking point and the European Commission was exploring ways to turn a trend into policy (since enacted).⁴ The theme binding these topics was the transformation of resources or manufacturing. These continental scale trends, policies and challenges lacked a clear context or space for action which made it hard to define what actually would be done.

Closer to the ground, quite different trends were affecting cities. A range of significant sites and projects were put on the table that involved some element of manufacturing. This included Rotterdam's M4H⁵ 100 hectare site for a 'maker's district', in Brussels the ZEMU zoning⁶ (translated literally as Economic Mixed Use

Zones) to allow housing above industrial space and in London the redevelopment of the 650 hectare industrial zone at Old Oak Park Royal⁷ to include co-location of housing and industrial land. In the meantime, New York's Brooklyn Navy Yard and Sheffield's Advanced Manufacturing Park were emerging as important experiments for clustering manufacturing. Cities, that had actively taken over vacant land, had become increasingly interested in the virtues of retaining manufacturing yet did not have the tools or the arguments to change decades of rezoning industrial land into housing and parks. In contrast, some cities that were still haunted by the 2008 global financial crisis were looking at manual labour as an opportunity to pull down unemployment rates. A few cities including Brussels were on the verge of rolling out circular economy plans, in part as an answer to socio-economic issues that could be combined with sustainability initiatives. Furthermore, entrepreneurs were literally taking making into their own hands, evidenced by a surge in microbreweries and specialty bakers.

The urban dimension of manufacturing and its place in cities became a clear point of departure. Cities once produced vast amounts of things, yet relatively little was known about the relationships between what cities made and the networks of makers, retailers, designers, researchers, financiers and so on. Public authorities were clearly needed to play an important role in developing clear planning visions, where necessary supporting business networks and protecting land against unnecessary speculation. For cities that were interested in manufacturing, the subject was so vast and complex that it was difficult to know where to start, how to prioritise manufacturing over other land uses (like housing) and what type of manufacturing to focus on. For public authorities attempting to address the topic, collaboration and planning was required amongst a range of different actors, public and private, yet there was little guidance on how to do this without depending on external consultants or experts.

DESIGNERS IN ROTTERDAM USE WASTE PLASTIC TO MAKE STREET FURNITURE
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WHAT IS URBAN MANUFACTURING?

Certain terminologies in this book have been used with care and the definitions require some clarification to avoid misunderstanding. The term **urban manufacturing** has certain cultural and political sensitivities that need to be taken into account before attempting to use it in planning or policy.

The term **manufacturing**, has been summed up simply as: 1) the transformation of physical material; 2) through labour, tools and/or machines; 3) resulting in a product; 4) and produced at scale. Manufacturing is hardly an isolated activity and depends on and is supported by a vast network of other activities. These may include education and training, logistics, material supplies, research, design and engineering, marketing and communications, finance, retail and distribution. We have attempted to distinguish between manufacturing and these supporting services, however as will be elaborated throughout the book, the boundaries are rarely clear. For example, as described later in the book, even though logistics is an important aspect of manufacturing, logistics hubs can involving large volumes of imported goods which has little to do with local manufacturing.

With the 21st century being referred to as the urban century, the term urban manufacturing can be easily miss-construed to simply refer to any form of manufacturing in or near cities. This can be a strategic error as not all manufacturing that occurs in cities is 'city-oriented'. We refer to two particular aspects. Firstly, cities have vast concentrations of knowledge, technical skills, ambition, sources of finance and concentrations of technology - which city-oriented manufacturing will be based on. Secondly, certain manufacturing is difficult to disentangle from the city as it provides food, manages waste, customises technology for hospitals and so on. Urban manufacturing also refers to manufacturing that fits into the urban fabric of the city in terms of scale, logistics, impact on the context and so forth. For the purpose of this book, we have not committed to a definition of a city as this can depend on a vast range of factors such as commuting networks, polycentric urban areas, the level of city-oriented economy and so on.

The term **urban manufacturing**, however imperfect, is the closest term we could find that linked the production of physical things and cities. The term **making** and **makers** are often associated with artisanal activities and the maker movement,⁸ however it is used occasionally in this book to refer to manufacturing. The word **industry** has been used reluctantly and occasionally. While industry is a term used in land use plans, not all industrial land involves manufacturing and not all manufacturing will occur on industrial land. Likewise industry can give allusions of activities involving non-physical products such as the financial industry, the film industry or the tourism industry - mixing these with manufacturing can be very problematic. Long discussions can be had regarding the distinction of physical and non-physical goods (such as a piece of computer code or an animation), but due to the question of space and co-existence with other land uses we have focused on the former. Other terms like **production** or **productive** have also been used with caution. While manufacturing alludes to the production of physical products, this too can be heavily misconstrued and politicised with no links to manufacturing.⁹ Since the 2008 financial crisis, "productive" has been used by some businesses within the financial sector to refer to jobs rather than the production of physical things. This term requires much more rigorous analysis than can be afforded in this book.

Urban manufacturing is a relatively new concept, used with more fluency in the United States.¹⁰ The research of this project occurred in Europe where the term urban manufacturing cannot be easily translated into other languages and cultures. For example in Dutch, French and German, the term 'productive city' (or *de productieve*

stad, *la ville productive* and *die produktive Stadt* respectively). This term commonly also includes logistics, urban agriculture, energy systems and so forth. Direct translations of urban manufacturing in French, *la manufacture urbaine*, is not common and many native speakers associate it with smaller scale artisanship. The Dutch use the term 'manufacturing industry in the city', *maakindustrie in de stad*, however this is a relatively uncommon term. As the concept requires translation, it has not been easy to make comparisons between European cities based on both data and research.

Terms like **manufacturers** and **businesses** are used interchangeably in this book. While manufacturers can be private, public or non-profit, they often function as a kind of business with suppliers, clients, a production space and operate with a mix of labourers and technical or administrative staff.

CONTEXT

This book is the fruit of the Cities of Making project, translating experiences and field research that focused on three city regions: Brussels, London and Rotterdam - The Hague. The project was developed by seven organisations over the course of almost three years: Latitude Platform for Urban Research and Design; Brussels Enterprises Commerce and Industry (BECI); Technical University of Delft (TU Delft); The Royal Society for the Encouragement of Arts, Manufactures and Commerce (RSA); l'Université libre de Bruxelles (ULB); University College London (UCL); and Vrije Universiteit Brussel (VUB). The team explored the topic of urban manufacturing through the perspective of three key questions. Firstly, considering innovations and changes in environmental planning, what kind of resources and technology will be the focus of 21st urban manufacturing? Secondly, with the rise of new forms of technology, where will 21st century manufacturing occur in cities? Finally, if manufacturing were considered a priority by cities and their policy makers, how should existing and new forms of manufacturing be supported or protected? These three questions engulf a broad range of topics, but come with evident limitations as the research team was built around these questions. The team brought together researchers from urban planning and spatial design (architecture), environmental engineering and industrial ecology, sociology and anthropology.

The book is designed primarily to provide a sound basis for discussion. While hundreds of interviews and discussions were held with a broad range of actors (public authorities of various levels, academics, businesses, sector representatives and so on), the research is not exhaustive in its exploration of the state of manufacturing in each city, nor on its exploration of the changing nature of urban manufacturing in Western economies.

There are several issues that are relevant to the topic of urban manufacturing but fall outside the scope of this book. Even though employment was explored, the output of the research does not provide an in-depth account of employment in manufacturing, or the potential changes resulting from new technology such as artificial intelligence or automation. Nor does it provide an in-depth account of the skills required for current manufacturing activities, or of those that may be required in the future. It has not included a study of the role of education in cultivating these skills. Furthermore, there is little knowledge of foreseeable skills gaps or the capacity for businesses to adapt to a younger, digitally oriented workforce as skilled workers age and businesses look for new employees.

The economic research for this book focused only on qualitative analysis of instruments such as taxes or financial stimulus. The book has not explored in depth the role of trade in manufactured goods across urban economies. Quantitative research

of economic instruments is lacking to understand value chains associated with urban manufacturing, particularly compared to other competing land uses such as housing.

Research focused on three city-regions undergoing considerable pressure for increasing housing, where much of the land projected for housing is or has been associated with manufacturing or logistics. Therefore the perspective of shrinking cities or cities with low pressure on industrial land has not been included in the book. Regardless, the outcome of the contents of this book remains relevant even for cities with little pressure on industrial land.

Finally, while the outcome of the research is based heavily on qualitative and quantitative fieldwork, the interviews cover a limited sample of manufacturers which means that further research is required to provide more detailed empirical conclusions. The authors hope this book will help open the door to a more detailed analysis and further research.

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OBJECTIVES

This book does not promote the wholesale protection or development of urban manufacturing in cities. Through our research, we have been regularly confronted by 'blinkered' conversations concerning manufacturing in cities. We have observed that debates are generally analytical, or reductionist¹¹, and focus on a particular topic or perspective without showing the systemic relationship between one issue and another. For example, conversations around rehabilitating abandoned industrial land often focus on real estate potential that quickly narrows down to housing and offices. Conversations around the circular economy or waste management often remain at a meta level without connecting

the flow of materials with the need for space. While conversations around innovation often focus on specific technical breakthroughs but do not acknowledge the importance of the local technical skills or the industrial capacity to turn innovation into production. This quandry is not restricted to dialogue, but manifests in books, research and the media. Our primary ambition is to offer a systemic or synthetic narrative of how manufacturing is connected to cities, showing how relationships exist between seemingly disconnected issues. Evidently our capacity to do this is limited. Regardless, we aim to lay out a range of opportunities, tools and processes that can be used to support or promote urban manufacturing.

Firstly, this book aims to establish a narrative on urban manufacturing.

Chapter 1 lays out a brief history of how manufacturing has changed and why manufacturing remains relevant for cities. We aim to inform the reader that manufacturing remains a vibrant and diverse element of urban life, even in cities like Brussels, London and Rotterdam that have long allowed or encouraged the gentrification of manufacturing and rezoning of industrial areas.¹²

Chapter 2 presents four needs that manufacturing addresses in cities: creating a thriving economy, stimulating innovation, addressing climate change and environmental impacts & providing economic and social inclusion. This chapter also provides hints to evaluate the place of existing manufacturers within the local economy and to help determine if they are city-oriented or not.

Chapter 3 is structured by three pathways: 1) urban integration; 2) circularity and technology; and 3) people, networks & policy. These pathways, based on extensive fieldwork, aim to provide the reader with a broader sense of the conditions on the ground, while offering a glance into the dynamics of urban manufacturing. If a city is convinced by urban manufacturing, there are many ways to approach the topic. Urban manufacturing is a complex, dynamic system which means that changes to one aspect could have unexpected effects somewhere else.

As a result of field work done in a number of cities, our observations exposed certain universal repeated conditions, or patterns for manufacturing. This refers Christopher Alexander (et al) 1977 'A Pattern Language',¹³ that presented some 253 patterns for designing buildings and neighbourhoods. In **chapter 4**, fifty patterns are presented, synthesising some of the complexity of urban manufacturing.

Urban manufacturing is a truly multi-disciplinary topic that cannot be developed without discussion and collaboration amongst a range of actors or experts with different skills and interests. As there is no strict method for using the patterns, **chapter 5** aims to equip the reader with a range of processes to use the patterns as a tool for analysis, design and discussion.

The book concludes with a synopsis of some of the major challenges for manufacturing businesses, for neighbourhoods and cities. **Chapter 6** is framed as a manifesto for urban manufacturing and is a useful starting point for policy makers and territorial planners that would like to explore or develop urban manufacturing.

HOW TO USE THIS BOOK?

This is a useful sourcebook for **Politicians** of all levels of government interested in any aspect of manufacturing, from the circular economy to innovation, the social economy and how to rehabilitate industrial sites. Chapter 2 lays out four needs addressed by manufacturing, which can be used to assess a city's strengths and weaknesses. These needs can be used to develop economic vision that includes a place for manufacturing. Chapter 3 presents a series of challenges that can be used as a reference for other

cities. The patterns in Chapter 4 provide concrete action areas and offer a hint at what scale to focus on (transcalar, down to the building level). The manifesto in Chapter 6 lays out a number of opportunities to develop urban manufacturing.

For a **public authority or public agency** the patterns can be used to identify solutions for addressing problems (for example how to develop circular infrastructure) or it can be used on a site to define the program and set priorities. Refer to the exercises in Chapter 5 to help prioritise and animate the patterns in Chapter 4. Use the patterns also to set Key Performance Indicators (KPIs) or to assess development proposals. Pattern cards can be used for collaboration; refer to www.citiesofmaking.com.

For **planners and designers**, as the topic often involves a complex and dynamic system, refer to Chapter 2 to gain clearer indication of how manufacturing can be embedded into cities. The patterns in chapter 4 are particularly useful addressing public policy with a specific site in mind, for analysing a project brief, defining the program and developing a concrete design for a specific site. When a project has been developed, the patterns can also be used to clarify what the project is actually delivering. Use the pattern cards for collaboration and refer to the processes in Chapter 5.

For **researchers**, there is a vast amount of research opportunities presented in this book. Much remains to be learnt about the dynamics between manufacturers and the way they profit (or are affected) from being located in the city. Refer to the pathways in Chapter 3 regarding some of the issues encountered through working on the research and fieldwork for this book. The 'problems' and 'forces' described in the patterns (chapter 4) also provide a healthy insight into areas that require further research and knowledge. Refer also to the manifesto in Chapter 6 for opportunities to implement some of these higher level ambitions that have emerged from the research of this book.

For **community groups and business sector organisations**, refer to chapters 1 and 2 to learn how to communicate the value of manufacturing and what types of manufacturing to support or attract. Then refer to the patterns in Chapter 4 to analyse your city and define how the sector could be supported or developed. If the role of the Curator (Refer to R3 in chapter 4) is not proposed by a public actor, partner with local businesses to define the role of an area manager, caretaker or business manager.

WHY

WHY MANUFACTURING IN CITIES MATTERS

Manufacturing is intimately connected to cities. But the relationship is in constant flux as both living conditions and manufacturing processes continue to develop. This makes it challenging to forecast what role manufacturing will play in the future, as much depends on planning, policy and the whims of the local economy. Hints can be drawn by looking at the recent evolution of cities and manufacturing. Western cities depended heavily on manufacturing for growth in the late 19th and early 20th centuries. This changed radically in the wake of the world wars due to trade, costs, technology and urban policy. Now, a catch-all term referred to as services dominates the focus of the economy and share of employment. This evolution has turned manufacturing into a 'weaker' activity and is increasingly under pressure to justify its place in the city. To address why urban manufacturing matters, it is necessary to consider not only what is currently made in cities but also how the needs for manufacturing are evolving. Observing how the marriage between manufacturing and urban development has evolved over the preceding centuries offers precious insights into pressures, opportunities and paradigms guiding new forms of urban manufacturing. This chapter provides an abridged reflection of the evolution of making in cities, focusing particularly on the radical change that occurred over the last century.



WHY URBAN MANUFACTURING, NOW

On a warm afternoon in 2009, Merijn Everaarts was sitting on a beach some twenty kilometers from Amsterdam, watching the sun dip into the horizon. He noticed the beach was speckled with plastic waste from the day's visitors. Saddened by the sight, he expected the beach would be cleaned but gazed in disgust as the tide rose and took the waste out to sea. This set Everaarts, an entrepreneur with a background in food, on a track to fight single use plastic bottles, a major source of (urban) waste. He thought the answer involved promoting the virtues of tap water. Having little knowledge of design, he launched a competition to find the ideal format for a long-lasting drink bottle.

The competition was won by a student from the Technical University of Delft. The simple but robust design, felt confident and was easy to clean while it could be unscrewed to form a cup. The concept was developed locally, then launched through a series of grass-roots awareness raising campaigns. Everaarts turned the bottle concept into *Dopper*¹, a social enterprise employing 45 people, producing a couple of million high-quality bottles in the Netherlands annually to reduce many tonnes of plastic waste.

Merijn Everaarts's story illustrates how cities draw together a range of people who through collaboration can turn an idea into a life improving product. Manufacturing firms and activities harbour great potential for preparing cities for the future yet the opportunities are underappreciated in today's economy.

Firstly, existing economic systems are damaging the environment and undermining society's ability to flourish in the long term. These need to be replaced with systems which are regenerative, boosting capital assets and promoting well-being.² Rather than the 'take, make, waste' model that currently results in pollution and waste, there is a wave of enthusiasm from both the private and public sector for a 'circular' economy that would transform the way we use resources and could be underpinned by manufacturers.

Secondly, with urbanisation projected to continue and automation set to shift the job market, urban manufacturing could help provide stable high-skilled, middle class jobs, and secure more fairly paid conditions for some of the most foundational forms of labour including maintenance, cleaning and food production.

Thirdly, with advances in computing power and digital technology, cleaner, higher tech and smaller scale manufacturing could take place across cities. Some advocates for 'distributed manufacturing' see this vision going beyond the mechanics of production, and foresee that new means of production could change socio-economic relationships, enabling people in cities to act as co-creators or co-investors and not solely as consumers.³

There is a rich relationship between manufacturing and cities which is underappreciated by both policy makers and the general public. Due to the confluence of environmental challenges, technical evolutions and urban development pressure, urban manufacturing is at a point of transition in many European cities. Its existing attributes and latent potential should be positioned as leading components of a thriving future for urban centres. Yet without recognition of its role and concerted action, this potential risks going unfulfilled.

Many cities have grown out of the production of manufactured goods. But since the 1960's, trade, financial systems and urban development have increasingly created tension between manufacturing and other land uses. Now, the knowledge and skills to develop and produce a product as simple as the Everaarts *Dopper*, to effectively manage waste or to adapt and develop new technology is at stake. To understand where this tension has come from, and to consider how ultimately to deal with it, it is necessary to look at the evolution of manufacturing in cities.

THE RISE OF MANUFACTURING IN CITIES

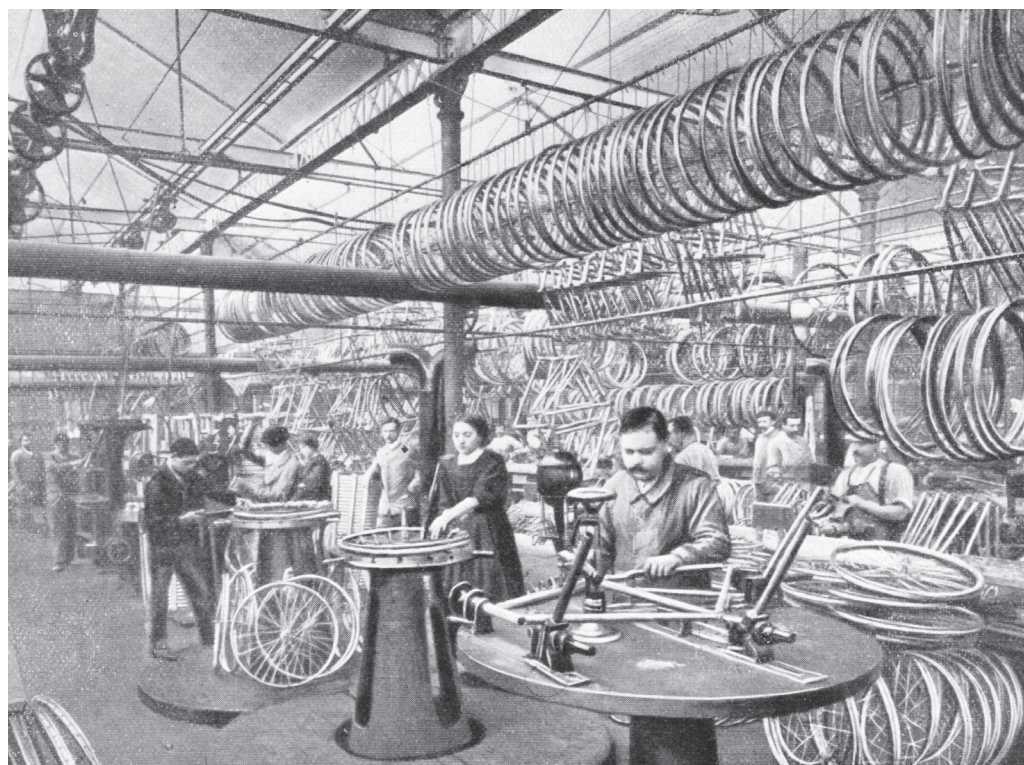
Since the emergence of cities some 12,000 years ago, they have been places of trade associated not only with the exchange of goods, but also the capitalisation of knowledge, the source of financing and as a marketplace for processed products. Cities provided a protected environment with a supply of workers, competition to encourage the improvement of products and a range of producers to negotiate prices.⁴ It was in cities, with their surplus of resources, which allowed workers to specialise: to be dedicated to and perfect a specific skill while building new knowledge on old.⁵

Artisanship is the genesis of the word manufacturing, emerging in the 16th century from the latin *manu factum* or 'made by hand'. Available materials were relatively simple and in a large part bio-based (such as cloth, wood or leather). Manufacturing was often small in scale and businesses were family operated. The living environment was typically located over the working space while the front entry to workshops doubled as a kind of shop-front. This attracted manufacturing to high-streets, which concentrated a flow of customers and were linked to other parts of the city, particularly the main market space. Business types also clustered to take advantage of certain interdependencies or resources⁶. For example, metal smiths performing similar but complementary tasks may have been located near a canal to access heavy raw materials and fuel.

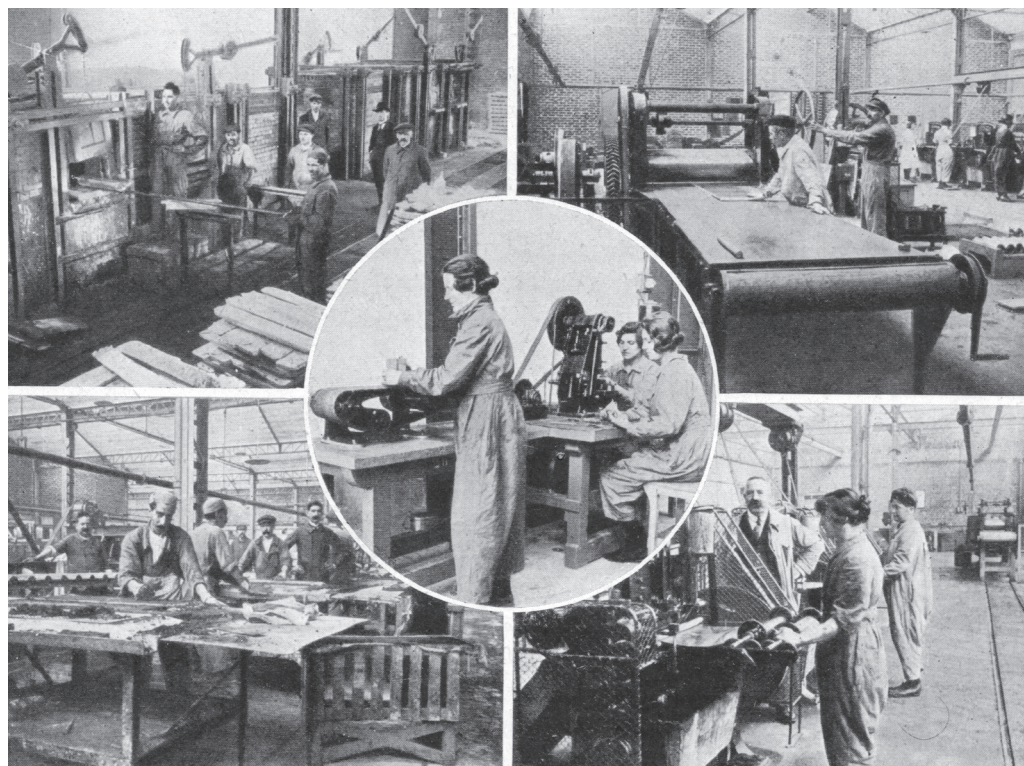
Artisans formed associations or trades based clusters to protect their interests. In Roman times they were referred to as the *collegium* and since the middle ages, *guilds*. In 10th century Bologna, skill began to be formalised and institutionalised through the development of technical universities. In London guilds evolved into some 110 trade associations, each were referred to as a 'livery company' and some still exist today (such as the Hackney Carriage Drivers, Tax Advisers and the City & Guilds Institute). In fact In Europe, the so called Pre and Proto-industrial period⁷, the period between the 11th century and the industrial revolution (the early 19th century), generated social capital and professional networks that provided some level of stability for the local economy⁸. Not all of the crafts that the guilds represented involved complex tasks. But many expected members to have a certain level of skill and material intelligence⁹ which required years of developing knowledge and training. Their knowledge was controlled and skills transfer was based on years of training, involving progress from apprentice to master.

Guilds in principle could help correct '*imperfections in the market*'¹⁰. Through collective action, the guilds could mobilise capital to support members. For example, some provided forms of pension and support support for injured members and widows. Others made strategic investment that benefited their members. They would focus around a building dedicated to their members, refer to Brussels' Grand Place. Guilds also could help assist trade and investment by creating a money-driven economy rather than bartering commodities.

The guild system was far more complex and inconsistent than what has been described above, yet there are aspects that are becoming an increasingly relevant reminder for the 21st century. Communities of small manufacturers are looking at the medieval guilds for inspiration in terms of protecting interests and providing business support¹¹. However, the age of the guilds offers important points of caution. The decline of guilds resulted from a range of issues such as their inability to adapt, their tendency for '*rent-seeking*' and '*protectionism*', their aversion to innovation and entrepreneurialism and their manipulation of the market to suit vested interests¹². Such observations should not be forgotten and comparisons could be drawn of similar contemporary behaviour in other sectors, such as finance¹³ or by unions.



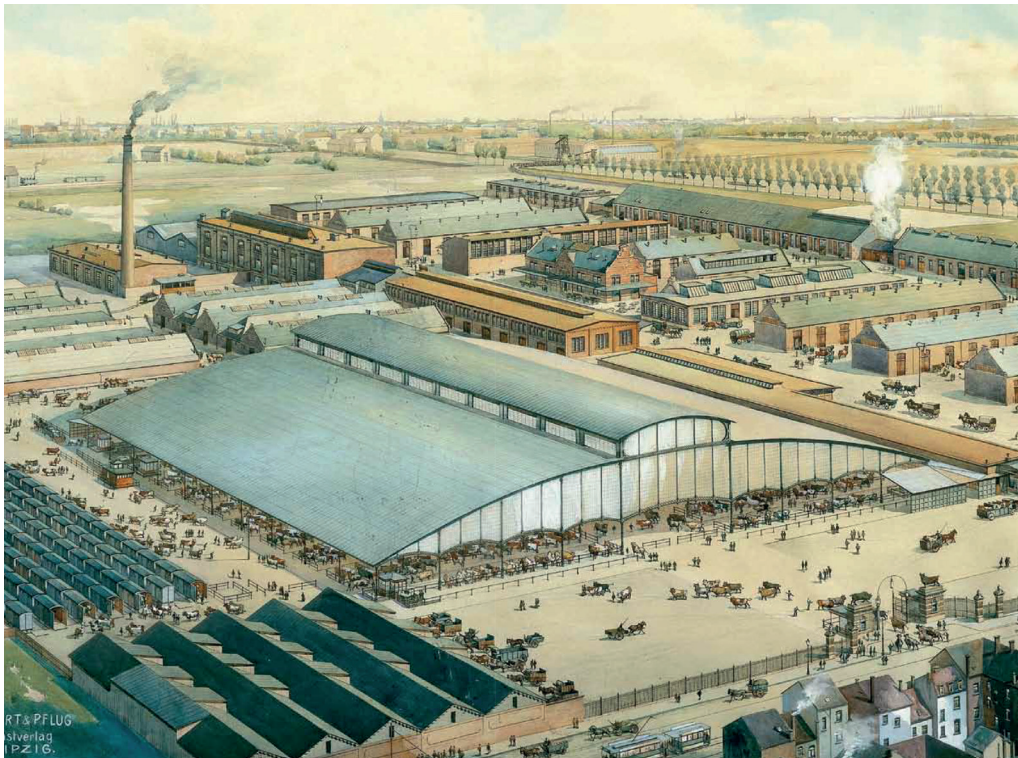
'LES MERVEILLES DES SCIENCES ET DE L'INDUSTRIE' AUTHOR: EUGÈNE H WEISS (LIBRAIRIE HACHETTE: 1926). BELOW: PRODUCTION OF BATTERIES. ABOVE: BICYCLES AND WEAPONS.



HOW MANUFACTURING DEVELOPED CITIES

The disruption of the guild system has been attributed to the development of more efficient technology and increased trade. This was famously observed by Adam Smith in his 1776 opus *The Wealth of Nations*¹⁴ whose account of pin-manufacturing helped expose the ideas behind **division of labour**. Increasing productivity levels were facilitated by new technology which allowed workers to concentrate on simple and repeatable aspects of the larger manufacturing process. Division of labour provided a number of benefits which remain relevant to industrialisation. Products could be manufactured at a fraction of the cost which made them affordable to a larger range of customers. Where production volumes and efficiencies were greater than the needs of the local market, the manufactured good served as an export commodity which in turn helped to inject money into the local economy, and allowed for cities to specialise. As neither skilled workers nor extensive training were required to produce many suitable quality products, the guild system was disrupted and ultimately bypassed, largely left to perish. The step towards mass production was the birth of an age where goods increasingly lost their connection to place, as the trade of goods grew to span the globe and consumption became fixated on price.

It was in the late 18th century United Kingdom where power, more robust materials, larger scale mechanisation, a pool of cheap labour and more efficient industrial processes increased output while reducing the production costs of a vast range of goods. This not only led to a radical evolution in the production process but also a reconfiguration of society and cities. Despite some resistance to industrialisation, iconised by a group referred to as the 'luddites', the labour saving technology created



new work in middle-management and administrative tasks. The net result was the growth of the middle class and greater levels of female employment and independence (women were preferred for tasks involving precision). This evolved into the democratisation of industrial societies.

The available source of manual labour located in cities and large towns made them attractive locations for manufacturing firms who sought workers and access to markets. Industrial growth further increased population expansion in cities as people migrated from the countryside in search of work. In Greater Manchester, a city region famous for its textile production, and dubbed 'Cottonopolis', the population more than quadrupled in size between 1801 and 1861.¹⁵ Such rapid expansions were common across many European and North American cities.

Factories, warehouses and canals transformed the layout and appearance of cities. Smaller factories continued to grow, mixed into residential areas, as was the case during the medieval times. As factories developed and employed larger numbers of people, they moved out into areas devoted entirely to manufacturing. Locations around waterways were particularly attractive as they were often flat, would offer a supply of water, could provide a mode of transport and the land was often cheap. Districts and street names like Cable Street, Boulevard Industriel and Bottelaarstraat (Bottler's Street) point to this manufacturing heritage. Many civic buildings continue to bear the names of the industrialists who funded them, like London's Tate Gallery's funder, Henry Tate. The sugar refinery he opened in Silvertown, East London in 1877 remains in operation today.¹⁶ New transport systems emerged, particularly rail since the 1840's, to draw in a wide pool of workers. Through improved transport, real estate could be developed, made affordable even for the working class, but located housing further and further away from workplaces.⁵²

Manufacturing turned many cities into great machines of production and opportunity. Industrialists saw belching smoke stacks as a sign of success and progress. But the conditions were far from ideal, bringing nuisances (referred to as *externalities*) that had serious effects on living conditions. Coal, the fuel for the industrial age, lined the air with smog and soot which in the late 19th century blacked out the sun over many cities.

"I was going to say, "But is this the Thames?" but held my peace in my wonder, and turned my bewildered eyes eastward to look at the bridge again, and thence to the shores of the London river; and surely there was enough to astonish me. For though there was a bridge across the stream and houses on its banks, how all was changed from last night! The soap-works with their smoke-vomiting chimneys were gone; the engineer's works gone; the lead-works gone; and no sound of riveting and hammering came down the west wind from Thorneycroft's."

- William Morris 1892

In this passage from his utopian novel of 1892 *News from Nowhere*, Morris imagined a London in 2003 without industry.¹⁷ This vision for a society, founded in nature, was fuelled by his experience of the environmental degradation and heightened social problems that the Industrial Revolution had brought to the city.

Labourers, many attracted from towns and the countryside, piled into tiny housing conditions to work long and tiring days without pause or social protection. For a worker, life was short, dangerous and precarious. Air pollution was the second largest killer of Londoners in the 20th century, second only to the 1918 influenza pandemic¹⁸.

Those with means, such as royalty and the new industrial class, afforded houses well away from the city centre to retreat from the foul urban conditions. With the democratisation of mobility through the arrival of passenger rail, the new middle

class could also afford to live out of the city. In 1898, Ebenezer Howard published *To-Morrow: A Peaceful Path to Real Reform*, endorsing a town planning model that could combine home and work with access to the country and green space. This garden city utopia emerged into what is now called suburbia and became the idyll for the working and middle classes. The impulse to move out of cities became embedded in culture. The English built mews and row housing with small gardens. The Belgians¹⁹ built along the dense rail network, generally housing backed onto the countryside. Eventually the highly controlled Dutch planning institutions also developed housing well away from city centres. Such housing environments reached a crescendo in the 1980's but suburban growth remains higher in many countries than in city centres.

As for the workers, their quality of life improved through collective action. The decline of the guilds in cities almost coincided with the rise of another form of labour based protection system: the unions. While guilds protected the artisan and their business activity, the **unions** emerged in an era where workers had no ownership of the production process.⁵¹ They originated from the class struggle of disadvantaged factory workers in the late 18th century in the UK and spread throughout other parts of the then industrialising world. They were despised by industrialists, who saw them as both a hindrance and a cost. Yet unions brought many aspects of modern life that are now taken for granted, such as fair wages, weekends and the eight hour working day.

WHY MANUFACTURING LEFT CITIES

During the second half of the 20th century, manufacturing **globalised** and moved away from many European cities. There are various reasons for this evolution, that still account for some of the fundamental struggles shared by many manufacturers today. The capitalist spirit that gave birth to the industrial revolution, was also responsible for the decline of manufacturing in cities. The rise of worker's rights, unions and the improvement of living conditions increased the costs of urban labour. Competition and the need to lower production costs pressured many manufacturers to look for cheaper alternatives, simultaneously taking advantage of increasingly affordable transport costs and (re-)establishing in more attractive international tax regimes. Those local businesses that could not compete for price were quickly or easily edged out of the market.

The end of the world wars and the opening of trade markets, encouraged imports from further and further away. This was marked particularly by institutionalised reconstruction efforts such as the World Bank (1944), the International Monetary Fund (1945), the establishment of the General Agreement on Tariffs and Trade (1947) and eventually the World Trade Organisation (1995). **Environmental regulation**, such as London's 1956 Clean Air Act, also forced manufacturers to become responsible for their environmental impact.²⁰ The cost of updating equipment or remediating polluted sites, added to the power of labour unions, made it simply more attractive for businesses to abandon their factories or to claim bankruptcy. The loss of larger manufacturers also triggered the loss of suppliers or subcontractors which made it harder for remaining businesses to survive. This process signalled the first stage of the decline of manufacturing not only in cities but also across Europe.²¹

In Manchester, between 1966 and 1972, one in three manual jobs in manufacturing were lost and one quarter of all factories and workshops closed.²² Those manufacturers that did not ship their production off-shore, often changed format and modernised their equipment. This increased output and required fewer workers. Industrial labour efficiency in the UK improved by 200 fold between 1750 to 1990¹⁸, in other words a typical task taking 1 day in 1990 would have taken 200 days 240 years earlier. Electrification



allowed factories to be set up almost anywhere. Many businesses moved out of cities, particularly those requiring lower-skilled labour and performing simple repetitive tasks. Non-urban sites could access a cheaper workforce and more affordable land. Likewise, with fewer neighbours, environmental regulation was more flexible.

The 1960's and 1970's saw changes and upsets in employment due to sometimes agonising shifts in the economy during the transition from industry to **services**, referring to a catch-all category ranging from accounting to cleaning.²³ The employment shift stabilised throughout the 1980's, and it is important to consider how this occurred:

*"Because private consumption is more services intensive, and services are more employment-intensive, job growth really took off in the services sector. Private consumption has made a major contribution to economic growth and was boosted by a 'feel good' factor related to the labour market's steady improvement and rising housing prices (with most double income families owning their own house)."*²⁴

Those generations growing up since the 1950's have changed the way society thinks and acts. With no major global wars, long-term investments could be made. Housing was affordable while long distances and cheap land were increasingly accessible by personal transport. The economy only grew: the equivalent GDP per person relative to today's prices in 1947 £7,300 rose to £30,000 in 2015²⁵. More choice of goods were available on the market and increasingly affordable. Health conditions improved, raising life expectancy for men in Belgium from 66 years old in 1960 to almost 80 years old in 2015²⁶. Education opportunities across Europe were accessible to almost anyone that applied. Furthermore, relatively stable and reliable work allowed workers long-term jobs. Land continued gaining value and almost all workers have a pension from around the age of 65. This shift in mentality away from tough and long working hours in highly polluted cities to relatively healthy urban areas focused on consumerism, has changed society drastically and is going to be one of the 21st century's greatest challenges.

The radical migration out of city centres resulted in vast swathes of vacant and blighted land, which helped to mythologise the negative qualities of manufacturing. It suggested that the sector was no longer compatible with a modern idyll of urbanity. The impact of urban blight was believed to be linked to criminality which needed to be cleaned up.²⁷ With the advent of the automobile, many once industrial cities like London, New York and Amsterdam, experienced a wave of mid-20th century suburbanisation also known as *white-flight*. This refers to the relocation of many privileged segments of the population, largely consisting of (predominantly white) middle class, that moved out of cities to suburbia.²⁸ The process shifted a major tax-base away from local public authorities, leaving cities beckoning for redevelopment. Many western countries triggered suburban development policies to help restart their economies and boost morale for those with the means to purchase real estate. This included a range of benefits such as tax cuts, investment in infrastructure (like highways) and rezoning land for development. The public and private sector soon found ways to turn inner-city blight into a 'win-win' enterprise that played up this private consumption mind-set. From the late 1970's a wave of redevelopment of industrial land resulted in extensive public amenities such as new parks, publicly accessible waterways, schools, modern streets, social housing and infrastructure. Without a doubt the redevelopment of vacant industrial land helped improve the quality of life for many inhabitants. Some industrial areas offered spectacular locations for housing, particularly those located next to transport infrastructure or attractive waterways, which made these sites even more attractive real estate propositions. The costs for such investment often came from a mechanism referred to

as *property-led development*²⁹, leveraging the sale of housing and offices to fund open space and public facilities.

Simultaneously, another trend emerged. Artists, looking for affordable space, turned to abandoned manufacturing buildings and warehouses. This launched a trend for 'industrial chic' which created a penchant for renovating vacant manufacturing spaces. This increased real estate potential increased the price of certain industrial buildings, particularly small workshops, which also meant that they were less accessible for manufacturers.

Real estate development and speculation were facilitated by freer access to finance. *Financialisation* of the economy in the 1980's eased access to loans and credit for both businesses and consumers. In many cities this allowed bigger businesses to grow, pursuing rent seeking activities such as real estate development¹³. For developers, the vast amounts of re-zoned industrial land was clearly a boon for their profit margins, since land value for housing is worth significantly more than that for industry. For consumers this reinforced a home ownership obsession spurred since the 1950's.³⁰ Humorist Robert Quillen referred to "using money you haven't earned to buy things you don't need to impress people you don't like"⁴⁸, while others call this a *growth fetish*.⁴⁹ For certain manufacturers, suburbanisation and consumerism initially also drove industrialisation through the demand for vehicles, furniture, building equipment and so forth.⁵⁰

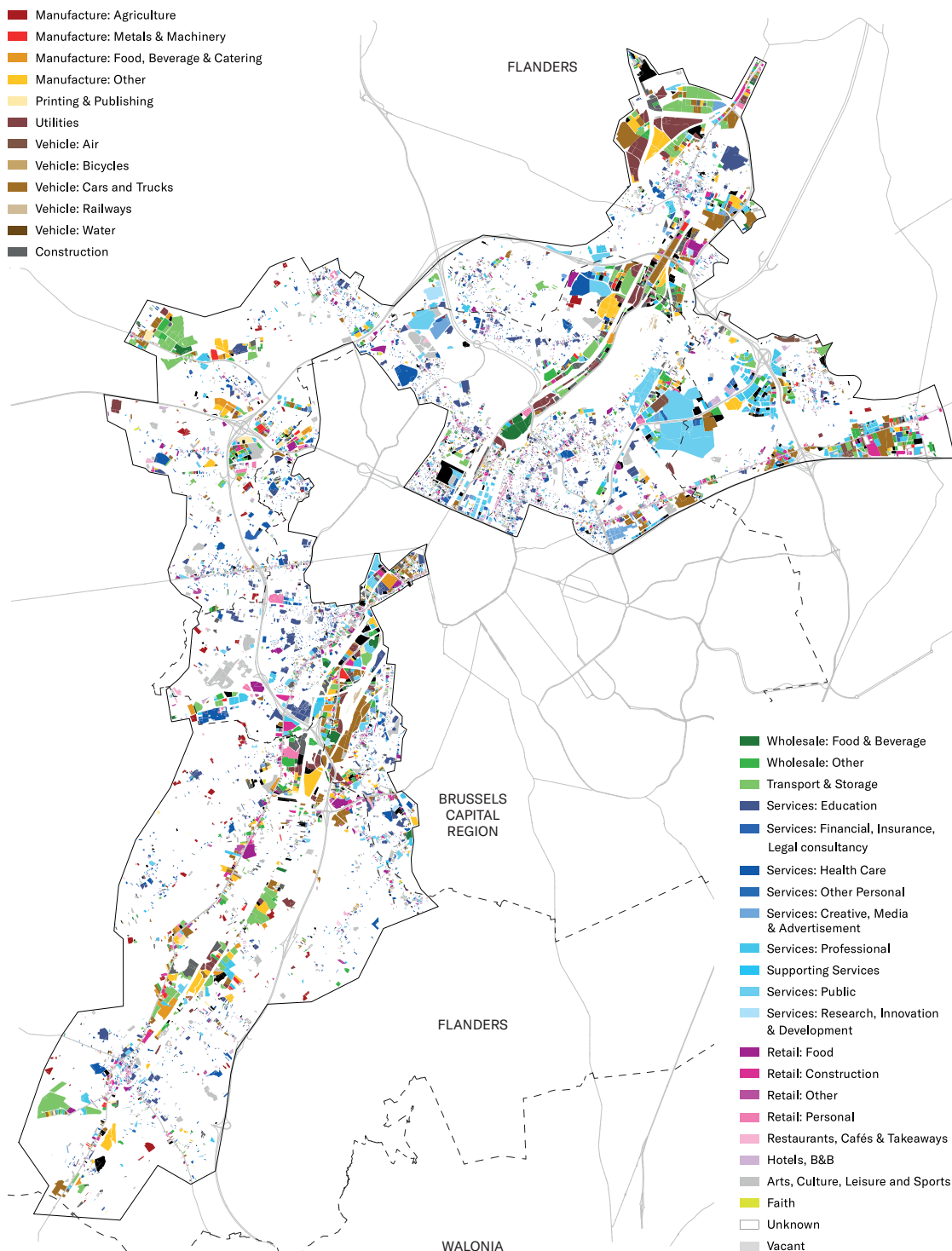
Many city centres that have grown since the industrial decline in the 1970's did so simply due to the redevelopment of their former industrial land, for example London's docklands. Property-led development is particularly attractive for local politicians who can show 'development progress' in terms understood by their voting constituents during the course of their mandate, while typically shifting costs to the private sector.³¹ In practice, evicting residents from housing to build a park is far more challenging and expensive for a public authority than to buy out a manufacturing business that occupies a large site and employs a relatively low number of people. Local authorities still actively employ this approach and intentionally implement planning policies to redevelop industrial land or to make working conditions difficult for manufacturers. Others are forced to use rezoning and redevelopment to cover basic investment costs. For poor municipalities that still have reserves of industrial land or can negotiate with developers, rezoning provides a potential resource for developer contribution taxes. Those can be used to cover the costs of public infrastructure and to attract a tax-paying middle class.

In short, there were two waves of change that disconnected manufacturing and cities in the 20th century. The first wave of decline in manufacturing resulted from increased productivity and competition from international markets. The second wave of decline resulted from real estate development and gentrification provided the. The rise in property prices and changes in the social structures have led to greater tensions in areas where housing and manufacturing once cohabited. As a result, manufacturing is considered as a *weak land use* as it has lower purchasing power and short-term financial results than activities like services or housing.

Other less obvious changes to cities have also made urban manufacturing far more complex. Red tape and bureaucracy required for businesses to address environmental regulation has created extensive administration. Taxes affect manufacturers sometimes unfairly due to their larger surface areas or because of archaic taxes on equipment. Slow processing for planning permits has stifled businesses' capacities to adapt their facilities. Improvement in public space for cyclists and pedestrians has reduced maneuverability for trucks. Congestion (and more recently congestion charging) has increased costs. Finally, neighbourhood committees and advocacy groups have become better organised and increasingly powerful, reacting to noise, use of large vehicles and suspicions of pollution.

BRUSSELS MAP

0 1500m



This abridged history chronicles how the character and livelihood of manufacturing in European cities changed radically over the course of a century, in part due to changes in manufacturing processes and partly also due to modern real estate mechanisms. Within the span of a few decades, manufacturing has shifted from being a major employer and generator of the local economy to one that has been not only overlooked but also actively pushed out of cities.

THE 21ST CENTURY CITY

For many established urban manufacturers, the future is bleak. London, the city with the greatest number of manufacturing jobs in the UK, **rezoned** almost 20% of its industrial land reserves between 2001 and 2015.³² The loss of land puts pressure on businesses, who struggle to find suitable space or lack the capacity to grow. This is continuing to shrink manufacturing jobs and reduce the supply of suitably skilled employees. Remaining city oriented businesses have lost suppliers, training facilities, suitable long-term spaces, supporting infrastructure, and a choice of skilled workers.

Higher levels of global competition have left local manufacturers short on trade organisations that can represent their interests or fight challenges from competing land uses such as housing. The services sector outcompetes other city-oriented activities for space and price.³³ Real estate trends that emerged in the 20th century favoured short-term profit, and financial speculation over value for the local economy still prevail. This has meant that urban manufacturing and associated activities of repair and remanufacture, have been viewed as being in terminal and inevitable decline, pushed out of city centres and marked as a dwindling sector on government spreadsheets.

Rarely have city officials taken pause to consider why urban manufacturing is relevant and what type of activities should be encouraged. As suitable space and land continues to be rezoned, there is little time left to make strategic decisions. Commentators noted, “we may be blindly heading towards a situation where London becomes a densely packed, high value residential dormitory, instead of a vibrant global city,”³⁴ such a reflection is echoed by many other European cities. Meanwhile, few inhabitants know where things are being produced, let alone what they depend on that are being made close to home.

Today, it is the service industries, including retail, hospitality and finance, that are heralded as the bedrock of many European city economies (ironically in many cases built on manufacturing sites).³⁵ Services may remain the main employer in the foreseeable future. However, this narrative fails to recognise the true value of manufacturing which takes place in cities, and how these activities are embedded into the local economy. Scratch beneath the surface and it is evident that the demand for urban manufacturing still runs deep into city economies. As will be discussed later in the book, cities depend far more on manufacturers for preparing the city to solve its biggest challenges than is communicated. Manufacturing serves business, which is hard to see. Very little is known about how much the city depends on local manufacturing, how much manufacturing brings to the city or even how manufacturers interact. An often invisible engine, manufacturing is a web of many small firms, their activities enabling other sectors to flourish and provide alternative forms of employment.

The negative side effects that pushed manufacturing out of European cities, have hardly been resolved. The extreme degradation William Morris witnessed in 19th century London continues to exist, but in other cities around the world. From Bangladesh to Mexico, cities suffer the consequences of our global system of production and its race to find the lowest costs of production. The environmental breakdown is now on a scale that Morris could not have foreseen and no doubt he would be saddened

to see this continued damage to the natural environment. Industry in Europe accounts for 25%³⁶ of energy consumption and 10%³⁷ of greenhouse gas emissions, but these are much lower than the global levels of 37% and 24% respectively,³⁸ as a sizeable portion of Europe's goods are produced off-shore. The side effects of extracting natural resources and manufacturing for western markets has resulted in the death of natural ecosystems across the planet, and has brought 19th century London smog to the global south. Tragic labour conditions with catastrophic deadly accidents occur regularly³⁹ while news rarely attracts attention of the West. Low value recyclable waste, such as plastic and electronics, are being sent to Asia only to be burnt or dumped. All this is supported through global trade with a highly polluting transport system.

Regardless of the decline of manufacturing, it persists in many cities, often unnoticed by the general public. In the cities that were studied for this book, manufacturers provide an important role in the local economy, such as food (both fresh and processed) and beverages, bicycles and vehicles, clothing, construction material, bio-technology equipment, theatre equipment, furniture and a vast range of parts and pieces that cities depend on for their livelihood⁴⁰.

We believe that despite development pressure, manufacturing is not in terminal decay in cities. On the contrary, it seems to be at the opening of a new chapter. It is emerging as a source of new projects and businesses dealing with urban issues, like developing novel ways to produce food in small spaces, managing resources locally with social enterprises and building hardware technology to accompany cutting edge software, examples which will be described later in this book. New forms of urban manufacturing are desperately needed to ground policy ambitions ranging from the circular economy, increasing innovation, reducing emissions, realising ambitions for the technology intensive Industry 4.0 and providing accessible jobs.

WHY WE NEED A CLEARER VISION OF URBAN MANUFACTURING

Local manufacturing contributes a great deal to cities, and many manufacturers are inseparable from their urban context. Yet there remains much incoherence in defining how cities should nurture their manufacturers. Cities will face many unanswered questions regarding what type of manufacturing to expect, where it may occur and how it helps them to be innovative, resilient, inclusive and sustainable.

Manufacturing still remains an activity without a clear narrative or voice. Furthermore, it is uncertain who should be responsible for it. Should it be a public actor, a private business group, a non-governmental organisation or an entirely new breed of bridging actor that helps to draw together the disparate aspects of manufacturing?

In practice, public authorities are expected to step in to correct market failures and support vulnerable but important aspects of the local economy. City authorities are increasingly seen as policy leaders to translate visions into action as other levels of governments find themselves politically paralysed. If urban manufacturing is considered important to a city, then public authorities must position themselves and decide how they will support the sector. This way opportunities can be explored for other organisations, such as non-governmental organisations or business communities, to play a complementary role.

Cities, represented particularly by civic leaders and public officials, are likely to face a range of questions regarding how they should act. Should they provide financing? Should a certain amount of real estate be publicly owned? How should education and

► **Schiedamse vrijwilligers zijn van alle markten thuis, gratis en voor niets**

Inwoners van Oost weten de weg naar de klussers van de werkplaats

Buurtwerkplaats Oost in Schiedam

ging een jaar geleden open. Inmiddels weten de inwoners van Oost hun 'buren' voor allerhande klusjes goed te vinden. „We zijn laagdrempelig, maar willen nóg laagdrempeliger zijn.”

Sandra Don
Schiedam

Zomaar een willekeurige middag in de loods van de Buurtwerkplaats Oost, aan de Parallelweg in Schiedam-Oost. Bas, de barbecuehond staart het gezelschap aan. Het 'beest' is van afval gemaakt en ziet er toch als nieuw uit. „Is Fikkie of Lassie niet een betere naam?”, vraagt een van de aanwezigen. „Nou, als Lassie dat hoort, draait 'ie zich om in zijn graf”, reageert iemand. „We houden het bij Bas.”

Bas krijgt straks een plekje in galerie Illias aan de Hoogstraat, ter promotie van Buurtwerkplaats Oost.

Welkom bij de Buurtwerkplaats Oost, waar de slogan 'bij de burens maak je alles' nog steeds van toepassing is. Van het repareren van een fietsbandje, het leggen van dakpannen tot aan het helpen met verhuizen. De vrijwilligers van de wijkonderneming zijn van alle markten thuis. En zijn ze dat niet, dan zoeken ze in hun netwerk iemand die de klus wel kan klaren. Gratis en voor niets.

Hulp

Joost Krop en Thijs Wilschut geven leiding aan de vrijwilligers,



▲ In de Buurtwerkplaats Oost wordt de laatste hand gelegd aan barbecuehond Bas. FOTO JOEP VAN DER PUL

zo'n vijftien in totaal en de wisselende stagiaires van Lentiz Life College. „Mensen weten ons steeds beter te vinden”, steekt Krop van wal. „We hebben al heel wat mensen blij kunnen maken”, vult Wilschut aan. „Bij ons kan eigenlijk alles. Wij sturen mensen niet met een kluitje het riet in, want beseffen heel goed dat zij

niet voor niets bij ons aankloppen. Ze hebben weinig geld te besteden en hebben wel dringend hulp nodig.”

Beetje leuk

„Maar”, zo haast Krop zich te zeggen, „we moeten wel altijd een afweging maken. Is het werk dat wordt gevraagd veilig voor onze mensen? En het moet een beetje leuk zijn. Ik wil onze mensen best de hele dag rolertingen laten vervangen, maar dan moet er ook een fatsoenlijk salaris tegenover staan. Daarnaast proberen we mensen ook een beetje op weg te helpen. Sommige klusjes zijn eenvoudig zelf te klaren, als je maar weet hoe het moet.”

Krop, die een achtergrond heeft, in de maatschappelijke sector vindt het ook belangrijk dat zijn mensen 'achter de voordeur kijken'. „Als iemand hulp nodig heeft, schakelen we die in via het wijkondersteuningsteam waar we mee samenwerken. Die komt nog steeds heel wat schrijnende gevallen tegen in een wijk als Oost.”

Buurtwerkplaats Oost krijgt subsidie van de gemeente Schiedam en ontvangt onlangs ook een investeringssubsidie van het Oranjerfonds waarmee de loods afgewerkt kan worden. „Die subsidie is fijn, maar ik hoop dat we uiteindelijk zelfstandiger kunnen worden. Hopelijk kunnen we in de toekomst op eigen benen staan”,

blijkt Krop vooruit. „Over vier jaar moeten we bestaansrecht hebben.”

Maar ook meer samenwerken met een organisatie als Stroomopwaarts en partners in de omgeving, zoals basisschool de Peperklip, die plannen heeft voor een insectenhotel op het terrein van Buurtwerkplaats Oost. Er is ook al een moestuin gevestigd, waar iedere zaterdag buurtbewoners in aan de slag gaan. „We zijn laagdrempelig, maar willen nóg laagdrempeliger zijn. Aan de andere kant willen we ook meer volume creëren en voor meer reuring in Oost zorgen. Hopelijk kunnen we een voorbeeld zijn voor andere wijken.”

training be supported? Should networks or clusters of manufacturers be stimulated or should the sector simply be left to the market? Should certain activities be prioritised over others? How can manufacturing remain competitive but also provide benefits for the city? How can manufacturers ensure wages remain competitive yet workers have suitable working conditions and affordable accommodation?

Many cities are being confronted by the serious challenge to manage tension between the demand for housing, the improvement of public amenities and the need to retain industrial land. Planners have attempted to deal with this challenge by proposing mixed use developments, the 'co-location' of manufacturing and housing or other activities. Much of this remains an experimental process that is being rolled out in cities from Los Angeles⁴¹ and New York⁴² to Brussels⁴³, London⁴⁴, Rotterdam⁴⁵, Vienna⁴⁶ and beyond. Developers involved in such mixed use projects are often housing developers and have limited experience with industrial spaces thus risk making irreversible errors.

Technology is also moving faster than it can be regulated. Innovative policy is required at a city scale to allow new forms of manufacturing to fit into novel conditions such as old office blocks, in underused parking garages, basements or even in homes.

Unlike William Morris' view of a future industry-less city, this book provides a vision for a future for European cities where manufacturing supports inclusive communities and thriving economies which have a regenerative relationship with the environment.

KEY IDEAS

Manufacturing and urban areas have evolved heavily during the 20th century. They provided the development force to build large parts of cities and laid the foundations for infrastructure that we depend on today. But since the end of World War II, innovations in technology, improvement in productivity, environmental regulation and strong international competition, radically impacted the sector and saw the closure of many large factories within larger cities. This left large sections of the city in a state of blight or disregard, while those with means left city centres in search of more attractive living conditions in the suburbs. Furthermore, the turn of the economy towards services also changed the way society deals with consumption and consequently increased the demand for consumer products. Both public and private actors used real estate development to improve living conditions and real estate value through a mechanism referred to as 'property-led development'. While a large amount of manufacturing has left cities, much of what remains still has a valuable contribution to play to the future of the city. One of the largest questions is: what is the relevant narrative for manufacturing that reflects the needs and opportunities for the 21st century? Furthermore, who should be responsible for facilitating the role of manufacturing in cities and what should be the role of public authorities? Over the following chapters we will explore a vision for urban manufacturing, and then will look at how cities may develop their manufacturing future.

FOUR NEEDS

FOUR NEEDS CONNECTING CITIES & MANUFACTURING

Cities depend on having many forms of manufacturing nearby, while some manufacturers are dependent on the rich economic base provided by cities their viability. Part of the current erosion of manufacturing in cities, as we learned in **Chapter 1**, is due to the lack of a clear narrative that stresses the relevance of city facing manufacturing. This chapter will help structure a narrative for urban manufacturing which can be translated into policy or used to found a local economic vision in which manufacturing has a clear place. This narrative is built around four needs met by city-oriented manufacturing. Firstly, it can help *sustain a thriving economy* by creating local work, developing export products and providing an important base for services. Secondly, it can *stimulate innovation* by turning technical skill and ideas into prototypes, or prototypes into product ranges. Thirdly, it can be an essential vehicle for *addressing climate change and environmental impacts* through more efficient technology, providing the means to repair or improve existing technology and to turn local waste into new products. Finally, manufacturing fosters *economic and social inclusion* by providing low barrier jobs, a diversity of work conditions and accessible opportunities for entrepreneurship.

#1 SUSTAINING A THRIVING ECONOMY

The relationship between manufacturing and services European cities is more nuanced than the tug-of-war waged between proponents of manufacturing and services suggests. On one side of the argument, the basic function of the economy is provided by locally oriented needs.¹ At the other side of the argument, the economic base is produced by finance generated through exports.² Either way, manufacturing and services are inextricably entangled.

A VITAL SERVICE FOR THE LOCAL ECONOMY

A significant proportion of the economy is underpinned by activities in manufacturing. A study based on the European NACE statistical system in the UK³ found that the **direct impact** of the manufacturing sector was responsible for nine percent of the UK's Gross Domestic Product and provided 2.6 million jobs. Furthermore, the **indirect impact**, the economic effect supported in the supply chains of those businesses, increased this statistic to cover 15 percent of the overall economy and over 5 million jobs. The **induced impact**, the effect of the spending by people employed directly and indirectly in manufacturing, brings this number up to 23 percent of the population and 7 million jobs.⁴ One reason for this large indirect impact is the outsourcing of activities from manufacturing firms. Activities which would once have taken place within a manufacturing business, such as cleaning, catering, finance and logistics, have been outsourced over the last few decades. Their economic contribution is no longer counted within manufacturing, but such services businesses will rely heavily on the manufacturing sector and would suffer without its presence.⁵

Indeed, many service businesses depend on manufacturing and local technical knowledge. Printing, for example, is needed by businesses from restaurants to law firms; carpenters fit out shops; and dressmakers produce costumes for theatres. This kind of production has been termed **regional processing** to denote activity which needs to take place in proximity to where it is used, either because close relationships are required between producer and client, or because the products don't have a long life.⁶ Manufacturing also supports a vast range of mundane daily needs that residents of any city depend on, referred to as the **foundational economy**,⁷ which involves basic aspects supporting the foundation of civilised life. This includes manufacturing related activities such as food production to waste management, infrastructure maintenance and construction. Regional processing and the foundational economy are often invisible to many residents as it is based on business to business relationships or it involves things that people take for granted. For cities with a strong services economy, foundational forms of manufacturing therefore remain important. These activities not only cover the largest number of employees in manufacturing but are also are most resilient to international competition and changes in technology. Although the study of economic resilience is in its infancy, available research concludes that economic diversity within a city enhances its resilience.⁸

IMPORT REPLACEMENT AND LOCAL VALUE ADDED

Jane Jacobs identified that **import replacement** (creating local alternatives to goods that were previously brought in from elsewhere) is an important path to innovation and improving local economic purchasing power. In the 1950's, Japan, Taiwan and South

Korea transformed their crippled post-war economies by firstly copying technology and then developing their own adaptations. In Shenzhen (China) this technology counterfeiting and copycat culture is called *shanzhai*.⁹ Jacobs refers to the genesis of the Japanese bicycle industry, which emerged by repairing bike parts and piece by piece began replacing imported parts with locally made interpretations. The locally produced bicycles not only replaced imports and satisfied local demand but also became a major export.¹⁰

Through import replacement money can be reinvested in the local economy, such as via purchasing locally made products, which is believed to have a **multiplier effect**. For example, a cabinet maker buys wood from a local forester and sells furniture to a local boutique. All three will spend their profits at local food markets, visit local hairdressers and doctors, all the latter invest their profits in buying furniture from the cabinet maker. In other words, for every currency unit invested, there is an additional value produced as currency is circulated from business to business or consumer. There is a noticeable difference between the multiplier effect of **tradable sectors** (such as manufacturing) compared to non-tradable sectors (such as the public sector or restaurants).¹¹ In the US, a study found that each dollar invested in a locally manufactured product supported \$1.33 in additional output, which was more than twice that of sectors like retail (\$0.66) and professional and business services (\$0.61).¹² It is hard to generalise about such results but it shows that the economic benefit to society of local manufacturing producing locally needed goods can be much larger than what shows up on a business' profit sheets.

Consumers may not be concerned about the economic benefits, but local sentiment is showing the capacity to capture a market niche. A recent wave of place-based branding, think of 'Made in NYC', has shown that there is a market for locally made products even if prices are higher. This has been particularly a hit for tangible consumable products, such as craft clothing and food. In 2012 there was only one remaining brewery in Brussels, by 2020 this number exceeded twenty, profiting from the local branding.

As a side note, the inherent assumption that 'local is better' is not always correct and prudence is required when attempting to replace imports. Economies of scale and production efficiencies are not necessarily achievable at a city scale¹³ for some forms of manufacturing such as chemicals, metals, pharmaceutical products and even electronics. These can be significantly more expensive or simply inefficient if decentralised.

Import replacement can serve for far more than simply financial gain. Many cities depend heavily on large **supply chains** to provide a vast range of materials and resources that cities rely on a daily basis. This is nothing new. Ancient Rome was believed to have had just a few days worth of grain reserves during its peak in the Roman Empire.¹⁴ In times of stability and growth, dependence on such supply networks may provide more affordable goods, better quality products or a broader range of choices. However, in times where supply chains are stressed due to natural disasters, conflict, infrastructure issues or political tensions, these supply chains can prove to be weak and stress local citizens and businesses.

There are many contemporary examples of how global supply chains can have local impacts, such as the 1970's oil crisis, the breakdown of the USSR or even the outbreak of international health epidemics like the coronavirus that have quarantined high-tech production centres in China. The recent Brexit transition is showing how much the United Kingdom depends on European neighbours for a large supply of food, construction materials, medicine and even mundane goods such as fresh flowers. Shutting down businesses that provide foundational goods and resources, due to international competition, can whittle away the **resilience** capacity of the local economy to deal with international supply chain problems.

Protecting the local economy from external shocks is commonly referred to as raising **autarky** and fits into a very different concept for the economy than the financially oriented **value-added** drivers. Local producers may be less efficient compared to importing goods, but they may be necessary to deal with sudden changes in supply networks, to implement new policy (such as climate change adaptation) and also to allow local industries to change or adapt.

PRODUCING TRADABLE GOODS

Arguments have raged between those who view manufacturing as the economic engine of a country and those who see it as having been superseded by services. The state of a country's manufacturing base, typically measured in terms of exports or GDP, has been traditionally used as an indicator of a country's wealth.¹⁵ There are several factors which contribute to this. Firstly, manufactured goods are generally highly **tradable** and **exportable**. This can play an important role in avoiding crises in a country's balance of payments.¹⁶ Secondly, manufacturing can more readily benefit from technology related productivity gain (producing more with the same amount of input) than service businesses.

It is important to note here that productivity rises, for example through **automation** of production, may reduce **labour intensity**, and thereby reduce employment without a decline in the economic share of the sector. Therefore, citing falling manufacturing employment as an indicator of the importance of the manufacturing sector for the economy is often a statistical illusion. Consider the difference between a lawyer a biscuit maker. The lawyer's work methods have changed little over the last centuries, still involving letters to be written (or typed) by hand while being one of the highest paid professions. In contrast the biscuit production process is largely automated, requiring fewer employees, and also possibly increasing production volumes while wages have changed modestly.

Measures of GDP are not the ideal yardstick to equate to progress and in the backdrop of international climate change agreements, the merit of exporting large volumes of goods is weakening and this indicator needs to be revisited. The GDP does not equate to holistic economic indicators such as quality of life or happiness indexes.

PREPARING CITIES FOR THE FUTURE

Technological developments hold promise for manufacturing, and economic opportunities for cities. Commentators are heralding the arrival of **Industry 4.0**, the moniker for a collection of technologies from cloud computing to additive (or 3D) printing, which look set to enable smaller scale, more flexible and customisable production to take place. Predictions include an increase in **distributed manufacturing** where, in contrast to centralised factories, production can take place in smaller sites, including within city centres. **Mass-customisation** is also foreseen, where individually tailored products are viably produced locally and at scale.¹⁷

Such technology comes with both opportunities and threats for cities. Distributed manufacturing could increase productivity, reduce production costs and be smaller or more compatible with dense urban areas. But this technology may be expensive, it may be energy intensive and may not necessarily provide more or better quality local jobs. Cities must find ways to leverage new technology to benefit their citizens and local economy. If such technology is deemed beneficial, planning conditions should look beyond traditional land use regulations and find performance based rules that can permit manufacturing to be distributed across the city.

#2 STIMULATING INNOVATION

Innovation can help cities to solve challenges, such as reducing air pollution and capitalise on the economic benefits of new technology or products. Drawing inward investment is often seen as paramount to stimulating innovation in cities and it is of course beneficial to attract specific firms or industries to build expertise and strengthen networks.

BUILDING NEW WORK ON OLD

New ideas can spring from existing skills and products. Urban manufacturing generates tacit skills and knowledge, termed the **industrial commons**, which can seed and support innovation. The industrial commons held by one city can lead to developments which wouldn't arise from another city's knowledge, often morphing across sectors in a way which is difficult to predict. Cities should therefore encourage locally-rooted innovation to develop **business ecosystems** from within the city.

Coventry's automotive industry can trace its history back through its bicycle industry, to origins in the local watchmaking and ribbon-weaving industries in the late 19th century.¹⁸ Brussels' chocolate industry emerged from confectionary developed in a local pharmacist's shop in the 1870's.¹⁹ Bologna's hi-tech packaging and automotive cluster emerged from its heritage in processing silk during the middle ages.²⁰ Such developments could not have been predicted, but had existing manufacturing bases not been nurtured (along with skills and tacit knowledge) the potential to innovate would have been unlikely.

ORCHIDAE. HIGH TECH PRODUCTION OF FLOWERS (SOUTH HOLLAND) / © V SANZ - R1, R4, R5 & B4



TAKING ADVANTAGE OF DIVERSITY

In 1890, at a mature period in the UK's industrial revolution, the economist Alfred Marshall observed in his foundational tome *Principles of Economics*, that **agglomeration**, **density** and **diversity** of businesses were key ingredients for a vibrant economy.²¹ Seventy years later, Jane Jacobs revisited these ideas in the twilight of New York's industrial age.²² She gave Marshall's observations an urban scale and showed how the evolution of ideas was heavily connected to layers of history and culture while stimulated by particular urban conditions. Jacobs reflected on what built local economies in places like New York and the factors that had led cities like Detroit and Birmingham to economic decline, pointing particularly to the loss of small businesses. They were more inclined to take risks and innovate than the larger ones. She considered manufacturing and other 'making' activities a vital foundation for a vibrant economy. Around the same time on the other side of the Atlantic, French sociologist Henri Lefèbvre was developing ideas on *space production*²³ and began to draw links between the materiality of the city and the social relations which are vital in generating ideas and meaning.

"Nothing disappears completely ... In space, what came earlier continues to underpin what follows ... Pre-existing space underpins not only durable spatial arrangements, but also representational spaces and their attendant imagery and mythic narratives."

– Henri Lefèbvre [1991:228]

Over a century after Marshall and half a century since Jacobs and Lefèbvre, economist Edward Glaeser observed that there is a notable return of larger (service oriented) businesses that had left during the 1960's and 1970's. Glaeser notes that these businesses are increasingly conscious of the importance of agglomeration, density and diversity of the local economy.²⁴ Ironically diversity is under threat due to severe congestion, rising land values and real estate driven development (see Chapter 1), destabilising the very substance that makes such areas attractive. Planning could play a role in moderating the business relationships in most large cities. For cities looking for measures to protect diversity, Alfred Marshall pointed to three particular ingredients: **sharing**, **learning mechanisms** and **matching**.²⁵

Sharing

Manufacturing benefits from sharing technology, infrastructure and facilities. Many forms of manufacturing have traditionally co-located with other similar businesses, located in the same street, block or city. Decades ago, anecdotally one could walk along London's Old Kent Road with a piece of wood and walk out with a chair. **Co-location** is particularly useful for businesses within the same sector, performing similar tasks and bearing complementary skills as shown in the analogy of the chair where business can specialise in woodturning, painting or upholstery. Co-location may have emerged out of practicality but through sharing, a sense of community and interdependence is created which can help manufacturers to be more dynamic, innovative and collaborative. Such knowledge is 'sticky' and can be bound to specific places.²⁶ Manchester remains innovating in textile technology years after the decline of their cloth industry while Bologna continues as a leader in precision machinery centuries after the decline of their specialised in manufacturing silk. Cities have much to gain through creating conditions (buildings and infrastructure) that foster sharing, whereby businesses with similar activities are physically clustered.

Learning mechanisms

The economy depends on learning mechanisms for sharing knowledge and experience to result in new ideas or skills. Coffee shops were said to have spurred the ideas by giving strangers the space for exchange, leading to the English enlightenment period²⁷ and consequently the industrial revolution. The 17th century coffee shop has evolved into university agoras, local business forums, technology communities and knowledge hubs. Education and training has largely institutionalised and by virtue of the high cost of buildings and infrastructure, they are often connected to larger urban centres. Cities have the capacity to offer students a wide range of options for education, from hands-on trades paths to more theoretical university courses. Urban centres harbour extensive amounts of living knowledge and experiences upon which new ideas and products can be created. They should ensure that knowledge and training institutions are well embedded in society and are public facing. This can stimulate learning and show how businesses and researchers are relevant to the local community.

Matching

Cities allow matching of supply and demand of labour. By having knowledge institutions, training centres and an ample supply of work, they allow businesses to have a choice of workers, but likewise encourage competition for talent. While living costs and wages can be higher in cities, the choice of workers and skills to fit the needs and character of a business can easily justify the extra costs. Furthermore, labour is believed to be more productive in agglomerations. Cities can help brokering the supply and demand of labour, particularly through future looking investment in education and training that is relevant to the evolving needs of business.

The antithesis of diversity is ***stagnation*** and ***homogeneity***. Since deregulation and free-market capitalism in the 1980s, trends such as the financialisation of the economy, property led development and a focus on services jobs (see chapter 1) has resulted in a level of homogeneity in cities. This has led to market failures, notably two. Firstly real estate in the city is being produced primarily for profit driven motives, driving up land values to draw in the highest payers while making it inaccessible to young risk-taking businesses and many foundational manufacturers that provide valuable products (such as food and construction). Secondly, the private sector is very good at commercialising proven technology but struggles to stimulate foundational research and development needed to push along the economy.

The public sector has a significant role to play in correcting markets and stimulating innovation particularly under the framework of a mission oriented vision, as noted above.²⁸ The risks of not intervening and allowing the free-market to evolve naturally are neatly summed up in the claim that 'cities are eating themselves' by allowing monocultures to proliferate, from carbon copy retail districts to luxury real estate developments.²⁹ Brussels, for example, has been shown to have a low intensity of research and development, attributed to its lack of industrial activity, which has knock-on effects elsewhere in the economy.³⁰ Cities need to be careful to cultivate, rather than reduce diversity.

NURTURING COMPLEX NETWORKS

Cities are ***complex dynamic systems*** which are difficult to understand or manage. How can the local economy be positively stimulated without damaging it? This involves working at an awkward scale between ***macroeconomics*** (charting larger trends such as employment and inflation) and ***microeconomics*** (focused more at the scale of the individual or firm). The meso scale remains vague due to a lack of suitable granular data and the lengths required to study how the local economy works, let alone

foresee the effects of one action on the larger system.²⁷ In 1909, the German economic geographer Alfred Webber³¹, published observations on why businesses select specific locations. Webber's ideas, which are ever so prescient today, noted that there are cost savings and benefits afforded to cities due to efficiencies in travel times, access to resources and talent. This is referred to as **agglomeration economies**.³² Within agglomeration, there are three variables: *scale*, *localisation* and *urbanisation*.

Scale Economies

Sharing tasks between one business and another can be time consuming and inefficient. Business may decide to improve efficiency by growing and absorbing many different activities under the same roof. This is referred to as **economies of scale** and means that processes can be optimised. Jane Jacobs observes how companies in Detroit, such as Ford, improved *production efficiencies* by buying up smaller businesses that contributed to the production on the vehicle. The evident advantage was a cheaper vehicle, the downside was that Detroit lost most of their smaller businesses, which destabilised the local economy when vehicle manufacturing declined.

Localisation Economies

Cities are often home to **clusters** of businesses performing similar but complementary work within a specific sector. Businesses may have suppliers, specialist companies that perform small supporting tasks and consultants that are required to provide expertise. When located on a specific site or area, this is referred to as **localisation economies**. Cities can identify and stimulate specific sectors through providing financing and other resources, or networking to improve collaboration. The European Commission has encouraged regions towards *smart specialisation* by focusing on particular sectors that form part of larger **Global Value Chains**.³³ If specific sectors are prioritised they should be carefully selected so they can be supported through suitable infrastructure, knowledge, training and fit into the local economy.

Urbanisation Economies

Cities of a certain size may have a wide range of sectors benefiting through sharing resources and knowledge across sectors without singling out one specifically. For example, a food production sector could be linked with a biotechnology sector as there are likely to be interchangeable research and expertise. This form of economic diversity, if located on a specific site or area, is called 'urbanisation economies'.³⁴ Cities can be very helpful in creating links between sectors and finding efficient public investment into research and infrastructure. Supporting the development of *Knowledge Intensive Business Sectors*, known as **KIBS**, which provides the service of knowledge and research, which is essential for innovating manufacturing as will be discussed further on. Manufacturers often create new product lines in-house but development is likely to be limited to evolutions of existing products rather than revolutionary development requiring extensive specialist knowledge. KIBS businesses can be a strategic way of improving knowledge of the 'software', such as materials or production processes, which is needed to drive the 'hardware' provided by manufacturers machines and production units.³⁵ KIBS businesses can also export their knowledge and services.

The ideas behind agglomeration economies may be more conceptual than founded on clear parameters, but they offer some guidance on how to plan for the local economy.³⁶ It should be noted that the counterbalance of the benefits of agglomeration are a range of costs including: high cost of land, high wages, congestion, complex regulation, impact on neighbours and so forth. Furthermore, public authorities need to be careful to support relevant sectors (through localisation economies) without neglecting relevant innovations in other areas (through urbanisation economies).

BRINGING TOGETHER DESIGN AND PRODUCTION SKILLS

A belief prevalent since the decline of manufacturing in Western Europe was that firms could **offshore manufacturing** but retain *high value aspects* of product development like design and research, without damaging the capacity for innovation. The British technology company Dyson, for example, designs and develops products in the UK but manufactures them in Malaysia.³⁷ US academics Gary Pisano and Willy Shih argue that offshoring manufacturing is an unwise tactic. Their research, confirmed in our fieldwork, shows that dividing production from the rest of the value chain risks missing the transfer of important, tacit knowledge and damages prospects of unexpected or spontaneous innovation. They explain that the co-location of manufacturing and development is particularly necessary for activities in which process is embedded in **product innovation**, such as high-end garment making or advanced materials production.³⁸ In these cases there is **material intelligence**, as Glenn Adamson puts it, where highly skilled tradespeople develop skills through years of practice.³⁹

Where the process is new or rapidly evolving, such as in nanotechnology, researchers and makers need to work together to understand how the technology can be used in real-world applications, where the value will be created. Cities are home to both kinds of production. London, for example has a large fashion design sector, and the advanced manufacturing campus in Sheffield is an example of a high-value manufacturing ecosystem benefiting from shared skills, research and development. Designers and developers need fast feedback through *prototypes* or via *research by design* to understand how to adapt products. For other forms of manufacturing found in European cities, high-value *customisations* and adaptations require skilled workers to be located very close to clients.

While many companies continue to contract their production to third countries, or simply import manufactured goods, a new wave of manufacturers are actually returning production back to Europe accounting for 15% in the UK and 1 in 3 companies in Germany.⁴⁰ Reasons can be attributed to quality standards, lead-times, intellectual property, research and development, skills and knowledge and threats from regime change of trade policy.⁴¹

ADDRESSING DIFFERENT TYPES OF INNOVATION

It is easy to consider innovation as the development of new technology and fancy gadgets. However there are many forms of it, most of which go easily overlooked by the general public. The OECD defines two particular strands.⁴²

Product Innovation

The first, and most visible strand, is product innovation, which includes goods or services. Cities are ideal places for product innovation as the urban environment can help designers to prototype and develop products, while providing a short distance from a local market that can finance or purchase the products. Many new products emerging on the market are minor adaptations of already functional products and simply encourage greater levels of consumption. This may result in the production of products, which can result in money and jobs, but also unnecessary resource extraction and waste. The passing of 'right to repair' regulation in Europe can pave the way for new forms of innovation that extend the life of products to encourage decoupling growth from resource consumption.⁴³

Business Innovations

The second strand is referred to as business innovation which more specifically includes innovation in: production, distribution, communication, administration and process

development. This strand of innovation can have a much greater impact on production processes and society at large, yet is often hard for consumers to identify. Such innovation may improve efficiencies or reduce costs. Entrepreneurs and public authorities alike are particularly looking at these kinds of innovation to help leverage production closer to home or result in more affordable output. Higher levels of **automation** and **artificial intelligence** may not change the range of available products, but may make them more affordable and customisable to the end user. For example, new technology for urban agriculture is allowing food to be grown efficiently within city centres based on careful resource management. In other cases, neither the products or production processes have changed, but innovative new business models have shifted revenue streams to be generated through, for example, tourism rather than just the sale of products.

LOCALLY EMERGENT TRENDS

While manufacturing in the 19th and 20th centuries stressed the importance of high-volume production, the 21st century is becoming increasingly concerned by 'smart' manufacturing: manufacturing that solves pressing social and environmental problems, often within the city itself.⁴⁴ This could range from new mobility solutions to treating organic waste, to technology to monitor water consumption. A combination of design skills, local technical knowledge and the market to purchase the solutions are required to spur such innovation, and cities should recognise the value of manufacturing's contribution to achieving this. Cities that are serious about addressing urban problems are likely to blur the traditional roles distinguishing public authorities, business, civil society and the knowledge sectors while defining missions and creating conditions for risk-taking.⁴⁵ They could focus on five particular growth areas for manufacturing in general, which can be applied to urban areas.⁴⁶

Global innovation for local markets

This is the production of medium to high technology products that are linked to global trade and knowledge networks but are produced close to customers. It could include chemicals, pharmaceuticals, machinery and appliances.

Regional processing industries and foundational manufacturing

As referred to earlier in the book, these are activities that are hard to disengage from their context. Food, construction materials, repair, waste management or business to business services like printing. This segment of the economy often employs a large amount of people and is relatively resilient when faced with international competition. It is likely to benefit from business innovations.

Energy- and resource-intensive commodities

From an urban manufacturing perspective, this could be interpreted as manufacturing solutions for the circular economy, whereby resources are captured and reused as possible at the urban scale.

Global technology sectors

This relates to high value density products such as electronics. Cities may have a very specific 'smart specialisation' cluster that focuses on a particular component of a larger componentry system.

Labour-intensive tradables

These include the production of consumer technology, furniture, jewellery and apparel

(such as clothing and wearables). Typically, high value, highly customisable activities have remained close to cities. This includes furniture making, jewellery and high-end fashion. Simple and repetitive processes (such as most consumer clothing) often occur in low cost countries where working conditions and environmental standards are hard to guarantee. **Re-shoring** such manufacturing, or producing locally, will require process innovations that can speed up production time or reduce labour costs.

#3 ADDRESSING CLIMATE CHANGE AND ENVIRONMENTAL IMPACTS

The world is facing climate breakdown and cities contribute heavily through their demands for manufactured goods. The negative impacts of manufacturing, referred to as ‘externalities’, are rarely fully appreciated by consumers while the consequences remain both out of sight and out of mind in third countries. Global production chains make it highly problematic to trace the manufacturing process from resource extraction, to processing of raw materials, transportation of goods and other environmental and social impacts. Alongside emissions, cities are accumulators of vast amounts of resources and producers of high volumes of waste. Not only is this environmentally destructive, it is costly for city budgets with the World Bank estimating that twenty percent of municipal budgets are spent on dealing with waste.⁴⁷ To tackle numerous environmental issues associated with global manufacturing, cities must find ways to separate material and energy consumption from growth of the economy and improvement of quality of life in urban areas.

ADDRESSING THE EXTERNALITIES THROUGH INNOVATIVE DESIGN AND PROCESSES

Environmental challenges make it abundantly clear that the current status quo is not sustainable, and that society must find new and just ways to manage resources by focusing on the demand rather than the supply of goods. A range of regional and international policy objectives and international agreements are putting pressure on consumers and manufacturers.^{48,49} While it is easy to interpret this as creating red tape and infringing on freedoms, there is much to gain from using resource management as a driver for innovation and to strengthen the local economy within the planetary boundaries.

Cities, as sources of innovation, stores of resources and drivers of culture should be vanguards in this shift. Developing environmentally sound innovation is within the gift of cities, and the urban manufacturing sector with its capabilities and skills should be recognised as a key enabler. Cities should combine the design of objects and services that can reduce low value resource consumption and waste. Consider for example the vast volumes of plastic waste from imported single use water bottles, producing many tonnes of waste despite many (Western) cities having high quality tap water. This plays into the concept of **designing globally and producing locally** which can include a range of both product solutions and changes to resource consumption.⁵⁰

SHIFTING TO A CIRCULAR ECONOMY

The circular economy sets out a framework for a shift in the way we make and consume goods which has a heavy link to local manufacturing. Rather than the current linear, ‘take, make, waste’ means of production, circular economy principles seek to keep

resources in use and at their highest value for as long as possible.⁵¹ Viewing manufacturing as a key component of circular economy infrastructure, along with activities like repair, recycling and reuse, establishes it as part of a wider *production and care system*.

Research has found that both environmental and economic benefits could be derived from this systemic transition. Government agencies at various levels have made commitments to transitioning to a circular economy.⁵² But the focus has been on recycling, which is the least effective intervention and fails to capitalise on the potential of urban manufacturing. The volume of resources present in cities are excellent potential flows for new activities, particularly by starting with resources used directly within the manufacturing sector itself. The following could take place:

High quality production

The manufacture of good quality products which are designed to stand the test of time is a clear way of reducing waste. European cities are already home to high quality manufacturers across a range of products, from ceramics to clothing. Quality products often come with higher prices, which can pose a barrier for the general public. New businesses or financing models are needed to justify extra costs that could be incurred.

Repairing and maintaining

Repair and maintenance are key functions of a circular economy. These activities were once found on every high street, from the cobbler to the tailor, but they have waned as new products have fallen in price and the incentive to repair has dwindled. However, increasing demand for repair would see it returning to our cities and providing additional income for manufacturers and skilled tradespeople. Repair should be combined with 'right to repair' regulation that is appearing in many countries across the world to avoid unnecessary disposal of goods.

Re-manufacturing or refurbishing

More in-depth than repair, the remanufacture or refurbishment of a product strips it back and rebuilds it for a new life. From upholstery to heavy plant machinery, this creates new employment within cities. Technology should be easy to upgrade without having to replace the entire unit.

Recycling

This is currently where most efforts are focused. However, under circular economy principles, recycling is the least effective intervention, as large amounts of energy are required while recycling remains limited to certain materials and is costly. Recycling waste locally (rather than sending it overseas, which is currently common in Europe) would reduce environmental impact and provide feedstock for a circular economy loop at a local scale. To incentivise local recycling, there must be productive activities driving demand for the resources. Manufacturing in cities is vital to support this development and keep resources cycling locally, otherwise perfectly recyclable materials will continue to be exported or to be simply incinerated.

#4 PROVIDING ECONOMIC AND SOCIAL INCLUSION

It is no longer acceptable for cities to seek growth without ensuring that all citizens are able to benefit from the creation of that value and share in its success. The 'trickle-down effect' approach has failed to deliver, resulting in communities (or entire regions) feeling left behind and being exposed to a host of economic and social challenges.⁵⁴

When seeking development, cities should be looking for policies and approaches which are designed to provide both economic and social benefit. Urban manufacturing can help to do this in several ways.

DIVERSE EMPLOYMENT

Manufacturing currently provides a diverse range of employment opportunities, from entry-level to highly-skilled positions. This offers businesses an important resource of locally available labour. It means that residents can find jobs close to home that fit their skills, interests and competences. It means businesses can open up new fields of work or competencies. It also means that the local market is capable of adjusting and customising products to their needs.

Manufacturing work is highly diverse. Salaries certainly vary according to role and type of industry but competes on average favourably with other employment sectors.⁵⁵ Data shows that roles in manufacturing are associated less with precarious working conditions, such as zero hours contracts, than other sectors, like retail.⁵⁶ The range of roles provides scope for vertical job progression into management positions or technical specialisation. Manufacturing is less associated with the erosion of middle-tier jobs than service industries like retail and finance.⁵⁷ But since informal and freelance work is common in urban manufacturing and very difficult to detect in available data, statistics can easily distort reality. Companies have also increasingly outsourced or subcontracted non-core activities, which make workforce surveys difficult to distinguish where one business begins and another ends.

The changing nature of manufacturing work is increasingly putting into question what the future of manufacturing employment will look like. Since the 1970's, with growing productivity, there has been a **servicification** of the manufacturing sector which has meant that in many companies, more people are employed in services aspects of the manufacturing process (such as sales, design, logistics or management) than in the actual production process.

Artificial Intelligence, 5G communications networks, advanced robotics and other aspects associated with the digitalisation of manufacturing (referred to as Industry 4.0) have been theorised extensively, resulting in a confusing array of scenarios subject to the capacity and cost of new technology.⁵⁸ Projections conclude that middle level jobs, in the services sector and manufacturing will be most exposed to automation. Entire jobs are not likely to be replaced by technology, at least overnight. But many tasks which make up jobs could be automated and therefore reduce the demand for workers. It can be useful to distinguish five job typologies, the associated education tracks and the way such jobs will evolve in the near future.

Low skilled manual labour

There are many jobs that are difficult to mechanise but require little training or even official diplomas. Jobs include simple assemblage for limited production runs, warehouse labour, food processing, waste management and basic repair or disassembly. Such jobs are highly accessible (there is a low barrier of entry), often informal (rarely based on long contracts) and generally low paid. This makes such work highly accessible for recent immigrants, the long-term unemployed and people with disabilities. While some of these jobs can be mechanised, such as warehouse labour, there will always be a demand for such labour. The challenge is to match demand and supply. To compensate for the low wages and low profit margins for low skilled labour, work has been increasingly adopted by the social economy sector and social enterprise who combine employment with skills development or supervised positions for disadvantaged workers.

Technical skills

Skilled labour requires specialised technical knowledge of a skill or vocation. Following in the footsteps of the guild system, skills are gained through a mix of institutional education and hands on experience through apprenticeships. Such skills are essential for manufacturing as they generate tacit technical knowledge and material intelligence. While technical vocations were a common and respectable career choice at the beginning of the 20th century, they are increasingly being cast aside by youth for reasons ranging from (perceived) higher paying services jobs, a poor culture of encouraging youth into technical vocations, the closure of technical colleges and training institutions, the reduction of work and the reluctance of youth to take on 'dirty jobs'. The result is a common shortage of tradespeople (like electricians or plumbers) in many large cities. Training is increasingly requiring digital literacy and complex machine operations needed to improve production quality or reduce production time. Quality training colleges are needed to attract and prepare students for future jobs, rather than simply addressing current demand. When national employment surveys talk of skills shortages, they're often referring to high skilled technical jobs. Some of these jobs are likely to be exposed to the effects of automation (such as joinery or construction) while others will evolve with it (like electronics).

Knowledge intensive roles

Knowledge workers generally have followed some form of tertiary **STEM** related degree (science, technology, engineering and mathematics) and have both theoretical and technical knowledge of a topic. Degrees may range from sciences (particularly the natural and formal sciences but also some branches of social science), engineering (all branches including chemical, civil, electrical and mechanical) and design (particularly industrial design). Successful education programmes will immerse students in practical experiences to ensure that theory is well grounded in reality. These jobs are likely to undergo significant changes due to new technology. Some traditional knowledge jobs are becoming redundant due to artificial intelligence and more effective software. Other forms of knowledge intensive roles are replacing manual labour and technical skills through automation.

Management and public facing roles

Process management, human resources, communications, logistics and sales are a range of jobs that have become increasingly necessary for companies in competitive markets. Like knowledge roles, these jobs generally involve tertiary education. Unlike knowledge roles, they tend to have basic technical knowledge of production processes. These roles are forecast to change significantly over the coming decades as technology either replaces tasks or improves capacities. In some cases these jobs will remain within businesses, but for smaller manufacturers there is an inclination to outsource or subcontract them. Employees may also choose to have career changes and move from knowledge or technical roles into management roles. These roles generally require some on the job training. Furthermore, some of the greatest innovations are likely to emerge from new business practices, particularly in terms of services that help reduce material consumption while retaining existing qualities of life.

Supporting services

While not essential work for manufacturers, there are a range of supporting services that are important for a successful business. Examples include cleaning, logistics, catering and possibly in the future resource management. Such jobs are generally low-paid and low-skill work and often outsourced as the work is rarely core business for manufacturers.

While there remain large amounts of uncertainty around the future of manufacturing work, hybrid skills are in increasing demand, particularly those linking creative problem solving with tacit knowledge of materials and technology. Considering the future of manufacturing points towards more multi-disciplinary labour, universities and training institutions need to find new ways of teaching content. University College London's Institute of Making⁵⁹ provides a very tactile and autodidactic club format where students and staff can embark on missions to address real-world problems. Rotterdam's RDM facility, a technical training college that shares space with a hub for manufacturing start-ups, teaches students technical skills by setting up projects that are mixed with entrepreneurship challenges.⁶⁰ Education and training must adapt to rapidly changing technology which means that workers need shorter and more regular forms of training and readiness for life-long-learning. Regardless of education, the quality of work conditions across all sectors is under scrutiny and urban manufacturing firms will be pressed to ensure jobs provide economic security and employee well-being.⁶¹

LOCAL ECONOMIC BENEFIT

Whereas urban service sectors, like finance, are dominated by multinational players, a high proportion of manufacturers are SME (Small and Medium-Sized Enterprises) businesses employing fewer than 250 people, or micro-businesses, employing fewer than 10.⁶² A significant amount of these smaller businesses depend on the local market for a large part of their income and play an important role within their local communities.

A UK based research project identified that 80% of small businesses were actively involved in their community, while 30% employ people with a disability or mental health condition and provide their communities with 'in-kind' support.⁶³ Whether it be out of altruism or pure private benefit, small businesses must engage in maintaining healthy relationships with other local businesses and institutions, even if in direct competition with similar businesses, as there is always a likelihood that partnerships are necessary to survive.

THE COMMONS AND COMMUNITIES OF MAKING

Inclusive **community oriented organisations** are emerging to help sustain city focused manufacturing. **Social enterprise**, **cooperatives** and **communities of makers** are examples of organisations utilising 'making' to equitably and inclusively connect communities.⁶⁴ The first group involves social enterprises, which are non-profit organisations focused on supporting the disadvantaged. These businesses are increasingly providing services for tasks that may have been deemed unprofitable by the private sector. The social economy sector offers two particular benefits: firstly it is a low-threshold entry to work for certain minorities and secondly it can offer a community service for the likes of sorting or treating resources. A second group involves cooperatives that can pool finance or resources to keep equity local or to provide a valuable service to the community that is not available on the market. They can include breweries, energy production or even rental of technology. Cooperatives can be guardians of the commons and may also find a way of retaining certain traditional skills or a particular building.⁶⁵ A final group includes communities of (often freelance) makers, that operate on small production volumes or customised products and need to pool money to invest in technology or space. Communities may grow around shared workshop spaces or commercial maker-spaces. Such communities may be small but are often an easy way for entrepreneurs to start a production chain or to prototype an idea.

The three groups noted above offer ways of increasing inclusivity. But they are generally founded by people with tertiary education, which can present an entry barrier for some users who are uncomfortable about self organisation and entrepreneurship. Increasingly, multi-actor collaborations (referred to as social alliances), cross-sector social partnerships, or social innovation public-private partnerships are emerging to tackle common problems while also addressing inclusivity challenges.⁶⁶

ALTERNATIVE ROUTES TO EMPLOYMENT

Domestic 'making activities' and access to infrastructure like open workshops and new equipment can help hobbies become fledgling businesses and provide a gateway to supplementary income or entirely new employment opportunities. In the last few years craft industries, such as dressmaking and woodworking have grown in popularity.⁶⁷ A survey conducted in the UK in 2015 found that 26 percent of people regularly make things for their own use, 57 percent would like to learn how to make more things they and their families could use, and 24 per cent would be interested in using a shared workshop space.⁶⁸ Businesses may spring from these hobbies particularly with the support of platforms like Etsy and social media, which have lowered barriers to entry and allow makers to sell directly to the public. This can benefit those who wish to grow a business on the side or who may have difficulty accessing the traditional workplace. Public authorities can stimulate small scale entrepreneurship by providing infrastructure (such as space and technology) to test and develop ideas while sharing knowledge and expertise. There are many examples of such spaces including fablabs, makerspaces and community workshops, which often represent a public good and display similar characteristics to the public library of the 19th and 20th centuries.

KEY IDEAS

Manufacturing can help cities meet four important needs. By sustaining thriving economies, manufacturing can provide tradable goods, replace imports and prepare for the future. Through stimulating innovation, manufacturing can build on established industries to develop new products, take advantage of diverse networks of designers and makers and channel innovation into dealing local problems. Through addressing environmental sustainability, manufacturing can help cities to reduce their global environmental impact while finding more durable technology to decouple urban life from material and energy consumption. Finally, by supporting social and economic inclusion, manufacturing can help support a wide range of job opportunities, create opportunities for small entrepreneurs while ensuring cities and businesses share common goals. No two cities will depend the same constellation of manufacturers due to their links to larger markets, histories and economic conditions. Likewise, each city will harbour different types of manufacturers that depend on links to materials, research organisations, particular infrastructure or a specific local market condition. The following chapter will shed some light on experiences from fieldwork focusing on Brussels, London and Rotterdam-The Hague. Then the rest of the book provides resources for cities to explore manufacturing opportunities in practice.

PATHWAYS

THREE PATHWAYS TO SUPPORT URBAN MANUFACTURING

Urban manufacturing is subject to a range of place-specific pressures, challenges and dynamics, which renders it extremely complex to manage. **Chapter 2** helped to identify relevant forms of city oriented manufacturing. This chapter signals potential conflicts between ambition and reality. Manufacturing is by no means a monolith, practices are often context or business dependent, making it difficult to make assumptions about what kind of manufacturing is relevant or feasible. This chapter summarises first-hand experiences and fieldwork.¹

The research for this chapter followed three ‘pathways’, reflecting on different disciplines or ways of approaching manufacturing in cities. The first pathway is *Urban Integration*, concerning spatial morphology, infrastructure, urban design and architecture. The second pathway is *Circularity and Technology*, which relates to resource and waste management, the development of technology and planning for manufacturing. This draws on the perspective of engineering and environmental planning. The third topic is *People, Networks and Policy*, which covers issues such as governance and planning, workplace conditions, employment types, skills and knowledge development, financing and legal conditions for manufacturers. This pathway draws on the perspective of sociology, local economics and strategic planning.

URBAN INTEGRATION

Urban development during the last century saw a gradual upscaling and separation of manufacturing from other land uses. While there have always been land uses considered incompatible with living in cities, like cemeteries or heavy polluting industries, until the 1960s manufacturing was mixed quite well with other urban functions on a small scale, within buildings or blocks. However, urban renewal processes and planning 'cleaned' most European cities from the 'nuisances' of manufacturing. The co-existence of industry and housing, was common in working neighbourhoods throughout the 19th and early 20th centuries. More recently it has been restricted through building regulations.

The fieldwork identified the following key points. Firstly, a new paradigm for urban intensification is needed. Secondly, manufacturing can be well integrated into urban areas if the design of spaces takes advantage of local place conditions. Thirdly, good transitions spaces are required between different land uses to improve compatibility in mixed use areas. Finally, more shared manufacturing spaces should be developed.

A NEW PARADIGM OF URBAN INTENSIFICATION

The right mix

European cities have increasingly favoured mixed use development policies, motivated by sustainability goals and the general scarcity of available land in urban areas. Densification and urban intensification are two strategies used by urban planning for transforming neighbourhoods, addressing both scarcity of land and rendering areas more sustainable. Densification refers to increasing the amount of similar activities on a site so that the land is used as efficiently as possible, also known as 'industrial intensification'. Intensification refers to increasing the variety of activities on a site, also known as 'industrial co-location'. These two approaches offer very different ways of dealing with 'mixed use' to densify urban areas. They can affect the kinds of activities or businesses that could be located in such spaces.

Densification or **industrial intensification** is increasingly used as a political solution to protect industrial floor spaces while also allowing other activities such as housing. By using floor area rather as a measurement unit, industrial floorspace can be stacked thus freeing up land for other kinds of activities (such as housing). The basic premise for industrial intensification is to concentrate industrial activities (such as manufacturing) within the same building or block and to avoid conflict with non-industrial activities (such as housing or retail). While this was common for manufacturing at the turn of the 20th century, rarely are new industrial sites stacked or intensified. There are various logical reasons for this: businesses often need yard space for deliveries or storage of goods, fire represents a serious threat which becomes more problematic if it occurs in a compact environment, vertical access with goods lifts can cost time and infrastructure (lifts are expensive) and multi-storey manufacturing can come with costly load bearing structure for equipment. Regardless, there is also much to gain from industrial intensification such as sharing spaces, infrastructure, local knowledge and resources which reducing physical distances between interdependent businesses. Brussels' Abattoir provides a vivid example of industrial intensification where a food related manufacturing cluster surrounded by a residential neighbourhood contains a rooftop aquaculture farm, heated from waste heat from the butcher's refrigeration units and where a mushroom farm uses organic waste from a neighbourhood brewery. By clustering or intensifying activities in areas near mobility infrastructure, manufacturing can be located near related services such as design, communications, finance or research and development.

Intensification or **industrial co-location** is a different way of achieving a similar end. If industrial areas currently occupy ground floor areas, planning policy may offer the possibility to build multi-storey developments which contain other activities on the upper levels. While co-location was common in many neighbourhoods from the late 19th and early 20th centuries, modern planning legislation restricted it due to health issues (air quality), noise or simply due to the perception that land uses should be best segregated. Such legislation is still in place in many countries and does not allow certain types of land uses to be mixed. Residents still find the idea of housing incompatible with other land uses. However, small manufacturers such as breweries and bike assembly workshops are finding their place in city centres, successfully incorporated into retail areas. Here they are being used as attractions for traditional retail areas or to revitalise those suffering from competition online. This proves that in practice certain but not all activities can be easily mixed. Complaints often arise from small issues that can be easily avoided through good urban planning and design such as deliveries, noise, waste management and the possible residual mess surrounding manufacturing spaces. The downside of co-location is that only manufacturers that produce very limited nuisances will find such spaces suitable.

Industrial intensification and co-location are hardly new ideas, as they were common in traditional manufacturing areas and mixed use neighbourhoods. However, since many of these neighbourhoods are located close to city centres or mobility networks, there is great pressure by building owners or real estate developers to re-zone or convert the spaces into 'higher value' land uses (such as housing and retail). Converting manufacturing spaces can fracture long established business networks or can put an end to certain businesses that need to be close to clients or staff. Public authorities need the resources, tools and ambition to ensure that neighbourhoods do retain some aspect of mixed use. This is increasingly evident in monofunctional housing areas, particularly those built since the 1940s-60s. They are now considered bland while mixed use areas offer a variety of local services, opportunities for employment and activities across the day.

Manufacturing locations

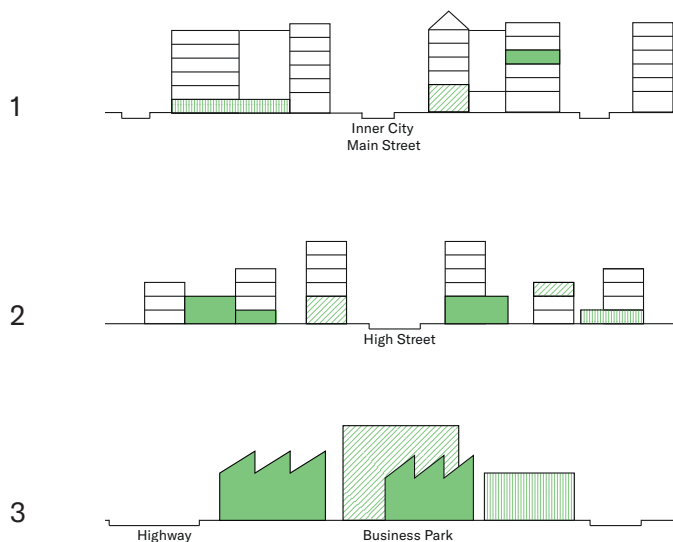
Manufacturing mainly falls into three spatial conditions, related to the compatibility of the business with other types of land uses (see Figure 1). These include: 1) inner-city mixed use locations, 2) transition areas along high streets, and 3) business parks. These three conditions have been categorised based on certain mix of activities and access to infrastructure such as streets and highways, rail lines or waterways.

- 1 ***Inner-city mixed use:*** These areas facilitate small scale manufacturing, often crafts or repair services integrated in the plinth of buildings or as work-homes. Makers may occupy temporary spaces including shops or buildings out of their previous commercial function, like garages, vacant retail spaces, office buildings or backyard buildings. Makers can work from home, producing crafts-oriented work, like sewing clothes, artisanal production of textiles or similar. In newly planned areas, small scale workspaces are often included, which mostly serve creative businesses. They are sometimes located in collective workplaces that also include design ateliers and make (or prototype) small scale high tech products.
- 2 ***Transition areas:*** These are frequently developed along high streets linking urban centres. Transition areas have excellent accessibility based on historically grown structures with commercial and community

functions. Often there are larger buildings behind the high street, providing a transition towards industrial areas. These buildings, such as former backyard factories, now are frequently transformed into collective workspaces, facilitating hybrid businesses that develop and produce on-site.

- 3 **Business parks:** These mono-functional business areas are based on planning regulations that may focus on services activities or industry. Many of these business parks are currently under the pressure of housing development. This process is problematic, as business parks can accommodate larger-scale manufacturing that depends on more heavy logistics and activities which may risk explosion or pose a nuisance for residential areas. As a result, business parks are being pushed even further out of the city.

Fig 1. The three urban conditions / Illustration: Petra Grgic



Clear guidelines

The current process of industrial intensification and adapting manufacturing spaces results in many cities developing policies associated with urban manufacturing, but lacking guidelines of how it could be realised. The absence of guidelines often leads to conflicts between users with different interests in urban development sites. Industrial intensification with co-location of manufacturing and housing needs to be facilitated in a systemic way, not just taking advantage of incidental real-estate possibilities.

Dealing with (new) neighbours

Many manufacturers located in mixed use areas have noted an increase in complaints from neighbours. Residents are increasingly effective in forming alliances mounting campaigns to pressure public authorities. Businesses, particularly small businesses, rarely have time or political power to address such complaints. Typical complaints received by

businesses include noise from early morning deliveries, street blocked by delivery vehicles and odours or steam that is confused for pollutants. There are two core challenges that are affecting both well established business and new ones. Firstly, neighbours often have little connection to the business and therefore they do not understand them or see their value. Secondly, businesses are not sufficiently involved in urban planning processes and often find out far too late when urban planning decisions are difficult to change. In neighbourhoods undergoing 'revitalisation', footpaths may be widened, corners narrowed and other infrastructure like cycling paths could be installed that can render logistics impossible. These small interventions which may improve environments for one actor could be disastrous for another. Without involving manufacturers into the planning process, unintended consequences can occur that impact how businesses operate and can result in unnecessary friction between the manufacturers and their neighbours.

Long-term planning

Rethinking the spatial integration of manufacturing, three challenges have to be considered. First, not everything can be mixed with housing. Second, a multi-scalar approach is required to address the complex long term needs of urban development and residents. Processes of manufacturing businesses have to be correctly understood and considered, in order to reorganise urban space to suit a wide range of actors. Third, due to the high number of different stakeholders and typical long time frame of European redevelopment projects, stable frameworks for the long durée have to be developed, accompanied by a guidance system that allows for adaptation and flexibility along the way.





BELOW: A BLANK FACADE, ROTTERDAM © V SANZ - N.8 / ABOVE: LOADING DOCKS ON THE SIDE OF A BUILDING REDUCES THEIR PRESENCE FROM THE STREET FRONT, ROTTERDAM © V SANZ - B.6

GOOD TRANSITIONS BETWEEN FUNCTIONS

A range of available spaces

Current mixed use areas often are developed rather incidentally, as land prices are subject to demand of commercial functions, retail and manufacturing, each competing for space under the same terms. This is a form of 'natural selection', and the mix of uses depends on the diversity of available space to capture different markets. A diversity of spatial conditions provides choice which means that the market can naturally regulate prices. However in some cases, the lack of available space has rendered even the most unattractive locations overpriced for manufacturers. This is the case especially for medium size businesses in central locations, where a combination of gentrification and privatisation of the real estate market has left businesses unable to afford suitable space. Urban regeneration projects and commercial developers have a tendency to standardise spaces that are most suited for manufacturing. This does not favour manufacturers as they need a variety of sized spaces to choose from to fit their needs and budget while allowing the possibility for growth or downsizing. A range of available spaces can also encourage different but complementary businesses to form a cluster.

Zoning inside-out or outside-in

In the current urban development and land use planning systems, we find two mechanisms: outward and inward zoning. Outward zoning gives priority to concentrations of manufacturing, referred to here as business parks. It regulates the minimum distance that housing must keep from the manufacturing areas to avoid nuisances. Inward zoning, on the other hand, creates buffers of distances starting at a housing unit. Distances are distinguished by types of nuisances: noise, odour, the risk for explosion and attraction of pedestrian or motorised traffic. Businesses are categorised according to levels of nuisance and are subjected to a minimum distance from dwellings. This approach requires transition zones between opposing land uses such as housing and a chemical factory, for example. This is not an effective way to manage mixed use development as businesses can change quickly, including the technology they use to avoid transmission of nuisances, while the zoning is much harder to adapt.

Transitions zones

An alternative to zoning is instead diversifying urban conditions. Through creating transitions, a choice of available spaces can be provided, in terms of publicness and visibility, size of buildings and types of streets with related logistics. Transitions can occur at the scale of a neighbourhood, block, street or building and will depend on the predominant activity in the industrial area. Building good transitions can be introduced especially into urban intensification projects. Typological transformations of buildings and urban blocks, transforming them from one specific type to another, are central in this process and can facilitate vertical manufacturing.

A public facade

Manufacturing activities are frequently hidden from sight, either segregated on industrial sites or behind unmarked doors. While manufacturers may not seek to engage with the public, this lack of visibility at the street level can result in manufacturers and their work going unnoticed and unvalued by citizens. However, there are ways that businesses create a public interface for manufacturing. Firms have been observed taking advantage of mixing production with direct retail, or education and training activities. The Brussels Beer Project set up a showcase brewery in the city centre and the automated orchid business, TerLaak near The Hague, has invested in improving their public facade.

Small manufacturers that work together in shared premises have exhibition, social, or hospitality spaces open to the public. Manufacturing activities can create focal points or atmosphere that draw the public in.

Hybrid conditions

In many cities, high streets are struggling as changing shopping patterns, online retail and out of town logistics centres are reducing footfall for traditional shops. Light manufacturing which have a public face, such as shoe repair, garment-making or furniture production, offer opportunities for repopulating high streets, benefiting both industry and communities. Examples in Schiedam, The Netherlands, show artisanal forms of manufacturing as a way to breathe life back into the flailing retail areas. Urban renewal projects can take into account hybrid forms of manufacturing that have a public face in the main streets while containing larger scale manufacturing spaces, storage and loading zones in the back of the block or in courtyards.

Other examples of hybrid spaces are makerspaces and other open-access workshops which are taking on the role of the community centre or public library, and require central locations. They allow the public to learn and to meet people with different skills and ideas. Bucharest's main maker space,² the Nod Makerspace, offers room for community activities and activities related to knowledge sharing and skills development. Makerspace Buurman³ in Rotterdam is integrating circularity ambitions with educational activities teaching the design and making of furniture with recycled materials. The Microfactory in Brussels, a professional maker-space, is noticeably located next to a metro station, which enhances the relevance and accessibility for the larger public.

From clustering to mixing activities

Where industrial zones do exist, there are opportunities to actively encourage clustering of similar businesses or seek diversity of activities. However, such zones also can isolate businesses from the pulse of the city and are rather impermeable to the urban community surrounding them. There are opportunities to better integrate industrial land into the rest of the city. This can be achieved through blending building use at the edge of these areas, creating complementary functions that attract people outside work hours, such as a gym or event centres. London's Old Oak industrial zone hosts a number of immigrant communities on weekends while also hosting spaces like a guitar making workshop for amateurs along one of the main streets crossing the area.

The transition zone between manufacturing areas and central mixed land use areas can blend a high diversity of activities such as dwellings, hotels, banks and financial agencies, designers and engineers, restaurants, material suppliers, small artisan workshops and mechanics, health clinics and so forth. This zone can, therefore, also offer a diversity of jobs, which again supports manufacturing businesses.

SHARED SPACES ENABLING URBAN MANUFACTURING

Adaptability, decentralisation and resisting off-shoring manufacturing

Rapidly changing consumer trends and adaptations in technology result in the need for manufacturers to continually improve and adapt, which adds risk to any investment. Furthermore, real estate is an even more significant investment that requires a long-term stable business model. For makers who don't own their land, there is a risk that contracts are cut or not renewed. Being forced to move could put investments and business operations in jeopardy as space, technology and location can be heavily interlinked. Given the investment needed to purchase certain technologies, investors and banks suggest growing and merging operations, forming larger companies, increasing automation

to reduce labour costs or outsourcing and offshoring production as ways of reducing risks and lowering costs. Such trends could end up further depleting the presence of local manufacturing in cities.

The emergence of new digital platforms for sharing and co-ownership in the maker movement, in general, is exposing opportunities for new business models to share the inherent risks of contemporary manufacturing among diverse users - especially that of space and technology. Opendesk⁴ is an online platform to purchase locally made, customised furniture at competitive prices. It provides the service of connecting furniture designers, makers with carpentry skills and workshop spaces with the technology to produce the furniture. The challenge of such platforms is the capacity to scale up production.

Working around yards: loading docks, storage and logistics

There are a number of very basic features of typical industrial buildings (including logistics, manufacturing and storage) which at first sight render them incompatible with urban areas. Loading docks accessed directly from the street generally require buildings to be set at some distance back from the front boundary. This makes the public street space appear oversized, messy and sometimes dangerous. Yard space is an important aspect of manufacturing particularly for businesses located in mixed neighbourhoods or transition zones.

Traditionally, yards have been located at the back of buildings, off the public street front, which provides a number of benefits. It means that logistics can occur safely and not interrupt traffic on public streets. It offers a buffer space for bulky or messy production processes and provides space for temporary storage, particularly for storage of waste for recycling services. For noisy activities, it is a way of dampening noise inside a confined space.

For small businesses, the yard space offers a place for interaction and exchange. Historical places like Iliffe Yard in London accommodate crafts, artists and creatives around a yard. More recent projects have built on this idea, such as RecyK or Greenbizz in Brussels. In Schiedam Centre (NL) and London's Old Kent Road, commercial yard spaces were observed to be used by local residents in off-work hours as a shortcut to cross commercial areas and reach their destinations quicker.

Vertical making

There is increasing pressure for manufacturing to develop vertically. While this was typical for buildings at the turn of the 20th century, where transport costs were a serious cost, modern manufacturing has occurred rarely above a ground floor level. As land value is increasing, the cost of the land is increasing above construction costs which is allowing multi-storey industrial buildings to be profitable. There are various other limitations which are now being overcome. Technical requirements, especially relevant in buildings combining working and living, such as fire safety, transmission protection of noise, dust and other nuisances can be prevented due to modern building technology.

This then means that buildings need to be designed to accommodate manufacturers. Goods lifts are essential to move things vertically, buildings should be equipped with various pallet sized lifts to avoid waits or account for breakdowns. Large openings along the building facade with cranes are also necessary, to transport heavy equipment or bulky material. Vertical making means that floors will need to be enforced to carry heavy loads.

Vertical manufacturing allows established inner city manufacturers to remain and expand in their location, like the Manner factory in Vienna. The Manner factory⁵ covers two regular size inner city urban blocks, and organises their production vertically

on seven floors in a high tech production chain, provides 400 people a workplace and the neighbourhood with heat for 600 homes.

Working space vs storage

Traditionally, businesses have done a lot of logistics in-house, and this has required storage facilities, drivers and vehicles. In companies, especially smaller SMEs, generous amounts of 'unproductive' working space is dedicated to the storage of material, manufactured goods and waste. Reducing on-site storage space could allow for higher amounts of on-site production, more significant numbers of employees and a larger market share for some businesses. It can also simplify the focus of the company on productive tasks rather than adding pressure from complex logistics. This could be possible only if their storage space could be easily shifted off-site and logistics could be subcontracted, promoting economies of scale in distribution activities, which is especially relevant to SMEs. Sharing spaces is a strategy that is effective on the smaller scales of buildings and blocks.

Flexible spaces

Flexible spaces are key to facilitate different and changing business processes. They are achieved with open layouts, that can facilitate the rearrangement of the processes of one company, or facilitate the growing and shrinking of different businesses in co-working settings, that usually provide shared services.

LOCAL CONDITIONS: ENVIRONMENTAL QUALITY, CHARACTERISTICS & SKILLS

Following the lay of the land

Most cities started to grow alongside (or at crossroads with) already existing landscape features: higher ridges in the often wet and swampy marshlands, waterways, and dykes. The meeting of higher ridges and waterways created excellent conditions for the rise of ports and industry, as such encounters brought together safe ground with "critical natural infrastructure" (such as a river). Dykes protected the hinterland but also offered dry and safe transport routes. Through the Industrial Revolution, canals, rail, and road infrastructure grew on top of natural landscape elements, older infrastructure and transport routes, creating a diversity of place conditions.

Very often, natural and human-made infrastructure created spaces where industry, manufacturing or logistics have tended to locate. This could be a harbour or dredged swamp. These places allowed noisy or messier activities need to be separated from other land uses, while remaining connected to civic centres.

Manufacturing historically developed in special topographic conditions. A common example includes manufacturing in small valleys that allowed messier activities to be located in the lowest levels of buildings related to canals or small rivers, while commercial activities and services were located on upper floors facing the main streets.

Linking place dependent supply and demand for skills

Many forms of manufacturing historically agglomerated in cities, concentrated around a particular specialisation or forms of labour. New forms of manufacturing should not ignore this heritage and has much to gain from building new knowledge on experienced technical knowledge or established infrastructure. Rotterdam's RDM is an excellent example of a former shipyard located close to the city centre, that now accommodates innovative education and research initiatives for the maritime and offshore sectors.

Companies often depend on the skills of their workers that were developed specifically for a company's manufacturing processes. This aspect has direct consequences when industrial areas are decommissioned. Businesses that depend on particular types of skilled workers, face challenges when moving. It is necessary for such businesses to either settle in an area where these skills are present or where it is affordable and attractive also to motivate employees to move with the company.

Ensuring the business fits the place

An evolution in manufacturing includes hybridised businesses. They generally perform a range of activities under the same roof such as some aspect of design, research and development, short-run production lines, distribution and sales but may also depend on having a public facade for retail or commercial clients. These kinds of businesses can afford higher land costs and need to be well connected to partners or clients but often struggle to find suitable spaces. Suitable spaces may not allow manufacturing due to zoning regulation while sites with more of an industrial profile that allow manufacturing are too far away from their client base. Conditions for these kinds of businesses need to be developed to ensure that 21st century manufacturing can be located within cities and close to partners and clients.

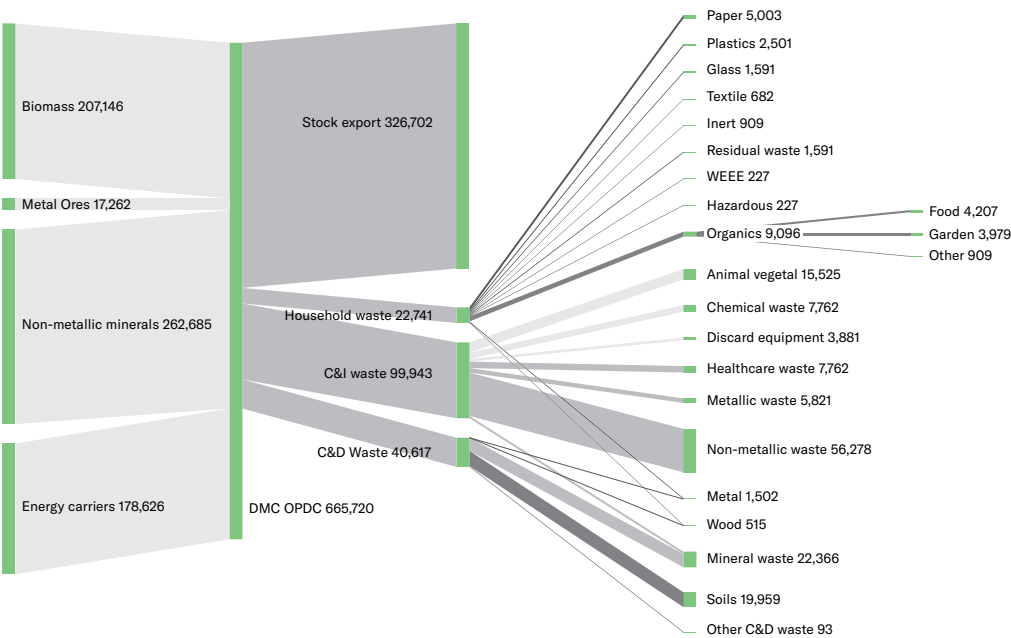
CIRCULARITY & TECHNOLOGY

Changes in manufacturing processes, increasing use of cleaner technologies, new policies for resource management and maturing knowledge of the role of manufacturing in the metabolism of cities are providing opportunities for urban manufacturing. Different types of manufacturing activities may have different levels of compatibility with city functions, and not all manufacturing will be compatible with commercial and residential activities. Certain types of manufacturing or ways to manufacture can be well adapted and provide positive synergies for the urban system.

European public urban authorities are keenly aware of their consumption of resources and large volume of waste generated. This has motivated policies and initiatives to address current linear use of resources and catalyse change towards the Circular Economy. London launched in 2017 the Circular Economy Roadmap for London. Similarly, Rotterdam has a Circular Economy strategy and Brussels adopted a regional plan to increase circularity. Most of these policy commitments recognise a need for cities to manage resources differently. In London alone, around 84 million tonnes of materials are consumed (this includes fossil carriers used as fuel and to produce energy) every year. Around $\frac{2}{3}$ of this material will become emissions or waste, while the other $\frac{1}{3}$ will be added to the stock of buildings, infrastructure and machinery.

Evidence from field work found that for cities to become more circular, a productive base must be maintained and promoted. The research has shown that urban manufacturing plays a key role in this transition in at least three ways. Firstly waste streams produced by the city in the form of solid residuals, waste and grey water, heat and steam can be productively utilised by maintaining productive activities within cities. Secondly, co-location of consumption and production activities increases the traceability of products and processes, promoting the adoption of cleaner technologies. It also allows for higher customisation and thus reduces wastage of resources associated with unsold stock as well as built-in obsolescence and high turnover of products. It also may encourage circular business models around take back systems, reverse logistics and upgradability. Thirdly, keeping a productive sector in cities helps to maintain a skills base and promote activities which maintain the value of resources, such as repair and

Fig 2. OPDC Material Flow Analysis / Source: Teresa Domenech based on a combination of databases Eurostat & ONS. Illustration: Federico Gobatto



re-manufacturing services and it is connected to the development of digital and technologies adapted to the city's socio-economic fabric.

CIRCULARITY

Sourcing resources from waste management

Most of the policy attention has been focused on the management of household waste, even though this represents only a small fraction of all waste arisings (around 12% for the UK as a whole). Excluding construction waste, which is by far the most resource-intensive sector in EU economies and cities, commercial and industrial waste represents around double the volume of the waste generated by households. Moreover, given its composition and higher degree of homogeneity compared to household waste, commercial and Industrial waste has a high potential for further reutilisation in line with circular economy recovery and regenerative loops. The Figure 2 Sankey diagram (see above) provides an example of this taken from a case study in the OPDC. Although the specific share between sectors may vary across cities and case studies, in all cases the material flow analysis shows a number of commonalities:

- 1 Resource consumption in cities is very relevant and underpinned by a largely linear way of consumption.
- 2 Household waste, which represents a large fraction of the management costs of local municipalities and is the centre of policy discussion, only represents a small fraction of all waste generated by cities.

BOTTOM: SAW DUST COLLECTION POINT, PARK ROYAL (LONDON) - N.2 / ABOVE: RECYCLING PLANT FOR C&D WASTE, INDUSTRIAL AND COMMERCIAL WASTE, PARK ROYAL / © T DOMENECH - R.7, C.8 & N.5





- 3 Leaving aside the uncertainty of available data, additional demand for stock (fresh resources) in cities are very relevant even in highly developed cities. This highlights issues of the scale of the industrial metabolism and the need for increases in circularity to reduce consumption of primary resources.
- 4 Commercial and industrial waste represents a key opportunity for introducing more circular ways of using resources while creating business opportunities and jobs for cities.

Recycling: theory and practice

Secondary data for city-level waste generation show that reported recycling rates are generally high at 60-70% or even higher in some countries like the Netherlands. In fact, most of the circular economy measures have paid considerable attention at increasing recycling rates using a combination of strategies that range from improving collection systems, increasing awareness and supporting waste recovery infrastructures.

Primary data collected through our fieldwork tells a different story. Recycling data reflects material sent for recycling but do not capture losses from the recycling system or how much of it has been downcycled for other low-quality applications. There are several examples of this, such as plastic waste used as filling material in construction or concrete being crushed into secondary aggregates. Also problematic is the export of waste for recycling to third countries. Despite being theoretically subjected to stringent recycling standards of the EU, in practice final destination is extremely difficult to monitor. Despite effective economic instruments, landfill in the UK still plays an important role as final destination of waste.

Opportunities for non-residential waste

The analysis of primary and secondary data indicated that for cities to transition to the circular economy, there is a need to look beyond household waste and recycling in order to identify opportunities to generate added value and preserve the function of resources in the productive cycle. One key limitation is the current segregation between uses in cities and increased 'servitization' approaches with limited understanding of the role played by manufacturing in cities and opportunities to create added value and employment linked to maintaining a productive base in cities. The fieldwork highlighted positive examples but also highlighted large amounts of unrealised potential to increase circularity in cities through urban manufacturing. The main opportunities can be classified by core circularity loops, differentiating between technical and biological elements. For technical elements there are three areas that present greatest potential. Firstly, extending the life of products as it enables repair and maintenance. Secondly, recapturing of end of life products, through take back systems (such as a deposit used on bottles) and re-manufacturing activities. Finally, transformation of previously discarded materials as raw materials substitutes for manufacturing processes.

Distances between consumers and re-users

In all these cases, proximity between end consumer and manufacturer facilitates access to repair, simplifies take back systems, creates consumer-manufacturer information feedback loops and helps to reduce waste generation by preserving or maintaining function of products. The three cities and case studies have provided examples of this. In Brussels, CF2D⁶ provides opportunities for extending the life of computers and other electronic products, based on social enterprise. This kind of initiative has also been observed in London and Rotterdam where the collection of electronic waste creates potential for skills training and employment for people at risk of exclusion. Brompton⁷



A TYPICAL YARD SPACE IN A MIXED AREA, PROTECTS MAKERS (BRUSSELS) © C DUBINI - B1

bikes, a brand born and made for the city in the city, not only manufactures in London also provides maintenance services which contribute to extend the life of bikes. UrbnRok⁸ creates high quality worktops for kitchens and bathrooms in London from materials, primarily glass mined from London. Buurman in Rotterdam upcycle old or broken furniture. Being located in the city provides easy access to resources, increases the traceability of the product and also allows interaction with designers and end consumers.

Food and organic waste management

There are opportunities to retain value of organic waste by substituting mineral products with biomass based products including its use for generating energy as an alternative to fossil based fuels. Very importantly nutrients must be captured from biomass for regenerative purposes. Here again, opportunities are huge, as cities are the main contributors to food waste. In London alone, around 1.5 -1.75 million tonnes⁹ of food waste is produced. The London Mayor has committed to halve the amount of food waste generated by the city by 2030, in line with the revised targets set by the Waste Framework Directive to prevent biodegradable or recyclable waste ending up in landfill.

A few innovative companies have identified business opportunities from more effective use of biological resources in cities. Volumes of organic waste produced in commercial and manufacturing sectors are high. In many cases issues associated with a lack or limited availability of yard space constrains adequate separation of food and biological waste from other waste. In Park Royal (OPDC), the largest area of food production in London, segregation of food waste and recyclables in SMEs is extremely low, with over 90% of companies interviewed having just one skip for all types of waste.

While some companies have tried to introduce strategies to minimise food waste, such as through a caterer selling extra food in street markets or a bakery pairing with a charity that collects unsold products, the reality is that a large proportion of food waste is not adequately captured.

A number of companies have identified business opportunities for better use of food resources. An animal feed company collects unsold and left-over bread from a bakery in Haringey for its product. This benefits both companies. The bakery obtains an additional revenue stream (for produce that otherwise will have to be disposed of and would be a cost) and the animal feed company obtains a high quality feedstock for a fraction of its price. Toast¹⁰ is a brewery located in London that also uses starch from unsold bread from London bakeries to produce beers and ales. Bio-Bean¹¹ collects coffee grounds from coffee shops across the city to be transformed into biofuel, logs and bio-chemicals (aromas, colouring, etc). Rotterdam's Rotterzwam¹² uses locally collected coffee grounds to produce oyster mushrooms. From 2018, a share of London Buses have been fueled by biofuel produced from coffee grounds. Biohm¹³ is a university spin off which creates insulation material and packaging made from food waste. The company has raised capital to create a state of the art plant in London, close to their main feedstock sources to minimise costs related to collection and transportation. While all these companies are excellent examples of new ways to think of resources and transform cities, the large share of resources in cities are still being lost or downgraded.

Conditions to enhance circularity

Enabling conditions to enhance circularity requires transformation of current waste

AN ELEGANT FACADE J HOYLE & SONS FOUNDRY (LONDON) / © T. DOMENECH - B3





management systems from end-of-pipe to regenerative systems. The research has shown that the first critical aspect to retain the value of resources is by ensuring that different streams maintain purity (minimising cross-contamination) and integrity of the material stream. This has spatial and operational implications. Maintaining integrity requires adequate segregation and a collection system, which requires space and harmonised systems for sorting resources across local boundaries. Limited yard space in industrial areas is one key limitation to better sorting of waste, reducing drastically viable opportunities to use waste as a resource.

Storing facilities for reusable components or products (i.e. construction materials) could act as material banks providing secondary materials to a range of sectors. Rotor¹⁴ in Brussels is an excellent example of material reclamation from buildings that can then substitute unnecessary primary materials and in some cases add value to the design by retaining period features. Beyond reutilisation, waste treatment facilities need to be planned so that recovered materials can be used by the city. In London, Closed Loop Recycling¹⁵ now owned by Veolia, recycles plastic PET and PP bottles into food grade plastics that can then be used to create new products. The New Raw, is a Rotterdam based public street furniture manufacturer, that uses waste plastic.¹⁶ Plastic used in milk bottles can be recycled and turned back into milk bottles, therefore reducing consumption of primary resource. However, recycling plastic would currently cost more than the value returned in the plastic. Recycling may one day be viable for a vast range of materials but today it competes with other demands for industrial land. Clear planning strategies are needed to protect industrial land and meet the needs for space by the waste management and remediation sector with future development in technology and resource management in mind.

Not everything can be circular at the city scale

Industrial activities linked to steel melting and processing or clinker production at a large scale may not be compatible with residential activities. However cement production from imported clinker or small scale metal processing can be made compatible with services and residential activities if adequately planned and controlled. At the core of an urban regeneration area in Hackney (London) a metal smelter remains active to serve a highly specialised customised market of metal art work products. Very close to the Olympic park (London) and in proximity to an area of upmarket residential properties, there is a large area occupied by the London Cement plant and construction material storage and distribution. While this activity is likely to relocate in the future, concrete plants can be found close to the centre of many cities as they need to serve the dynamic construction sector while mixed cement needs to be poured soon after the materials are mixed.

SKILLS AND DESIGN

Moving design and production

Urban manufacturing has characteristic features that enhance the compatibility of functions with the city. The sector is highly hybrid and is likely to embed elements of design and service activities. The Maker's Mile in Hackney (London) has become an area of experimentation where traditional industrial heritage mixes with new technologies linked to IT (information technology), big data and AI (artificial intelligence). A number of playful companies manufacture hardware components as a spin off of the software hub around Old Street. Companies such as Technology Will Save Us¹⁷ or Primo¹⁸ have emerged in the last years with prototyping activities and small scale manufacturing in London.

Innovation and knowledge focused products

Urban Manufacturing is linked to highly-innovation and knowledge-focused products that serve specialised and highly customisable markets. Hackney Gelatos¹⁹ is an example of a company in a traditional sector that revolutionised the art of making ice-cream through highly creative and innovative formulations and that also responds to demands of traceability and local trade marks by an increasing number of urban consumers.

Just-in-time production and short value chains

City manufacturing offers high communication and involvement of the final customer in the co-design and delivery of the product, and an ability to implement just-in-time processes that serve the market as it requires. Park Royal, the largest industrial area in London, hosts more than 3000 food companies that produce fresh and just-in-time products to serve the city, from sandwiches, pizza dough to exclusive ready-meal products or innovative products (children snacks made of remains of veggies and fruits from other products).

While the textile sector and shoe making has been largely moved off-shore just beyond Europe and to Asia in the 80's and 90's, the last years have seen a renaissance of the sector. Haringey (North London) is one of the key locations for textile and fashion activity in the city. The sector serves a wide range of fashion market segments, from high-end to high-street fashion and independent fashion labels. The main opportunities of its location in London location is the ability to collaborate with designers and labels that this way maintain a close monitoring of the whole process of production. The range of activities also varies with a significant number of companies working on the pattern cutting sub-sector.

Skills, skills and skills

One aspect that underlies most of the technology dimensions of urban manufacturing is skills. The activity itself can vary from high to low technology, as traditionally defined, but it is the skill of applying the technology and the design of products and processes which sets apart urban from other types of manufacturing. The fieldwork has shown that most of the drivers from city based manufacturers depend on their access to local, highly qualified labour, which would be difficult to get access to in non-urban locations. Brompton, a world leading folding-bicycle maker established and located in London, uses a relatively simple range of materials, equipment and manufacturing techniques to produce a high quality product that is exported worldwide. Brompton depends on highly skilled labour to achieve this.

City-oriented and diversity of manual labour

While the above is true for critical staff, urban manufacturing also requires employees with more general, technical skill sets (soldering, cutting, pattern cutting, sewing, etc). One of the biggest challenges for developing production chains in (expensive) cities is to find staff with the required skill set at affordable prices. The fieldwork has identified a profound skill gap for technical professionals that are critical for most urban manufacturing activities. Lack of visibility of manufacturing in the city has led to progressive de-skilling of labour and poor adequate technical training. Most urban manufacturers have created on-the-job training schemes to address this and build on Eastern European workforce to cover some of the technical positions.

The third sector, known as the social economy sector, has also been active in trying to partner up with manufacturers to address the skill gap and labour costs by providing training and job opportunities for groups at risk of exclusion. Travie²⁰, a non-for-profit in Brussels, performs simple manufacturing runs for local clients, offering

fast turn-around. A short walk away, CF2D is another social enterprise training staff in sorting waste and recovering parts from wasted electrical equipment.

TECHNOLOGY

Old technology, new ideas

While many urban manufacturers use relatively simple and widely available equipment, it is the application of great technical skill, extremely innovative design and trust in the brand that helps to justify the costs of businesses being located in cities. Brompton's innovation, as noted earlier, lies on the fact that the product builds on a new vision of living in cities with a brand that is more than its product: an inspiring urban life statement.

Some urban manufacturers have changed relatively little over the last century yet find their business still highly relevant and viable within cities. In Brussels a discreet business in an unmarked building, produces a high quality stationary, exported from London to Tokyo using 100 year old equipment by focusing on the luxury market. The London Cloth Company²¹ uses technology developed in the late 19th century by concentrating on design and supporting designers. In Hackney, an over 100 years old umbrella manufacturer produces a high end, quality product that is shipped all over the world. While their technology has remained practically unaltered, the business has remained extremely innovative in the design of the fabrics, which incorporate new technologies that increase impermeability and wind resistance but also are mindful of new customer requests around social responsibility and reduced environmental impact of products.



New technology for new products

Cities are generally earlier adopters of new technologies, due to the short distance between designers and manufacturers, even if production costs are greater and available space is limited.

One of the latest trends is the emergence of distributed manufacturing. Digital technologies such as laser cutters and 3D printers have ensured high customisation of final products while challenging some of the limitations of standard technologies that allow limited customisation, production at scale and production of large volume of waste (such as off-cuts). The urban environment has acted as a laboratory of these new production technologies which allow to connect to the needs of the individual customer, introduce variation to the design without altering production processes and match supply to the demand (on the demand production).

Some of the successful cases of on/re-shoring manufacturing have been largely based on the efficiency gains through the use of distributed manufacturing and the reduction of lead times in industries such as high-end fashion. Numerous examples of this have been identified during fieldwork finding low-cost fashion brands re-shoring production to reduce lead-time and costs associated with unsold stock.

Emergent technologies have been introduced at different scales in all sectors of urban manufacturing. In London, the introduction of digital manufacturing technologies across almost all processes, from design to product delivery, in the furniture sector have remarkably increased productivity, reduced wastage and improved the quality of the design and final product.

In some cases, cutting-edge technology meets handcraft, and some companies prefer to craft their prototypes to produce them at scale using digital technologies. This still allows them to keep the design and creation process connected to the material but then achieve polished final products using digital fabrication. To this respect, many urban manufacturers also highlight the intrinsic connection of the process of manufacturing and design, and how design without manufacturing fades the understanding of the product and thus limits opportunities of innovation in the future.

Technology with labour saving support

There are instances where technology does not necessarily impact the product but creates efficiencies by reducing labour input in highly standardised processes. This labour saving equipment such as lifts or sorters can improve working conditions for staff, reduce costs for the business and contribute to increasing scale of production. Lowy, a semi-industrial artisanal baker in Brussels, invested in technology to avoid staff from lifting heavy bags of flour or mixing heavy vats of dough. Lowy finds that the most benefits are gained from extra finishing touches such as applying grain to the crust, a step which must be done by hand. In London a Jamaican artisanry bread maker uses dough mixers to ease a highly manual dough preparation process that consists of several stages. The result in both cases is an artisanal product that respects the production traditions but increases productivity.

New technology solutions for circularity

Emerging technologies can help transform what was previously waste into useful products based on new ideas or research on industrial processes. ECOR²² in Venlo, the Netherlands, uses different compression equipment to transform cellulose fibre waste into a durable product with different applications in furniture, construction and packaging. BioBean has designed new processes adapting existing industrial equipment to create bio-fuel and bio-chemicals from coffee grounds. Biohm uses pressers, compactors and a range of other technologies, including an auto-clave (for sterilisation), to



deliver an insulation product made out of food waste. Sometimes the innovation is not so much in the technology but in the interface between technology and new processes. For example, Toast uses left-over bread to create beer within a standard beer-making facility.

Technology to reduce the environmental footprint of manufacturing

New forms of urban manufacturing include flexible, highly customised and innovative products that respond quickly to local needs with a lower environmental footprint. Cleaner manufacturing technologies have contributed to significant reductions in energy consumption (such as efficient boilers, heat pumps or CHP systems), minimisation of emissions and generally greater efficiency in the use of resources. Digital technologies can also contribute to resource-saving through better product specification, reduction of industrial material losses and minimisation of unsold stocks. Introduction of 3D printing in metal or wood work reduces losses or downcycling of off-cuts which can increase material productivity by 20-30%.

Combining new and old

Businesses will often combine a range of technologies from traditional equipment to digital manufacturing. For example, Bio-Bean, mentioned above, needed the adaptation of existing standard technologies for the specific needs of their processes. They worked with industrial equipment manufacturers to specify sizes and functions of the equipment which resulted in collaborative processes of innovation. In this case, product innovation (new form of natural biomass insulation material that competes in performance with standard mineral/composite based insulations) and needs of urban manufacturing facilities promoted innovation at the technological level. Similarly, Biohm adapted standard production technologies to the requirements of their process.

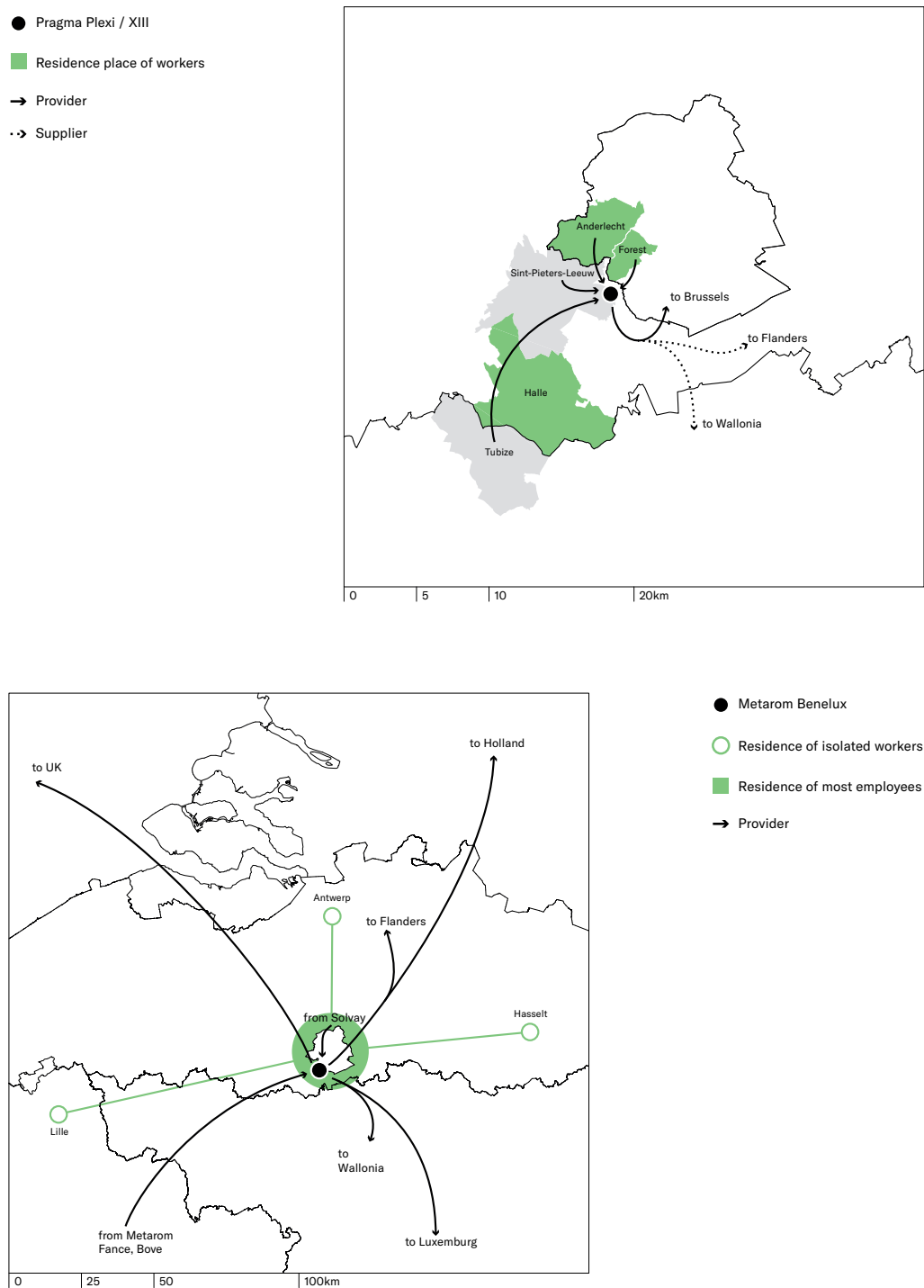
Blurring boundaries of manufacturing through technology

With a touch of new technology, activities that formally were non-urban, non-manufacturing, such as agriculture, are blurred into urban manufacturing. This is particularly relevant for food production. New hydroponics systems and industrial symbiosis is allowing for food to be produced in city centres. BIGH²³ has a 2000 m² greenhouse and fish production unit that uses waste heat from the Brussels' Abattoir. Nextdoor, Urban Harvest²⁴ is producing micro-greens in challenging underground space. In Rotterdam, Rotterzwam²⁵ produces mushrooms in an abandoned pool. In London, Grown Under²⁶ activates unused underground tunnels to grow herbs to feed the city. Access to new forms of less intrusive technologies also allow for new manufacturing hybrids such as manufacturing and training or manufacturing and retail, in line with transparent and visible manufacturing.

PEOPLE, NETWORKS & POLICY

After extensive discussions with manufacturers, a general finding was that many businesses are very isolated and poorly supported, particularly well established business associated with noisy and dusty activities. A large portion of the manufacturers comprise of micro (up to 10 employees) and small businesses (up to 50 workers), while there are only a small number of medium sized businesses (50-250 employees) and rarely manufacturers larger than 250 employees. As a result, most manufacturers simply do not have the financial means to lobby for public support, to create coalitions to deal with problems or even to find suitable employees. Conversely the manufacturers that do have the means to lobby government represent a minority of the business interests. This renders urban

Fig 3. Two schemes showing differences in workers' home to work travel distances
Source: Alexandre Orban/ Illustration: Federico Gobbato



manufacturers extremely vulnerable to change. It also means that the contributions of local manufacturers to deal with the needs of cities are being underappreciated.

Through fieldwork and research, three particular conclusions were made. Firstly many businesses have poor relationships with neighbours and have little knowledge of other business' operations or ways to collaborate. This could have much to do with shared social spaces or an agent that can broker relationships or support manufacturing neighbourhoods. Secondly, there are poor links between available employees, job openings and training opportunities. Triangulating job offerings, competent skills workers suited to local jobs and relevant education remains a serious challenge. Finally, limited access and ownership of space creates systemic constraints on the capacity for a business to invest, grow or adapt. Businesses need both choice and security to take the necessary risks to innovate or to employ suitable skilled labour.

SOCIAL SPACES AND BROKERING RELATIONSHIPS

Shared social spaces

Medium to large manufacturing areas often lack both shared outdoor and indoor spaces for socialising, such as recreation areas, bars-caf  s, canteens and restaurants, as well as meeting and conference rooms. Companies tend to incorporate social spaces such as canteens into their own premises, to focus specifically on their employees. The frequent disconnection between businesses and surrounding neighbourhoods lead to social tensions and mistrust.

Enhancing the quality of public/shared spaces in manufacturing areas and planning shared and inclusive facilities can have positive effects for creating community and exchanging ideas. There are two key benefits. Firstly, providing shared meeting/eating spaces for companies (for workers, employees and CEOs) is fruitful to enhance interactions and possible collaborations between individuals, creatives, companies. This can boost synergies and innovation, and can lead to shared projects and shared problem-solving. Secondly, such spaces can function as interfaces between manufacturers and the surrounding neighbourhoods and communities. Inclusive spaces that open also to neighbours can enhance the communication and integration of makers, producers and the city, including public authorities.

Eat at Cantine, in Buda in the north of Brussels, provides a range of functions from caf   and lunch spot, while the co-working space above (Firma) offers a number of meeting spaces, an events hall and a maker space.²⁷

Dealing with bureaucracy

Bureaucracy can be troubling for any business, but it is particularly challenging for manufacturers when dealing with policy, regulations, planning and local plans, possible subsidies or benefits, relationships with local administrations and knowing how to deal with local neighbourhood members. The process for simply renewing environmental permits or apply for development permission can be exacerbated when several public agencies are responsible for different issues concerning with manufacturing. To illustrate this point, in Brussels many issues concerning business permits are handled by local municipalities or the regional agency called Hub.brussels. Leefmilieu Brussel is responsible for environmental issues, such as adherence to environmental standards. Innoviris handles innovation related projects, particularly research and development. Waste is generally managed by a private contractor but could involve Leefmilieu Brussel or Bruxelles Propret  , subject to the type of waste. Bruxelles Mobilit   is responsible for major roads while local ones are managed by the local municipalities. Employment is handled by Actiris, while there are a number of other organisations that may be



responsible for job seekers and training. Smaller planning permits are handled by municipalities, while larger ones can also involve three to four regional authorities. Issues relating to the circular economy plan (the PREC) could be handled by four different agencies. As a result, businesses can receive mixed messages which are a costly investment of time and is particularly challenging for smaller manufacturing firms.

The curator

Having an actor who can broker the relationships between businesses and local authorities could lead to stronger outcomes for both public and private stakeholders. A “curator”, who could be either a public authority, a private or a third party, can play a vital role in supporting businesses, identifying necessary community infrastructure requirements and complementary businesses to add to the community, linking manufacturers with researchers, financiers, public authorities and potential clients. Such a role could be largely applied across the city and multiplied in small, medium to large manufacturing contexts. Examples of the curator’s role include the Abattoir in Brussels; the East End Trades Guild, the Guardians of the Arches and the London Working Rent in London; and Vienna’s Business Districts Managers.²⁸

Strengthening local identity

While the curator can play a crucial mediating role, strengthening the identity of manufacturing zones by creating a shared visual identity online and on the site can have a twofold effect. On the one hand makers can benefit from cluster relationships and a common umbrella to have their interests heard, to make local products more visible, to

soften the edges between businesses and the neighbours. On the other hand, thanks to a clearer image and visibility, public support can more easily connect to clusters and better orient public contributions.

JOBS AND TRAINING: FINDING THE RIGHT FIT

Diversity of jobs

Manufacturing processes are very different from one sector to another and require very different skills. Some sectors are famous for being quite accessible to low-skilled workers, such as food or construction where training often occurs on the job. Others expect more specific qualifications, such as chemistry or mechanical engineering. Two examples in Brussels prove this striking difference: meat handling jobs at the inner-city Abattoir site are very accessible and require little training with workers sourced locally. Metarom, developing aromas with a large part of R&D, requires high-skilled workers who are attracted to come to Brussels for the job.

Training

Often, on-the-job training is necessary because of the specialisation of manufacturing activities. That's where long-lasting links with training centers can help, providing internships for adapted training, which can turn into a formal job. Currently this kind of partnership mainly concerns large businesses, who also draw a large volume of interns. Small and middle-sized companies don't have the resources to compete with them and therefore have more challenges to find suitable employees.

Access to skilled labour

The availability of skilled and knowledgeable workers allows business to flourish, while manufacturers depend heavily on the reliable supply of local talent. This is no exception for urban manufacturing, which is increasingly under pressure due to a smaller pool of available workers. In Brussels and London, in the 1960's, a large part of the population was once somehow connected to manufacturing, while now under 3% of the jobs are related to the sector. Despite manufacturing representing a small portion of the urban workforce and coming with a range of costs, manufacturers are often highly dependent on a broad pool of potential workers and education facilities, which means cities remain attractive to manufacturers.

Finding staff

Businesses have difficulties finding well-trained workers. Word-of-mouth remains a major way to find new workers. Some businesses struggle to find staff thus are forced to use work agencies. There is often a complex dynamic of competition and solidarity between similar manufacturers. A business may recommend a job seeker to one of its competitors one day, then the following day it will covertly recruit workers from the same competitor. Such double standards are based on the demand for labour and the evolution of the market.

Risks & stress

Even though working conditions have changed since the 19th century, risks and stress have not disappeared in manufacturing and there are still tensions between management and workers. For example, employees in vehicle manufacturing have been observed to suffer health problems due to repeated strain injuries from working long hours in a specific position or suffering stress from being forced to go hours without a toilet break. Workers in large businesses are more likely to have union representation, which can



assure some level of protection of working conditions. In smaller companies, conditions are likely to be much more informal and workers may not be aware of the exposure to health issues or workplace risks due to the nature of the workplace or simply due to pressure from colleagues. In some countries, such as Belgium, businesses over 50 employees are forced to have union representation. Some SMEs have found ways to circumvent both the paperwork and the employee power sharing by breaking businesses into smaller legal entities.

Automation and labour saving technology

Companies are often eager to invest in labour-saving technology if production and profits can be increased or if labour costs can be reduced. However both technology and personnel have their strengths and weaknesses. A tap manufacturer was quoted to prefer manual labourers (machines also are expensive and break down) yet due to fierce competition for machinists from a nearby large vehicle manufacturer, the business needed to invest money in machines to guarantee output.

In contrast, the CEO from a semi-industrial bakery in Brussels claimed to invest in technology to reduce back-breaking work such as lifting sacks of flour and mixing dough, expressly noting that more attention could be invested in improving the quality of the product. Automation artificial intelligence appear to be most present in larger companies with global supply chains, such as vehicle production. Automation has allowed some businesses to invest more resources in logistics and client facing services - such as Ter Laak Orchids²⁹ near The Hague that automates a considerable part of their growing processes yet now has a large office space with staff that program machines and supervise the production process from computer workplaces.

Commuting

Higher skilled workers are also more inclined to travel long distances for suitable work. We can observe this phenomenon with the Audi Brussels factory and Metarom (aromas producer), both employing specialised labour located as far away as France. Conversely, administrative employees and low-skilled workers responsible for repetitive tasks are often located closer to their workplace. For instance, workers in wood and metal for the building sector in Drogenbos (Brussels) largely live within the metropolitan area (see p91).

Labour and services

Employment in many manufacturing businesses is diverse. Manufacturing activities are also highly embedded and inter-connected with services, inside or outside the company. Manufacturers often have extensive networks of partners, clients, suppliers and subcontractors, essential to their development. Those represent a significant amount of tertiary jobs that are dependent on manufacturing activities. For example, logistics is subcontracted by Jean Wauters, a Brussels based specialist steel wholesaler and fabricator, between suppliers and the warehouse and between the warehouse and the client. Just down the road, the Audi factor has ensured a range of subcontractors are located nearby to provide specialty parts.

Job expectations

It is not always easy for manufacturing businesses to find workers. Training in manual labour is not very popular today and where possible employees are suitably qualified, their expectations are not meeting the work conditions or hours that are proposed. At Lowy/La Wetterennoise, a semi-industrial bakery in Brussels, there are difficulties to find new workers notably because applicants are rarely interested in working late at night or on the weekend.

OWNERSHIP OF SPACE, FINANCE AND TECHNOLOGY

Security of space

The fieldwork has emphasised two main barriers limiting the use of emergent technologies. The first barrier concerns long-term access to suitable space. Numerous manufacturers have experienced pressure from regeneration and conversion of industrial land into other uses in many cases leading to costly relocations across the city. In London, a curtain pole manufacturer was forced to move three times over a five year period. Having to move can paralyse a business and prevents investment in costly technology.

Secondly, there is a lack of skilled technicians to use and adapt new technology. Maker spaces and fablabs offer a useful model to reduce access costs to technology and create a community of makers that are willing to engage in informal training networks. However, maker spaces have also been facing pressure leading to downsizing or closure. An example of this is Machines Room in Hackney, East London, which played an instrumental role in the development of a community of start-ups, called the 'makers mile'. The pressures of gentrification pushed the relocation of Machines Room from its industrial building, now converted into apartments, to two shipping containers by the canal, which meant some of the large pieces of technology could no longer be used.

Protection of industrial land

Zoning is one of the most effective ways to ensure that land remains affordable and manufacturing remains within the city. Protecting existing industrial space in cities is critical to provide continuity for businesses and prevent the disruption of existing networks. Protection needs to extend across different kinds of spaces to ensure there is space for a variety of businesses and space for them to grow and shrink. This ranges from small ateliers in residential neighbourhoods to large sites in industrial zones.

In recent years, zoning has not been enough to protect land. Rezoning of industrial land is common even in cities that have planning policy in place to halt loss of industrial land, such as in London. In Brussels, the period from 2000 to 2018 saw industrial surfaces reduced from 6.02% to 4.22%, occurring largely in some of the country's poorest local government areas such as Anderlecht and Molenbeek.³⁰ In London between 2001 and 2015, some 1,300 hectares of land was rezoned leaving less than 7000 hectares of industrial land, or 4.4% of Greater London, which far exceeds planned land release.^{31, 32}

Planning in some cities have been developed to halt further loss of land. Yet there are a number of reasons why it is unlikely that planning will be enough to halt the trend to repurpose useful manufacturing space for higher yielding functions like housing. Firstly, many useful manufacturing spaces are in mixed use areas and may be considered as workshop spaces or shop-fronts. It is easy for building owners to find alternative uses for such spaces, even if informally. Secondly, asymmetries between planning ambitions and the forces behind industrial land gentrification occur due to the way municipalities are funded. Municipalities, particularly poorer ones, are attracted to rezone industrial land as taxes or developer contributions can provide a means to finance basic services (such as schools and public space).

Leveraging capital for space or technology

Banks can be reluctant to finance manufacturers due to the inherent risks compared to other investments. Smaller and younger companies are particularly limited by their capacity to access loans to purchase technology or secure spaces. Public authorities can be vital to either provide affordable space, shared space or provide start-up capital (grants or loans) to turn good ideas into business. Established companies are in a much

better position to secure bank loans or credit as they are likely to own assets or have a strong client base. These businesses are less risk taking - which is both a virtue and a disadvantage.

The trappings of private equity

For young companies who are prepared to launch new ideas and take big risks, private equity is a means to upscale quickly. It may come from individual investors, agents or companies. Examples of private equity investment in urban manufacturing are diverse, from urban agriculture to bikes and beer. While private equity can help boost a business quickly from idea to production, accepting investment from large financiers has another face. Private equity investors that become shareholders, will also likely have voting rights and may expect fast returns on their investment. As such high-growth oriented projects are often high risk, there can be a likelihood for businesses to sever local community support in their ambition for growth.

Community oriented businesses for city-oriented manufacturing

Cooperatives, community owned businesses and Non Governmental Organisations (NGOs) are often characterised as community facing organisations. By collaborating, organisations pool funds to purchase expensive technology or share the use of a space, which would otherwise be impossible for small businesses. Members or interest groups of such organisations are generally also users and based in the local area while decision making is often based on direct democracy (each member has a vote). For instance, the Brussels based Micro-factory is a cooperative that manages a 500 square meter



EN STOEMELINGS, USING A SHARED YARD SPACE (BRUSSELS) © A HILL - B1 & B.2

workshop space, within a building owned by the regional government. Such a space allows the 120 members to share space and invest in technology such as a CNC cutter or metal working tools. Smaller cooperatives, like the Micro-factory, may not have the time and money to source large amounts of finance or have access to bank loans. Therefore they depend on some form of public subsidies to ensure that they remain affordable and accessible. Next door, the 12 hectare Abattoir site, is a company owned predominantly by around 150 individuals, many who are also local stall-holders on the site. This is one of the reasons why Brussels is one of the last European cities that has an 'urban abattoir' and offers a useful example of how local interests can avoid speculation.

The need for public financing and stimulation

Public actors (from municipal, regional, national and European levels), have a recent history in investing in developing new technology, materials and products. This falls into the classic triple helix industrial strategy (of public administration, research and business), yet at a city scale more pragmatic investment can be made.

Generic public subsidies can also help a company to grow, develop, take risks or adapt to new environmental standards. Public investment may provide networking, marketing and administrative support services. Many businesses are unaware that this kind of support is available or know where to start looking for it.

Incentives can be thematic, aimed at aligning specific economic policy. Brussels' Regional Circular Economy Plan (known as the PREC) included actions oriented at encouraging businesses to adopt circular economy practices, particularly within the construction sector. Stimulus may not simply involve cash incentives but also may offer businesses planning support, assistance with permits and support with employment or training. Rarely are businesses aware of such incentives and therefore need an intermediary to point out the benefits of the incentives. Such support is very place bound, meaning that the company must stay in the same political area or risk losing its investment.

Public financing and policy can be combined to avoid market failures when banks fail to offer crucial financing for local businesses. For example, in order to hold onto local industrial horticulture, the Province of South Holland (outside of Rotterdam) adapted loan schemes offered by the banks to facilitate upgrading glass houses instead of funding only complete new projects.

KEY IDEAS

The three pathways presented in this chapter present both the richness and complexity of grounding urban manufacturing in place.

Firstly, urban integration can be dictated by the type of business, based on how close it should be to potential clients or if it should be located in an exclusively industrial zoning. Planning is needed to manage the 'transition zones' to ensure that a healthy mix of making and living occurs. New buildings need to be planned to allow for flexibility, providing spaces for businesses to share equipment or for spaces to be easily adapted to the needs of the business. Many forms of manufacturing can be integrated into natural or man-made geographies and take advantage of place conditions.

Secondly, circularity and technology provide both a constraint and opportunity. There is great potential to capture resources, however this requires suitable storage and sorting facilities. To achieve this, both skilled workers and creative thinkers need to be available to find ways to create circular loops or reduce waste. While new technology is plentiful, there is much to gain from investing in skilled workers to get the most out of available technology to do new things.

Thirdly, people, networks and policy offer the basis to provide better support for local urban manufacturers. A big challenge is to create local networks to get the most of the knowledge, skilled workers and locally technology available. This is subject to the availability of suitably trained skilled workers. Finally, all of this hinges on the capacity for businesses to retain access to suitable space.

*Exploring the topic through one of these three lenses can help to reduce the complexity. However concentrating on a specific aspect can also lead to blind-spots. In **chapter 4** a practical approach will be presented, formulated by fifty patterns of urban manufacturing. These patterns help the reader to grasp the complexity of urban manufacturing and explore possible solutions. Furthermore, **chapter 5** provides a number of exercises and applications of the patterns. Finally, if this remains daunting, **chapter 6** provides starting points in the form of a manifesto for urban manufacturing.*

A PATTERN LANGUAGE

A PATTERN LANGUAGE TO FACILITATE URBAN MANUFACTURING

No form of manufacturing or manufacturing environment can be identically copied. Still, there are similar characteristics found in many cities. Based on our field work and observations, as described in **chapter 1** and **chapter 3**, we have mapped out these similarities into fifty patterns. By understanding patterns, the complexity of urban manufacturing can be rendered more accessible and manageable. This chapter presents the patterns according to experiences described in **chapter 3** and structured according to five scales of action. Each pattern is linked to others: certain combinations of patterns can form a *pattern language*. In this way, the patterns and pattern language provide a systemic approach for analysing sites, developing place-based visions, supporting design processes and help monitor the state of urban manufacturing.

SYNTHESISING OBSERVATIONS

The research for this book was based on three different perspectives as described in **chapter 3**: urban integration; circularity and technology; and people, networks and policy. These three perspectives, explored in three metropolitan areas (Brussels, London and Rotterdam), ensured that a range of different issues could be identified and tensions or conflicts could emerge, while also aiming to avoid blind-spots in the research. A vast range of actors were engaged in interviews, workshops and discussions, including public authorities (both elected officials and administrative staff from different levels of government), businesses, entrepreneurs, special interest organisations, practitioners (such as urban planners, designers, geographers and economists) and real-estate developers. This helped to expose challenges, motivations and needs of urban manufacturing and to cross reference how certain positions were interchangeable across other cities. Interviews were complemented by extensive literature analysis, fieldwork, spatial analysis, workshops and experimental projects as part of academic education.

The ambition was to identify the building blocks for urban manufacturing in European cities according to technology and resources, spatial conditions and governance. Our research showed that conditions could be very different from one city to another, rendering it difficult to find a concise and transferable formula. For example, real estate pressures and regulation in cities like Brussels, New York, Paris and London were making multi-storey manufacturing financially viable yet in many other cities, this was not the case. Culture and heritage could influence the kinds of feasible activities - Brussels' Audi factory or Rotterdam's port lent to certain kinds of manufacturing which could not be easily transferred elsewhere due to particular infrastructure or unique local economy. Politics were also an evident variable which could position manufacturing within the local economy or radically work against it. In public authorities, urban manufacturing is commonly split into separate problems and managed by different (public and private) organisations that can work in isolation furthermore increasing the complexity of the topic. Ultimately the research showed that a one-size fits all approach could not be applied to urban manufacturing and a systemic and adaptable approach was required.

An instrument or methodology was required to address the complexity of planning and urban development, that could incorporate the perspective of many different actors and interest groups operating at multiple scales. There was a particular need for multi-disciplinary collaboration, allowing different world views and means of communication to interact particularly in dialogue. After considerable research, we found no suitable instrument that integrated both different forms of knowledge or different stakeholders and provide a framework to use multi-disciplinary knowledge. The consequence of planning could have slow but irreversible effects on manufacturers, even while some levels of government are making concerted efforts to support urban manufacturing. Therefore, it was important to be able to show the consequences of decision making and have the means to constructively discuss policies and plans.

PATTERNS FOR URBAN MANUFACTURING

The concept of patterns was introduced by Alexander, Ishikawa, Silverstein, King, Angel and Jacobsen in their seminal book 'A pattern language: Towns, Buildings, Construction' (1976)¹, that presented an 'archetypal language' to universal problems found in the built environment. Patterns involve a generic set of ingredients and possible solutions, translatable to a wide range of conditions. Alexander (et al) wrote of some 253 patterns

TRANSITION ZONES ARE IDENTIFIED IN THE PATTERNS / BOTTOM: SEGREGATING LIVING AND MAKING IN SCHIEDAM © V SANZ / ABOVE: DELIVERIES BLOCKING TRAFFIC / © C DUBINI - C10, N.9, N10, B1 B.6



concerning the built environment. This systemic approach breaks down complexity into easily understood blocks of knowledge. The patterns facilitate constructive and solutions-oriented discussions amongst people with very different expertise and knowledge without either devaluing the richness of a topic or getting lost in detail.

To define the patterns, we synthesised our research into a list of elements, until each could be translated into a hypothesis with a tangible solution. This process was reviewed and refined over a series of iterations, resulting in fifty individual patterns. The patterns were then developed further through discussion with local stakeholders and design based research to test the relevance of each pattern, resulting in regular adaptations to the titles and contents. Each pattern description consists of the context it is embedded in, problems that it tackles, forces that might influence it and at the core of the pattern ideas for possible solutions.

A PATTERN LANGUAGE FOR URBAN MANUFACTURING

Patterns never stand on their own. They are linked to other patterns in terms of complementarities (solutions) or in terms of possible tensions (forces). Alexander (et al) referred to this as a *pattern language*. For example, the ambition to reuse waste will inevitably be linked to logistics, accessibility and particularly types of jobs which could represent some six to nine different patterns.

Both the patterns and the relationships between them were based partly on our own experiences using and testing them and we expect they will further evolve as they continue to be used. Therefore the patterns found over the following pages offer a proposal of a pattern language for urban manufacturing. We accept that these patterns offer a limited amount of depth for some experts. Experts may choose to break them down to smaller segments for the meaning of each pattern to be more nuanced according to a specific field of expertise.

Salingaros elaborated in his book 'Principles of urban structure' (2005)² that patterns can be connected in five ways:

- 1 First, one pattern contains or generalises another smaller scale pattern.
- 2 Second, two patterns are complementary and one needs the other for completeness.
- 3 Third, two patterns solve different problems that overlap and coexist on the same level.
- 4 Fourth, two patterns solve the same problem in alternative, equally valid ways.
- 5 Fifth, distinct patterns share similar structure, thus implying a higher-level connection.


The relations between each of the patterns noted over the following pages are based on qualitative data. They were defined through observations and experiences, research, verified in multiple stakeholder workshops and discussions. For example, at the end of workshops, evaluations were made that allowed an assessment of the correctness of the relations between patterns.

After scanning through the fifty patterns over the following pages, readers will ask how to use them. There are a vast amount of ways that the patterns can be used as a tool. **Chapter 5** will elaborate four main types of applications of the pattern language: visioning, analysing, designing and monitoring.

THE PATTERNS AT A GLANCE

The patterns follow a standard structure for consistency and clarity. Their contents consist of an interpretation of fieldwork observations, interviews and spatial analyses and attempt to make the descriptions as specific as possible while rendering them transferable. Some of this is supported by quantitative data, while in other cases the descriptions are based on qualitative experiences or comments received from stakeholders in various cities. Regardless, the contents of these patterns must be interpreted according to the context where they are applied.

- A We have identified five scales of action: R = Transcalar, C = City/Neighbourhood, N = Neighbourhood/Block, B = Block/Building, P = Programme. The numbers (1,2,3...) do not represent a particular order, but serve the cross-referencing.
- B The **title** of the pattern.
- C The **hypothesis** of what this pattern represents.
- D **‘Connected to’** indicates links to related patterns.
- E The pathways (refer to chapter 3) can be distinguished by the background colour: white = Urban Integration; black = Circularity and Technology; green = People, Networks and Policy.
- F The **context** provides the conditions a pattern originate in.
- G The **problem(s)** addressed by this pattern.
- H **Forces** may be encountered from other patterns or have an effect on other patterns that are important to be aware of.
- I **Solutions** are possible ways of implementing the pattern.

<p>R.2 A</p> <p>TRANSPARENT B</p> <p>MAKING</p>  <p>Providing transparency in environmental, economic, and social processes helps building local acceptance of urban manufacturing, while also founding a basis for interaction and collaboration between businesses.</p> <p>Connected to: R.1/R.3/R.5/R.11/R.12/B.3/P.8</p> <p>CONTEXT</p> <p>Increasingly public authorities, industry lobbies, NGOs and the general public are expecting greater levels of transparency in how businesses operate. This could include material sources, waste management data, taxation, employment figures, output levels, environmental impact and so on. For public authorities, transparency could help with decision making. For industry lobbies, transparency could help better understand the needs of their members and how to provide relevant support. For NGOs and the general public, transparency will help making informed decisions about if or how to support local manufacturers based on</p> <p>their environmental impact, their economic performance and their general value to society. Manufacturers in turn will need to decide how to provide relevant information without exposing their intellectual property, exposing themselves to taxation, affecting their level of support or endangering their client base.</p> <p>PROBLEM</p> <p>Friction can occur simply due to miscommunication between manufacturers and their residential neighbours, particularly in gentrifying areas, may be intolerant to nuisances from manufacturers (from noise, visual impact</p>	<p>PEOPLE, NETWORKS & POLICY – TRANSCLAR</p> <p>issues, unpleasant odours and dust) and lodge official complaints which creates tension for manufacturers. Statistics is also challenging, while cities are increasingly relying on data to make decisions, much of the available data lacks realistic insights into the operations, resource flows, employment conditions, business networks or financial value generated by businesses with various allies. For example, the well-known European statistical system, the NACE codes, provides a useful guide to the variety of manufacturers existing at a national scale but is problematic in providing more granular information and in fact easily over- or under-compensate the value of manufacturing. Data sets often agglomerate data based on the headquarters rather than the location of production site. Companies are regularly placed in the wrong category which is particularly problematic for multinational companies or companies that change activity. Several other aspects of urban manufacturing are lacking available data such as freelancers, actual workplace location or small and medium-sized locations.</p> <p>FORCES</p> <p>Some public authorities have acknowledged their lack of awareness of the mechanisms of their local economy. However the difficulty comes from the possible costs for local or regional authorities to have more realistic and reliable sources of data and knowledge. Tension arises between the inability of public authorities to rely on the usability of data and the business community that has no or a tangible sense of how the data operates. For issues such as resource flows, many companies simply have no or poor records which means that no one has a realistic view of what moves in and out of production process (see R.12 Material Databases). Furthermore businesses are apprehensive to risk infringement of privacy or exposure to competition if their practices or commercial data becomes public. Conversely, few businesses have the habit of investing</p> <p>in public communication campaigns to build trust with their local marketplace or community.</p> <p>SOLUTIONS</p> <p>To improve the legitimacy between local clients and manufacturers, find both statistical data and factual information that can help clients, public authorities and neighbours to make informed decisions. As conventional statistics rarely provides a realistic insight into how business actually operate, a comprehensive list of economic and socio-spatial indicators should be built and sourced locally. This will require both qualitative and quantitative data collection of what happens on the specific site. This can start with an annual door-knocking survey and evolving into a more comprehensive (digital) accountability tool. For example a R.12 Material Database provides improved insight into resource flows. Friction between manufacturers and their neighbours can simply involve improving communications which can avoid social and financial polling costs. To complete support for public databases, R.11 Incentives for Research & Development could be mobilised. Public institutions should encourage businesses to build more open facades (R.2 Public Face) to make them more accessible, encourage businesses to run tours and support the development of a P.8 Community Hub in Making Locations to act as a bridge between makers and the larger community. Companies can provide more transparency by investing in communications campaigns, R.1 Making Making Visible. For businesses in mixed neighbourhoods, assigning a responsible staff member as liaison can avoid conflicts while potentially stimulating tourism. In industrial neighbourhoods this could be managed by the R.2 Curator.</p>
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MAKING MAKING VISIBLE



Manufacturers need visibility to connect their products and services with the local market, while ensuring that the general public values what manufacturing does for the city.

Connected to:

R.2 / R.3 / R.10 / R.11 / B.3 / N.7 / N.10 / P.7 / P.8

CONTEXT

Visibility, in terms of communications campaigns, local branding, promotional events or simply prioritising local products in public and private contracts, are important for local manufacturers to have an edge over imports and help strengthen the local economy. By making making visible, businesses can help to communicate their goods and services, develop pride in the locally made ('Made in My City'), help enforce local culture and particularly to help raise awareness and create value in what is being made locally.

PROBLEM

After decades of decline, gentrification or land use change, manufacturing and industrial areas have not only lost their immediate relevance to local citizens, but have also become pushed out of sight of daily life for most residents. This has created a large divide between makers and their local markets or between manufacturers and their neighbours. As a result the general public knows little about manufacturers and little is done to support them. For the sector in general, lack of visibility means manufacturers (and associated services) are losing their place in society. Production processes

have also become highly complex which make it difficult for the general public to understand. This has knock-on effects. Less people are interested in following traineeships, investing in local products or supporting local businesses. Other land uses (such as housing or commercial spaces) are becoming prioritised at a political level. Furthermore, neighbours have become increasingly intolerant to externalities from manufacturers (such as traffic or noise) in part because neighbours are less likely to work in the sector, they have a lack of awareness of what businesses do or what they contribute to society. While some businesses have begun to use marketing to their advantage (**R.2 Transparent Manufacturing** and **B.3 Public Face**), there remains a vast amount of making that the local community is unaware of yet is dependent on, on a daily basis.

FORCES

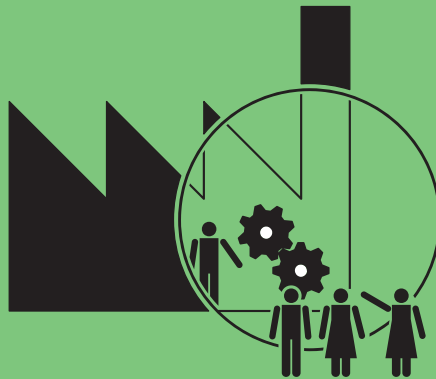
While few businesses will refuse better advertising, many lack the time, resources and competency to actually do it themselves. Conversely, some businesses depend heavily on secrecy and intellectual property which makes making challenging to communicate - car factories or pharmaceutical companies for example. More importantly, industrial neighbourhoods rarely have the financing or the organisational capacity to build awareness of what is produced locally. Finding an organisation capable of communicating a relevant message to capture the attention of the local market is therefore challenging in terms of expertise and financing. Some industrial districts also would prefer to remain unnoticed as they don't see the direct benefit of drawing attention to their businesses.

SOLUTIONS

To improve exposure of local manufacturers and communicate

their production processes, build communications campaigns that address both immediate neighbours and the larger urban context. Visibility can come in many formats ranging from traditional advertising, to events and even exposing how the manufacturing process operates. Firstly, simple media campaigns can raise awareness of the materials, processes and people behind local products. This message could come from public agencies, business organisations or community groups supported through **R.10 Place-based Financial Levers**. Secondly, **R.2 Transparent Making** can help build trust through creating traceability. Tours, open days and presentations allow citizens and neighbours to see for themselves, particularly giving an insight into businesses that are otherwise hidden behind closed doors and large walls. **N.7 Local Design and Prototyping** can be particularly captivating, while **P.7 Spaces for Development and Education** are useful to attract students. Finally, exposing production related infrastructure can render manufacturing an attraction in itself. A **B.3 Public Face** is a simple and important way to expose the production process and also to improve brand awareness, strengthen local cultural identities and potentially increase customers. To apply all of these interventions, it is useful to have an dedicated intermediary such as the **R.3 Curator** who has the responsibility to communicate a realistic view of the local manufacturing sector.

TRANSPARENT MAKING



Providing transparency in environmental, economic, and social processes helps building trust and acceptance of urban manufacturing, while also founding a basis for interaction and collaboration between businesses.

Connected to:

R.1 / R.3 / R.5 / R.11 / R.12 / B.3 / P.8

CONTEXT

Increasingly public authorities, industry lobbies, NGOs and the general public are expecting greater levels of transparency in how businesses operate. This could include material sources, waste management data, taxation, employment situations, output levels, environmental impact and so on. For public authorities, transparency could help with decision making. For industry lobbies, transparency could help better understand the needs of their members and how to provide relevant support. For NGOs and the general public, transparency helps making informed decisions about what kind of relationship to have with local manufacturers

based on their environmental impact, their economic performance and their general value to society (should their products be prioritised over cheaper imports?). Manufacturers in turn will need to decide how to provide relevant information without losing their intellectual property, exposing themselves to unnecessary public interventions, affecting their community support or endangering their client base.

PROBLEM

For residential neighbours, friction can occur simply due to miscommunication. Residents, particularly new inhabitants in gentrifying areas, may be intolerant to

nuisances from manufacturers (from noise, mess, unpleasant odours and dust) and lodge official complaints that create tension with manufacturers. Statistics are also challenging, while cities are increasingly relying on data to make decisions, much of the available data lacks realistic insights into the operations, resource flows, employment conditions, business networks or financial value generated by businesses on a specific site (for example data sets often agglomerate data based on the headquarters rather than the location of production). The well known European statistical system, the NACE codes, provide a useful guide to the variety of manufacturers existing at a national scale but is problematic in providing more granular information. In fact due to the difficult distinction between manufacturing and services, the value of manufacturing can be easily over- or under-accounted. Companies are regularly placed in the wrong category which is particularly problematic for multinational companies or companies that change activity. Several other aspects of urban manufacturing are lacking available data including information on freelance workers, actual workplace locations or small and medium-sized locations.

FORCES

Public authorities often acknowledge their lack of awareness of the complexity driving their local economy. Tension can arise between those actors with a metropolitan scale view that depend on available aggregated data and actors that have a tangible sense of the day to day challenges facing businesses. These two perspectives often struggle to see eye to eye. Costs for local or regional authorities to acquire realistic and reliable data and knowledge can be prohibitive. For issues such as resource flows, even companies generally have poor records which means that no one has a realistic view of what moves in and out of production process (see **R.12 Material Database**). Furthermore businesses are apprehensive to risk

infringement of privacy or exposure to competition if their practices or commercial data becomes public. Conversely, few businesses have the habit of investing in public communication campaigns to build trust and transparency with their local marketplace or community unless it plays an essential part in their business model.

SOLUTIONS

To improve the legitimacy between local clients and manufacturers, find both statistical data and factual information that can help clients, public authorities and neighbours to make informed decisions. As conventional statistics rarely provide a realistic insight into how business operate, a comprehensive list of economic and socio-spatial indicators should be built and sourced locally. This will require both qualitative and quantitative data collection of what happens on the specific site. This can start with an annual door-knocking survey and evolve into a more comprehensive (digital) accountancy tool. For example a **R.12 Material Database** can help create insights into resource flows. Friction between manufacturers and their neighbouring housing areas can simply involve improving communications which can avoid social and financial policing costs. To support the use of public databases, **R.11 Incentives for Research & Development** could be mobilised. Public institutions can encourage businesses to build more open façades (**B.3 Public Face**) to make them more accessible, encourage businesses to run tours and support the development of a **P.8 Community Hub in Making Locations** to act as a bridge between makers and the larger community. Companies can provide more transparency by investing in communications campaigns, **R.1 Making Making Visible**. For businesses in mixed neighbourhoods, assigning a responsible staff member responsible for community relations liaison can avoid conflicts while potentially stimulating tourism. In industrial neighbourhoods this could be managed by the **R.3 Curator**.

CURATOR



The curator helps businesses or neighbourhoods by aligning interests, building partnerships, exploring needs, communicating news and protecting community interests.

Connected to:

R.1 / R.2 / R.4 / R.6 / R.9 / R.10 / R.11 / C.1 / C.2 / C.4 / N.3 / N.4 / P.2 / P.4 / P.8

CONTEXT

The curator could refer to the area coordinator, community manager, development advisor, city architect, facilitator or the development agency. The curator provides a vital but largely invisible role in supporting businesses (with subsidies, equipment, staff, space and resources), identifying necessary community infrastructure requirements (such as storage areas, logistics, waste and training space), identifying complementary businesses to add to the community and/or helping with networking (linking manufacturers to researchers, financiers, public authorities and potential clients). The role can operate

at a range of scales, from the city scale down to the building scale. In some cases this role will emerge very strategically, imposed by heavy top-down policy. While in other cases the threat of eviction could provide the impetus to delegate a community's interest to an executive group or spokesperson. The curator can be the bridge between public authorities and policy makers, local stakeholders and other businesses.

PROBLEM

Businesses often struggle to collaborate, lack support from public authorities, are not well integrated into the local context

and can easily become isolated. While businesses in the past often depended on a local community for practical issues such as technical knowledge, resources and staff, increasingly manufacturers are operating in isolation. Rarely is there an actor that has an overview of the diversity of businesses within a neighbourhood or even at the scale of the city. Isolation can lead to a range of negative effects including poorly optimised use of space, the inability to improve common problems, unnecessary duplication of technology, poor capacity to collaborate and the lack of common infrastructure such as informal meeting places or waste collection points. Moreover, individual businesses struggle to align their needs from public authorities such as training, logistics areas, business development or financial assistance. Isolated businesses are also less capable of creating synergies for research and development (R&D), which can be counterproductive for competition or even hamper the search for talent. In contrast, large manufacturers that can afford R&D are more reluctant to share knowledge. As a result, cities often have to deal with poorly managed manufacturing areas, badly optimised business networks and weak conditions for innovation.

FORCES

Businesses that share a building, block or neighbourhood may collectively amount to a great deal of knowledge, infrastructure, resources, spaces, technology and political power yet lack the initiative or capacity to collaborate. This could be due to the lack of **R.10 Place Based-Financial Levers**, **R.11 Incentives for Research and Development** to inspire neighbouring businesses to collaborate or simply a lack of clarity of what is happening locally (**R.2 Transparent Making**). Businesses can also feel that developing relationships is a waste of time, particularly if their focus is on day to day issues or they risk eviction (**R.9 Assured Security of Space**). On the other hand, local organisations and public authorities may have the time, finance and mandate to

play a key role in better supporting manufacturing activities but lack the knowledge, trust or facilitation skills to provide a supporting role.

SOLUTIONS

Launch a curator to link businesses and concerned stakeholders, to identify local opportunities and defend common issues. Firstly, the role of the curator needs to have buy-in from at least the local businesses and where possible also the concerned public authorities. Second, once stakeholders have made a commitment to the role, the objectives of the role must be defined according to the needs of the project or site. This could include negotiating for **R.10 Place-Based Financial Levers**, finding **R.11 Incentives for Research & Development**, developing a vision for **R.1 Making Making Visible** or pushing for more **R.2 Transparent Making**. It could involve optimising businesses' needs through **N.4 Clustering Similar Making** or **N.3 Mixing Complementary Making and Related Services**. It may include enhancing socio-spatial integration through the **R.4 Availability of Diverse Jobs** and pushing for the most suitable and **C.4 Diverse Tenure Models**. Third, it will be necessary to define the scale of operation (such as building, neighbourhood or city scale) and role (such as facilitation, business development, area management, vision production or community building). Fourth, the role will need to be financed and this should reflect the interests, scale and responsibility of the curator. The curator can be either a person or organisation. It could also be public agency, private business, a freelance, a not-for-profit organisation, a university or even a chamber of commerce. It could be paid for through structural financing (**R.10 Place-Based Financial Levers**) particularly if the area is of strategic importance. Alternatively it could be financed through research financing attached to a project (**R.11 Incentives for Research and Development**). It could also be funded by members or by providing a specific service.

AVAILABILITY OF DIVERSE JOBS



A diversity in job opportunities that are fairly distributed across the city allows for workplaces to fit the skills, capacities and interests of the local workforce, provides businesses with options for staffing while ensures cities are resilient and accessible.

Connected to:

R.1 / R.3 / R.5 / R.10 / C.6 / N.10 / P.2 / P.3 / P.5 / P.6 / P.7

CONTEXT

A hallmark of accessible and resilient 21st century cities are those that harbour a diverse range of competencies and work opportunities. Urban manufacturing supports three distinguishable types of jobs. Firstly the low skilled labourer, which involves a fairly limited scope of repetitive tasks such as a machine operator, line worker or logistics labourer. Necessary skills can be trained on the job, which make this kind of work a highly accessible entry point into the workforce. Secondly, the highly trained machinist or skilled technician. This role requires extensive training and experience to master,

involving a trade school or possibly a 2-4 year apprenticeship. Thirdly, the pluri-disciplinary worker. This role is increasingly important for 21st century manufacturers where automation and technology have a strong position in the business, yet where workers must also perform a range of knowledge based tasks such as engineering, design, logistics planning, sales and communications. In addition to these three job profiles, manufacturing supports a range of more typical services type jobs such as design, sales, communications, distribution and administrations, which may require some knowledge of the manufacturing processes.

PROBLEM

As modern European cities shifted focus from industry to services economies, manufacturing opportunities have become narrower. Jobs in many (European) cities are increasingly rewarding services skills in terms of pay, education opportunities and job options. Over recent decades, numerous training colleges have closed, courses and equipment in technical schools have not been adapted to the needs of the industry and formal pluri-disciplinary training (both technical and knowledge) required by many 21st century manufacturers is becoming increasingly rare. Segments of the population also face difficulties to find sustainable work (such as the disabled, migrants and ex-convicted felons). Manual labour can offer meaningful work and pathways to other jobs however such work is increasingly unviable in cities due to land prices or labour costs. Manufacturers in this situation generally cannot survive without some form of structural support or public subsidy to balance their books, which governments may be reluctant to cover.

FORCES

Many cities aspire for diversity and resilience but few find sustainable and politically robust ways to provide required support for sectors like manufacturing. Training and education is a critical challenge, particularly to inspire future workers to develop basic skills and knowledge to be employable. Cities require programs and relevant **P7 Spaces for Development and Education**. This generally needs some kind of public investment to ensure that the training is of a suitable quality and the education is relevant to a range of employers. Furthermore, as many urban manufacturers involve small to medium sized businesses, they lack the human resources to find suitable staff. Many businesses thus depend heavily on job agencies, which can be costly or simply incapable of addressing the expectations

of future employees due to messy, dusty or noisy workplace conditions.

SOLUTIONS

Provide the city with a wide diversity of jobs, to build on both the competencies of existing available workers and to develop long-term urban scale (policy) ambitions for accessible work. Firstly, inspiring students into vocational training, particularly women, is essential (see **R.1 Making Making Visible**). Secondly, companies hiring and training employees in vulnerable circumstances (such as the disabled, migrants or ex-convicted felons) could be given advantages when applying for public financing, support or contracts. The social economy can be promoted and financially supported through tax cuts, subsidies and **R.10 Place-based Financial Levers**. For example, subsidised work could include environmentally necessary but low-skilled work, like **P.6 Re-use and Repair Centres**, to reduce waste. Thirdly, where jobs and demand for employment exist, encourage 'social quotas' and campaigns to promote **R.5 Fair Work Conditions**. A **R.3 Curator** could help bridge public interest, business opportunities and community needs. A diversity of jobs should also be fairly distributed across the city, ensuring a healthy social mix and allowing workers to have **C.6 Strategic Access to Multimodal Mobility** with healthy travel distances between work and home. Finally, cities should aim to provide a range of ways of training workers, supporting mentorships or internships for younger students, providing **P.7 Spaces for Development & Education** such as traditional training colleges or even a **P.8 Community Hub in Making Locations** that supports **P.2 Shared Technology & Making Spaces**. In some cases freelance workers can take advantage of **P.5 The Work Home** or **P.3 Flexible Spaces for Making**.

FAIR WORK CONDITIONS



Fair working conditions are integral for providing good quality output, a reliable and agile workforce, a strong brand and in turn to promote manufacturing businesses as a valuable source of employment.

Connected to:
R.2 / R.4 / R.11 / C.6 / P.7

CONTEXT

Workers are a critical part of the production cycle and businesses often claim to have a shortage of high-quality workers. Yet workers are in constant tension between the expectations of management in delivering suitable levels of output, adapting to new technology and being subject to the threat of replacement through automation. Jobs are increasingly changing and need to be more reactive to market demands. Conversely, the working conditions can play a significant role in the performance of a worker, which can be linked to the comfort of the job (amount of breaks and the workstations), the length of the working

day, the workplace atmosphere, exposure to pollution (noise, dust or fumes), the capacity for independent decision making, the pay level, access to holidays and pension and so forth. Poor work conditions can impact productivity, result in illness or lead to strikes that can paralyse businesses.

PROBLEMS

While manufacturing has changed significantly in many western cities, conditions remain challenging, often involving workers in precarious conditions who's well-being can affect the quality of the products and the standard of production. Positions are increasingly flexible and paid by the hour

(zero-hour contracts), affecting workers capacity to make long-term personal investments. Even if flexibility can be seen to have competitive advantages, uncertainty can degrade relationships between workers and their managers. Low wages have a direct impact on health conditions. In addition, manufacturing remains physically challenging which can involve carrying heavy loads, repetitive strains and extensive periods without breaks. While some low-skilled, low paid and physically challenging jobs will most likely remain in cities, such work may be considered incompatible with the local costs of living and result in moving such businesses to cheaper locations. The knock-on effect will result in a smaller pool of available workers for remaining companies. Conversely, when businesses close or manufacturing processes change, there may be challenges to find related jobs or retrain workers to adapt to similar meaningful work. Retrenched skilled workers can be left both demoralised or isolated and result in radical social consequences.

FORCES

Cities are a great source of labour, but higher urban wages can increase the overall production costs and impact the capacity of manufacturers to compete against imported goods. Manufacturers also compete against services businesses for space, which can produce greater profits on a smaller footprint. Due to high costs, urban manufacturers are often pressed to generate a marginal turnover, which means balancing production costs and providing suitable work conditions, even if their products are 'foundational' for the city (such as **N.2 Re-use of Materials & Energy Flows** or **P.6 Re-use and Repair Centres**). Likewise, businesses may struggle to find suitable skilled labour and be incentivised to replace human labour with labour saving technology. Furthermore, unnecessary labour costs may have arisen from friction with management, poor work conditions, poor work culture or poor training - issues which can be addressed through

non-mechanical solutions. Manufacturers may be attracted to labour saving 'innovation', where workers are treated as machines and their actions are measured carefully to achieve optimum performance.

SOLUTIONS

Ensure work conditions are dignified, comfortable, democratic and fair to support a motivated workforce. Firstly, job conditions should encourage diversity in the broadest sense, from skill level (**R.4 Availability of Diverse Jobs**), to ethnicity or sex. Where imbalances occur, manufacturers should do their best (and be encouraged) to invest in diversity. Secondly, business structures could be adapted for profit sharing. Cooperatives can provide incentives for workers to feel responsible to adapt their working conditions to their needs while non-profit company structures can help push down overheads or encourage reinvestment of profits back into the business. Thirdly, the active participation of workers in a business' decision making process can help to motivate workers while helping them to take responsibility for changes and help them to prepare for change. **R.2 Transparent Making** can provide legitimacy and avoid miscommunication. Employers can improve quality through introduction of 'co-bots' or technical support, helping with repetitive tasks while supporting workers focus on quality control and creative thinking tasks. This also may require adapting the business model, distribution volumes or product pricing to benefit work conditions and improve the quality of products. Inspiring work conditions may offer **R.11 Incentives for Research and Development** and can be implemented, particularly within larger businesses, to motivate workers to also look for solutions to improve output. **P.7 Spaces for Development & Education**, in addition to making time available for training, can help workers to build skills on the job and to adapt to new technology incrementally. Commuting times are also an important factor, which can be addressed through **C.6 Strategic Access to Multimodal Mobility**.

SUSTAINABLE PRODUCT CYCLES



Manufacturing contributes to city-scale circularity, helping reduce distances from resource to processing site, distribution and retail, and then to re-use, remanufacture, material recovery and back to the production cycle.

Connected to:

R.2 / R.7 / R.8 / R.12 / C.8 / N.2 / N.5 / N.7 / B.8 / P.2 / P.5 / P.6

CONTEXT

The product cycle is the period between production, consumption and waste of a product. Over the last century product cycles have become increasingly shorter. This results in serious environmental impacts with large amounts of resources being used and disposed of within a short period of time. Some of these resources are highly critical and hazardous if released in the environment. This has been paired with increasingly complex supply chains that detach places of production from places of consumption while forcing down prices of goods such as electronics, furniture or textiles. Furthermore, shorter

product cycles have led to large volumes of waste and unused stocks accumulating in cities with poor opportunities to be used productively. Slowing down product cycles, to reduce environmental impacts, requires increasing the durability of products and the opportunities derived from extending the use of products through repairing, maintenance and remanufacturing processes. The city scale, where distances are shortest to the final consumer, are ideal locations to provide a space for new business models to emerge and through urban manufacturing to design better adapted products, extend their durability and recover useful components and materials at the end of their use life.

PROBLEM

The high cost of space close to clients and the low cost of technology makes it challenging for businesses operating with sustainable product cycles to remain viable. There is also little incentive for consumers to keep technology and goods functional as long as possible due to the low cost of consumer and professional goods and the fact that consumers do not pay for the waste costs upfront. This renders products increasingly dispensable and conversely increasingly difficult and expensive to repair. Few public authorities see it as their responsibility to invest in repair or re-use, yet pay the price through waste management. Furthermore, due to the complexity of waste management, there are only a small number of large resource management companies that can afford to invest in transitions to sustainable product cycles. Finally, skills in repair are not being stimulated, making technical capacity increasingly limited. The net result is a limited capacity for cities to repair or maintain products, with little opportunity for remanufacturing and recovery of materials at the end of the product life cycle.

FORCES

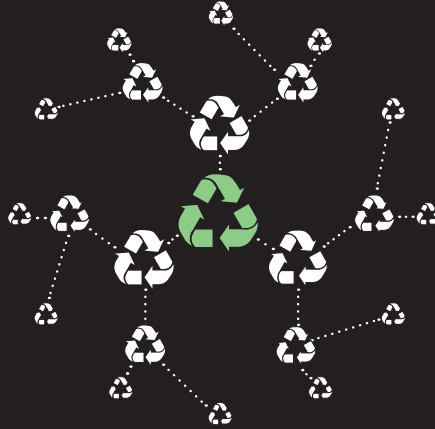
Currently private ***R.7 Multi-scalar Circular Infrastructure*** favours extracting only the profitable resources while disposing low-value components. Regardless, there are two opposing forces affecting consumption patterns. Firstly, there is a large supply of cheap and short lived products that have not been designed to be repurposed or recycled, generally from off-shore manufacturing. By contrast, regulation and growing consumer preferences is forcing companies to adopt different business models where there is increased attention to materials contained in products and responsible treatment of materials at the end of life of products. The best approach available for both consumers and public authorities is to use

more resilient and longer-lasting products, yet this often comes with a cost.

SOLUTIONS

Ensure suitable facilities are available to repair or re-use broken goods. Where possible, public and private investment should prioritise high quality goods to minimise the likelihood of failure. Purchasing equipment and goods that can be easily repaired. For sustainable product cycles to be enacted, urban planning and economic policies must recognise the network of infrastructure to provide a regenerative service for goods and materials consumed within cities. This can be done through addressing and mapping out the spatial needs associated with repair, storage, recycling and waste. Each will have different resource management systems at the city or regional scale. Provide a variety of spaces and ***R.7 Multi-scalar Circular Infrastructure*** to address both collection points and levels of waste treatment. Recycling should be considered as the last viable option (after repair or remanufacturing). ***N.5 Local Collection Points of Segregated Waste*** are importantly linked to ***B.8 Space for Storage*** to allow material stockpiling. This can give entrepreneurs or ***N.7 Local Design and Prototyping*** organisations an incentive to turn waste into resource. Where possible build on existing waste management processes to ensure that users understand where waste must go and where to repair fixable things. However, where the system is blocked by regulation or policy, explore how to adapt it. In some cases, such as for organic materials, legislation may need to be changed to make the resource circular. Businesses that have their waste collected, should sort waste as best possible at the source so that the waste can be taken to a suitable treatment site - penalise those that fail to do so through ***R.10 Place-based Financial Levers***. ***P.6 Re-use & Repair Centres***, both privately managed and public centres, can be located near consumers or businesses to help lengthen product cycles while offering accessible and meaningful low-skilled work.

MULTI-SCALAR CIRCULAR INFRASTRUCTURE



A system of integrated infrastructure at different scales is required to manage resource flows (materials and energy) and to promote effective circular economy approaches.

Connected to:

R.6 / R.8 / R.10 / R.11 / R.12 / C.3 / C.7 / C.8 / N.2 / N.5 / N.6 / B.7 / B.8 / P.1 / P.6

CONTEXT

Urban manufacturing could play a key role in closing the resource loop for cities. Infrastructure for circularity includes waste collection points, waste management centres and sale or distribution points. Management capacity depends on the resource type. Building materials are often best managed at a neighbourhood scale while electronics could be managed at a city scale. Some production and recycling processes must be located close to clients due to logistics costs or regulation. For example, for cement, there are legal limits in distance between production and pour (90 minutes in the EU). In general,

low value bulky waste needs to be recycled/re-used within a radius of 50km while high value recovered components and materials can be traded at national and international scale. Facilitating increased **R6 Sustainable Product Cycles** is also key for fostering more closed-loop approaches for materials, water and energy, which can be facilitated by manufacturers. Most of that waste could potentially be used/recovered/transformed back into raw materials through various processes.

PROBLEM

Resource management is often subject to a scale of action which makes it seriously

complex to manage. Cities have become consumption hubs that import vast quantities of materials that cannot be produced locally, while generating large amounts of waste. While there may be public will to improve resource management efficiencies, few cities have a realistic idea of how resources move around their respective urban areas and rarely is resource supply and waste management considered in urban planning. Waste storage or treatment sites can be located far away from the source of the waste, which makes it difficult for the **N.2 Re-use of Materials & Energy Flows**. With some materials, infrastructure is required at a local level (such as waste collection points) while in other cases it is required at the scale of the city (such as electronics waste recycling). Most cities lack adequate infrastructure across different scales that is integrated at the city/metropolitan level to optimise segregation, collection and treatment of waste streams generated by the entire urban system. This contributes to a substantial waste of resources and reduces opportunities to introduce circular loops.

FORCES

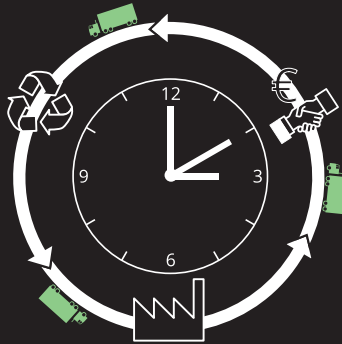
Waste produced by cities primarily includes; household, manufacturing and construction and demolition waste. The potential for re-utilisation of waste is highly dependent on maintaining the quality of the resource and avoiding cross-contamination between waste streams. A general lack of manufacturing activities in cities means that opportunities to reintroduce waste into the productive cycle are limited, especially in cities where yard spaces are limited and segregation of waste competes with other uses such as logistics. Also, at the city scale, waste infrastructure, including **B.8 Space for Storage** and **P.6 Re-use and Repair Centres**, compete with other land uses, which may have a higher commercial value. Waste management facilities are not easily integrated into the urban fabric

as they may create friction with other uses (such as commercial and residential).

SOLUTIONS

Ensure that waste transfer infrastructure and material recovery plants are distributed across the city according to resource type and the most efficient scale for resource management to take advantage of local waste streams. Reusing local resources (waste), requires suitable material sorting and collection points, piping for heat networks, logistics points, online platforms to track material flows and so forth in order to create more circular industrial ecosystems. Investment mechanisms (**R.10 Place-based Financial Levers**) should to be considered especially in large development projects where planning regulations requires integrating circular infrastructure (**N.2 Re-use of Materials & Energy Flows**), public investment in space, considering **C.3 Balance between Public & Private Land** could help facilitate this. To maintain the quality of waste resources, **N.5 Local Collection Points of Segregated Waste** are essential, requiring areas/space for separate segregation, collection and treatment infrastructure. Waste management centres (**C.8 Accessible Material Recovery Facilities**) are increasingly being located in mixed use neighbourhoods and are compatible with industrial co-location projects if suitably designed. Where labour costs are too high to deal with **R.6 Sustainable Product Cycles** and where businesses do not find the challenge commercially viable, social enterprises could step in to help maintain value of products and material through disassembly or remanufacturing.

MOVING THINGS EFFICIENTLY



Time-distance efficiency in logistics contributes to sustainable and competitive manufacturing.

Connected to:

R.10 / C.1 / C.3 / C.7 / N.6 / N.10 / N.11 / B.3 / R.10

CONTEXT

Logistics is a critical part of manufacturing. Manufacturers must ensure that their logistics systems optimise transport costs, shipping do not result in damaged goods, while delivery times are as efficient as possible (particularly) for local customers. Increasingly manufacturers are subcontracting logistics, which reduces the cost of equipment (like trucks), personnel and storage space. Furthermore, cities are increasingly taking interest in new urban logistics systems for low emissions zones, last minute delivery and smaller electric

technology such as vans and bicycles. Logistics depends heavily on the business type, the goods being produced and the business' client base. For city oriented businesses providing foundational forms of manufacturing (such as bread), deliveries are likely to remain embedded within the business but will be subject to congestion issues and urban emissions standards. For businesses with a focus on the local market but with competition from e-commerce and economies of scale from larger foreign manufacturers (such as printing), speed of production may be the strongest drawcard. These businesses will likely deliver (if bulky or delicate) or use a local courier service. Finally, businesses

with a sizable export production will likely depend on fast and affordable logistics. These businesses will likely have a business model built around economies of scale or niche production which makes it attractive for such businesses to be located near a logistics centre or transport node (like a highway).

PROBLEM

The biggest challenge is to foresee the future of logistics. Current energy and international production chains have rendered transport cheap. But logistics is a large vulnerability for manufacturers, particularly for export oriented businesses. Global supply chains can expose businesses to global issues ranging from cost of carbon emissions to war and disease.

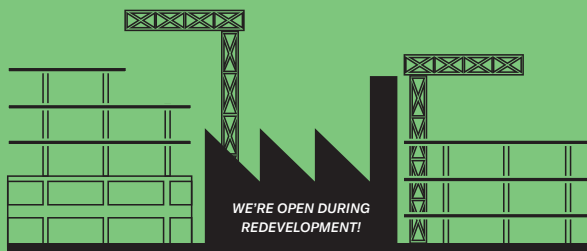
FORCES

Manufacturing has a strong dependence on both suppliers and clients, often who are not located in the same place. While many businesses like to cluster around **C7. Links to Transport Infrastructure**, large logistics companies are now often located on the edge of cities where both (commercial) clients and employees are not located. Likewise, while alternative urban logistics solutions or concepts for a **N.6 Centralised Logistics Zone** are being developed, not all are suited for simply delivering materials. Some businesses depend heavily on suppliers and their knowledge of materials or for using suppliers to stock material (construction related activities for example) and will therefore locate close to them. Many of these issues are encouraging businesses to move out of cities, where travel distance can be compensated by a lack of congestion. Finally, blanket policy may be placed on cities in terms of emissions or mobility levels which could directly affect manufacturers, requiring them to use energy efficient vehicles.

SOLUTIONS

Develop a city wide approach for logistics to help makers focus on making. Moving things efficiently requires a combination of well thought out storage, low impact transport and timely distribution. Manufacturers should consider if to be located close to clients and staff (**C.6 Strategic Access to Multimodal Mobility**) or closer to supplies and suppliers (**C.7 Links to Transport Infrastructure**). A **N.6 Centralised Logistics Zone** could allow collective storage and distribution, using vehicles that are more suited to urban conditions than large trucks while allowing night time deliveries to help evade congestion. Cities are beginning to explore alternative mobility options that are less exposed to congestion, such as the use of barges on canals and cargo-bikes. Manufacturers with a **B.3 Public Face** or a focus on retail should consider **N.10 Making Along High Streets** or **N.11 Back of the High Street** in order to be closer to clients. Planning instruments could facilitate better logistics by providing the right combination of infrastructure (such as collective storage, combined logistic systems) and **R.10 Place-based Financial Levers**. Businesses also need ways to adapt to policies oriented towards reducing congestion or improving air quality, which could include exceptions for logistics or subsidies to acquire low impact transport modes. Logistics hubs could be developed in the course of **C.1 Microzoning** and even acquired by public actors (**C.3 Balance between Public & Private Land**).

ASSURED SECURITY OF SPACE



Businesses require reliable long term access to their manufacturing space in order to make investment in staff, technology and local networks.

Connected to:

R.3/R.4/R.8/R.10/C.1/C.2/C.3/C.4/C.5/C.6/C.7/C.9/N.1/N.6/N.8
N.9/P.2

CONTEXT

Manufacturers, once installed on a site, can create deep and complex interdependencies with clients, suppliers and neighbouring businesses. Businesses that are under threat to move will be hesitant to develop or nurture these relationships and invest in equipment. Assured security of space is a strong indicator from public authorities or land owners that businesses can build in long-term relationships, making confident investment in technology and creating interdependencies which may give rise to shared equipment, personnel, resources and knowledge.

PROBLEM

There are many issues that will make a business doubt their future access to a site or space. Real estate prices are one of the biggest threats for cities suffering from land scarcity. Rezoning industrial land into housing, offices, parks and public infrastructure threatens businesses' long-term planning and capacity for growth. Even if a business owns their site, having residential neighbours can create other threats due to noise, dust, deliveries, reduction of accessibility by trucks (such as expanding footpaths for pedestrians or cyclists), low emissions zones and environmental projects such as water management or

ecosystem networks. Gentrification also means fewer alternative spaces for the business to move to in case it wants to upgrade or downsize (see **C.5 Varying Unit Sizes**). This also leads to knock-on effects with suppliers. Furthermore, the result of increasing rental prices for housing or commercial space in larger urban centres has consequences for industrial land too, which increases either rental prices or taxation. It could force businesses to increase the price of their products to retain profitability, which can make a company uncompetitive.

FORCES

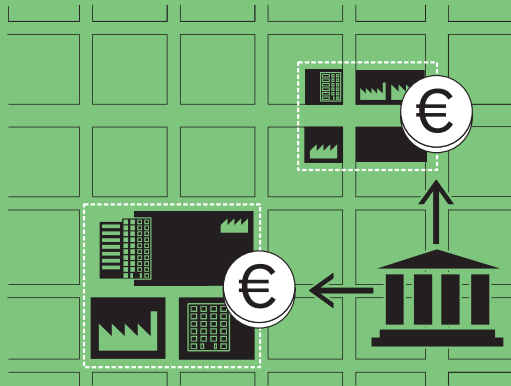
Urban planning policies intended to regenerate neighbourhoods and improve environmental conditions can have serious unintended consequences for manufacturers if not carefully managed. As a result, some cities have started developing policies for industrial intensification or co-location, such as **C.1 Microzoning** to protect or compensate the loss of manufacturing land. This can also have further unintended consequences by reducing the amount of contiguous space available to a single business (often co-located spaces are small, such as 100-1000m²) and by introducing residential neighbours that are easily disturbed by noise, pollution or messy streetscapes. Such conditions can be suitable for only a very limited range of manufacturers. Secondly, as industrial areas were once focused on production, they lack both public space and spaces for water and nature. Efforts to deal with both have found industrial land as an easy target to increase quotas or implement master plans. In practice more rigorous and inclusive **C.2 Negotiated Qualities & Environmental Criteria** can be biased against manufacturers. Furthermore, improvements in public space design, **N.8 Quality Urban Environment in Making Areas**, to improve footpath space or reduce road carriage space in older established mixed use neighbourhoods can impact businesses that depended

on public road carriages for deliveries or where corners are so tight that truck turning circles are hampered. Finally efforts to reduce pollution or carbon emissions through low emissions mobility zones, toll zones and reductions of particulate matter emissions (**R.8 Moving Things Efficiently** and **C.6 Strategic Access to Multimodal Mobility**) may be enough to bankrupt manufacturers.

SOLUTIONS

Build on three particular approaches for assuring space - through urban planning, finance and community management. Firstly, simple planning principles can limit conflicts by **N.1 Taking Advantage of Place Conditions**, **C.9 Concentrating Messy Making Along Infrastructure** and ensuring **N.9 Making Touches Making** and **C.6 Strategic Links to Mobility Infrastructure** to allow access by heavy transport. This can be complemented by solutions for **R.8 Moving Things Efficiently** or investing in a **N.6 Centralised Logistics Zone**. For sites that no longer attract larger industrial activities, it shouldn't be simply assumed that there is no demand for space. **C.1 Microzoning** may be able to offer an alternative type of space that is more accessible to smaller manufacturers. Secondly, **R.10 Place Based Financial Levers** could be applied to manage rental prices or taxation. Avoid available industrial land to be used by activities that can afford to be located in commercial areas (such as offices or retail). If policy is developed to reduce emissions, compensation should be required for manufacturers to invest in new equipment. Public actors can show assurances by investing in industrial areas to provide a **C.3 Balance between Public & Private Land**, build **P.2 Shared Technology & Making Spaces** and offer **C.4 Diverse Tenure Models** to correct market imbalances. Finally, manufacturers should define clear needs and dedicate energy to negotiate with planning authorities while developing positive relationships with neighbours in residential areas (see **R.3 Curator**).

PLACE-BASED FINANCIAL LEVERS



Financial instruments are important mechanisms to improve neighbourhood scale infrastructure and technology, while rendering businesses more compatible with their context.

Connected to:

R.1 / R.3 / R.4 / R.6 / R.8 / R.11 / C.1 / N.2 / P.1 / P.4 / P.6 / P.7

CONTEXT

Financial levers include incentives, called carrots (tax cuts, low barrier financing opportunities and stimulus funding), and disincentives, referred to as sticks (taxes and fines). Manufacturing businesses can be slow to adapt to new norms, regulations or planning. This is especially the case for issues such as environmental ambitions (such as CO₂, carbon emissions or flooding issues), business support (improvement of business strategies, training and financing equipment), mobility issues (urban congestion and logistics), commercial opportunities (such as tourism or public exposure) or resource management (processing units or

material recovery). Effective place-based financial levers, those focused on a specific area or neighbourhood, can be critical in the transition process to align businesses with a vision or master plan.

PROBLEM

Financial levers have clear limits if they are neither sufficiently engaging or overly threatening to push businesses to change. If the investment renders little value, changes can result in worse conditions for businesses. Failure can lead to a political backlash making it difficult for planning to be taken seriously and transitions to be implemented in the future.

FORCES

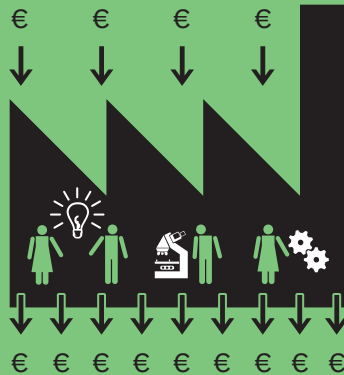
Manufacturers can be quick to adapt to new cost saving technology or tools that improve productivity. By contrast, they are often apprehensive to change established habits even if the costs or gains are insignificant. A number of environmental policies can have tragic impact on manufacturers. This can include low-carbon mobility, congestion charging and 'improvements' to public space (resulting in more difficult conditions for logistics). The unintended consequences of such policy can include reducing business competitiveness or costing unnecessary time completing paperwork. Blanket taxation, like car parking or taxation on technology, can be significant enough incentives to simply push businesses out of cities into areas where taxation conditions are more attractive. This is particularly concerning where metropolitan level tax regulation does not align with national scale legislation and encourages businesses to relocate over (local or regional) political boundaries to gain benefits.

SOLUTIONS

Use public financial levers as tools to align concerned actors and local businesses in order to enact changes to technology, production processes, land use or changes in the use of public space. Financial levers are best implemented within the framework of an economic or spatial vision, such as **C.1 Microzoning**. This may require financial incentives to deliver results if the market is not prepared to invest in development. A **R.3 Curator** or area manager can be assigned to mediate between the vision and the businesses' needs, providing feedback on which financial levers have successful results. Through **R.1 Making Making Visible**, a message can be communicated to a general public to show ambitions and the consequences of the vision. Business incentives such as carrots (funding) and sticks (taxation) can be used to negotiate. For example,

financing (loans) could be made available for businesses to change logistics habits by purchasing a small electric vehicle to help **R.8 Moving Things Efficiently**. Public funding can be used for companies to invest in innovation through **R.11 Incentives for Research & Development** or to create **P.1 Productive Rooftops**. Tax breaks could be offered to provide **P.7 Spaces for Development & Education** or **P.6 Re-use & Repair Centres**. Taxes and fines can be levered to improve the use of land and avoid unnecessary blight through **P.4 Meanwhile spaces and Transitional Uses**, **N.2 Re-use of Materials & Energy Flows** and for **R.6 Sustainable Product Cycles**. Likewise, in neighbourhoods undergoing rapid gentrification, increasing rents could be compensated through local land taxes to prop up foundational forms of manufacturing to increase **R.4 Availability of Diverse Jobs**.

INCENTIVES FOR RESEARCH & DEVELOPMENT



Cities can stimulate research and development through incentives such as providing finance and space, offering technical support, business development and support with tenders.

Connected to:

R.1 / R.3 / R.8 / R.9 / R.10 / C.4 / N.3 / N.7 / P.2 / P.3 / P.4 / P.7 / P.8

CONTEXT

Cities are breeding grounds for new products and technology to address local problems and opportunities. Such innovations fuel the urban economy and can be converted into tradable services, knowledge and exportable goods. Urban economies benefit from capturing value through import replacement while maximising exports. Innovation is often heavily underwritten by public financing, enabling inventors and entrepreneurs to take risks with the hope of recuperating public investment through taxes, private investment, job creation, intellectual property rights or dividends. Many nations invest somewhere

between 1.5-3.5% of their budgets on research and innovation. City regions are increasingly doing the same. The region of Brussels and London metropolitan area invested 1.75% and 0.99% of their GDPs in 2015. Cities are intensely competitive in terms of being at the forefront of innovation and each must create the most suitable atmosphere to incentivise cutting edge research and development while attracting businesses and retaining established ones. Incentives are therefore an essential tool.

PROBLEM

Research and development can involve a large amount of risk and uncertainty.

Individuals and organisations that have innovative ideas do not necessarily have the resources to develop or exploit these ideas. Likewise, due to increased technical complexity and specialisation, organisations doing the research, design and development of innovative products are not necessarily those that are capable of producing them at scale. This can fail to capture the value of research and development to boost the local economy, while ambitious individuals move to other urban centres that are more encouraging of their skills. By contrast, research and development may have little benefit to the city where it is being developed which means that the research has little practical application. Finally, research and development in itself may be of little value to cities unless it is well embedded in a larger ecosystem of finance, communications, supply chains and even a local market.

FORCES

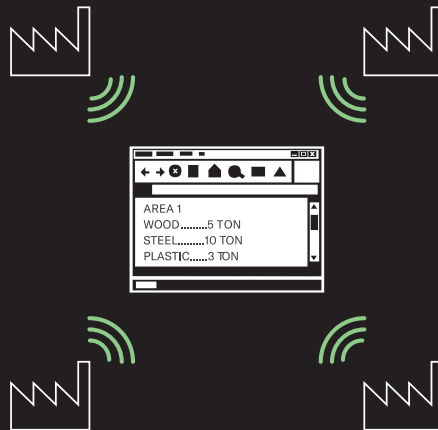
While innovation is difficult to predict, it is clear that conditions for research and development that lead to innovation can be nourished by third party actors such as public authorities, universities and private donors. Yet the fundamental questions arise from what kind of incentives will have useful results and which results will have value for the city. Is it focused on certain kinds of skills or knowledge such as computing, metallurgy or carpentry? Is the focus on sectors such as health, mobility (*R.8 Moving Thing Efficiently*), IT, waste (*R.6 Sustainable Product Cycles* or *N.2 Re-use of Materials and Energy Flows*), construction and/or aerospace? Focusing on developing specific sectors is referred to as economies of agglomeration. This will require making sensitive choices that will benefit some forms of research and development over others while ensuring that investment benefits the larger urban economy. Alternatively, there may not be a focus on any particular sector or activity. This is referred to as urbanisation economies, which is most attractive to larger

cities but may result in neglecting emergent initiatives or weakening resilience. Investment in either approach takes many years to reap rewards and requires donors to have a long-term vision and patience. Incentives that do not suitably involve *N.3 Mixing Complementary Making and Related Services* or useful links to established facilities and organisations and *N.7 Local Design and Prototyping* may result in little systemic impact.

SOLUTIONS

Use incentives to kick-start change and innovation while penalising poor behaviour. Build where possible incentives around a local brand, *R.1 Making Making Visible*. Incentives can be framed within a local economic vision to help orchestrate efforts for collaboration to strengthen the local economy (such as between the public sector, non-profits, universities and private companies). *R.10 Place Based Financial Levers* can be used to help cluster businesses around a certain theme or activity (such as the circular economy or advanced engineering) which could include tax deductions or tax credits. Access to space is essential to test or develop ideas and prototypes. This may include: rental spaces (*C.4 Diverse Tenure Models*), *P.4 Meanwhile spaces and Transitional Uses*, *P.3 Flexible Spaces for Making* or long-term investment through *R.9 Assured Security of Space*. Proximity, or *N.3 Mixing Complementary Making & Related Services*, can ensure ‘thinkers’ and ‘makers’ can easily collaborate. Likewise, a *P.8 Community Hub in Making Locations* can help build informal relationships that spark new ideas while *N.7 Local Design and Prototyping* and *P.3 Flexible Spaces for Making* can bring ideas to life. *P.7 Spaces for Development & Education* may be necessary for building skills, particularly when new products also require using new technology. Any form of incentive could be followed up by a *R.3 Curator* to help guide future development and refine investment.

MATERIAL DATABASE



A centralised spatially connected database, containing data on flows of material (and waste), helps to facilitate and optimise local distribution of resources and maximise opportunities for material recovery.

Connected to:

R.1 / R.2 / R.3 / R.6 / R.7 / R.10 / R.11 / C.1 / C.8 / C.10 / N.2 / N.3 / N.4 / N.5 / N.7
P.3 / P.6

CONTEXT

Cities are consumers of about 60% of global resources and about 1/3 of total global energy yet are very ineffective in taking advantage of their waste streams. A material database can be a vital tool to help track the demands and flows of resources, helping cities to plan for material supplies and waste management. A spatially based, real-time material database could provide the engine for a truly circular management of resources in cities and contribute to identify infrastructure gaps and also business opportunities to create a more optimal **N.2 Re-use of Materials & Energy Flows** in cities to identify gaps in **R.7 Multi-scalar**

Circular Infrastructure. It could also define criteria for **C.8 Accessible Material Recovery Facilities** according to volumes, composition and distribution of waste. An integrated material database could help identify opportunities for **P.6 Re-use and Repair Centres** and assess the financial viability of different recovery options, including the development of new products with re-used and recycled materials and, through **N.7 Local Design & Prototyping**, provide opportunities for new business models. It can help identify opportunities for **R.11 Incentives for Research & Development** and access to **P.3 Shared Technology & Making Spaces**. Understanding geographical movements of resources could

enhance the design of **C.1 Microzoning** and **C.10 Transition Zones**, helping evaluate potential synergies and trade-offs between residential, commercial and industrial uses. The material database can also become embedded in planning policy by helping cluster similar activities, where resource connections may encourage it, while also promoting **N.3 Mixing Complementary Making & Related Services** when there are opportunities for cross-sectoral innovation and material exchange.

PROBLEM

Although information on waste generation and composition (in European cities) is quite advanced, the data remains far too vague and superficial at the business level to assess opportunities to increase the circularity. While data on household waste is generally collected and reported by local governments, understanding and visibility of commercial and industrial data in cities is much more problematic. Commercial and industrial waste is larger in volume than domestic waste and generally more homogeneous. The poor data and the division of competences among public authorities has resulted in poor understanding of resources flows within the city and thus has constrained opportunities to identify optimal recovery options. This means that opportunities for re-use, recycling and recovery may be overlooked. Without a good understanding of the volume, composition and spatial distribution of resources, including waste, options for high quality re-use and recycling are unlikely to be realised as feasibility is difficult to assess.

FORCES

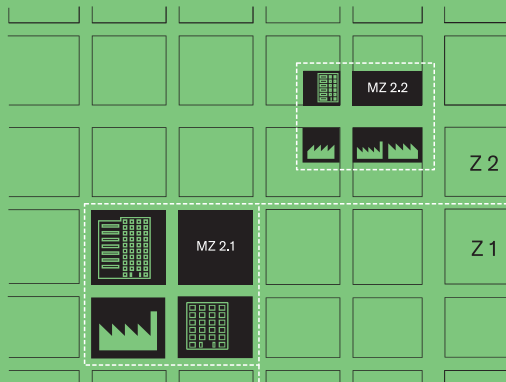
While governments may have ambitions for greater levels of **R.2 Transparent Making** and **R.1 Making Making Visible**, there are a number of reasons for the lack of rich data: 1) statistics generally involve aggregated data per sector with no granularity of geographical distribution; 2) responsibilities for collection and processing of data in the

case of commercial and industrial waste are split between different levels of government; and 3) composition of commercial and industrial waste in cities is lacking due to limited waste segregation. **N.2 Re-use of Materials & Energy Flows** and opportunities for **R.6 Sustainable Product Cycles** are thus constrained by the availability and quality of data. Sourcing data from businesses would create a very realistic picture of resource flows but businesses are generally reluctant to share data that may reveal their manufacturing processes or intellectual property.

SOLUTIONS

Gain a clear indication of resource demands and production of waste by exploring ways to create an accurate picture of the local situation. Sourcing materials, capturing waste and recovering resources requires extensive collaboration among municipalities, waste managers/contractors, households, manufacturing activities and recovery facilities. It involves assembling a picture of materials used, waste streams and storage locations. Tracking waste can be threatening to companies concerned with exposing commercially sensitive data. However public authorities or park managers will struggle to invest in effective resource management without clear guarantees based on trends. Therefore, it is important that appropriate procedures are put in place to generate a realistic picture of material flows while assuring businesses with necessary anonymity and privacy. A neighbourhood scale park manager or **R.3 Curator** could help build the trust required to source information from businesses such as running an annual survey. **R.10 Place-based Financial Levers** could be used to tease out data where necessary. Alternatively, managing waste with a single operator at the neighbourhood scale for **N.2 Re-use of Materials & Energy Flows**, can reduce complexity if data collecting and sharing agreements are made. **R.11 Incentives for Research & Development** can focus on a limited range of resources to reduce possible data issues.

MICROZONING



Strategically enabling zoning exceptions can protect vulnerable land uses or provide the grounds for experimentation in mixing land uses and building types.

Connected to:

R.3 / R.9/C.2/C.3/C.4/C.5/C.6/C.9/C.10/N.3/N.11/B.1/B.2/B.5/B.6/P.5
P.6/P.8

CONTEXT

Microzoning is a tactical planning tool that can create flexibility in zoning plans and define unique conditions for a specific site. Urban manufacturing areas with high real estate pressure are often exposed to piecemeal change through rezoning. Vacant sites in cities with low real estate pressure may struggle to change due to a lack of strategic planning to align investors or finance and deadlines to drive development. Microzoning can be used to increase the symbiosis of existing businesses in a neighbourhood. It can help build a thematic cluster of businesses. It can reorganise sites

to make ‘industrial land work harder’ (known as industrial intensification). It can also be used to introduce mixed use zoning to take advantage of airspace that manufacturing doesn’t use (referred to as co-location). Often conditions are particular to each site. There are many examples of microzoning, including ‘urban innovation districts’ in the USA, ‘urban innovation areas’ in the Netherlands, PDR (Production, Distribution and Repair) in San Francisco, ‘Planned Manufacturing Districts’ in Chicago, ‘co-location zones’ in London and ‘zones for economic mixed use’ (ZEMU/OGSO) in Brussels. If well planned, it can provide **R.9 Assured Security of Space** for manufacturers in

both highly mixed neighbourhoods and industrial zones.

PROBLEM

Considering that microzoning provides flexibility, it also provides uncertainty as there may be no precedent for a certain typology or project. This can mean that businesses may be reluctant to invest or choose to sell their land to speculators. Investors may be uncomfortable about loans and potential. Future occupants may be unconvinced to purchase land. Furthermore, for new construction projects requiring design and planning permissions can easily take five years before the building is ready to be occupied which is far too long for a business to wait. For this reason, microzoning which is driven by property led development risks being generic and taking many years to become functional.

FORCES

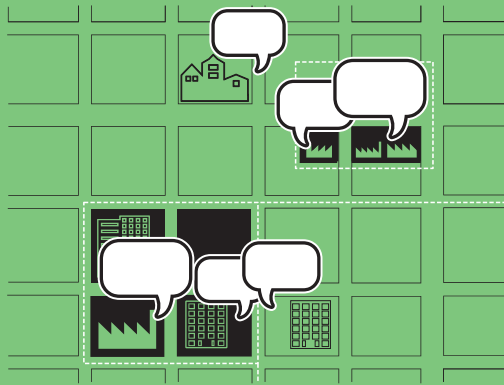
Microzoning helps develop sites and projects with very particular qualities. But certain mixes of users or occupants will require good planning and design in order to create comfortable conditions for cohabitation. Logistics can conflict with pedestrians, noise from trucks arriving early in the morning can disrupt sleeping neighbours, industrial spaces can appear messy and unsightly and buildings require suitable technical solutions to insulate against noise. This requires the individual or organisation coordinating the project from the developer's side and the public authority's side. Furthermore, there is a risk of co-location that results in gentrification rather than cohabitation of different land use types. Developers responsible co-location projects (co-location of industry and housing) are generally housing developers and may be tempted to follow their instincts and convert the industrial spaces into retail or office spaces to fetch larger returns in investment than workshops and production spaces. Finally,

design is critical as some technicalities like noise and fire can unnecessarily limit the types of manufacturers that can occupy spaces under housing.

SOLUTIONS

Use microzoning to provide a range of unique interventions or activities which cannot be developed under standard planning regulation or where unique conditions are present. Considering that Microzoning can involve mixed use, it could be used strategically as **C.10 Transition Zones** between residential/commercial areas and industrial areas. If planned strategically, microzoning can accommodate solutions for **N.3 Mixing Complementary Making & Related Services**, which could include a **P.8 Community Hub in Making Locations** and **P.6 Re-use and Repair Centres**. **C.5 Varying Plot Sizes** and **C.4 Diverse Tenure Models** can also be planned with microzoning. **C.9 Clustering Messy Making Along Infrastructure** and **B.5 Enabling Vertical Making** can shield housing or other activities which are more sensitive to noise. **B.1 Making Around Courtyards**, a **B.2 Yard for Logistics** and making at the **N.11 Back of the High Street** are ways to provide **B.6 Easy Loading and Unloading** and to avoid conflict with pedestrians. **C.6 Strategic Access to Multi-modal Transport**, is a trigger for industrial intensification and co-location, particularly for sites located near a train, tram or metro station. Microzoning can offer public authorities with a negotiation tool to access space and therefore acquire sites for manufacturing to increase **C.3 Balance between Public & Private Land**. A **R.3 Curator** can be an essential guide to interpret the ambitions for the microzoning and the application on the ground. This role could involve protecting businesses, intensifying development (industrial intensification), creating greater symbiosis between businesses or developing suitable mixed use neighbourhoods (co-location).

NEGOTIATED QUALITIES & ENVIRONMENTAL CRITERIA



The environmental impact of manufacturing can impact areas far beyond the production site, requiring informed decisions by affected stakeholders to be made to avoid conflict and unintended consequences.

Connected to:

R.1 / R.2 / R.3 / R.4 / R.6 / R.8 / R.10 / C.1 / C.9 / N.2 / N.3 / N.5 / N.9 / B.1

CONTEXT

Manufacturing often has some level of environmental impact. This can include the extraction of resources (mining, forestry or agriculture), the processing of resources, emissions from logistics, the production process itself (noise, air and water) or from waste generated (directly from the manufacturer or the consumption process). Business owners and their suppliers may be directly responsible for environmental issues but they are not necessarily directly affected by the environmental consequences or communicate them to consumers. Some environmental issues must simply be avoided, such as

discharging pollutants into waterways or burning toxic waste. Other issues are 'tolerable' (such as noise or logistics). But in order to avoid conflicts it is important that appropriate discussions can occur to determine the trade-offs between the benefit manufacturing and the cost on the environment. The fundamental question is what environmental issues can be tolerated and which cannot?

PROBLEMS

There are a vast range of possible environmental issues that make it very challenging to understand the environmental impact of manufacturing or manufactured

goods. Firstly, issues depend on establishing and policing environmental standards. Citizens confer much of their responsibility to public authorities due to the complexity of interpreting environmental risks and impacts. Secondly as a result of noise, smells and even water vapour, manufacturers may be perceived as polluting while in practice have little environmental impact. Such perceptions can create unnecessary friction between manufacturers and neighbours which can make making unbearable. Thirdly, due to the complexity of production chains, consumers are often unaware of their larger environmental impact and therefore do not see how environmental issues occur in third countries. Finally, as many industrial areas are located in flatter sites or former wetlands, they're increasingly exposed to flooding and rising water levels. Protection measures and compensation for abandoning sites may require public debate. Neighbours and consumers need access to information on the (global) environmental impact of manufacturing on their lives so that well informed discussions can occur.

FORCES

Decision making requires an extensive amount of data and knowledge which can result in large amounts of complexity and difficulties in defining priorities. One of the biggest challenges involves defining whose interests to put forward, what to protect and where to seek compromise. Is it about **R.4 Availability of Diverse Jobs** or about pushing for high air quality standards? Is it about sharing the impact of noise and odours or **C.9 Concentrating Messy Making Along Infrastructure**? Is it about the impact of material extraction? Secondly, the question of the negotiation process is challenging. How are the actors and interest groups involved? Do they have decision making power? How are minor and serious concerns addressed when some issues such as noise and odours can be subjective? This depends on the

capacities of a negotiator or facilitator (**R.3 Curator**) to support the process and reach workable solutions.

SOLUTIONS

Ensure a platform is available for debate and collaborative decision making while providing conditions for constructive discussions that minimise long-term conflict. Develop trust by providing stakeholders and interest groups with suitable information that clearly and honestly explains the situation at hand (refer to **R.2 Transparent Making** and **R.1 Making Making Visible**). Ensure discussions contain broader issues of material extraction and foreign production processes (**R.6 Sustainable Product Cycles**) to avoid discussions focusing on NIMBYism or financial value. A respected intermediate actor, such as a local **R.3 Curator**, could help both communicating the environmental impact to actors and interest groups while hearing their concerns, and helping find workable solutions. At the planning stage, particularly with **C.1 Microzoning** projects, explore solutions to reduce nuisances through **C.9 Concentrating Messy Making Along Infrastructure**, ensuring **N.9 Making Touches Making** or concentrating **B.1 Making Around Courtyards**. Where decisions are made to increase environmental standards, the most vulnerable businesses should be fairly compensated by **R.10 Place-based Financial Levers**. Some businesses find simple dialogue and open door events (**R.1 Making Making Visible**) are enough to help local residents better appreciate the production process and reduce preconceptions about what manufacturing activities entail. Participatory processes and matchmaking between businesses can offer constructive outcomes for **N.2 Re-use of Materials & Energy Flows** through **N.5 Local Collection Points of Segregated Waste**. This can lead to **R6 Sustainable Product Cycles**.

BALANCE BETWEEN PUBLIC & PRIVATE LAND



Public ownership of manufacturing space enables public interests to have an active stake in neighbourhood issues while ensuring space is available for unconventional or foundational forms of manufacturing.

Connected to:

R.1 / R.3 / R.9 / R.10 / C.1 / C.4 / P.7 / P.8

CONTEXT

While businesses generally prefer to own their land, purchasing space may be either inconvenient (expensive for cash-poor businesses) or impossible (because there is no suitable space available on the market). Cities with high real estate pressure can help guarantee that city-oriented makers (such as food, construction, resource management and so forth) can retain a place in the city, through public ownership of land, helping also to influence rental conditions and the nature of the organisation that have access to land (such as a cooperative or non-profit). Public land ownership also

guarantees a stake in the area at the on equal terms as private owners. This means that public authorities have a more realistic understanding of issues faced by private landholders. Finally, in co-location projects or on sites where developers argue for land use change due to perceived lack of demand by the industrial sector, publicly owned land puts public actors in a strong position to understand the real needs of the local market and manufacturers.

PROBLEMS

Very few public authorities have assets in manufacturing neighbourhoods beyond

those for their own basic needs, such as for waste management, storage or equipment repair. As industrial land is generally a much lower priority than other forms of public infrastructure, such as hospitals or community centres, acquisition is a serious question. Furthermore, public authorities generally do not have experience as real estate managers, particularly for industrial land, therefore it may require acquiring new skills or staff. Finally, land itself may be useless without providing buildings or infrastructure to house manufacturers and therefore may require more significant public investment and long-term responsibility. Diving into such a commitment may be far too much for a public authority.

FORCES

Without owning land and curating the program (see **R.3 Curator**), public authorities will be limited in their capacity to balance or adapt the market, relying **R.10 Place-based Financial Levers** or market trends which may not result in the same objectives as those aspired to by the public sector. While on paper public authorities can define regulation and stipulate planning conditions for **R.9 Assured Security of Space**, in practice history has shown that private interests are capable of bending and adapting planning regulations into outcomes that are ultimately not in the public interest. Furthermore, creating space for facilities that support manufacturing, such as an **P.8 Community Hub in Making Locations** or **P.7 Spaces for Development and Education**, cannot be entrusted to the market if they're to be genuinely inclusive.

SOLUTIONS

Ensure public actors acquire assets to support a more diverse and just economic agenda, to protect or boost manufacturing and to correct conditions due to market failures. There are three aspects to the balance of public and privately owned

land, namely: acquisition, development and management. Firstly acquiring and developing land can be difficult for cash-poor public authorities. However industrial land has been seen as a major investment opportunity by the private sector and can offer more attractive returns than housing in the long-term. Cities that can afford to purchase land, can help contribute to **C.4 Diverse Tenure Models** by filling any gaps in the market. Public authorities can strategically acquire industrial spaces in the process of adapting land for **C.1 Microzoning** - this can be a win-win if the private developer profits from the residential surface area at the cost of the construction of industrial space. Public authorities can also acquire land through larger infrastructure development (such as a highway) however this is far rarer and more expensive. Conversely, public authorities can purchase strategically important sites (like a market or waste management centre) and then sell the access to the site through time-share or lease the site management to a third party. Finally, the **R.3 Curator** can take on the role of asset manager and define rental/usage conditions. Where possible communicate plans and priorities by **R.1 Making Making Visible**.

DIVERSE TENURE MODELS



A range of land and property tenure models allows for manufacturing space to be accessible to businesses according to their financial means and ownership needs.

Connected to:
R.3 / R.9 / C.3 / C.5 / P.4

CONTEXT

There are three main forms of property tenure models (in Europe): ownership, leasehold title (such as a 99-year lease) or rental (both short and long-term). Neighbourhoods that have a variety of different tenure models allow businesses to access space based on their needs and capacity. For example, young and/or risk-taking organisations are more inclined to rent in order to invest their capital in the development of their businesses while minimising unnecessary long-term commitments. Established business are more inclined to own their property in order to increase stability while having a

long-term investment (such as for collateral against bankruptcy or to finance a pension). NGO's, cooperatives and community oriented businesses may be inclined to accept a leasehold title as a happy medium between renting and outright ownership. This provides a guarantee in order to make strategic investments (necessary for loans) while also being a more affordable asset.

PROBLEM

The real estate market does not naturally provide a suitable balance of tenure models as its primary focus is on the most profitable model. Conversely manufacturers in cities with high real estate pressures

will accept the type of space and tenure conditions that are available at the point in time they are looking for real estate. Without regulation or compensation mechanisms (balancing measures), tenure models can have a big impact on the types of manufacturing available.

FORCES

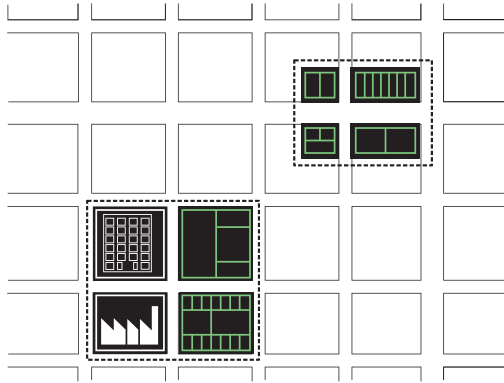
In cities with high real estate costs (such as London) the only sites on offer for manufacturers is rental space, since purchasing land is simply unimaginably expensive. For businesses that need to make long-term investments in both technology and personnel, **R.9 Assured Security of Space** is critical to gain access to bank loans and to ensure their investments can be paid off without having to move or interrupt their production process. For businesses located in dense and expensive cities that suffer from some serious incident, like a fire, finding a suitable alternative site can bankrupt the business unless a similar kind of space is quickly available (**C.3 Balance Between Public & Private Land**).

SOLUTIONS

Ensure areas for manufacturing contain a suitable mix of tenure models to offer space for a diverse range of business types in according to the phases of their development. Where necessary, use public acquisition of manufacturing spaces to balance the real estate market. The **R.3 Curator** can help look for suitable space while supporting businesses to use their sites more effectively. A **C.3 Balance between Public & Private Land** also means that prices can be regulated support crucial forms of manufacturing that the city depends on. Tenure models are often linked to plot sizes. Smaller spaces are typically rented while larger sites are owned). Therefore offering **C.5 Varying Unit Sizes** can help support diversity by supporting business of various sizes and financial means to find their place.

Ensuring there is some unoccupied space can be important to allow businesses to move easily based on their needs rather than the limitations of the market. Assuring the market has a vacancy rate (around 5% from small to large spaces) can provide options and space to grow. While this may seem counter-intuitive, a buffer allows for emergencies (such as fire) and retaining free space means efforts can be made to acquire more space if demand increases. In practice, developing new space could take a decade to realise so planning must be progressive and proactive. By retaining a small buffer, real estate rental rates can be managed. Finally, **P.4 Meanwhile Spaces and Transitional Uses** are also useful for very young or risk-taking businesses who want to minimise their real estate costs.

VARYING UNIT SIZES



Variations of unit sizes help to promote a variety of business types and facilitates manufacturers growing or shrinking without needing to leave an established neighbourhood.

Connected to:

R.9 / C.1 / C.3 / C.4 / N.3 / N.10 / B.1 / B.5 / P.2 / P.3 / P.4 / P.5

CONTEXT

A variety of unit sizes is important to guarantee businesses' needs according to their size and financial means. It also allows for diversity and complexity since not all types of manufacturing activities need the same amount of space at the same time. Varying unit sizes provide businesses with choice which helps provide **R.9 Assured Security of Space**. A business' choice of location can be linked to a network including related services, cooperation partners and suppliers. This can be essential for servicing a machine or replacement of parts for example. The presence of a local network is crucial for some manufacturers

and therefore having a variety of unit sizes allows the possibility for a business to stay within an area even if the business' demand for space grows or shrinks. Increasingly businesses share premises and are accommodated in flexible units for a range of reasons including cost, community or flexibility. Such units have doors, fences, walls and even floors that can be easily adjusted. Flexibility can also occur at plot level (the building envelope) or with partitioned spaces within buildings.

PROBLEM

Businesses are constantly changing, triggered by increasing or decreasing

work, fluctuating need for workers, changing technology and processes and demand for space. While manufacturers can change their needs for space over time, local networks and resources can be so important that moving far away will threatening the viability of the business. If the options for alternative spaces are not available, the business may be forced to close or downsize. Furthermore, due to movement costs and challenges to find suitable alternative sites, businesses may simply live with a space that is not fit for purpose. This can mean that space could be underused and be a liability or the space is too cramped and limits potential for growth.

FORCES

Real estate pressure is one of the driving forces for determining unit sizes and prices. If left to the market, the result will likely focus on standardised units sizes. Clusters of manufacturers need both small and large spaces as larger businesses can gain capacity by subcontracting specialist tasks to smaller businesses.

C.3 Balance between Public & Private Land can be used to ‘correct’ imbalances in the market. But the development of new space can take many years which can result in businesses being stuck in unsuitable spaces. Through **C.4 Diverse Tenure Models**, leaving some space free or flexible can help relieve possible stress. Further, adaptations in building and tax laws can enable industrial intensification with varying unit sizes in buildings stacked vertically. In practice, manufacturing above the ground floor may not be feasible for some manufacturers due to access, technology or even technical regulation.

SOLUTIONS

Ensure a range of unit sizes are available to provide businesses with a choice of space subject to their needs. Where possible, adapt sites or buildings by creating a variety of easily adaptable

unit. **C.1 Microzoning** can be triggered to renovate existing sites and help **N.3 Mixing Complementary Making & Related Services**. **R.10 Place Based Financial Levers** could help to balance market forces to incentivise a variety of unit sizes (refer to **C.3 Balance between Public & Private Land**) or to help dealing with increasing rent. Alternative manufacturing spaces such as **P.5 The Work Home** can be encouraged for smaller spaces. For younger and experimental businesses, **P.4 Meanwhile Spaces & Transitional Uses** can be useful. **P.2 Shared Technology & Making Spaces** allow particularly smaller manufacturers to have flexibility and access to affordable space when it is needed. Sharing also makes it easier for businesses to move spaces. The architecture of shared buildings should provide the possibility to easily adjust the size and function of working areas (see **P.3 Flexible Spaces for Making**). With a large enough goods lift (**B.5 Enabling Vertical Making**), manufacturing can occur in multi-storey buildings, allowing industrial intensification to achieve more efficient land use. It is thus useful to develop a diversity of unit sizes on the urban as well as the architectural scale.

STRATEGIC ACCESS TO MULTIMODAL MOBILITY



The location of a business will depend on defining strategic priorities regarding accessibility by clients, partners, staff and the cost of space.

Connected to:

R.1 / R.4 / R.5 / R.6 / C.7 / N.6 / N.8 / B.1 / B.2

CONTEXT

The price of land and the accessibility levels are heavily connected. Sites that are easily accessible by many different modes of transport have the evident advantage of giving businesses a greater levels of choice of who to work for or work with. Businesses must therefore weigh up the cost-benefits of accessibility choices over land values. Accessibility can concern three particular users: clients, partners and staff. These three user types are likely to have very different needs. Low paying manual labour work will generally need to have access by public transport otherwise businesses will struggle to find staff.

High-tech manufacturing clients will likely travel by private transport and will be frustrated if there is no parking adjoining the business. Business conditions are changing. Increasingly businesses are outsourcing their logistics (refer to **C.7 *Links to Transport Infrastructure***), while the boundaries between clients, partners and staff are continuously being blurred. This makes access to multi-modal mobility strategically important for businesses interested in a variety of staffing options and flexibility for clients. The question is, which modes are the most relevant? These can include soft modes (walking and cycling), collective transport (rail and buses), private transport (links to highways

and parking spaces are important) and even airport links. Multi-modal refers to the choice of taking a range of these forms of mobility for the main travel leg (a rail traveller will likely do a portion of walking).

PROBLEMS

The biggest challenge is when there are serious tensions between different aspects of a business. Staff, clients and partners may reside in very different places and travel by different types of mobility. Finding a location that is affordable and suits all these user's needs is highly unlikely. Public facing businesses will likely focus on clients' needs. Employees can be the most critical aspects of the business but rarely do businesses prioritise employees' interests. Employees with lower skills are far less likely to be able to afford to travel long distances, making public transport or soft mobility access essential. For specialist knowledge workers, jobs may be so rare that long travel distances are simply inevitable.

FORCES

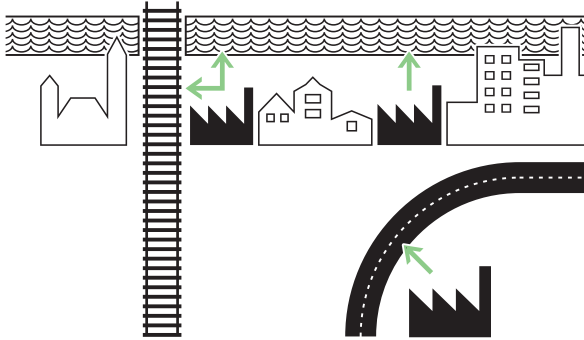
Mobility and accessibility are serious defining factors to determine a business' competitiveness, capacity for innovation and production costs. Businesses will need to decide if to prioritise links to staff, clients and partners or if to prioritise logistics and **C.7 Links to Transport Infrastructure**. Furthermore, not all mobility solutions are suitable all day and every day of the week. Public transport may not run between midnight and 6am, peak hour congestion can make car travel infeasible while cycling and walking may be unsafe at the best of times. Business can decide to locate in compact inner city sites to take advantage of a diverse range of multimodal mobility, but this may come at a price in terms of **R.8 Moving Things Efficiently** or **B.8 Space for Storage**, while limiting their capacity for growth. Changes to accessibility regimes in cities, such as congestion

charging or pollution regulation (see **C.2 Negotiated Qualities and Environmental Criteria**), can add a competitive disadvantage to local manufacturers as proximity to markets and clients increases costs. Furthermore, as inner-city mixed neighbourhoods undergo 'regeneration', they also attract gentrification and the likelihood not only of increased costs but also reduced accessibility due to wider footpaths or difficult conditions for loading and unloading vehicles. This highlights the need to carefully consider the **N.8 Quality Urban Environment in Making Areas**.

SOLUTIONS

Prioritise manufacturing locations according to a variety of available mobility options in order to draw on workers, employees and clients. Businesses should resist simply looking for the most affordable land. Sites should be considered that benefit accessibility of employees and clients. Workers with manageable home to work times (around 30 minutes) are happier and less stressed, contributing to **R.5 Fair Work Conditions**. Creative solutions should be considered to deal with high(er) land costs such as **B.1 Making Around Courtyards**, a shared **B.2 Yard for Logistics** or even outsourcing storage with a **N.6 Centralised Logistics Zone**. Furthermore, bike parking and showers should be provided to encourage workers to use soft mobility while public authorities should provide suitable cycling and pedestrian infrastructure into industrial areas. As the pressure on industrial land increases, public authorities are allowing or encouraging industrial intensification and co-location with other land uses. In doing so, public authorities should also improve public transport services or install safe soft mobility infrastructure to compensate additional users and avoid dedicating precious road space to parked cars.

LINKS TO TRANSPORT INFRASTRUCTURE



Manufacturing benefits from being near relevant infrastructure, multimodal logistics hubs and good access to distribution networks.

Connected to:

R.7 / R.8 / R.9 / C.3 / C.4 / C.6 / C.8 / C.9 / N.1 / N.2 / N.5 / N.6 / N.10 / P.2

CONTEXT

Efficient movement of material, goods and people is critical for export oriented manufacturing businesses and particularly those with dependence on long-distance supply chains. Logistics infrastructure often plays a crucial role in a business' location. This kind of infrastructure can include the national highway network, a canal, a port, an airport, a connection to a logistics hub, a material supplier or a manufacturing cluster.

PROBLEM

For cities with high land prices, sites near

transport infrastructure are sometimes considered as viable land for housing. This is particularly the case for businesses adjoining a motorway connection with a fast and reliable link to other parts of the city. Sites next to noisy transport infrastructure can be worth significantly less than quiet sites, but high real estate markets and demand for land can result in a healthy development profit. Conversely, some transport infrastructure, like canals are considered of high scenic value which raises land value, even if they're located in industrial zones. Sites with access to heavy rail infrastructure are often also adjoining passenger railway lines and offer potential for transport oriented

development. The gentrification of one site can have serious knock-on effects on many other industrial sites. Furthermore, many ideal locations next to infrastructure simply do not offer ideal living conditions. Manufacturing could be compatible with housing but logistics can result in a significant conflict regarding noise and occupation of space. Planning authorities are therefore under pressure to favour one or the other land use.

FORCES

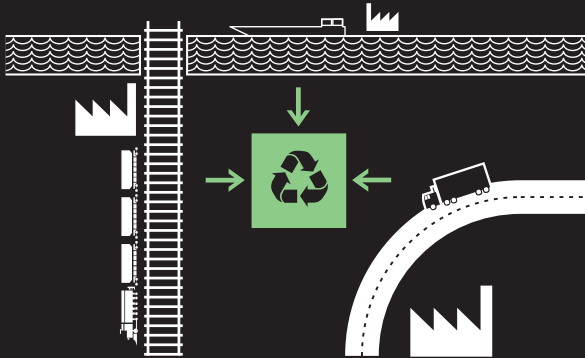
A few extra kilometres away from a significant infrastructure link could come at the cost of hours of lost time due to congestion and logistics. Often a trade off needs to be made between being located on a site favouring **R.8 Moving Things Efficiently** over a site which may be attractive for clients and employees (**C.6 Strategic Access to Multimodal Mobility**). This level of tension can effect either the business' bottom line or its capacity to attract suitable staff (due to the site being located far away from a range of urban mobility options). Sites which are highly accessible to both logistics infrastructure and multimodal mobility can be expensive or in high demand as many other businesses are looking for such locations.

SOLUTIONS

Where possible, locate or connect manufacturing to infrastructure to improve accessibility and reduce impact on non-industrial land. Zoning manufacturing uses close to infrastructure can help bundle activities with similar nuisances (such as noise and pollution). **C.9 Concentrating Messy Making Along Infrastructure** and **N.1 Taking Advantage of Place Conditions** can help concentrate noise and pollution in specific areas to ensure that manufacturing is accessible but does not affect other land uses, like residential areas and public space. Furthermore, areas on or beside noisy or busy infrastructure can be ideal to couple with manufacturing in

order to offer **R.9 Assured Security of Space**. Land could be publicly owned (**C.3 Balance Between Public & Private Land**) and leased on a timeshare arrangement (**C.4 Diverse Tenure Models**) to ensure that sites remain protected from speculation. In inner city locations, where traffic restrictions or congestion is a concern, placing **N.10 Making Along High Streets**, those that are better connected to regional networks, or having a **N.6 Centralised Logistics Zone** and fleets of smaller electrical vehicles should be considered. Sustainable manufacturing can be efficiently bundled with transport infrastructure to ensure **N.2 Re-use of Materials & Energy Flows** by having **C.8 Accessible Material Recovery Facilities** and/or **N.5 Local Collection Points of Segregated Waste**.

ACCESSIBLE MATERIAL RECOVERY FACILITIES



Waste processing and recycling facilities must be locally accessible through efficient logistics networks.

Connected to:

R.4 / R.6 / R.7 / R.8 / R.12 / C.7 / N.2 / N.5 / N.6 / P.6

CONTEXT

Local recovery facilities are a key step in capturing waste and developing business opportunities through re-using resources. Transportation of waste over long distances is generally discouraged, both legally and economically, with the exception of very specific streams of by-products with high value per volume which after transformation fall under end-of-waste status, becoming a product (such as metals). Local segregated waste collection points can help to consolidate waste streams if they're connected to a network of recovery and processing plants that can transform waste back into a resource (or recover its

energy). The value of waste materials is highly dependent on the level of purity, capacity to process materials, secondary markets and volume available. Furthermore, availability of recovery facilities depends on the type of material, the available technology (some recovery facilities are currently not commercially available for various resources), the commercial profit margins of processing waste locally, the material recovery rate and any subsidies available to help convert waste into local resources.

PROBLEM

In cities, spaces for waste processing and recovery tends to be limited and

generally co-located with manufacturing activity but synergies do not tend to be developed between manufacturers and waste management for different reasons. Firstly, there may be a mismatch between required recovery processes and types of waste. Secondly, transport to waste recovery facilities needs to be undertaken by authorised waste transport vehicles. In practice, manufacturing companies often arrange collection and treatment with private waste contractors that have their own waste networks to treat their waste and dispose of residuals. Different types of waste streams may require different conditions of accessibility to recovery facilities which can make it difficult to access material flows. Specific types of waste, low value and high volume, like construction and demolition waste, cannot be transported over long distances due to the high costs associated with transport and embedded carbon emissions. For low value bulk waste, a 50km distance for recovery facilities may be required. Electronic waste **P.6 Re-use and Repair Centres**, in many cases associated with the social economy sector, can undertake activities separating/dismantling products to enhance recovery options, however this generally requires public support of some kind to deal with the low (or no) profit margins.

FORCES

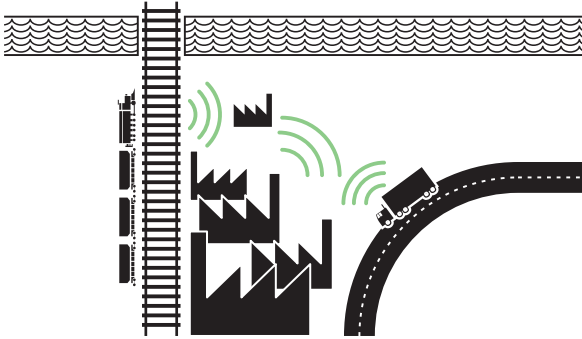
Material recovery is highly dependent on availability, market cost and transformation capacity. For example, soft-wood is readily available but unless clean and uncut, this waste stream is largely incinerated close to the point of disposal. Steel is easily recovered and generally sold for recycling, and scrap is collected in scrap yards around the city but its' final recovery may occur in regional or national facilities. For **R.6 Sustainable Product Cycles** to be desirable, the infrastructure, logistics, storage, processing capacity needs to be well understood. Initial sorting and dismantling can happen at the city scale

but more specialised recovery options may need to be connected to regional, national or supranational recovery networks. There is no one-size fits all solution as recovery facilities depend on scale, technology, subsidies and possible re-users of the recovered materials. A fundamental questions are: who pays for the waste and how is costly material recovery subsidised?

SOLUTIONS

Provide material recovery facilities based on the scale that they function most efficiently for both the waste producer and the use/treatment of the specific waste stream. Before defining what kind of material recovery facilities could be implemented, the composition of urban waste must be better understood, which can be done with a **R.12 Material Database**. The design criteria for accessibility and a hierarchy of facilities can be then considered strategically at different geographical scales. As waste can lead to congestion, waste transport should be considered at a metropolitan scale for **R.8 Moving Things Efficiently**. To minimise congestion and potential hazards, **N.5 Local Collection Points of Segregated Waste** may reduce accessibility problems to recovery facilities by consolidating waste and reducing unnecessary transport. Having the segregated waste collection points connected to recovery facilities through the **R.12 Material Database**, the most common waste streams can be dealt with according to demand. Social enterprises (**R.4 Availability of Diverse Jobs**), with public subsidies, can be supported to deal with manual labour based around treating low value materials while private companies can be engaged to treat high value materials. Locating facilities adjoining **C.7 Links to Transport Infrastructure** can provide opportunities to use lower emissions and efficient combinations of transport modes while adapting to the **R.7 Multi-Scalar Circular Infrastructure** and recovery options beyond the city.

CONCENTRATING MESSY MAKING ALONG INFRASTRUCTURE



Concentrating manufacturing activities that produce noise, dust, and problematic odours along infrastructure, minimises nuisances.

Connected to:
R.9 / C.1 / C.2 / C.7 / C.10 / N.1

CONTEXT

Just like manufacturing, infrastructure (roads, railways and canals) create disturbances in terms of noise and accessibility. Urban manufacturing can be concentrated along infrastructure to minimise nuisances. This is particularly relevant for businesses that depend on heavy transport and particularly those with production processes that are noisy or emit unpleasant odours or dust.

PROBLEM

Manufacturing is not the only activity that results in environmental nuisances.

Infrastructure, such as roads or rail lines, can affect the quality of life of residents due to noise and emissions. When the externalities of making activities (noise, dust, vibrations, smells) enter in conflict with residents, manufacturers generally are forced to adapt or move. Environmental regulations in many countries impose limitations on where certain types of manufacturing can be located in relation to other land uses. Generally, as a result, industries are relegated to industrial neighbourhoods and pushed to the periphery of the city, away from housing, which in turn can make manufacturing less accessible to workers. In spite of the emergence of new,

more quiet technologies such as additive manufacturing, some activities remain noisy. Building materials used in industrial structures tend to be cheap, lightweight and poorly insulate noise. The absence of **R.2 Transparent Manufacturing** and communication of manufacturing processes, leads to confusion and friction with concerned neighbours. This makes manufacturing next to infrastructure an ideal solution.

FORCES

While concentration of manufacturing makes perfect sense, housing remains a persistent conflict particularly for sites located along transport routes, as buildings can easily be insulated to deal with noise. In many cases, this does not lead to ideal living conditions due to noise and transport related emissions but real estate mechanisms can be hard to halt. Public authorities can use manufacturing and effective **C.10 Transition Zones** to buffer noise and air quality issues, but this requires firm protection of industrial areas and sometimes political will to avoid housing.

SOLUTIONS

Where possible reduce nuisances by concentrating manufacturing along infrastructure. Focus first on the needs of city oriented heavy manufacturing to create **C.7 Links to Transport Infrastructure** for **R.8 Moving Things Efficiently**. Take advantage of edges, enclaves or drosscapes that are generated through large infrastructure that runs across urban regions and is secluded from the city and its surroundings. **N.1 Taking Advantage of Place Conditions** by design, could use these areas to host and protect large scale, 'messy' manufacturing. Infrastructure, particularly roads and rail, is also noisy, yet it will continue to be fundamental in cities. In fact, freedom to make noise and odours and operate on a 24 hour basis provides

benefits for businesses. A **R.3 Curator** could help defining complementary forms of manufacturing that result in similar nuisances. Organising these businesses in **C.10 Transition Zones** could be done by **N.9 Making Touches Making**. Define a noise gradient away from the infrastructure, clustering compatible kinds of nuisances. Use **C.2 Negotiated Qualities & Environmental Criteria** to also open dialogue with manufacturers when it comes to locating proposed housing along noisy infrastructure or manufacturing activities. In more dense urban contexts, building design could help to attenuate noise and dust. As infrastructure is slow to change, manufacturers could be given **R.9 Assured Security of Space** by investing more in their factories, using sturdier and heavier materials with higher levels of noise insulation.

TRANSITION ZONES



Zones adjoining industrial areas can provide ideal space for small to medium size manufacturing businesses and supporting services that help transition into mixed use and residential areas.

Connected to:

R.3/R.4/C.1/C.5/N.3/N.9

CONTEXT

In ecology, transition zones contain the richest variety and greatest interaction between species. The transition zone between manufacturing and other land can be much the same with a high diversity of activities such as residential, hotels, banks and financial agencies, designers and engineers, restaurants, material suppliers, small artisan workshops, mechanics and **P.6 Re-use & Repair Centres**, health clinics and so forth. This zone can offer the **R.4 Availability of Diverse Jobs** supporting manufacturing. Transitions can occur at the scale of a neighbourhood, block,

street or building and will depend on the predominant activity in the industrial area.

PROBLEM

Over the last decades, many manufacturing businesses left European cities, leaving blight and voids. Affected neighbourhoods have regenerated without suitable strategies to have both good quality housing and a functional mixed use activities without resulting in conflict between one and the other activity. The result is that a lot of complexity and dynamism of mixed use neighbourhoods has been lost or is in the process of decline.

Transition zones do exist particularly in older and poorer neighbourhoods where the mix evolved naturally over decades. Currently there is little formal urban development planning to protect manufacturing spaces. This renders workshops, material suppliers and manufacturing spaces highly vulnerable to gentrification. Financial returns from housing can be far higher than other activities in old mixed use neighbourhoods, retail inclusive. Once the groundfloor spaces are converted to housing, it is very challenging for these spaces to change back to previous activities.

FORCES

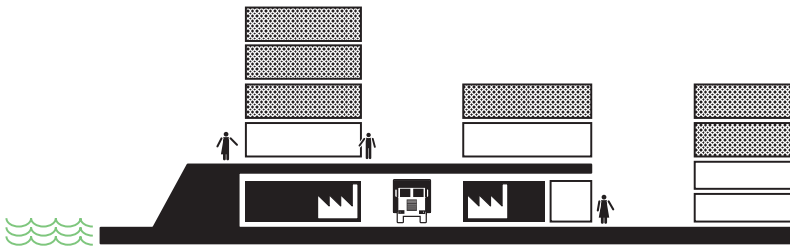
Transition zones mostly are not planned and are vulnerable to the will of the market. This can be advantageous, allowing land uses to have more flexibility. On the other hand, if the manufacturing activities are intended to stay, it means that clear guidelines are required and a strong public authority to avoid unnecessary gentrification. Zoning is the most effective instrument for protecting space for manufacturing but this can then result in rigid urban planning.

SOLUTIONS

Develop planning and development mechanisms to allow transitions between industrial areas and other land uses. Transition zones may involve three types of gradients: 1) scale of space, 2) publicness of space and 3) degree of nuisances. Firstly, the scale of available space should start from **C.5 Varying Unit Sizes**. This can include small spaces in mixed use buildings located along main streets or as integrated workplaces within dwellings (**P.5 The Work Home**) as part of residential or mixed use neighbourhoods. It can grow to larger scale plots and buildings along infrastructure, **N.1 Taking Advantage of their Place Conditions**. Transitions can range from a mixed use high streets (refer to **P.5 The Work Home** and **N.11**

Back of the High Street) towards clusters of similar types of manufacturing (**N.3 Mixing Complementary Making & Related Services**). Secondly, the publicness gradient of space can vary between the type of activity. Making at home is private while making along the high street is very public. Larger manufacturing spaces tend to be located away from very publicly accessible sites and behind walls or gates unless there is a **B.3 Public Face**. Thirdly, gradients of nuisances depend heavily on the business type, the proximity to other manufacturers (**N.9 Making Touches Making**) and how close a business is to residential areas. **C.1 Microzoning** is a sensible way to structure formal and informal manufacturing spaces within mixed use neighbourhoods.

TAKING ADVANTAGE OF PLACE CONDITIONS



Making use of place qualities and particularly existing conditions along rivers, canals and railway arches can use these special conditions advantageously to accommodate manufacturing.

Connected to:
C.1/C.2/C.7/C.9/N.8

CONTEXT

Cities have often grown along roads, canals and waterways, railway lines and natural topographical formations, resulting in urban infrastructure and a diversity of place conditions. As a result edges and odd conditions were created that were often dark, damp and challenging to use for housing or shops. Such spaces were traditionally cheap and affordable for manufacturing, construction and logistics activities. Due to locations under a rail embankment or next to a dyke, they offered a place for noisy or messy activities. Consequently these activities could be located in cities, close

to clients. With modern engineering, ventilation systems and surface finishes, these spaces can be adapted to the needs of more expensive land uses such as retail, horeca (restaurants and cafes) and even office spaces. Such solutions can be expensive but they can create greater return on investment, particularly for highly valued inner-city land. This is creating tension between the traditional occupants of such spaces and the market.

PROBLEM

Taking advantage of place conditions comes with some challenges. In renewal

and redevelopment projects, site conditions that are beneficial to manufacturing are rarely exploited to facilitate manufacturing. This is particularly the case for locations along water edges, waterways and decommissioned elevated railways that historically accommodated manufacturing. The unique quality of spaces along water (like canals) is becoming increasingly attractive for (high-end) housing projects. Due to this competition of land uses, many manufacturers have been forced to move to other locations that often are less central.

FORCES

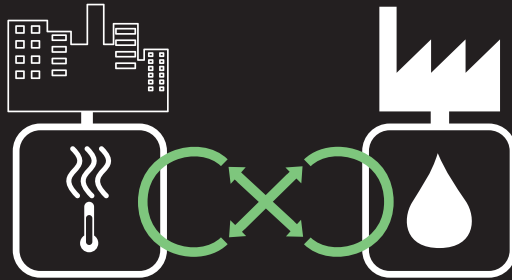
General development requirements like addressing a housing shortage, need for recreational spaces or places for climate change mitigation measures put manufacturing in competition with other land uses. Where located on sites with scenic value, economic pressure can be disadvantageous to manufacturing.

SOLUTIONS

Take advantage of edge conditions created by infrastructure or natural geography to prioritise manufacturing. Strategic **C.1 Microzoning** with **C.2 Negotiated Qualities & Environmental Criteria** along infrastructure (such as railways, roads or dykes) can help to maintain manufacturing, particularly in mixed use areas. The proximity to highways or train lines could be a good place for **C.9 Concentrating Messy Making Along Infrastructure**. An increasing share of empty shops in high streets provides places with excellent connectivity and optimal access to staff and clients and thus promotes **N.10 Making Along High Streets**. Repurpose buildings like decommissioned parking facilities for manufacturing, that offer high weight carrying ceilings. Industrial intensification or **B.5 Enabling Vertical Making**, could be concentrated along special infrastructure that helps to

protect the manufacturing spaces. Design spaces to take advantage of dykes, berms and natural topography. This can allow the public facing activities on one side and the manufacturing at the other, with noised buffered through height differences in the building, resulting in **N.8 Quality Urban Environment in Making Areas**. In sites connected to waterways, develop precautions against flooding risks. For example, uses floodable areas for workspaces and locate heavy machinery, supplies and electronics above floodlines.

RE-USE OF MATERIAL & ENERGY FLOWS



Local production of waste water, materials and heat could be turned into innovative new uses, to reduce the dependency on primary raw materials and reduce environmental pressures.

Connected to:

R.3 / R.6 / R.7 / R.10 / R.11 / R.12 / C.2 / C.7 / C.8 / C.10 / N.3 / N.4 / N.5 / N.6 / B.1
B.7 / P.6

CONTEXT

Large volumes of waste generated by cities can be considered a local resource that with adequate planning and infrastructure can be put to productive local use, helping to close loops for resource demands. Manufacturers have much to gain from this as they have large demands for materials and are a source of considerable waste. Cities require policies for treating waste locally and means to capture the waste for local use, to avoid it being exported. Manufacturers are also needed that can convert waste into a usable resource, while others are required for converting such resources into products.

PROBLEM

Although cities produce large volumes of waste materials, water and heat, most of it is dispersed or disposed of, increasing the urban environmental impact of waste. This is in part due to issues surrounding governance of resources and waste. The legal and institutional framework around waste can mean that usable resources or potentially valuable waste streams are not recovered due to the administrative restrictions imposed on the movement and exchange of waste. This becomes increasingly complex in cities where waste responsibilities are divided among different departments, agencies or even political interest groups,

creating a complex architecture of decisions surrounding waste movements. Quick wins for waste management involve mining valuable materials such as steel, copper, gold and so on where there is a well established secondary market. However, on the whole much of the material waste produced in urban areas is of little value compared to the cost of processing it, especially with respect to household waste and mixed waste streams. Furthermore, concepts behind ‘energy cascading’, in other words using residual heat from one user to provide heat for another user, requires expensive upfront infrastructure costs for piping. Likewise, water is also an undervalued resource that is by default sent into the sewage network as other options tend to be more expensive if they are not considered early in the design and planning process. As a result, re-use of material and energy flows requires extensive support.

FORCES

There are plenty of sensible ideas for improving the management of material and energy flows conceived particularly by designers and engineers. However complexity of the resource management system is often far too overwhelming for individual businesses to improve their own material or energy flows even if there is genuine interest. Even manufacturers interested using waste streams can be plagued by red tape. Business models often require a large one-off infrastructure investment (such as a pipe network for heat exchange), which can involve using public space and expose a certain institutional complexity in terms of permits and financing. Businesses can also get worried about path dependency through building heavy inter-dependence with a vulnerable resource (such as heat). Furthermore, questions of intellectual property can be highly limiting in terms of what kinds of knowledge and material sharing could occur between businesses and public authorities, and how to avoid possible industrial knowledge theft. Finally, there is rarely the political

mandate or financial instruments (such as incentives, loans or taxes) to stimulate or force businesses to collaborate (**C.10 Place-based Financial Levers**). Among all these obstacles, the main hindrance is a current lack of understanding and visibility of material and energy flows between activities at the city level (**R.10 Material Database**), which reduces the chances to identify potential for reutilisation.

SOLUTIONS

Take advantage of waste materials and unused energy, by developing workable synergies between waste creators and business that can re-use the waste. Resource recovery requires addressing three aspects. Firstly it requires an understanding of the flows of material, water and energy within the system which can be done with a **R.12 Material Database**. Secondly it requires appropriate **R.7 Multi-scalar Circular Infrastructure** to be able to recover the resources. This could involve **N.5 Local Collection Points of Segregated Waste** or **C.8 Accessible Material Recovery Facilities** which could be combined within a **N.6 Centralised Logistics Zone**. New projects should take resource recovery into consideration by ensuring sufficient **B.8 Space for Storage**, particularly for **B.1 Making Around Courtyards** where waste can be easily sorted or where businesses could exchange their waste. Thirdly, system interventions are required to engage city stakeholders and to create incentives to encourage stakeholders to re-use local material and energy flows. **R.10 Place-based Financial Levers** could also be activated. A **R.3 Curator** or area manager could help provide a matchmaking service between supply and demand of materials particularly where there is a strategy for **N.3 Mixing Complementary Making and Related Services** by curating systemic relationships between individual actors. Where no clear business model is available to manage waste, **R.11 Incentives for Research & Development** could be considered to build local innovation.

MIXING COMPLEMENTARY MAKING & RELATED SERVICES



Mixing complementary manufacturing with related activities creates conditions for efficient work flows and provides opportunities for resource and knowledge synergies through cross-sectoral innovation.

Connected to:

R.2 / R.3 / R.6 / R.12 / N.4 / N.6 / B.1 / P.2 / P.7 / P.8

CONTEXT

Many new forms of manufacturing grow out of environments where the sector is already thriving, where a network of suppliers and producers are established. Small to medium sized businesses in particular depend on a vast range of formal and informal relationships with other complementary businesses, service providers and material distributors. Proximity builds trust upon which relationships and projects can be developed. Having complementary makers and related services means that businesses can specialise while also working together to deal with mutually beneficial issues (such as waste or staffing). This also provides

businesses with a wider pool of skilled labour and knowledge without having to employ them directly. An ecosystem of complementary making and related services is heavily scale dependent. Within a mixed manufacturing area there could be clusters of sectors (such as health, food, etc). The dynamics of specialisation and diversification are extremely important and not necessarily contradictory. Mutually beneficial spillover effects may emerge such as cross-sectoral learning and innovation.

PROBLEM

Very little is known about how businesses interact and depend on each other as

relationships and knowledge exchange can be informal and invisible beyond the working environment. Policy and planning traditionally split manufacturing into separate activities without recognising the way businesses support or depend on each other. Mapping can be done through cross-sector VAT exchanges, but this only shows exchange of finance between businesses and not the interchange of knowledge or skills. Knowledge must go beyond statistics to fully capture network interactions between making and related services and requires an understanding of industrial networks. Businesses needs are not often evident to policymakers and planners, while businesses themselves may not necessarily know what public support is available or could be of use to their business. Public authorities rarely have the energy or resources to learn about the network of informal business relationships. As a result there is a large gap between what policy makers know about industrial areas and what they offer to support or boost businesses. Furthermore, when industrial areas or mixed use zones become under threat of gentrification, there is very little knowledge of how the loss of a few key businesses could affect a network of related businesses.

FORCES

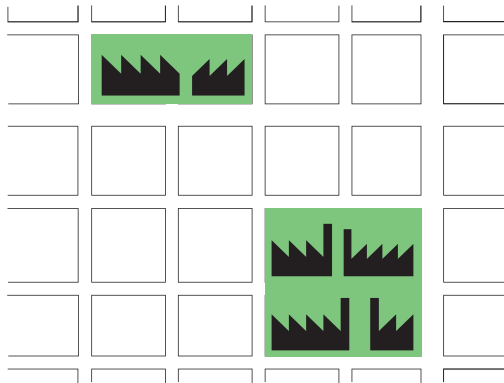
Cities that are interested in stimulating or protecting a manufacturing district, will be faced with the question of how to provide support. Is it more effective to sustain complementary and related services or to focus on one sector by **N.4 Clustering Similar Making**? This question can be highly politicised as it can be much easier for a public administration to back a well organised sector with many employees (such as the auto industry) than a wide field of smaller businesses with many different needs. Yet backing a single sector will likely lead to far smaller net benefits to society than supporting a complex network of interrelated businesses (SMEs). **R.2 Transparent Making** would help policy

makers and industry lobbies to better understand how businesses relate, at least financially, however many businesses will be reluctant to share information about how their business operates. A community manager, such as a local **R.3 Curator**, could be a sensible conduit to connect businesses' needs and public support, so long as this actor remains objective and uncorrupted. Sensitive protection measures are required to ensure that community interests are prioritised.

SOLUTIONS

Develop a complex manufacturing network by actively linking complementary business and services, facilitating exchanges of technology, creating synergies and collaborating on complex projects. Where possible nurture opportunities for industrial symbiosis and circular use of resources in line with **N.2 Re-use of Materials and Energy Flows**. A local **R.3 Curator** or a trusted community leader is essential to represent general interests, help build relationships while learning about how businesses work and how they can be supported. Such a role is more likely to gain traction and relevance if grown out of the community's needs rather than subcontracted to a professional real estate agency. The curator could also help with matchmaking between businesses to share equipment, resources, space and personnel through **P.2 Shared Technology & Making Spaces** and with **R.6 Sustainable Product Cycles**. The curator could be publicly financed (through taxes) or independently through business contributions. **R.2 Transparent Making** and a **R.12 Material Database**, while challenging to enact, can be a helpful means of communicating how complementary making and related services interact. Informal relationships can be built through spatial interactions such as a **B.1 Making Around Courtyards** or a **P.8 Community Hub in Making Locations**. Communities of makers can pool needs such as a **N.6 Centralised Logistics Zone** and **P.7 Spaces for Development & Education**.

CLUSTERING SIMILAR MAKING



Clustering similar types of manufacturing promotes conditions for innovation, competition and collaboration while increasing access to staff and concentrating associated environmental issues.

Connected to:

R.3/R.6/R.8/C.1/C.2/C.5/C.6/C.7/C.8/C.9/C.10/N.1/N.2/N.3/N.5/N.6/N.7 N.8/N.9/B.3/P.7/P.8

CONTEXT

Industry clusters are a concentration of similar and related firms that are connected to a geographic location, share similar forms of knowledge, technology, suppliers, attract similar skilled staff and interact in similar markets. Clusters of similar forms of manufacturing that have developed over time can become specialised centres of excellence. This provides space for skills and knowledge to be shared and competition to grow, thus encouraging innovation. Public stimulation of a specific sector is associated with economies of agglomeration and can help cities to focus and concentrate on

specific activities. Clusters in turn draw in more skilled workers who can develop specialised skills. Clusters of similar makers can be very attractive to clients by offering choice of comparable products, to explore customisations and the capacity to negotiate terms and prices. Clustering also helps makers by allowing them to band together when necessary to deal with staffing, training or regulation issues.

PROBLEM

Firstly, not all manufacturers can be clustered as they depend on being close to clients. Some types of manufacturers do not work well when clustered and are

more effective when well distributed across the city (bread and cement for example). Secondly, clustering manufacturers and their related services gain from efficiencies which benefit from concentrating activities around a specific site or area. Similar types of businesses often produce similar kinds of nuisances (noise, dust, odours or traffic). They also benefit from similar infrastructure such as logistics areas, waste management facilities, storage, piping networks, etc. Reducing impact or improve infrastructure efficiencies, could mean forcing similar manufacturers to be located nearby which in practice can take years and heavy negotiation with businesses. Third, when too many similar businesses cluster at a larger scale, an accessibility barrier can occur. Fourth, some business clusters inherently result in a poor **N.8 Quality Urban Environment in Making Areas**. Finally, clusters that function only at certain times of the day can result in security issues outside of working hours due to the lack of passive surveillance.

FORCES

The increasing pressure for cities to develop housing can lead to the break-up of manufacturing clusters and neighbourhoods into mixed use areas. Manufacturing clusters can develop into a rich ecosystem, which can fall apart due to the loss of space, the reduction in number of businesses and consequently the attraction for clients due to the loss of choice. This might eventually lead to the cluster being dissolved, or relocated. Clusters also depend on public infrastructure or financing to turn fundamental research into new products or services. This could include a hospital, a waste management centre or a research institute. If public investment conditions suddenly change, the cluster could collapse.

SOLUTIONS

Develop clusters of similar makers to take advantage of specialist knowledge

and skill. Concentrating similar types of making can be structured by **C.1 Microzoning** and facilitated by a **R.3 Curator**, encouraging complementary and related manufacturers to locate nearby. **C.2 Negotiated Qualities & Environmental Criteria** can be used to minimise or concentrate nuisances. Providing **C.5 Varying Unit Sizes** ensures businesses occupy the space they need and move to a site nearby if these needs change. The concentration of similar making is best kept to the scale of one or a few urban blocks and embedded in a larger area **N.3 Mixing Complementary Making & Related Services**. **R.11 Incentives for Research & Development** and **P.7 Spaces for Development & Education** could provide companies with the possibility of sharing technology and encourage them to co-locate. Clusters can support investment in a **N.6 Centralised Logistics Zone**, and if planned well, can be located near **C.7 Links to Transport Infrastructure** to help **R.8 Moving Things Efficiently**. Planners could be **N.1 Taking Advantage of Place Conditions** by **C.9 Concentrating Messy Making Along Infrastructure**, such as ports and waterfront for transportation. Clustering similar making brings advantages in transition towards more circular environments. Clusters can integrate **N.5 Local Collection Points of Segregated Waste** and **C.8 Accessible Material Recovery Facilities** that enable **N.2 Re-use of Materials & Energy Flows** and thus achieve **R.6 Sustainable Product Cycles**. A **P.8 Community Hub in Making Locations** located at the edges of manufacturing clusters can be used to link companies with surrounding residents, contributing therefore to acceptance of manufacturing by the general public. As clusters often involve similar land uses, **C.10 Transition Zones** could help increasing mixed use activity, where a more **B.3 Public Face** promotes **N.8 Quality Urban Environment in Making Areas**.

LOCAL COLLECTION POINTS OF SEGREGATED WASTE



To ensure full recovery of waste streams, non-domestic waste collection points must be both easily accessible and well distributed across the city, into segregated waste streams to guarantee homogeneity, purity and maximise value and recovery potential.

Connected to:

R.3 / R.6 / R.7 / R.8 / R.10 / R.11 / C.2 / C.7 / C.8 / N.2 / N.10 / P.6

CONTEXT

Summarised simply; 'waste makes cities / cities make waste'. Cities have the capacity to manage a vast amount of their waste, if the will and facilities are in place. Collection points have a vital role in being able to sort and distribute waste to relevant treatment plants. At a global scale, manufacturing and industrial areas produce large amounts of waste but also process a vast amount of materials. Waste collection services are the most costly part of the waste treatment chain and its organisation and provision generally is a responsibility of local governments. Waste collection systems are also highly

dependent on the city fabric, the density and type of sorting facilities and the amount of pre-sorting of waste.

PROBLEM

Unless there is a clear strategy to match sources of waste and users of the wasted resource, the waste remains inaccessible and a cost to society. Cities have increasingly reduced their productive activities, reducing their ability to be able to process residual materials back into usable products. Opportunities to increase value out of waste and maximise high value recovery options start from an effective collection system. At the city scale, manufacturing

activities are generally space-constrained with limited yard space that has to be used for both storage and segregation of waste, logistics and distribution. This reduces the incentives for manufacturers to segregate waste into homogeneous streams, unless there is a proven residual value for the material (such as metals). When this is combined with a lack of suitable **R.7 Multi-Scalar Circular Infrastructure**, the result is that a large part of waste in cities (particularly industrial waste) is poorly segregated, reducing chances of **N.2 Re-use of Materials & Energy Flows**. Waste management is also often involves a confusing mix of public and private actors. Municipalities are generally responsible for domestic waste collection but may contract the work to private businesses. Businesses (in general) often have private waste contractors, with the waste managed separately.

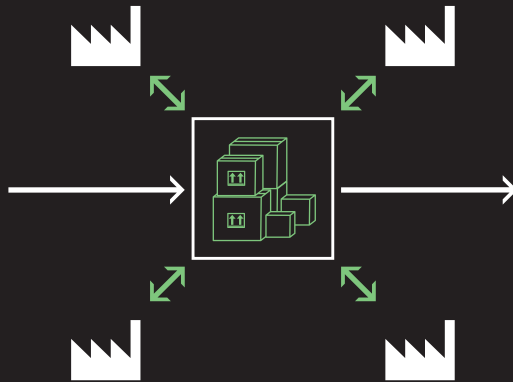
FORCES

Current cross-contaminated waste, throwing waste into an unsorted bin, is challenging to recycle. Viable opportunities for reutilisation require not only access to the resource in its purest and most integral form, but also the scale to make waste recovery and transformation into a valuable resource financially viable business opportunity. Changing sorting habits at the business and consumer end will require extensive amounts of training and support while it will also involve forcing private waste management companies to change collection and treatment process. This could require ending contracts or costing more in waste collection. While industrial waste is a large and poorly managed resource with great potential, the challenge lies in capturing and sorting it at the source. Urban manufacturing is made up mainly of SMEs that produce small scale waste streams which creates a collection challenge. Existing industrial waste management is often coordinated by the private sector that are incentivised to sort the materials of commercial value.

SOLUTIONS

Provide practical solutions for managing waste that are easy for businesses to apply without resulting in an unnecessary burden or cost. Local segregated waste collection points could help to reduce occupying yard spaces. It also helps sorting waste to retain purity and reaching adequate scale for viable recovery options. This will require defining how to move waste from the business to the collection point and if this burden is the responsibility of the manufacturer or the public authority. Local collection points need to be distributed across manufacturing districts at a distance of around 2km radius from the company to reduce congestion and cost for businesses. In well industrial areas undergoing regeneration, define the location of critical local waste collection infrastructure at the planning stage. The space required will depend on the number of neighbouring activities and their waste streams. For example, an area with a large furniture sector would need to have collection points of wood and wood derived products. It is important that areas are adequately monitored to avoid issues of fly-tipping (dumping waste on the side of the road) and cross-contamination, something which can be done using sensor and robotic technologies. The **R.3 Curator** could be instrumental in facilitating exploitation of recovered waste, which may include collaboration with local testing and developing facilities but also identifying gaps in available **R.7 Multi-scalar Circular Infrastructure**. **R.10 Place-based Financial Levers** can be used for training while fines given for miss-use. Innovation can be driven around new uses of waste through **R.11 Incentives for Research and Development**, supported with start-up and incubating programmes.

CENTRALISED LOGISTICS ZONE



Central collective logistics space in accessible locations facilitates efficient delivery and discharge of goods while providing opportunities to store material or manufactured goods.

Connected to:

R.7 / R.8 / C.1 / C.7 / N.5 / B.2 / B.8

CONTEXT

Traditionally businesses managed logistics in-house, which requires storage facilities, drivers and vehicles. Businesses, especially smaller SMEs, commit 'unproductive' working space to storage of materials, manufactured goods (stock) and waste. Reducing on-site storage space could allow for greater amounts of on-site production, greater numbers of employees and a more competitive market share for some businesses. It can also simplify the focus of the company on production of things rather than adding pressures from complex logistics. This is possible only if storage space could be easily shifted off-site

while subcontracting logistics. Centralised logistics promotes economies of scale, which can be especially relevant to SMEs. Manufacturing is changing as businesses choose to outsource logistics. This is especially relevant for urban manufacturers where land is at a premium and where in-house logistics provides little benefit for the business. If many businesses adopt this approach, there is value in considering a series of metropolitan scale logistics hubs where goods could be dispatched, which involves storage and is a way of transferring logistics from large vehicles to smaller ones. Such hubs may also be coupled with other activities that can take advantage of logistics like repair or waste management.

PROBLEM

Firstly, while a centralised logistics zone may seem sensible and feasible, changing logistics habits can be challenging for some businesses. Secondly, the outsourcing of logistics could result in a net increase in traffic due to dependence on just-in-time production and reduction of storage spaces within manufacturing sites. This can defeat part of the benefit of centralising logistics. Finally, the implementation of circular practices in manufacturing, implying the re-use of leftover materials (both on site or by other manufacturers) adds pressure on manufacturers to dedicate extra storage space for reusable goods/materials, service take-back and waste segregation. This makes not having a centralised logistics zone a challenge for **R.6 Sustainable Product Cycles**.

FORCES

R.8 Moving Things Efficiently often requires more than a single business to be onboard. Value is created when pooling logistics needs from a large number of businesses who would otherwise be wasting time and money with small deliveries and while generating emissions, air pollution and contributing to congestion. Manufacturers are increasingly outsourcing their logistics to improve the efficiency of their distribution system, reduce or streamline costs and specialise on the production process. Improving urban logistics could even be a disadvantage to urban manufacturers as imported products become even cheaper and more accessible. Furthermore, demand for logistics spaces can be in direct competition with manufacturing. While **B.8 Space for Storage**, is key for all businesses, the level at which this is required can vary a lot between one business and another. Therefore developing a centralised logistics zone may not be useful for businesses immediately and/or may take an extended amount of time for the businesses to adapt to. This will make investing in a centralised

logistics zone risky and best done by a public actor that can afford to recuperate costs over the long-term if there is a public benefit of centralising logistics (such as carbon emissions, reduction in congestion or improve efficiency of industrial neighbourhoods).

SOLUTIONS

Create a centralised logistics zone to reduce manufacturers' needs for idle storage while encouraging more efficient movement of goods and resources. A city may have a plan for **R.8 Moving Things Efficiently**, which is in their own interest to combat the rise of congestion through logistics vehicles and dealing with air pollution issues. Centralising logistics is a practical way of shifting mobility to smaller and cleaner vehicles. This needs to be considered in the context of **C.7 Links to Transport Infrastructure**, offering opportunities to reduce reliance on road transport to more efficient and environmentally adequate options, including the use of train, trams, canals and waterways. Electric and alternative vehicles (such as bikes) may be considered for inner city deliveries, ensuring low emissions and flexibility avoid getting caught in traffic. Storage often can be combined with other quieter land uses if congestion and noise are well managed (for example with a **B.2 Yard for Logistics**). If well considered within a master plan to avoid unnecessary conflict (a **C.1 Microzoning**), logistics can be easily combined with housing or commercial activities. **N.5 Local Collection Points of Segregated Waste** and **R.7 Multi-scalar Circular Infrastructure** can be used to bundle logistics with circularity, where logistic centres can also act as reservoirs of used resources and materials. Public authorities interested in centralised logistics zones will likely require strong centralised planning tools and top-down application to avoid double handling goods and creating unnecessary congestion with smaller vehicles.

LOCAL DESIGN & PROTOTYPING



Locating R&D testing facilities for manufacturing within knowledge hubs such as technology parks, innovation districts, and research centres promotes synergies in the use of technology and transfer of knowledge.

Connected to:

R.3 / R.10 / R.11 / C.3 / C.5 / N.3 / N.4 / P.4 / P.8

CONTEXT

Capturing innovation is high on urban agendas. Attracting and retaining talent is considered to increase the competitive advantage of a city and raise its profile. To that end, and following triple-helix schemes that bring together industry, research centres and government (now referred to as quadruple-helix or penta-helix to include civil society and capital related actors), cities can gain much from developing zones where knowledge intensive activities are clustered and supported by legislation, policy and finance and where networking and interactions are promoted and facilitated. R&D

depends on skilled manufacturers that are looking for ways to advance and develop products and services. In high performing economies, the R&D sector can create an entire cluster of its own, fitting into under Knowledge Intensive Business Services (KIBS). Manufacturers may employ local KIBS businesses to improve their products or production processes. This could be referred to as evolutionary development. KIBS businesses may also be providing R&D for fundamental research that can lead to important new breakthroughs or solutions, which can be referred to as revolutionary development. This type of development is often financed by public organisations but local manufacturers

may be able to turn the research into new products or services.

PROBLEM

One common misconception is the assumption that simple physical clustering of businesses brings innovation. Guided by competition and differentiation, this misnomer tends to focus on very specific sectors, overlooking existing valuable local networks. Often, where top-down public intervention occurs, the result becomes a mere rebranding strategy for real estate operations in unproductive neighbourhoods or for large business parks focusing on services type activities. In fact, it is not enough to accommodate innovators and knowledge-intensive activities together, but it is also necessary to provide the spatial, knowledge and financial conditions that can lead to fruitful interaction and collaboration from the realisation of an idea to turning it into a market ready product or service. This involves linking research, prototyping and testing by creating connections to application, manufacturing and commercialisation. Without leading researchers and designers, it is challenging to break into new markets and innovate. This involves public commitment and stimulation.

FORCES

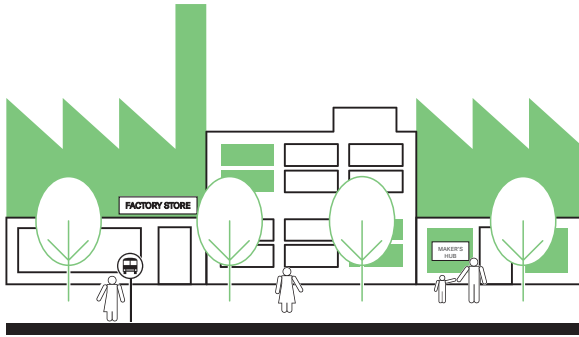
Local testing, R&D and analysis requires a wide range of complementary actors working together. While political ambition may desire a cutting edge centre for research and production, and despite adequate financing, rhetoric may not move into action. Likewise new ideas are generally built on old ones. Unless there is a history of research (researchers) and technical knowledge (technicians) to backup ambition, it will be difficult to lead to competitive results. The technology itself is not sufficient if the knowledge networks and culture have not been built and nurtured. Building a culture can take extensive investment and depend on

long term business relationships. Public investment is foundational but requires commitments that surpass election cycles.

SOLUTIONS

Use planning and regeneration projects to embed testing and product prototyping, by connecting knowledge and research activities with design and manufacturing. Universities and research centres can be integrated into manufacturing areas, providing businesses with opportunities for applied research and access to facilities and technologies (such as testing labs, prototype spaces, etc). Focus on ***N.3 Mixing Complementary Making & Related Services*** or/and ***N.4 Clustering Similar Making***. To ensure this will occur, it is necessary to provide space, incentives and conditions for interaction. Use ***R.11 Incentives for Research & Development***. In addition, a district with ***C.5 Varying Plot Sizes*** will help create diversity, essential for research and development. ***C.3 Balance between Public & Private Land*** may be necessary for influencing who occupies a district. Opportunities for ***P.4 Meanwhile Spaces and Transitional Uses*** help providing low-cost space for start-ups to spin out. Incentives such as ***R.10 Place-based Financial Levers*** can be used to stimulate projects or building owners to align with neighbourhood scale ambitions. Finally a ***P.8 Community Hub in Making Locations*** can be necessary to spark ideas and grow informal relationships, while a ***R.3 Curator*** can be vital to nurture relationships and build a community.

QUALITY URBAN ENVIRONMENT IN MAKING AREAS



A high quality public realm is attractive for both employees and clients, increasing a sense of safety, encouraging mixed use, improving staff retention and encouraging visitors.

Connected to:

R.1 / R.2 / R.3 / R.5 / R.8 / R.10 / C.1 / C.2 / C.3 / C.4 / C.5 / C.6 / N.1 / N.5 / N.6
N.9 / N.10 / N.11 / B.1 / B.2 / B.3 / B.6 / P.8

CONTEXT

Manufacturing environments that attract a wide range of users and visitors, that feel safe at all hours of the day, that are integrated into the context of the larger urban fabric, will include comfortable and attractive public space and urban form. This includes safe cycling and pedestrian areas, well defined façades with parking and storage located at the rear of the lot, well positioned street trees, well lit thoroughfares, seating and bins, passive and active forms of security and a regular street cleaning routine. The quality of the public space is very subjective and culturally sensitive, which makes it

challenging to define strict guidelines for suitably comfortable yet also useable and functional spaces for manufacturing.

PROBLEM

The image of an industrial zone typically is associated with impersonal and unattractive conditions, or characterised by signs of crime, blight or disregard. These spaces are perceived to be only (safely) accessible by motorised traffic, they are predominantly functional and have little need to be attractive. Furthermore, many contemporary factories are like islands within their urban context, set back from the street front, surrounded by residual spaces (for

parking or logistics), with blank façades or surrounded by fences and lacking any public amenity. The failure to deal with small signs of decay can trigger delinquency and bring a rapid spiral of decline, a pile-up of rubbish, low sense of security, and subsequent reduction of maintenance. This is described by the 'broken windows theory' where signs of decay stimulate further decay. Resolving this cycle can be time-consuming and costly.

FORCES

Shifts in manufacturing processes and production technologies (industry 4.0 for example) are changing the character of the workforce. Companies are in need of attracting higher educated and specialised employees, whom have different demands and expectations of a working environment and what is deemed to be **R.5 Fair Work Conditions**. Businesses are realising the need of an attractive **B.3 Public Face** and brand. This is forcing businesses into **R.1 Making Making Visible** and supporting **R.2 Transparent Making** to gain legitimacy towards employees, clients, and society at large. Furthermore, congestion and new urban mobility planning are encouraging soft modes of transport, which often requires new infrastructure (such as bike lanes). Such trends clash with the many realities of manufacturing: its messiness, its need for flexibility, its tendency to bend rules, its need for **R.8 Moving Things Efficiently** (or at least cheaply), and the diverse socioeconomic and cultural backgrounds of the labour force. By contrast, making industrial areas more attractive can be damaging for manufacturers. As areas become more comfortable for some, gentrification can render conditions more inaccessible for others. Investment in public space can result in increased land prices that can exclude low-skilled workers while eventually pushing out the manufacturers. Therefore, the balance between a quality urban environment and a healthy, functional, and productive

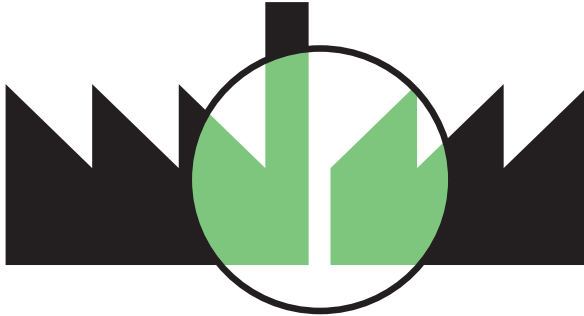
manufacturing neighbourhood can be dangerously delicate.

SOLUTIONS

Ensure that environments for making are also attractive and comfortable for a broad range of daily users and visitors.

C.6 Strategic Access to Multimodal Mobility could promote a modal shift in commuting, making it possible to redesign industrial areas, from vehicle-oriented to people-oriented environments with protected pedestrian and cycle spaces. These spaces should not affect truck turning circles or impact the capacity for vehicles to load and unload on streetscapes if that is the custom. Solutions could come down to reorganising the production process. A **N.6 Centralised Logistics Zone**, organising **B.1 Making Around Courtyards**, making on the **N.11 Back of the High Street**, promoting **B.2 Yard for Logistics**, ensuring waste is taken directly to **N.5 Local Collection Points of Segregated Waste** could relieve industrial streetscapes of their typical disorder and impact from heavy logistics vehicles. **C.4 Diverse Tenure Models** should be in place before any serious works are done to avoid unnecessary gentrification. This can include public investment to have a **C.3 Balance Between Public & Private Land**. Manufacturing and logistics space with an existing or a potential thoroughfare could look inwards with a **B.2 Yard for Logistics**. A **B.3 Public Face** could help reduce the barriers between businesses and the street while providing passive social control. Buildings should also be built along the front boundary to create a clear public streetscape while pushing parking, storage and logistics to the middle or back of the lot. Finally social functions, such as a **P.8 Community Hub in Making Locations** could also help attract the circulation of people, particularly outside of working hours. Key here is that such social functions address the needs, wishes, and expectations of all workers, skilled and low-skilled, with an accent on diversity of gender, race and class.

MAKING TOUCHES MAKING



Locating businesses according to similar environmental issues helps to minimise negative impacts of manufacturing by focusing on the block (noise and dust), streets (logistics) or neighbourhood (odours).

Connected to:

R.3 / C.1 / C.2 / C.9 / C.10 / N.1 / N.3 / N.4 / N.8 / N.11 / B.1 / B.5

CONTEXT

Many forms of urban manufacturing traditionally concentrated along specific streets or clustered in similar parts of the city. It is a trend that is still prevalent due to zoning and land use planning. Protecting these streets as zones of production, particularly in inner-city sites, can help avoid friction or nuisances from incompatible land uses. By contrast, the continuous growth of many European cities and especially the roll-out of designed mixed use areas requires cities to act strategically when planning for the co-existence of different and sometimes incompatible land uses. By concentrating similar kinds of activities along specific

streets, nuisances can be contained. This is particularly the case for businesses associated with similar environmental issues such as noise, dust and logistics.

PROBLEM

Challenges differ between well established streets that are home to manufacturers, and new mixed use projects that are creating industrial space. In cities where manufacturing has remained concentrated around a specific street, these areas are likely to contain large building blocks which are attractive opportunities for rezoning and development into housing. The moment that one manufacturing site

is occupied by housing, means that all other sites next to it will be exposed to occupants with very different perceptions of environmental issues and infrastructure requirements. This can aggravate future relationships. Residents are affected by logistics, dust, noise and messy public space resulting from manufacturing. Manufacturers are affected by complaints requiring adaptations to their work spaces with acoustic insulation, invest in low emissions technology, enhanced filtration devices and limiting logistics issues. On the other hand, new mixed use projects can be poorly designed from the outset making it difficult for manufacturing and housing to co-habit. If mixed use developments are a prerequisite, suitable technical and design solutions are required to allow these two activities to live apart, together. Furthermore, developers responsible for mixed use and co-location projects often have little experience mixing residential and manufacturing activities which can mean that financial models and spatial configurations render manufacturing unviable. This results in poorly conceived projects.

FORCES

Increasing pressure on urban real estate and increasing interest in local manufacturing creates an urgency to protect existing manufacturing zones or develop functional mixed use projects with solutions to reduce nuisances and use space more efficiently. For existing manufacturing areas, planning can be challenging to enforce where building owners or developers have (financial and political) means to push through rezoning and housing projects. While plans for mixed use developments can be sensible on paper, it can result in a vast amount of technical complexity that creates unnecessary friction between manufacturers and residents. Unless public authorities have experience in dealing with such projects, there is a high risk that the spaces created for manufacturing will be difficult to use and consequently turn into

retail or office space through rezoning. Aligning similar functions along a street can help divide incompatible activities but this requires planners and developers to commit to separating functions. This is a particular challenge in situations where industrial land quotas need to compensate space rezoned for housing.

SOLUTIONS

Concentrate similar types of makers along a street or blocks in order to minimise impact on neighbours. For new development areas, **C1 Microzoning** can be used to structure activities in specific zones using a master plan or vision document. For existing areas, **R.2 Transparent Making** and **C.2 Negotiated Qualities & Environmental Criteria**, mediated with a **R3 Curator**, can help reduce friction between manufacturers and residents. Manufacturing activities creating nuisances can be located in areas where such nuisances are tolerated. Making touches making is most effectively channelled along a street, but also in the back of industrial plots, at the scale of the block. **N.3 Mixing Complementary Making & Related Services** is one option to create a buffer between making and housing particularly for noise attenuation within **C.10 Transition Zones**. Making touches making works well by **C.9 Concentrating Messy Making Along Infrastructure**, and **N.1 Taking Advantage of Place Conditions**, developing along transport infrastructure, using topographic height differences to buffer noise or mixed with other compatible land uses. Cluster **B.1 Making Around Courtyards** inside blocks, by **B.5 Enabling Vertical Making** and organising logistics access via an entrance on a service street, (such as the **N.11 Back of the High Street**). If planned properly, making touches making can result in **N.8 Quality Urban Environment in Making Areas** that do not result in conflict with manufacturing activities. It is important to keep some mix to ensure that streets remain active after typical working hours which could include sporting facilities or a cafe.

MAKING ALONG HIGH STREETS



Concentrations of mixed use activities along high streets can take advantage of the best regional accessibility and the highest amount of pedestrian flows, enhancing visibility.

Connected to:

R.3 / R.4 / C.2 / C.3 / C.4 / C.7 / N.1 / N.3 / N.5 / N.8 / N.11 / P.5 / P.6 / P.7 / P.8

CONTEXT

High streets are roads which traditionally concentrated trade, institutions, cultural spaces and mobility. These spaces linked urban centres, infrastructure (like a port) or a significant destination (like a church or market) and therefore concentrated traffic flows while being the main thoroughfare to other parts of the city. Over time they have evolved into the city's commercial districts and are the obvious destination for residents to not only acquire goods but also to socialise. Consequently inner-city land on and beside high streets is often very expensive and highly prized. Their position as social and mobility

spaces provides opportunities and challenges. While there are advantages in manufacturing along high streets, with high intensity of use, they can also suffer from congestion and higher land prices. Changing consumer patterns led particularly by online shopping have dramatically reduced footfall and business for traditional 'bricks and mortar' retail, leaving some high streets largely vacant and reducing rental value. This opens up opportunities for small businesses, combining retail, services and manufacturing. Small-scale, public facing manufacturing can be very complementary to retail as it can be a spectacle and create emotional value of locally made products.

PROBLEM

One of the main challenges of high streets is that they are highly accessible on the local and city scale. This leaves them exposed to congestion which can be problematic for logistics and the production or delivery of bulking goods. By contrast, former high street retail spaces, those affected by changing local economic conditions, are prone to being transformed into dwellings. Housing can fetch moderate returns, yet public authorities should be cautious about allowing this as it is difficult for the space to be reconverted back into retail (or manufacturing) if needed. Switching between retail, office space and manufacturing is far easier.

FORCES

Shifts in economic conditions can change the potential for manufacturing to be part of high streets. In healthy conditions for traditional local retail, manufacturers and artisans would struggle to afford space on high streets. In current conditions, where retail is constantly evolving into larger physical spaces or online shopping, smaller shops are struggling to survive. But this does not simply open the door to other possible land uses, like manufacturing. Building owners are also uncomfortable about lowering rental prices for new activities, even if there is a demand for the space. **P.4 Meanwhile Spaces and Transitional Use** could help soften the blow for concerned building owners who are faced with losses. Where the transformation of high streets moves from retail into mixed land uses (including manufacturing), it is important to retain some of the basic conditions of a high street and create a 'shop-front'. Businesses should provide a **B.3 Public Face** and avoid blind façades. This can help maintain or create a **N.8 Quality Urban Environment in Making Areas**. Manufacturing activities on high streets need a practical solution for loading goods

and parking trucks without effecting pedestrians.

SOLUTIONS

Where opportunities are available, ensure that the local manufacturing on high streets is used advantageously while avoiding nuisances that affect neighbouring retail or commercial businesses. Manufacturing can be mutually beneficial for retail, gaining from the spectacle of artisans and manufacturing. A **R.3 Curator** can play a key role when integrating manufacturing in high streets, through **C.2 Negotiated Qualities & Environmental Criteria** to provide opportunities for dialogue and exchange amongst all actors concerned with activities along high streets (sometimes the responsibility of a local chamber of commerce). **C.4 Diverse Tenure Models** can help provide space along high streets. Likewise a **C.3 Balance between Public & Private Land** ensures that alternative land uses can occur and results in diversity, particularly where land prices prohibit suitable diversity to occur naturally. Retail oriented high streets, particularly where land is affordable, could provide space for crafts and artisans to be located above shops (such as the **P.5 The Work Home**) or in the **N.11 Back of the High Street** and link bespoke manufacturing with retail. Furthermore, while retail and services have traditionally grown together, diversity could be improved by **N.3 Mixing Complementary Making & Related Services**. Opportunities could be developed for integrating **N.5 Local Collection Points of Segregated Waste**, **P.6 Re-use & Repair Centres**. Due to accessibility, high streets can be a good place for people of different backgrounds and cultures to meet, to accommodate **P.7 Spaces for Development & Education** as well as **P.8 Community Hub for Making Locations**. Finally, a change in legislation may be a precondition to allow new functions (such as light manufacturing) in areas zoned for retail.

BACK OF THE HIGH STREET



Locating manufacturing behind high streets, facilitates the movement of goods, provides flexible space for making, while located in proximity to complementary activities such as logistics, material suppliers and repair centres.

Connected to:

R.8 / C.1 / C.5 / C.7 / C.10 / N.10 / B.1 / B.5 / B.6 / B.9

CONTEXT

Some manufacturers may need to be located near clients and are suited to be close to high streets. But due to their type of activity, manufacturing may be too big or unsuitable for sites along the high street itself. The back of the high street is therefore very useful for manufacturing businesses. Such environments can include alleys, driveways, delivery zones or storage spaces. The back of the high street is often far cheaper than the more customer oriented high street site and therefore it can be affordable for manufacturers. Furthermore, it is often where logistics spaces and material

suppliers are located, which can create a parallel high street for non-retail activities that depend on accessibility and proximity to clients. Examples could include food, clothing, niche technology and furniture.

PROBLEM

Urban manufacturing located in mixed use areas faces two particular challenges. Firstly, a lack of suitable accessible space. As high streets may have developed around retail activities, the design of available spaces may not be suitable for manufacturing whereby buildings have far too many columns, floor levels are

too low, spaces are too small and fire safety regulation requires expensive investment to upgrade buildings. The high real estate prices along main streets can have a spill-over effect on the real estate prices in the back of high streets, even if the demand for such spaces is lower. This can be limiting for manufacturers who have high overhead costs and often lower profit margins than other services that are more typical for such locations. Secondly, the back of the high street may be even more inconvenient for loading goods and logistics than the high street itself. If buildings are oriented towards the high street, it can mean that they do not have **B.9 Large Openings** to move bulky things or goods lifts (**B.5 Enabling Vertical Making**), that are necessary for many manufacturers.

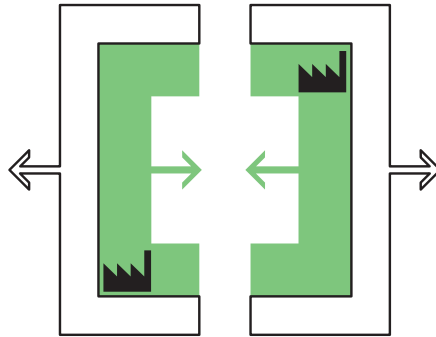
FORCES

Public authorities may find manufacturing to be an ideal way of reviving the community and cultural aspects of the high street that have lost foot-traffic and occupants due to changes in e-commerce and trends in the retail market. To avoid blight and vandalism, local public authorities may see the value in attracting a make-over from the creative sector. Light manufacturing, artisanal activities and crafts may fit into this narrative. While in the short-term, this can reanimate life into high streets and surrounding areas (through **P.4 Meanwhile Spaces and Transitional Use**), long-term solutions may be more challenging. Firstly, building owners, those that once paid a premium for such sites, may struggle to accept lower returns on their investment and are likely to fight for the highest value alternative (which is rarely manufacturing). Secondly, spaces that were developed for retail (or storage) may not be zoned or suitably equipped for manufacturing. This includes fire, exhaust systems, power, sewage capacity and so forth.

SOLUTIONS

Where suitable, locate manufacturing behind high streets, to draw on networks of retail and services businesses. As high streets lose their retail value to online shopping, **N.10 Making Along High Streets**, such as artisanal workshops and light manufacturing is considered an attractive alternative. To best accommodate manufacturing, focus on bigger buildings with zones for **B.6 Easy Loading & Unloading** and continuous floorspace. This provides opportunities to concentrate wholesale, repair, logistics and manufacturing, all of which can be linked to complementary retail activities on the high street. Spaces with **C.5 Varying Unit Sizes** allow for a mix of makers. The back of the high street, with lower pedestrian flows and lower retail value should take advantage of **C.7 Links to Transport Infrastructure**, allowing for the movement of goods and larger vehicles but in ways that do not lead to congestion on the high street. This requires suitable infrastructure for **R.8 Moving Things Efficiently** such as loading bays. **C.1 Microzoning** can be applied to provide exceptions for deliveries in streets behind high streets, since in many mixed use areas, loading might be restricted. Where space permits, co-location (housing above manufacturing space) can be developed with Shared Yards for Logistics and **B.1 Making Around Courtyards**. Consider also **C.10 Transition Zones** on the smaller scale and facilitate horizontal and vertical industrial intensification in mixed use areas and support the development of **N.10 Making Along High Streets**.

MAKING AROUND COURTYARDS



Organising manufacturing around courtyards inside blocks allows businesses to make noise, dust, move vehicles safely and provides additional space outside of the workshop area while allowing cohabitation with some forms of mixed use.

Connected to:

B.2 / B.4 / B.6 / B.8 / C.10 / N.1 / N.2 / N.4 / N.6 / N.10 / N.11 / B.2 / B.4 / B.6 / B.8 / P.8

CONTEXT

Historically internal yards in many urban blocks accommodated manufacturing, giving space for logistics and outdoor workspaces. The yard was treated as a flexible space that allowed businesses to grow and adapt. Courtyards also helped to divide staff from visitors and protect goods and equipment as gates could be easily closed and locked. This logic is being revived as it is seen as a feasible solution for mixed use activities where noise, dust and heavy vehicles can be comfortably contained within the courtyard area. The concentration of various businesses or manufacturing activities

around a courtyard creates a semi-private community which can help build trust and exchange. Making around courtyards is a useful solution for sites located at the **N1.1 Back of the High Street** where logistics, noise and dust could be problematic for the cleaner retail or commercial environments on the high street. Furthermore, courtyards do not need to be open and may be covered (by a roof or building) to allow these spaces to be useful in all weather conditions.

PROBLEM

In regeneration or redevelopment projects, many interior block spaces are being

transformed into dwellings, gardens or to accommodate offices to increase land values. In many newly built blocks, courtyards are too small to accommodate services and logistics that manufacturing would benefit from (see **B.2 Yard for Logistics**). Furthermore, old and poorly insulated buildings located near residential units can create conflict due to noise concerns.

FORCES

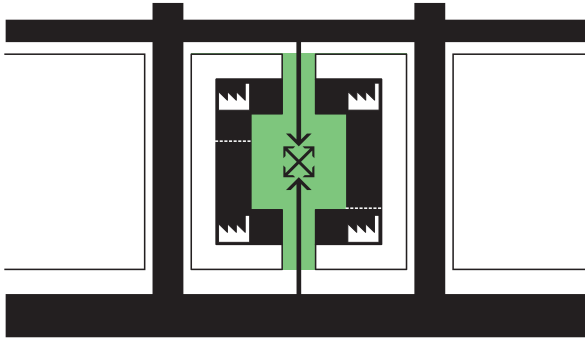
Making around courtyards will often occur in inner-city areas and sites located near residential areas as a solution for minimising impact on neighbours, for reducing exposure to theft and for safety. Sites located in gentrifying neighbourhoods may be under pressure from real estate development to develop all parts of the site into the highest value activity. Co-location projects can also heavily limit the kinds of manufacturing that could occur around courtyards with noise moving up building structures or dust blown to floors above the manufacturing spaces. Furthermore, developers of recently built co-location projects may be very tempted to lease out their manufacturing spaces as retail or office space to gain higher rental return with lower impact on the neighbours.

SOLUTIONS

Build manufacturing around courtyards to encourage informal relationships between makers, to create a buffer space for occasional tasks demanding larger amounts of space and to reduce the impact of nuisances on neighbours. Making around courtyards should include a clear entry and exit for both security and safety. The courtyard can come in a range of sizes, which will depend on the kind of activities that will occur in the yard, the cost of land and requirement for logistics. If possible, allow space for vehicles to turn in the yard, or a thoroughfare to the back of the building allowing for a **B.2 Yard for Logistics** and **B.6 Easy Loading & Unloading**. A

lane in between yards can be useful for logistics. Making around courtyards can be combined with multi-storey industrial intensification facilities so long as there is a suitable goods lift or ramp (**B.5 Enabling Vertical Making**). Suitable acoustic insulation and structurally detached units are key to avoid noise and vertical vibrations transmitted towards co-located dwellings. In high density areas the courtyards could be covered by roofs, minimising the exposure to noise and dust. In co-location projects, one or more units could be dedicated to the residents of the block, which would give an added value for the neighbourhood. Making around courtyards can be ideally combined with **P.2 Shared Technology & Making Spaces** to help share costs. To strengthen the position of manufacturing activities around courtyards, co-location projects could benefit from a **R.3 Curator** or being owned by a public actor, providing a **C.3 Balance between Public & Private Land**.

YARD FOR LOGISTICS



Yards with sufficient space for turning and parking can facilitate safe loading and unloading, without disruption, in high density areas.

Connected to:

R.3 / R.8 / C.1 / N.5 / N.6 / N.8 / N.9 / N.11 / B.1 / B.4 / B.5 / B.6

CONTEXT

Manufacturing businesses depend on logistics and need comfortable amounts of space for loading and unloading cargo. Conflicts can occur with trucks that block public space when unloading. It is also challenging for heavy vehicles entering into loading bays and conflicts with pedestrians and cyclists when turning. A yard is a simple solution to allow trucks the capacity to load and unload safely. This is particularly important in mixed use areas, for businesses that are client facing and in zones with high volumes of pedestrians. A yard can be located within the block,

under a building or at the back of the lot. Vehicles can pass between buildings or through an opening (at least 5m high) in the building. In this way, yards are not located at the front of the plot and buildings align street frontages to create an 'urban' quality.

PROBLEM

Yard spaces may be an ideal solution, but a huge expense if land is at a premium. If the business is served regularly by semi-trailers the typical turning circle is around 30-35m which can mean some 100 square meters of precious ground floor space required for logistics. Furthermore,

a common complaint from residents of mixed use neighbourhoods is the noise from early deliveries or reversing vehicles. For mixed use projects, yards may be unruly and unattractive, which can create friction if visible from residential units.

FORCES

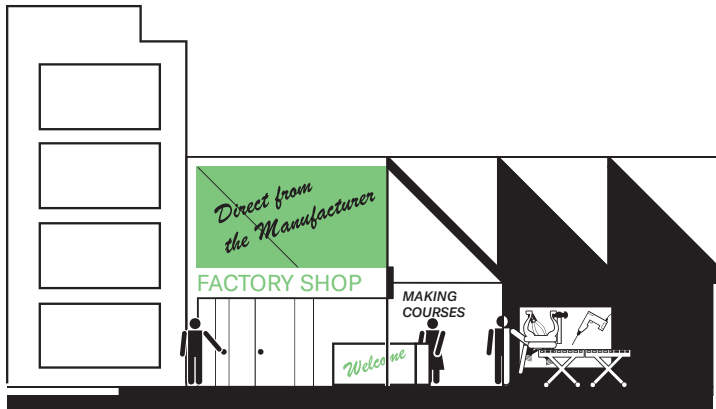
While a business may have the yard space for large vehicles, it can be rendered useless if the adjoining streets are too narrow due to the redevelopment of public space (**N.8 Quality Urban Environment in Making Areas**). The expansion of footpaths, the installation of separated cycling paths, increasing car parking spaces, gardens, tight corners and blisters or play spaces can conflict with the capacity for large vehicles to use narrow streets. Such issues are common for older industrial neighbourhoods, where public works are aimed at increasing pedestrian and cycling space yet consequently reduce road carriageways to an uncomfortable width while shrinking corners making it in some cases impossible for large vehicles to turn.

SOLUTIONS

Locate manufacturing and manufacturers around yards to reduce logistics issues in public spaces while making logistics safer and more efficient. The yard for logistics is best combined with other infrastructure, such as a dock for **B.6 Easy Loading & Unloading**, a direct link into the main production space(s) for **B.4 Facilitating Horizontal Organisation**, connection to the goods lift for **B.5 Enabling Vertical Making**, **B.8 Space for Storage** or infrastructure for dealing with waste streams to simplify sorting at **N.5 Local Collection Points for Segregated Waste**. A yard for logistics can be a multifunctional space. Organising **B.1 Making Around Courtyards**, shared among many businesses, reduces the impact of logistics on the neighbourhood. Clear entry point which helps also to limit

public access. For larger development projects, particularly when dealing with **C.1 Microzoning**, courtyards may be covered (for noise reasons) and can have a clear entry and exit which reduces the need for large turning space (6-8 meter widths rather than 30-35 meters). Also, in certain conditions, on the **N.11 Back of the High Street** or where **N.9 Making Touches Making**, roads can be dedicated to manufacturing, allowing for shared for logistics spaces. The use of smaller vehicles, for **R.8 Moving Things Efficiently**, could be beneficial if combined with **N.6 Centralised Logistics Zone**. Shared yards in small buildings can be managed informally by the respective businesses. But in large buildings with many uses a **R.3 Curator** (or building caretaker) is necessary to keep order and provide support for use of common spaces.

PUBLIC FACE



Activities which have a public interface achieve better neighbourhood integration and acceptance, while improving exposure to clients.

Connected to:

R.1 / R.2 / C.1 / N.3 / N.8 / N.10 / B.9 / P.2 / P.3 / P.6 / P.7 / P.8

CONTEXT

Manufacturers are increasingly seeing the benefits of creating a stronger relationship with existing and future clients. Businesses are also increasingly aware of the importance of generating community relations to avoid possible conflict and to generate clients through word of mouth. Public façades and street related spaces allow both clients and the general public to have an insight into what is being produced on the site, (**R1 Making Making Visible**). The public face can include a range of different solutions with varying levels of visual access into the business. A glass façade and

showroom can be enough to exhibit the business' products. A shopfront or retail façade provide even greater accessibility by the general public to purchase a sample of the production process. Alternatively a business may choose to have a large section of the façade in glass, which allows the general public to watch the production process. Such interventions are particularly relevant to both small and large businesses who mix manufacturing with direct retail, education and training activities. For these businesses, the public face provides not only an aesthetic but also a functional interface between the business and the general public. For more

discreet businesses, simple signage can be useful.

PROBLEM

Even when embedded in dense urban areas, contemporary manufacturing activities tend to be hidden from plain sight behind fences, blank walls or doors. This results in manufacturers having little presence or contribution to urban life at the street level. Manufacturing in general remains out of site and out of mind, making it invisible to many. As such, it can be deemed as undesirable for vibrant city life and expendable in urban renewal and development projects. Conversely, manufacturers which combine designing, selling and producing activities, often cannot find a suitable site in denser neighbourhoods that can offer a public face, since their manufacturing activities are not commonly perceived as 'suitable'.

FORCES

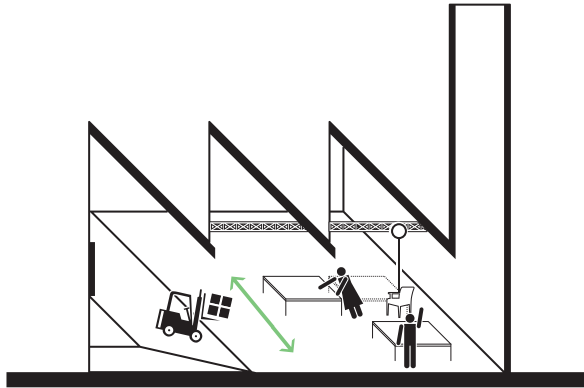
As political will and public opinion are key drivers in the acceptance of manufacturing in mixed use areas, businesses are under pressure to better communicate their activities. A public face that provides visibility to its business activities can also reveal their working processes and be exposed to industrial theft. As such, public authorities should be careful in encouraging businesses in how to disclose their activities, communicating the business' value to society, without forcing the business to give away more than necessary information.

SOLUTION

Improve the relationship between manufacturers and the general public with a public facing façade. Before doing so, the business should have very clear ambitions for what it aims to gain from increasing the link to the street. The level of interaction with the street should relate to the business' values

and the relationships it aims to build with their clients and the surrounding neighbourhood. Businesses with products requiring high levels of public trust, like food, can enforce this relationship with a public façade like a shopfront. A business, such as a pharmaceutical company, that requires high levels of security may simply offer signage. Achieving **R.2 Transparent Manufacturing** and **R.1 Making Making Visible** can be strengthened by a public face, and should be embedded in design regulations such as **C.1 Microzoning**. These rules should guide the interaction between the street, the community, and the manufacturing processes including windows, shop-fronts and public entrances. Smaller manufacturers and other professionals may also have shared premises, such as a **P.8 Community Hub in Making Locations** that can also be accessible by the local community. Manufacturing activities with a public face could also include well accessible **P.7 Spaces for Development & Education**, especially when they are **N.10 Making Along High Streets**. The physical public face could be complemented by open days and tours which may also offer an alternative revenue stream through tourism (see **R.1 Making Making Visible**).

FACILITATING HORIZONTAL ORGANISATION



Horizontal organisation of manufacturing spaces, including smooth floors, overhead gantries and wide spacing between columns enables easy reconfiguration and safer working conditions.

Connected to:

R.5 / R.8 / R.10 / B.5 / B.6 / B.7 / B.8 / B.9 / P.4

CONTEXT

An efficient and safe manufacturing process requires the capacity for a seamless flow of people, machines and goods in and between production spaces. Generally the workflow is most efficient along a horizontal surface area, without the interruption of steps, steep ramps, columns and ceilings. This allows for the most effective configuration of large equipment and room for adaptations of the production line. Space should be provided for the free movement of forklifts, pallet carts and other transportation devices. When the production process occurs on various levels, the heaviest and most intensive

activities are located on the ground floor while gravity is used where possible.

PROBLEM

Adapting and reusing purpose built manufacturing spaces can be problematic, particularly without contiguous floorspace, low ceilings (challenging for stacking), narrow column spacings (problematic for turning vehicles and for efficient storage) and weak structures (for storage, using forklifts and heavy machines). For new build projects, future-proofing the design of space to allow for changes in production processes and to allow new equipment to be easily moved in or out of the space.

FORCES

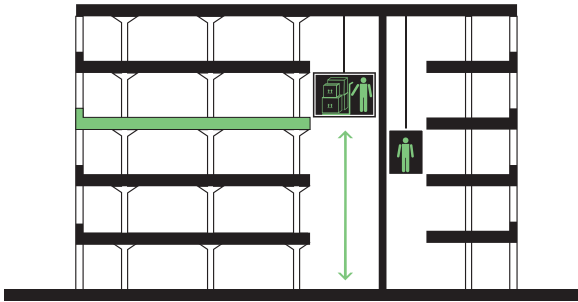
Due to limited space and the cost of development, it is common that manufacturing occurs in repurposed buildings and production processes are adapted to the capacity of the available space rather than the space being adapted to the potential of the production process. This can result in lower efficiencies or businesses being incapable of adapting to new technology. Where buildings are not fit for function, it may be cheaper for manufacturers to abandon the site than to redevelop it. This can be as problematic for the business as for public authorities that need to deal with vacant or poorly maintained buildings. To minimise unnecessary disturbances of the neighbourhood and avoid needless waste of resources, buildings should be adapted or reused to their best potential. This may not suit developers, who see lost potential. Where businesses do want to adapt buildings, public authorities should be flexible in allowing renovations and help fast track permit approval times to ensure that businesses are not held up by unnecessary bureaucracy. This can shortcut public policy (refer to **C.2 Negotiated Qualities and Environmental Criteria**). New projects should be forward thinking and ensure there is as much flexibility available in the space to allow for modifications and adaptations, which may go against developer's ambitions. For new industrial intensification and co-location sites, policies are pushing industrial areas to grow vertically, however this means that concessions are needed to by developers to ensure buildings are fit for purpose (investment in engineering solutions to manage weight) while allowing for flexibility (minimising where possible the number of columns or walls). Many building developers responsible for industrial/housing co-location projects were formerly residential developers and simply are not aware of the loading requirements and logistics standards required by manufacturers as constructed projects can be nearly impossible to retrofit. Poorly designed buildings can render spaces

unusable to businesses that have large equipment or that could be restricted by the existence of columns. Columns also allow for vibrations and noise to travel vertically, which can create further stress for mixed use buildings. Furthermore, the higher the building, the closer the columns are likely to be, with many businesses wanting wide column spans (such as no closer than 8 meters). This depends on the competency and capacity of the public authority to understand the capacity of buildings to offer flexible and adaptable spaces for manufacturing

SOLUTIONS

Provide horizontal spaces that are as flat as possible with a limited number of columns or partitions to facilitate movement of goods and production processes. When designing or refurbishing spaces for manufacturing, preference should be given for smooth flooring, soft ramps instead of steps (max 12%), **B.9 Large Openings** and goods docks for **B.6 Easy Loading and Unloading**, wide roof spans for the sake of flexibility, workstations on casters and overhead gantries. **B.7 Access to Technical Networks and Services** should include solutions to avoid cables laying on the ground to avoid trip hazards. Ramps and a gentle slope are required to overcome existing differences in grade. Paint columns with colours and patterns to make them more visible, particularly for older buildings. Such spaces should facilitate **R.8 Moving Things Efficiently**, while ensuring **R.5 Fair Work Conditions**. **R.10 Place-based Financial Levers** can support renovations and make spaces safer and adaptable. Increasingly, **B.8 Space for Storage** can involve using robots or computer programmed horizontal and vertical storage to get the most out of space and move goods efficiently. For co-location or industrial intensification projects, developers must build to minimum floor loadings and column spacings, to ensure buildings are flexible and adaptable. These solutions should be taken into account for each floor when **B.5 Enabling Vertical Making**.

ENABLING VERTICAL MAKING



Goods lifts and heavy load-bearing floors in multi-storey buildings allow for industrial intensification and for buildings to adapt according to demand for space.

Connected to:

R.5 / R.8 / R.10 / C.1 / C.2 / C.10 / N.3 / N.9 / N.11 / B.2 / B.4 / B.6 / B.7 / B.9 / P.5

CONTEXT

During the industrial revolution, the need for direct access to sources of power, water, labour and logistics infrastructure, with limitations of personal transport gave rise to vertical production spaces and compact industrial districts. Subsequent advances in transportation (such as the car) and technical networks allowed businesses to relocate to cheaper and larger industrial sites, functioning generally on one floor. Despite costs and engineering challenges, vertical production sites have a number of advantages over single story sites and are increasingly an attractive option for cities looking to retain or support their

manufacturing sector. Vertical manufacturing can allow for a large concentration of expertise and knowledge to be located on a small site, which is useful for nurturing informal relationships between makers and supporting services such as design, distribution or communications. In this sense, vertical making can distribute production spaces relative to weight, need for logistics and noise, thus installing heavy machinery on ground floors while locating offices and meeting spaces on the upper levels.

PROBLEM

As there is a revival in vertical manufacturing, existing facilities include mixed-activity

complexes, or even **P.5 The Work Home**, are old and unsuited to modern manufacturing. Makers struggle with issues such as: **R.8 Moving Things Efficiently** and **B.6 Easy Loading & Unloading**, due to the lack of goods lifts, the lack of cranes and **B.9 Large Openings**, small spacings between columns and unsuitable logistics docks. Retrofitting existing buildings comes with challenges and complications in using certain machinery due to safety concerns (particularly fire or explosions), noise, vibrations or engineering limitations for heavy machinery. Some cities are beginning to compensate the loss of industrial surface areas by proposing 'industrial intensification'. New buildings can be designed to minimise nuisances and allow for mixed use, even between manufacturing and housing. However stacking industrial activities requires a clear understanding of technical solutions to avoid nuisances and conflict. This is problematic for both public authorities and designers who have little practical experience with such complexity.

FORCES

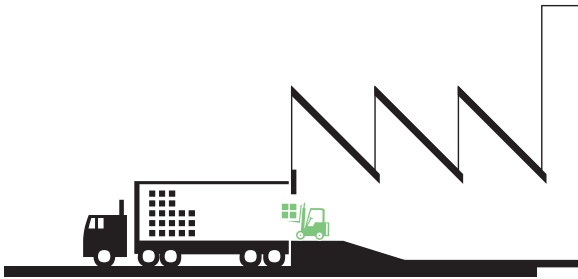
Industrial intensification or co-location of functions in certain areas (such as **C.10 Transition Zones** or **C.1 Microzoning**) comes with certain limitations to manufacturers which should be taken into consideration. Firstly, co-location and intensification limits the availability of large single floor spaces which can be necessary for certain production processes. Public authorities should carefully consider future occupants before approving legislation. Some activities may be problematic due to fire regulation, such as pharmaceutical or chemical related manufacturing. Vertical production requires engineering solutions to manage the extra weight which results in more columns or walls. This can limit flexibility and efficient use of space in terms of the layout of the workspace, limitations of the use of some machines that need continuous surface area and can be challenging for efficient configuration of storage. Management costs can also be

problematic. Goods lifts can be expensive or difficult to retrofit in existing buildings due to regulation or structural issues. The overall load-bearing structure needs to be address vibrations, fire safety and logistics.

SOLUTIONS

Where manufacturing occurs on numerous levels, ensure that accessibility (lifts), stability (floor loading), fire protection and interfaces between production and non production spaces do not limit the potential for manufacturing while allowing free and efficient circulation. Technical aspects of vertical making should be carefully considered when developing master plans such as through **C.10 Transition Zones**, **N.3 Mixing Complementary Making & Related Services** and **C.1 Microzoning** to avoid nuisances and tension between land uses. This includes locations for logistics (**B.6 Easy Loading & Unloading**) and concentration of similar kinds of making (**N.9 Making Touches Making**). For new buildings to host vertical manufacturing, goods lifts are essential. Provide preferably two or more to account for redundancy, large enough to take a pallet and pallet trolley or forklift, separating flows of people and materials. Provide **B.9 Large Openings** in combination with lift systems facing the **N.11 Back of the High Street** or **B.2 Yards for Logistics** for large and cumbersome objects. Provide suitable **B.7 Access to Technical Networks & Services** such as ventilation, water pressure and voltage. Include strong load-bearing structures, and flexible floor plans for **B.4 Facilitating Horizontal Organisation** of production. Provide suitable fire escapes and a range of exits. In the case of mixed use buildings, separating structural systems for different functions can avoid transmission of vibrations. **C.1 Microzoning** and **R.10 Place-based Financial Levers** can help solve financial and legislative constraints linked with mixing manufacturing with other uses, installing a goods lift, refurbishing buildings while complying with **C.2 Negotiated Qualities & Environmental Criteria**.

EASY LOADING & UNLOADING



Loading docks, ramps and dedicated parking bays are essential to allow for a smooth transition of goods in and out of vehicles.

Connected to:

R.5 / R.8 / N.6 / N.8 / N.9 / N.10 / N.11 / B.2 / B.3 / B.4 / B.5 / B.9

CONTEXT

Loading bays are one of the most critical technical interventions required to quickly and effectively move goods. They include docks, ramps and parking bays. Loading docks should be accessible by a range of vehicle types and heights. Access to the bays should be easy and safe for drivers in order to avoid awkward reverse parking, creating traffic jams or resulting in congestion. Suitably designed loading areas will avoid transferring goods within a public space. Access by forklifts and unloading equipment to the dock, ramp or parking bay is possible without risking conflict with pedestrians or cyclists. The

loading space can be secured with a gate or barricade, particularly where goods or equipment are stored temporarily. Loading spaces, between the vehicle and the building, should be covered from the elements. Finally, (temporary) parking space should be available for heavy vehicles, particularly for long-distances vehicles, to allow drivers to have necessary breaks.

PROBLEM

Noise and congestion is considered by many inner-city manufacturers as the greatest challenge for the cohabitation of manufacturing and residential land uses. Within established neighbourhoods, yard

spaces are rarely suited for larger vehicles, particularly semi-trailers, which makes a transfer station between large and small vehicles on the edge of the city necessary. Likewise entry areas adjoining manufacturers' premises may be consumed by improperly parked cars, making it difficult for trucks to enter, turn into loading bays or forcing trucks to double-park on roadways, creating tension when blocking thoroughfares. For manufacturers in established industrial neighbourhoods, loading spaces are often located in front of buildings. This consequently leaves large, desolate and often ugly interfaces with the street front which creates low **N.8 Quality Urban Environment in Making Areas**. For new co-location and industrial intensification projects, logistics should occur in a yard space behind the building, however this can be an inefficient and expensive use of space which does not appeal to developers. Conversely, a lane can be useful however this requires the site to be large enough to contain access from both sides of the block.

FORCES

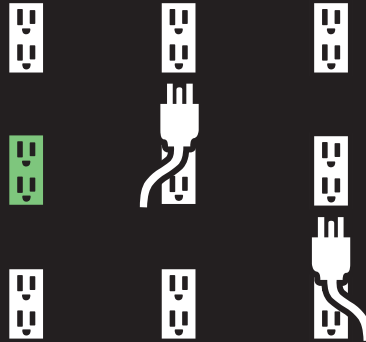
Safe loading and unloading space can be the critical challenge for creating mixed use zones in inner-city areas and for better integrating industrial zones. Loading bays and docks are best located in yards, where vehicles can safely discharge goods without interfering with pedestrians or other vehicles on public streets. In mixed use areas (such as **N.10 Making Along High Streets**), land can be prohibitively expensive to commit to logistics, therefore goods must be transferred on public street spaces. Solutions to improve safety or reduce friction with neighbours, include designating delivery times or forcing businesses to use small vehicles. However this is not always viable. In industrial zones, where loading bays are more common, efforts to put logistics at the back of the lot to (for the sake of **N.8 Quality Urban Environment in Making Areas**) can take decades to achieve as this

will only occur when a site is under major redevelopment.

SOLUTIONS

Ensure that loading bays provide efficient and safe infrastructure for transferring goods between vehicles and buildings. Well designed loading and unloading spaces helps **B.4 Facilitating Horizontal Organisation** and providing safe and **R.5 Fair Work Conditions**. Provide direct access from vehicles to shop floors, storage rooms, or goods lifts (**B.5 Enabling Vertical Making**) to avoid interrupting the manufacturing process. Most effective docks will be equipped with features such as dock levellers to access the vehicle cargo deck (semi-trailers (over 1m high) and vans (0.5m)), bumpers to protect the vehicle and dock from damage and a dock seal to shelter the goods from the elements. Besides the dock itself, a ramp (max 12%) from the loading dock down to the truck parking area facilitates accessing goods from small vans and from the sides of trucks. When a permanent loading space cannot be installed or is simply not flexible enough, a mobile version, often called a 'yard ramp', can be used. Parking space for large trucks should also be considered, particularly where drivers need a break or when waiting for goods to be loaded. Spaces should be considered for the largest vehicle that will regularly service a site: a 15-20 metre semi-trailer is around 2.6m wide and almost 5m tall, requiring a 30-35m turning circle. In mixed use neighbourhoods, **B.2 Yards for Logistics** are useful to provide **N.8 Quality Urban Environment in Making Areas**. This helps mask noise and minimise the risk of dangerous vehicles crossing with the general public (see **N.11 Back of the High Street** and **N.9 Making Touches Making**). Cargo docks and vertical circulation (such as goods lifts or **B.9 Large Openings**) are best located in yards or behinds gates. A **N.6 Centralised Logistics Zone** can help minimise large vehicles entering into city centres.

ACCESS TO TECHNICAL NETWORKS & SERVICES



Well-distributed and adequate capacity of technical networks (electricity, water, ventilation, communications and distribution channels) allows for flexible, responsive and distributed manufacturing.

Connected to:

R.3 / R.6 / R.7 / R.10 / C.1 / N.2 / N.3 / P.4

CONTEXT

Manufacturing depends on resources to ensure that production can function to full capacity. Businesses require guaranteed access to high quality and secure supplies of materials, energy and information / knowledge for production to be competitive. In the past, the location of manufacturing was heavily dependent on local resources. Traditional manufacturing areas were found next to rivers, mines or forests for suitable transport, energy and source of resources upon which the manufacturing depended. Through investment in infrastructure, resources and manufactured goods are now transported

through technical networks such as power lines, pipelines and transport systems. This can allow manufacturing to occur at the location which is most affordable or profitable to the business. Technical networks can also create positive inter-dependencies, which lead to industrial ecology. Waste heat from one business could serve as the fuel for another, if suitable networks are provided.

PROBLEM

Available technical networks can effect the type of manufacturing that is viable. Established industrial neighbourhoods may have low water pressure, electrical

capacity or communications lines due to aged installations. Non-conventional sites, such as old office blocks or parking stations, which could be suitable for manufacturing, may lack the necessary electrical networks or sewage capacity. Therefore technical networks may create a serious limit for production capacity and the viability of a business. Dependence on technical networks to provide resources from across the globe is not always desirable as this can lead to absurd impacts on the source of the resource. Dependencies on unreliable local technical networks can also create resiliency challenges which is particularly the case for industrial ecology (where one business is dependent on the resource supply of another business).

FORCES

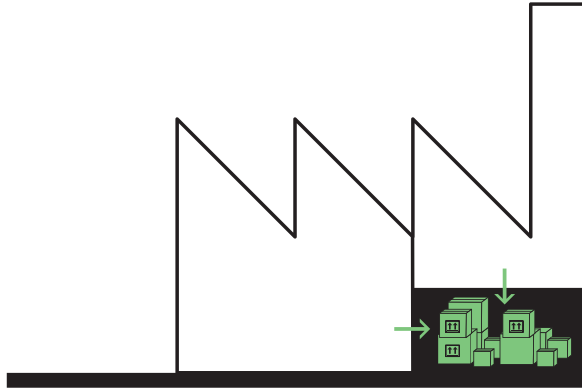
While old networks may need upgrading, it can depend on the service provider to determine if there is value in investing in upgrading or installing the network. Upfront financial costs may prevent updating and improving technical networks. This can be a limiting factor for new technology or **N.2 Re-use of Materials & Energy Flows**. Therefore older neighbourhoods with established manufacturers, may not gain needed network upgrades due to piecemeal adaptations and unwillingness of service providers to finance such projects. Poorly maintained technical networks can make it hard to attract new and innovative businesses that could help enrich a larger neighbourhood. Without upgrades, established industrial neighbourhoods can fail to grow or lack capacity to innovate.

SOLUTIONS

Ensure that technical networks, at both the neighbourhood and building scale, are suitable or do not limit a business' potential. Competitiveness can be dependent on available volumes of energy, water and other resources which are supplied through networks. At a neighbourhood

scale, supply can be subject to the capacity of shared infrastructure and the price of distributing resources. This will depend on local conditions (access to resources) and/or public investment in infrastructure. If there is a need for improved technical networks at a neighbourhood scale, businesses will need to build a case for public or private investment. A neighbourhood **R.3 Curator** could be engaged to learn about the infrastructure needs of local businesses to communicate with network providers. Doing so will provide opportunities for **R.6 Sustainable Product Cycles**, **N.2 Re-use of Material & Energy Flows**, support **R.7 Multi-scalar Circular Infrastructure** and contribute to rich manufacturing environments through **N.3 Mixing Complementary Making & Related Services**. At a building scale, technical networks can limit production and can be costly to update. Buildings subject to **P.4 Meanwhile Spaces & Transitional Uses** will require an evaluation of the capacities of the technical networks (particularly for fire safety) to avoid unnecessary costs or stalling short-term activities. In general it is important that technical networks are designed for flexibility and redundancy to accommodate new technologies, new forms of energy (such as renewables), energy efficiency options, water saving, heat cascading technologies as well as optimised collective use of heat and steam (such as a CHP) and **R.7 Multi-scalar Circular Infrastructure**. In an age of distributed manufacturing and greater levels of automation, access to fast and reliable communication networks is equally fundamental. Serious changes may require **C.1 Microzoning** and **R.10 Place-based Financial Levers**.

SPACE FOR STORAGE



Manufacturing spaces with smart storage solutions allow for efficient use of space and production processes.

Connected to:

R.6 / R.7 / R.8 / R.12 / C.8 / N.5 / N.6 / P.2

CONTEXT

Manufacturers of all sizes need to manage a balance between the amount of active production space versus inactive spaces for storage of materials, stock ready for distribution and areas for storing waste. The amount of storage required will depend heavily on the business type, distance to suppliers and the business model. Businesses focusing on custom made and just-in-time production often have high levels of material supplies but much smaller requirements for made stock. Businesses that produce large orders (such as electronics), those that need to have regular production cycles

(food) or those that produce seasonally (clothing or breweries) will likely need areas for storage near the production spaces. Storage can be located in poorer quality spaces or on light-weight mezzanines that don't need to handle heavy machines. Storage is also increasingly becoming mechanised, with automated vertical and horizontal systems.

PROBLEM

For manufacturing businesses, in particular those in a growth stage, decisions will need to be made regarding dedicated space for the production process and having sufficient space for storage of

materials or stock. Committing enough space for storage might not be an option, even if the business scrupulously manages storage, delivery and waste disposal and space for actual manufacturing. Likewise, tensions in global supply chains and material supply could delay orders and cost the manufacturer business or clients. As a result, businesses can restrict production, or be forced to move to a larger premises elsewhere (if this is feasible) to have access to storage space. Lack of storage can also limit a business' capacity to produce a stock of goods, deal with sudden demand for products or provide the capacity to adapt the business.

FORCES

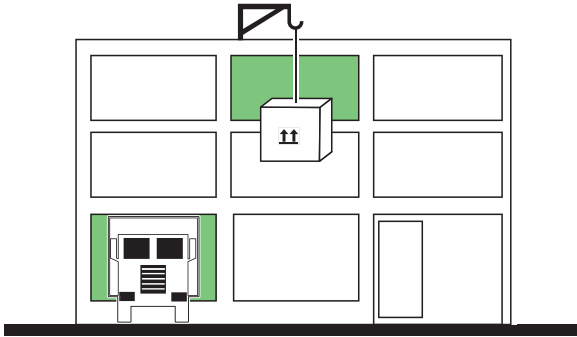
Many businesses are focused on production and increasingly outsource distribution and logistics. For manufacturing to function efficiently. For additional storage needs a neighbourhood manager or **R.3 Curator** may be required to help identify possible options that could link demand and supply of space at the scale of the neighbourhood. Some businesses use their spaces inefficiently and therefore could gain from renting out space to neighbouring businesses. This requires the suitable person (or organisation) that can connect businesses and space, while negotiating fair conditions. Furthermore, due to a lack of suitable storage space, businesses are unlikely to be able to channel waste into **R.7 Multi-scalar Circular Infrastructure** as suitable bins or receptacles are required to sort materials at the source of the waste.

SOLUTIONS

Provide practical and compact solutions for dealing with storage of materials and waste. This allows businesses to manage demand, to have a buffer of materials and to sort waste streams. Solutions such as shared storage space, or using market-places to share/sell waste materials, are ways to help manufacturers in solving

the issue of storage. Decentralising storage space could be a solution, when coupled with mobility strategies to avoid congestion. Solutions could include a **N.6 Centralised Logistics Zone** that facilitates **R.8 Moving Things Efficiently** at the scale of a neighbourhood. Digital solutions could become the most efficient and least disturbing way to move materials and stocks for just-in-time production. A **R.12 Material Database** and **C.8 Accessible Material Recovery Facilities** would be needed to achieve circularity and avoid having idle waste materials that are useful for others. Businesses in **P.2 Shared Technology & Making Spaces** need to find clever ways to avoid storage from consuming useful shared production spaces. Affordable low-tech vertical storage systems can use crate sized boxes lifted by forklifts onto heavy-duty shelving. More automated systems are emerging from the competitive logistics sector.

LARGE OPENINGS



Large openings in buildings enable vertical and horizontal accessibility to access goods, materials and large equipment.

Connected to:

R.8/C.1/C.2/N.9/N.11/B.2/B.3/B.5/B.6/P.2/P.3/P.5

CONTEXT

Manufacturing requires dynamic and flexible spaces that are adaptable to the needs, production cycles and capacity of modern technology. To adapt and renew technology, large equipment must be easily accessible in and out of buildings, on all floors of the building. For multi-storey buildings to handle manufacturing, large and bulky supplies of goods should be accessible above the ground floor. Some things can be moved through goods lifts or doorways while more cumbersome things, such as machines, require special openings. Industrial intensification is viable so long as the upper floors can

function to the same (or similar) capacity as the ground floor. In practice the main limitation for multi-storey factories and manufacturing spaces is the movement of goods and equipment. For smaller items, goods lifts may suffice (**B.5 Enabling Vertical Making**). But large openings provide options for the occasion when bulky or oversized goods need to be moved. This would allow smaller businesses to collaborate around **P.2 Shared Technology & Making Spaces** as their relationship often depends on sharing large machines. Buildings can also support a wider range of options for **P.3. Flexible Spaces for Making**, allowing businesses to easily move up or down a

floor subject to their need for space. It could also provide solutions to help **R.8 Moving Things Efficiently** and **B.6 Easy Loading and Unloading** if goods can be moved directly into or out of vehicles. For flexible and adaptable multi-storey residential buildings, large openings could facilitate the **P.5 The Work Home**, to access bulky equipment.

PROBLEM

While existing buildings, particularly those undergoing adaptive re-use, the cost of retrofitting can be expensive if the opening is used irregularly. This requires retrofitting both the opening and the lifting technology. In older buildings, structures may be insufficient to handle the weight of the equipment.

FORCES

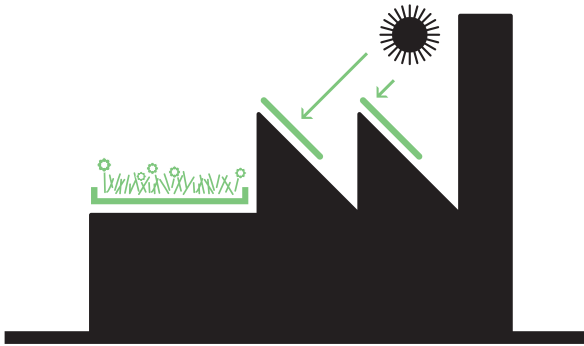
Large doors or windows might be limited by building regulations, heritage and scenic quality plans, or even the environmental demands for energy certificates. Moving goods or machinery in large multi-storey buildings can be dangerous and require protection systems to risk being used by untrained building occupants. This is particularly a concern where manufacturing and non-manufacturing activities are co-located.

SOLUTIONS

Build large openings into buildings to provide flexibility and resilience for future uses. New projects should include a range of technical solutions that allow bulky things to move in and out of buildings, through doors and windows, by employing lifting gantries or cranes. This is complementary to **B.5 Enabling Vertical Making** in co-location or industrial intensification projects. Openings (such as doors and gates) should be at least wide enough to allow the passage of a standard European pallet (1200 mm x 800 mm) otherwise a ceiling to floor height opening

is ideal. **C.1 Microzoning** could provide planning exceptions, if citywide codes impose limitations on the size of openings or materials in buildings. If manufacturing activities require a **B.3 Public Face**, large openings can be located out of sight on the **N.11 Back of the High Street**, in streets where **N.9 Making Touches Making**, or in a **B.2 Yards for Logistics**. Group buildings with exceptionally large openings, in order to safely lift heavy and bulky objects, and help businesses **R.8 Moving Things Efficiently**. Large windows can help **B.5 Enabling Vertical Making** or **P.5 The Work Home**.

PRODUCTIVE ROOFTOPS



Roofs complement the performance of a building or intensifying land use, allowing for climate adaptation, food and energy production.

Connected to:

R.7 / R.10 / R.11 / N.3 / N.8 / B.3 / B.5 / B.7 / P.7

CONTEXT

As manufacturing often requires large surface areas, rooftops provide an opportunity to also serve a productive function. In the context of growing needs to address both the effects of climate change and to become more resilient, a smart and productive use of rooftops in cities has become imperative. Productive roofs can perform at different levels. Adding vegetation can improve **N.8 Quality Urban Environment in Making Areas**. Collecting water can help with **R.7 Multi-scalar Circular Infrastructure**. Green roofs have benefits in evapotranspiration, carbon sequestration and space for

biodiversity. A sedum garden can improve building insulation while buffering water. Urban agriculture can be located on buildings, particularly where there is an opportunity for heat exchange (**N.2 Re-use of Materials & Energy Flows**). Roofs can also contribute to the production of renewable energy. The function of the rooftop should depend on the business type, location, local environmental issues (like flooding or urban heat-island), the roof structure and cost of installation.

PROBLEM

The only opportunity to install productive rooftops is during new construction

works or redevelopment of old buildings. Retrofitting existing buildings, which represents a significant underutilised surface area, is filled with challenges. Roof structures may be lightweight and incapable of carrying even the lightest of loads. Roofs could be inaccessible, as they were not built for serving any other function than covering the building. If accessible, they may have very limited accessibility as it would involve interrupting manufacturing activities (particularly if dust or pathogens are a concern for the production process), making it difficult for the roofs to be maintained. Likewise, roofing may be shaped or oriented in such a way that the roof offers little viable use. Finally, for rental spaces, building owners may have no interest in using the roof when tenants may not have a long enough contract to justify the investment.

FORCES

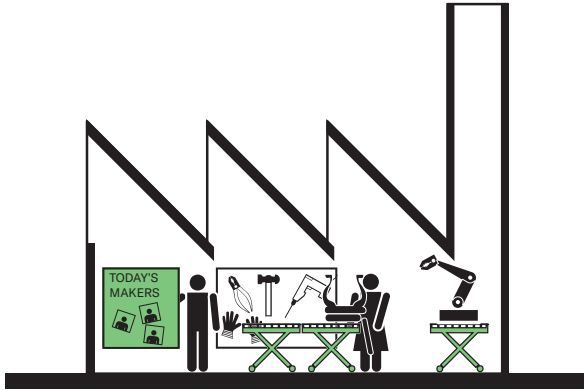
As buildings may take 30–60 years before undergoing a considerable renovation, established building owners need a good incentive to retrofit their rooftops. For new projects, public authorities need to be sure that buildings are designed to handle loads that can provide some flexibility in the use of the roof spaces. Finally, if building owners are required to install some roof system to mitigate environmental issues (such as sedum or water detention), the public authority must find ways to ensure that the system remains operational and maintained years later.

SOLUTIONS

Provide suitable infrastructure and roof access to ensure that even roof spaces can be put to good use. New projects will generally require by law the use of roof surfaces (such as for water management or energy production). If considered carefully, roofs can be used within the production process (to provide water,

energy, use heat etc.). Critical issues need to be considered. First, whether the structure of the building is able to hold the additional weight. Secondly, the cost of installing a productive roof and define how investments may be recovered. Thirdly, determine the additional costs for maintenance, irrigation, fertilisation, and safe access. Fourth, calculate the trade-off of having natural light from skylights versus a functional roof. Finally, define the context (existing roof landscape, orientation) and related regulations that can limit the potential functions added to a roof. For areas with poorly used of rooftops, **R.10 Place-based Financial Levers** can support the installation of green or productive roofs, sedum gardens, greenhouses for agriculture and solar panels. Subsidies can help adding the necessary **B.7 Access to Technical Networks & Services** (structural improvements, most importantly) for the new use and also providing for support maintenance. Solar panels may be seen as an investment to reduce energy costs and can be implemented by an energy cooperative that can become responsible for maintaining the technology. **R.11 Incentives for Research & Development** and **B.5 Enabling Vertical Making** could encourage new solutions or programmes for productive roofs. Urban farming could be used by staff to provide healthy and **R.5 Fair Work Conditions**. For urban farming, **N.3 Mixing Complementary Making & Related Services** can be useful in terms of industrial symbiosis (for heat or resources), by gaining access to specialist knowledge and by having clients nearby.

SHARED MAKING SPACES & TECHNOLOGY



Smart use of space and technology through sharing can increase accessibility to expensive equipment, make more effective use of technology, while encouraging knowledge transfer between manufacturers.

Connected to:

R.4 / R.6 / R.9 / R.11 / R.12 / C.4 / C.8 / N.2 / N.7 / B.2 / B.7 / P.3 / P.6

CONTEXT

Manufacturing often requires a high level of capital investment for assets such as space and technology. For start-ups trying to break into the market, upfront costs can neuter good and viable ideas before they can even be developed. For designers, sharing technology is essential to access machines to develop realistic prototypes. For smaller scale makers, particularly those in the construction industry or in cultural events, having access to large machines and flexible production space is essential as neither are required on a daily basis and both real estate and technology

prices make them difficult for a small business to own outright. Finally, makers may require occasional use of a tool or machine to deal with a specific problem, yet cannot justify the purchase costs for occasional use. Sharing can thus come in many guises. Sharing technology, in the form of renting, is an age-old business. Fablabs and maker spaces are taking on the role of the 21st library for designers and small-scale businesses. More recently, new digital platforms for sharing are revealing opportunities to share the inherent risks of ownership, termed the 'access economy'. Exchanges and matchmaking can be based on a local currency or a barter system. Sharing technology and space can offer

much more. It can be a basis for sharing knowledge (the ‘industrial commons’), for sharing interests and to pool collective action. This is particularly oriented to various complementary businesses sharing certain skills or production capacities.

PROBLEM

Both new and established entrepreneurs are limited by large capital investment required to purchase new equipment and acquiring space. Furthermore accessing finance from banks or finding suitable **R.11 Incentives for Research & Development** is a serious limitation for small and new businesses with little credit history. Rapidly changing consumer trends and adaptations in technology also results in the need to constantly change and adapt. This adds more risk to any investment. Furthermore, real estate is an even larger investment commitment that requires a long-term stable business model. For makers that don’t own their land, there is a risk of making longterm commitments (see **R.9 Assured Security of Space**) as contracts can be cut or not renewed. Being forced to move could put investments and business operations in jeopardy as space, technology and location can be heavily interlinked. Finally, many manufacturers, particularly those involved in construction related activities, use their workshop in waves resulting in wasted space and rental costs. Many such businesses are aware that they could share space, but it remains a novel concept.

FORCES

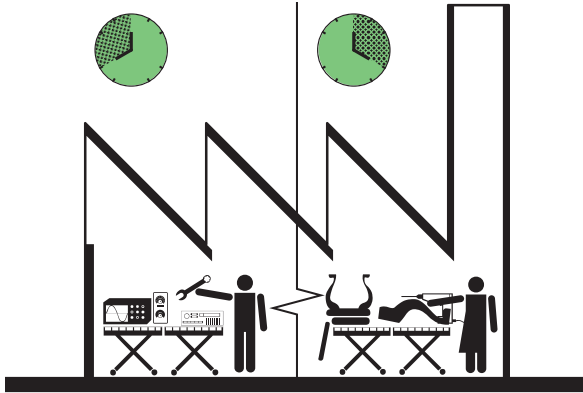
Cities have an increasing need for managing **R.6 Sustainable Product Cycles**, developing innovative products and services or providing **R.4 Availability of Diverse Jobs**. Financial or spatial pressures make it unattractive for businesses to get started or grow. Maker spaces or fablabs provide access to digital and manufacturing technologies but the focus is on amateurs, hobbyists and small scale entrepreneurs. Conversely, **R.11 Incentives for Research**

& Development may be offered, but also requires development financing for businesses to turn prototypes into production runs. Given the finance required to purchase certain technology, investors and banks are inclined to suggest growing and merging operations, forming larger companies, increasing automation to reduce labour costs, or outsourcing and offshoring production as ways of reducing such risks and lowering costs. Such trends could end up further depleting the presence of local manufacturing in cities while limiting the ‘industrial commons’ and the tacit knowledge that highly skilled technicians can bring to developing new products.

SOLUTIONS

Develop opportunities to share technology and space to improve efficiencies and reduce costs while sharing knowledge and skills. Start-ups, micro and small businesses benefit particularly from access to shared technology, production/manufacturing space, **N.2 Re-use of Materials & Energy Flows** and a **B.2 Yard for Logistics**. Employing **C.4 Diverse Tenure Models** could take place in the form of a ‘studio-workshop’ (see **P.3 Flexible Spaces for Making**). This could be combined with access to technology labs and production areas. Cooperative ownership models and management could foster more democratic foundations for shared making, depending less on big investors or single entrepreneurs for scaling up. Ecosystems of makers could be built on a **R.12 Material Database** or linked around **C.8 Accessible Material Recovery Facilities** to improve the circularity of materials. Larger and established manufacturers also have much to gain from renting out space or technology to smaller manufacturers, to get the most out of their assets while attracting younger talent or finding new approaches for collaboration. The potential to establish valuable links for the lateral transfer of know-how is very high. Old-fashioned technology rental companies remain useful, where technology is mobile and not needed on a regular basis.

FLEXIBLE SPACES FOR MAKING



Multi-functional spaces accommodate different user needs over time, allowing for easy reconfiguration, growth, or shrinkage of manufacturing processes.

Connected to:

R.6 / R.9 / R.11 / C.3 / C.4 / C.5 / B.3 / B.4 / B.5 / B.7 / B.8 / B.9 / P.2

CONTEXT

Flexibility in the architecture of manufacturing spaces is essential for businesses to adapt to new technology, to evolve according to production demands and develop manufacturing processes. Furthermore, with increasing pressure on urban industrial land, it is important for cities to encourage manufacturing spaces to be used efficiently. As many manufacturers rent space, there is some incentive to explore ways for businesses to have access to space that suits their needs. New industrial intensification and co-location projects can take 4-5 years, from conception to completion, to be finalised.

This is far too slow for most manufacturers and makes it nearly impossible for developers to predict the types of businesses that will occupy a space when a project is completed. Simple architectural solutions can allow for flexibility and spaces to be adapted according to needs. This particularly helps manufacturers who are exposed to economic cycles outside of their control. New technologies, hybrid business models, **P.2 Shared Technology & Making Spaces**, demands for **R.6 Sustainable Product Cycles**, or **R.11 Incentives for Research & Development** and flexible spaces are ways to incentivise manufacturers to be innovative, flexible and take risks.

PROBLEM

Most manufacturing spaces are to some extent customised to the occupants needs. Businesses can have very specific workflows, needs for design and management spaces, show-rooms, storage and distribution. Manufacturing spaces which are highly customised can be expensive or difficult to reoccupy after the original inhabitant has vacated the premises. This can be problematic for the city in terms of facing urban blight and underused space. Conversely, buildings which are not sufficiently flexible can render a business incapable of adapting to new technology, environmental standards or work processes. Businesses which are in a growth or contraction phase, may want to find a new location nearby their existing location to avoid interrupting relationships with other businesses or suppliers. If alternative available spaces require excessive amounts of renovation, the business may not be able to relocate.

FORCES

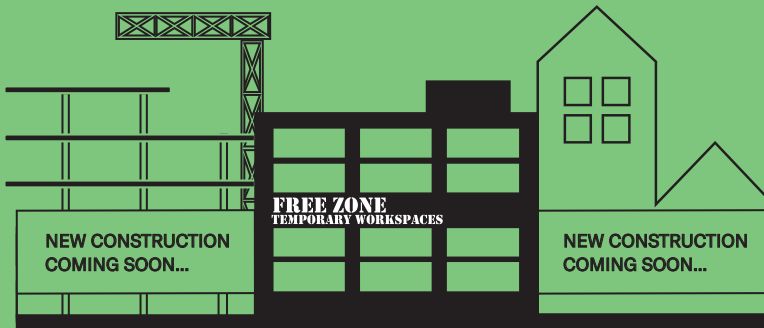
The responsibility for ensuring that spaces are flexible and adaptable lies both on the owner of the building / site and the public authority approving building permissions. Contingency and adaptability are the foundations of dynamic urban manufacturing but requires strong knowledge of industrial processes and negotiation capacities on behalf of the public authority approving the project.

SOLUTIONS

Provide flexibility in the design of spaces and buildings so manufacturing environments can be adapted to business' needs. At a district or block scale, **C.5 Varying Plot Sizes** (or buildings of different sizes or spaces) and **C.4 Diverse Tenure Models** can facilitate businesses to grow or contract within a specific location, particularly if they depend on the location for suppliers or clients. A **C.3**

Balance Between Public & Private Land can be necessary to correct the market by providing spaces that are necessary for critical forms of manufacturing (such as food production or waste management). At the building level, flexibility could include: ample **B.7 Access to Technical Services**, a design **B.4 Facilitating Horizontal Organisation** and **B.5 Enabling Vertical Making**, **B.9 Large Openings**, abundant **B.8 Space for Storage & Logistics**, modular construction, moveable or easily removable partitions (such as doorways), building heights to allow spaces to include a mezzanine (at least 5-6m floor to ceiling height), the capacity to create a client facing **B.3 Public Face** for retail or a showroom and possibilities to create a 'box in the box' insulated workroom for design or administration. Rental contracts can be developed for businesses to have **R.9 Assured Security of Space**, allowing them to subdivide or sublease space for **P.2 Shared Technology & Making Spaces**.

MEANWHILE SPACES & TRANSITIONAL USES



Meanwhile spaces can allow makers access to low-cost and low commitment access to space for making activities while also provide planners with a period to test new activities.

Connected to:

R.3 / R.10 / C.4 / C.5 / N.7 / B.7 / P.6 / P.7 / P.8

CONTEXT

Meanwhile, temporary or transitional space can offer makers affordable and low-risk conditions to develop a proof of concept or test manufacturing processes. Framing a site as 'meanwhile', 'transitional' or 'temporary' helps to reduce any preconceptions or stigmas held against foreign activities (like manufacturing) by local stakeholders and interest groups. Furthermore, some lighter and clean manufacturing can be tested in less conventional spaces for manufacturing such as office buildings or stacked car parking spaces. Finally, for land owners who find it difficult to fill in a space after a large tenant has left, transitional uses

can be a tool to test new usage typologies, particularly for communities of makers (see **C.5 Varying Unit Sizes**).

PROBLEM

While finding temporary occupants of vacant space is generally easy (particularly for cultural or community organisations), it can be challenging to find suitable businesses and organisations that will use the temporary period as a stepping stone before developing their idea or business into a longer term activity. Businesses or entrepreneurs may fail to think of temporary space to prototype or test small production runs. Consequently

new businesses may struggle to find local contract manufacturers for **N.7 Local Design and Prototyping** and consequently send their testing and production offshore from the beginning because of the assumed cheaper costs. The result is lost value for the local economy in terms of jobs, technical skills and local production chains. For businesses that use temporary spaces, **B.7 Access to Technical Networks & Services** may not be sufficient, rendering manufacturing challenging. Furthermore for building owners (of all types) temporary use may appear complex and daunting due to legal issues and the consequences of removing tenants at short notice. Building owners can also have little concern for their property, thus buildings can remain empty for extended periods of time and can evolve into blight.

FORCES

While temporary use of buildings can breathe new life into a site, it can also be used as a tool for gentrification to change poor neighbourhoods through ‘cultural’ or ‘community’ organisations or to mark the beginning of a ‘regeneration’ process of a former industrial neighbourhood. This can have positive outcomes however the consequences of gentrification should be properly studied, and where necessary suitable measures foreseen to avoid disrupting the neighbourhood (such as evictions or unreasonable rent increases). While meanwhile and temporary use are often a logical solution for activating vacant space, it can tread on questions of legality. Therefore occupants should sign a contract that assures the owner certain rights, including the capacity to easily terminate the contract. Even with water-tight contracts, it can be difficult to convince owners to allow temporary use unless the owners are threatened by a serious tax or fine, see **R.10 Place-Based Financial Levers**. Likewise, temporary use may involve buildings with old or poorly maintained infrastructure and electrical networks which can be costly to fix or

requires a clear definition of who is responsible in the likelihood of a problem, see **B.7 Access to Technical Networks & Services**.

SOLUTIONS

Take advantage of vacant buildings or spaces as an opportunity to test new ideas, create locations for start-ups or provide a place for community oriented activities. Temporary use of spaces, buildings or sites give priority to start-ups, **N.7 Local Design & Prototyping** to get new ideas off the ground and test production processes and **R.11 Incentives for Research & Development**. Temporary use can be seen as a community service vehicle and allow testing of activities that have a supporting role for a neighbourhood such as an **P.8 Community Hub in Making Locations**, spaces for **P.6 Re-use & Repair Centres** and **P.7 Spaces for Development and Education**. Likewise available space can be useful for businesses wanting to upscale (refer to **C.4 Diverse Tenure Models**). Temporary should not be considered simply an ephemeral activity, filling in time between two other activities. Quite the contrary, the temporary activity should be considered as a transitional period allowing for risks and exploring opportunities that could evolve into longer-term businesses, services or facilities. To activate temporary use, public authorities can use **R.10 Place Based Financial Levers** which either support owners to make their buildings available for temporary use, or fine those that leave their buildings vacant. Temporary use could be facilitated by a **R.3 Curator** operating at the district scale who is capable of connecting the needs of the owner and user. A call for proposals is a useful way to identify projects and select ones deemed compatible. The curator should stipulate the rental agreements to ensure both the building owner and the activity have some level of protection and security while understanding costs and charges. One important dimension involves clearly defining the minimum temporary use period so that the projects can make appropriate investments.

THE WORK HOME



Homes can be a key part of local production processes and provide accessible and flexible income if domestic spaces and work-live concepts can be used for micro-manufacturing.

Connected to:

R.5 / R.6 / C.1 / C.2 / B.5 / B.7 / B.9 / P.8

CONTEXT

Micro-manufacturing, refers to a living room sized production space involving just up to a few people. Such forms of manufacturing can provide both independence and flexibility for workers for those that offer niche and highly customised products. Affordable rental space can be very difficult to find, considering that this type of manufacturing often involve one person operations. With the rise of online platforms (Etsy, etc), activities of this scale are increasingly profitable and can provide a viable living. Making from home can consume little space while being compatible with or supplement other stable sources

of income. Micro-manufacturing may be commonly associated with fashion and clothing but can include emerging technology by assembling small electrical components or producing parts with 3D printers.

PROBLEM

In general, zoning plans can limit the kinds of activities that are permitted in housing. Working at home could be therefore illegal even if common practice and does not disturb neighbours. Irrespective of many inane reasons not to allow small-scale manufacturing in housing spaces, issues such as insurance

may provide a barrier or risk particularly for residents in apartment buildings. When working from home is permitted, particularly involving some form of light manufacturing, activities must have very low environmental impact (such as noise or odours). This concerns not only the neighbours but also the occupant of the space that may be exposed to unhealthy fumes. A serious investment in technical solutions like a fan or exhaust may be required, particularly for micro-manufacturing in denser neighbourhoods. Finally, working from home means that workers are isolated from social interactions that occur in larger working environments, resulting in poorer levels knowledge sharing.

FORCES

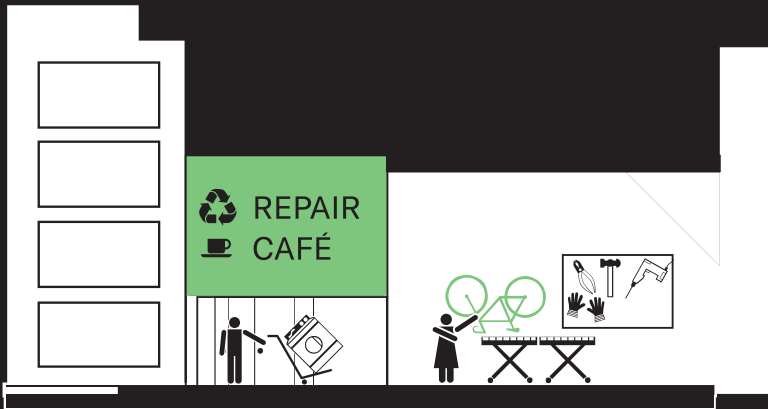
If working (manufacturing) from home is permitted, it could create conflict with neighbours as a result of nuisance from the production process, logistics or risk of an explosion or fire. This is particularly an issue when work occurs outside of typical working hours and particularly at night. Poor regulation and control over activities taking place in the domestic sphere could potentially result in undesirable activities and inequitable conditions (contrary to **R.5 Fair Work Conditions**). This could transform into sweatshop type conditions, linked also to labour through digital platforms that do not respect work regulations. It is therefore necessary for small-scale making to stay at the intersection with craft (knitting, tailoring, food preparation, etc.) to avoid unnecessary health and safety implications.

SOLUTION

Provide choice and flexibility for small-scale makers to work from home. City-wide regulation or **C.1 Microzoning** could allow residents to use a percentage of their residential floor area for economic activities, that include artisanal or highly customised forms of manufacturing.

Activities performed at home can be diverse and include speciality food production, bespoke clothing and niche electronics. Environmental impact should be performance based to ensure that there is flexibility in what can be made so long as neighbours are not affected by noise, odours or fire risks. Use **C.2 Negotiated Qualities & Environmental Criteria** and **R.5 Fair Work Conditions** as a guide. This way, the use of new, cleaner and more circular forms of making can be encouraged. Ultimately this could result in **R.6 Sustainable Product Cycles**, particularly for high value resources. New urban intensification and mixed use projects with work-live concepts should consider opportunities for working from home such as: **B.5 Enabling Vertical Making** (including a goods lift), **B.7 Access to Technical Networks and Services**, **B.9 Large Openings**, a flexible apartment layout, and good noise insulation. A **P.8 Community Hub in Making Locations** where support for home-workers is provided, could facilitate knowledge exchange within networks of decentralised producers, and offer a point of contact between entrepreneurs, employees, and residents to address issues and labour conditions. A **R.3 Curator** can be an important figure to help connect these small manufacturers and share relevant knowledge on trends, regulation and collaboration opportunities.

RE-USE & REPAIR CENTRES



A network of local exchange and repair centres encourages re-use and re-circulation of consumer and professional goods, providing opportunities for local employment and community building.

Connected to:

R.4 / R.5 / R.6 / R.10 / R.12 / C.1 / C.3 / C.4 / C.8 / C.10 / N.2 / N.5 / N.10 / P.7

CONTEXT

Re-circulation of resources through extending the life of products is beneficial to cities in a range of ways. Firstly promoting re-use and repair helps reduce material and energy use and generation of waste, particularly for electronics and furniture that can be costly to recycle. Re-use and repair help to create technical knowledge that can be used to build new products or improve established ones. Furthermore, through new technology, customised replacement parts can be developed that help prolong the life of a perfectly usable object while providing local business opportunities. Finally,

re-use and repair can be a gateway to very accessible work and help move people into specialist technical skills.

PROBLEM

While re-use and repair services were common in the past, global trade and reduction of commodities prices, especially those imported from abroad with lower labour costs, have resulted in the paradoxical situation that repairing activities have become marginally or substantially more expensive than buying a new product. This has resulted in an increasing volume and turnover of products and their associated waste

streams. For example, electronic waste is the fastest growing waste stream in European cities but opportunities to repair are limited firstly by a shortage of skills in product repairability and secondly in price of new products. While re-use and repair generally are considered low added value activities, they have substantial benefits in social and environmental value. They are socially beneficial, because in many cases these activities employ people at risk of exclusion, or are carried out by social enterprises. They're environmentally beneficial because they extend the life of products and reduce waste generation. Also, these activities can be better arranged in city areas where scale, density and proximity to customers and the market are optimal for establishing such networks. The biggest problem is that these activities need a viable business model or a change in legislation, otherwise the waste will ultimately remain the responsibility of public authorities.

FORCES

Land prices and competition with other higher added value activities mean that re-use and repair activities may require specific incentives to emerge and develop in cities. **C.6 Strategic access to Multi-Modal Mobility** connecting repair and re-use hubs to the rest of the city can stimulate **R.5 Fair Work Conditions** and may be necessary for social enterprises to provide **R.4 Availability of Diverse Jobs** as well as host **P.7 Spaces for Development & Education** but such locations will generally require some kind of support (such as subsidies) to cover rent of labour costs as businesses are rarely profitable. Pricing waste treatment into the cost of products would offer an incentive for large businesses to invest however that requires continental scale political support and regulation.

SOLUTIONS

Distribute re-use and repair centres across the city to ensure they are close to consumers, easily accessible, to minimise waste and extend product life cycles. Providing affordable and accessible space for repair and re-use activities, such as **N.10 Making Along High Streets**, can contribute to community building and **P.7 Spaces for Development & Education** connected to **N.7 Local Design & Prototyping** and result in **R.6 Sustainable Product Cycles**. Incentives are needed to safeguard space for social enterprises such as **C.4 Diverse Tenure Models** or through a **C.3 Balance between Public & Private Land**. They can also be supported through specific instruments such as tax-breaks, to stimulate the market and increase their competitiveness as an alternative to cheap imported products. Examples include generating profits from selling second hand products in charity shops or remanufactured products or lower Value Added Tax for repaired products. These could be accompanied by other policy incentives and **R.10 Place Based Financial Levers** to enhance social and environmental integration of these activities with the community. **C.10 Transition Zones** can also be suitable locations as they can benefit from both proximity to residential and commercial uses but also manufacturing activities where products and components can be further remanufactured. **C.8 Accessible to Material Recovery Facilities** can also be beneficial as a main source of pre-sorted products that are suitable for upcycling through repair and remanufacturing. Similarly, **N.5 Local Collection Points of Segregated Waste** may supply materials/ components and products for re-use and repair activities.

SPACES FOR DEVELOPMENT & EDUCATION



Training centres are necessary to facilitate education, share knowledge and develop relevant skills.

Connected to:

R.1 / R.2 / R.3 / R.4 / R.5 / N.3 / N.4 / B.3 / P.2 / P.8

CONTEXT

Training, whether for basic education or development of skills and knowledge, is an essential part of manufacturing to improve the capacity, efficiency and quality of production. Various types of training exist, ranging from simple certificates (such as first aid, health and safety or equipment licences), to trades (involving apprenticeships and technical education in training colleges) and to tertiary level degrees requiring extensive theoretical knowledge (typically provided by universities or a professional skills institutes). Businesses generally provide some level of introductory training for all new staff to adapt to

the company's technology and production processes. In some cases, businesses have such particular work that new employees will be expected to have just general skills as training occurs largely on the job. More recently, with rapid changes to technology and production processes, short development courses have become more common to encourage incremental learning. Irrespective, spaces are required for training, spaces which allow people to easily gain skills and knowledge to adapt skills for an existing job or prepare for a new one. These spaces could come in a range of formats, from traditional trades colleges to universities and simple community spaces.

PROBLEM

Manufacturers complain of the difficulty to find suitably skilled workers. The decline of manufacturing jobs in many cities has also lead to serious reductions in both public support for and financing of training facilities and programs. In many cases, instead of modernising and adapting training to trends in manufacturing, training budgets have simply been cut, reducing the availability of skilled workers. Skills and training issues are different depending on the size of the company. Small and middle-sized businesses have smaller resources to create partnerships with training centres or to find rare skills on the labour market. Conversely, larger companies are increasingly providing in-house training, making it hard to replicate for complementary or competing businesses. Furthermore, with rapid change in technology, employees need regular but shorter courses and training modules to remain relevant to industry standards and for businesses to remain competitive. One of the fundamental questions remains: what role should public actors play in the development and education of staff?

FORCES

Training often relates to market demands. Many cities have changed their technical training institutions to focus more on services oriented work rather than technical and mechanical skills as this is where job growth is foreseen. Likewise, many universities and tertiary education institutions are decreasing budgets for mechanical training while shifting focus on ICT and software development as it is considered more profitable in terms of grants and training costs. Unless incentives are given for training and business development, the net result will be a loss of the 'industrial commons', the knowledge and technical skills that is shared across a manufacturing sector. This can be contrary to political ambitions for the likes of developing the circular economy or building technology clusters.

SOLUTIONS

Provide spaces for development and education to ensure that staff are suitably trained, workers have opportunities to expand knowledge and employees are capable of delivering high quality goods. To prepare for the ***R.4 Availability of Diverse Jobs***, there are three predominant training streams directly focused on manufacturing. Firstly low-skilled and repetitive jobs may need to adhere to certain standards including safety, hygiene, communications and possibly first aid. Such training could occur on-site or through an accredited training centre, especially within neighbourhoods ***N.3 Mixing Complementary Making & Related Services***. Secondly, skilled workers, those with extensive technical training such as electricians or bakers, require classic institutional education to accredit basic knowledge, with a suitable (2-4 year) apprenticeship. To avoid using outdated machinery, equipment for education could be co-sponsored by industry groups or by locating education in ***P.2 Shared Technology and Making Spaces*** to ensure that young talent is relevant for the market. Finally, pluri-disciplinary workers, those with both technical and tertiary education, can build skills through university technical labs or maker-spaces. Examples of advanced manufacturing centres exist that combine technical training (vocational training) and theoretical knowledge (universities) within neighbourhoods ***N.4 Clustering Similar Making***. Such spaces allow thinkers, makers and entrepreneurs to rub shoulders. Neighbourhood training spaces can be combined with a ***P.8 Community Hub in Making Locations*** while a ***R.3 Curator*** could help link available training with small and medium sized businesses. In addition, communication campaigns are needed to raise the profile of skills training programmes and centres that feed the manufacturing workforces, ***R.1 Making Making Visible*** is essential to draw interest in education.

COMMUNITY HUB IN MAKING LOCATIONS



An inclusive hub helps facilitate knowledge exchange, nurture a place-based network of makers, encourage collaboration and provide businesses with a space to discuss collective problems and opportunities.

Connected to:

R.1 / R.3 / R.7 / R.10 / N.3 / N.4 / B.3 / P.2 / P.7

CONTEXT

While historians have connected the arrival of coffee houses in the UK as a trigger for the enlightenment and eventually the industrial revolution, there is no doubt that informal places for interaction and engagement are critical for building relationships, sharing ideas and spreading news. There is no standard format of such spaces, who owns them or what activities occurs. Yet such spaces provide unquantifiable value.

PROBLEM

Industrial neighbourhoods often have cafés, sandwich shops, bars and even

restaurants, but few naturally develop into the status of a community hub which supports and stimulates the manufacturing community. The conditions and soft skills required to facilitate a community hub are not naturally found in industrial areas and may require external financing and capacity. Likewise as a result of a lack of meeting places, (larger) businesses will invest in their own, which is unlikely to encourage the free exchange of ideas and knowledge between neighbouring businesses.

FORCES

Community hubs require stimulation

by a public authority or an organisation that is interested in pulling together the traditional triple helix actors (public institutions, knowledge generators and businesses) to support **N.3 Mixing Complementary Making & Related Services**. Public financing is a serious challenge to provide long-term structural support. Subsidies and donations can dry up quickly unless there is a clear public benefit in supporting such an organisation. Private financing for such a role is very unlikely unless it comes in the form of a membership or local tax. A mixed funding model is sensible but it also requires an entrepreneurial organisation that sees the benefit of community building. The actor involved in developing the hub must have a clear idea of the needs of the area and what kind of spaces and activities will naturally draw local businesses to it. Furthermore, even if finance is available for a community hub, local businesses and workers may need good reasons to use it. Reasons include social events to learn about challenges and opportunities, training sessions or presentations on new expertise. Finally, there is a serious dependence on an area manager or **R3 Curator** to be the point of contact, requiring strong interpersonal skills and generalist knowledge of technical, social and financial issues affecting businesses.

SOLUTIONS

Create a community hub to improve informal relationships between makers, while generating opportunities for innovation, skills development and business incubation. In some cases the hub will be a bar or restaurant. It could be a community centre or a cafe connected to a public business development agency. It may also be a conference space or hotel. Regardless, the atmosphere of the space should be sufficiently inclusive to draw a wide range of actors at any time the day, irrespective of class, sex or background. The facility should be multi-functional and encourage users to visit the hub for

various reasons, whether it be a meeting, attend an event, have lunch, look for a possible project partner or seek business support. A range of small and large spaces should be available where meetings and events can take place. There are three particular dimensions to address. Firstly, the purpose of the hub can be diverse, and could facilitate **R.1 Making Making Visible**, supporting businesses in **N.3 Mixing Complementary Making & Related Services**, **N.4 Clustering Similar Making** and/or even becoming **P.7 Spaces for Development & Education**. Secondly, financing the hub will change from place to place. Some will start with public or private seed funding and then auto-finance through a restaurant or events. Public financing can be generated through **R.10 Place Based Financial Levers** such as taxes, cultural and research grants or business development financing. Finally, responsibility for the community hub is essential. It should be coordinated by a person or organisation with strong interpersonal skills that can facilitate events and connect individuals. A **R.3 Curator** or curatorial team could be actively involved in understanding the needs of the local businesses and develop relationships, host events, explore opportunities for **P.2 Shared Technology & Making Spaces**, build **R.7 Multi-scalar Circular Infrastructure** and help convert informal relationships into business, new design and output.

APPLICATION

APPLICATION: PROCESS ORIENTED PLANNING & DESIGN

Turning knowledge into action involves design and planning. As described in the first three chapters of this book, urban manufacturing comes loaded with a large range of variables which renders it challenging to manage. Urban manufacturing is a complex dynamic system, where a change to one element can have consequences that are not self-evident elsewhere. The pattern language illustrated in **chapter 4** comprises fifty generalised solutions, referred to as patterns, that can be interpreted and prioritised according to a specific problem or place. To deal with the complexity of urban manufacturing, a collaboration is key and the patterns offer a discussion aid for planning and decision making. Multi-disciplinary collaboration may not come naturally for all concerned actors and working with a pattern language is likely to be novel or alien. Therefore, this chapter outlines a range of ways to facilitate concerned actors to address urban manufacturing through discussion and collaboration. Finally, we cover four methods to use the pattern language according to the phase of a project or discussion.

APPLYING THE PATTERN LANGUAGE

Urban development processes are increasingly challenging in many cities due to the constantly growing claim for limited space and an acceptance of social, financial and environmental complexity. Co-creation and co-development can enhance these development processes in three ways. First, it can help to address the multitude of interests and needs. Second, it can increase the applicability and implementation of effective solutions. Third, it can ensure that the project ambitions, defined by the concerned stakeholders, is based on shared experiences and not on assumptions.

As introduced in chapter 4, the patterns lead to concrete solutions, examples we have found through fieldwork and research. The application of specific patterns will depend on the specific context, including: concerned actors, spatial conditions, available resources and opportunities. These conditions will rarely be similar. The patterns provide a base for a useful discussion and decision making yet need to be selected and prioritised to be useful. A *pattern language* will include the range of patterns that have been selected or prioritised to address a specific site or problem.

In this chapter we present four types of applications, common for urban development processes that can be applied in a range of workshop settings. **Analysing** (p222) involves using the patterns to explore main questions facing a business, site or area. **Visioning** (p223) is about defining the main ambitions or objectives. **Designing** (p225) involves building the specific functions and spatial configuration of a site or neighbourhood. **Monitoring** (p225) is about assessing the impact of development or the performance of an area. For each application we provide a suggestion of the main steps, from the selection of individual patterns to their systemic implementation.

Before presenting the four applications we introduce process tools that support the facilitator/organiser of the co-development workshops in their preparation. It is



increasingly evident that 'soft skills' are needed to bridge disciplines and build projects around discussion and collaboration. A skilled facilitator can draw the essence out of collaborative processes, allowing different perspectives to manifest while finding constructive outcomes. The patterns should be 'facilitated' to ensure that these generic solutions are relevant and applicable.

PROCESS TOOLS FOR CO-CREATION AND DEVELOPMENT

Over the following pages, we present four process-oriented design tools to support workshop facilitators in the preparation phase to preselect relevant patterns (described in chapter 4). These exercises can take 30 minutes to a few hours, ideal with a group of 3-10 participants. Such exercises build on a vast amount of collaboration tools for social innovation¹, design² and business³.

STAKEHOLDERS & ACTORS

Overview

Integrating the needs of different stakeholders is one of the most challenging aspects of urban planning and policy making. Mapping out stakeholders can help to organise how to understand interests, how to create alliances and how to avoid conflicts. It also can help to understand which stakeholders will play an active role in the process, which could be useful to include, and which are either observers or have an administrative interest (for example the fire brigade or police). The stakeholder map is a crude instrument and therefore should be used for scoping. It is best developed through collaboration and if necessary combined with a scale map of a site to show the specific location actors are connected with.

Description

The 'Penta-helix stakeholder map' is a simple tool to analyse interest groups and actors. The map is based on the concept of the 'triple-helix', which emerged during the 1950's, for public financed based innovation. There are five stakeholder groups:

- **Public services:** There are two strong subgroups. Firstly, the elected official, dealing largely with policy. Secondly the administrative and technical staff.
- **Knowledge:** Actors offering services to support through knowledge and expertise. This includes designers, researchers, engineers and so forth.
- **Community:** These are organised public groups that are concerned with the health and welfare of their community. Such groups are often non-profit or completely voluntary.
- **Business:** Businesses represent organisations which are often providing a product, which may be both material and non-material. If looking at the city scale, businesses could be clustered under their respective typologies (such as the bakers or waste management companies) or they can be represented by an industry lobby (such as the chamber of commerce). When focused on a neighbourhood, it can be useful to distinguish individual companies.
- **Capital:** This refers to the ownership of land, technology or finance.

THE PENTA-HELIX STAKEHOLDER MAP



Fig 4. Source: Osmos

These five groups can include stakeholders which fit into numerous categories (a public developer may be a public service, a kind of business while also owning capital). If this is the case, it is very possible that the organisation will have subdivisions responsible for different aspects of the organisation.

The map requires stakeholders to be located at the scale they are most active in since a stakeholder's interest can differ according to the scale they operate on. The difference between these scales needs to be reviewed according to each site. The micro scale could relate to a building, block or street, the meta scale could be the metropolitan area or beyond.

Stakeholders are generally representatives of an organised group. This may be a public institution, a lobby group, a company (or group of companies) or even a community organisation. If community members are assembled behind a legal entity, such as a non-profit association, they can also be included. Users and residents who are not assembled should be analysed according to their needs.

Application

- 1 If in a group, take 10 minutes to individually (to avoid groupthink) write down the names of relevant stakeholders for the project. Where possible note their interest (or possible conflict).
- 2 On a map (A3-A1 sized is useful), note the location of the stakeholder in the diagram, with post-it notes if necessary. Stakeholders may be positioned in more than one category. Consider also the scale of their interest.
- 3 Once the stakeholders are mapped, use the map as a discussion point with people that were not in the workshop but may represent other interests.
- 4 Look for gaps in the map, where there may be an evident lack of stakeholders. This could be a weakness or opportunity.
- 5 Finally, consider alliances or possible conflicts between actors.

Stakeholders can change their interests or priorities; therefore it is useful to regularly consult and update the map.

VALUES / DRIVERS

Overview

Developing a project or dealing with a problem is often filled with emotional motivators or apprehensions. These can be borne out of previous experiences. Collective experiences can be important starting points. Past traumas for example, can be poisonous for a project if not addressed early on. It is therefore useful to help surface both past positive and negative experiences while looking at future hopes and fears.

Description

The chart of emotions is created by the future and past, bisected by the positive and negative. This creates four quadrants of hopes, fears, trauma and nostalgia.

- ***Nostalgia and trauma should be based on concrete and tangible***



Fig 5. Source: Osmos

experiences. Where possible, anecdotes are useful to revisit these experiences.

- *Hopes and fears can be abstract, but can also be tangible outcomes (for example, completing a project or having a machine break down).*

Application

Ensure there are a range of people present that represent different perspectives. If working at the neighbourhood scale ensure representatives for mobility, environmental issues, urbanism and planning, employment and work and business. If focusing on a business, ensure the presence of general management, human resources and staffing, sales, distribution and the labourers.

- 1 Draw the quadrant on an A1-A0 sized page. Use post-its or write directly on the sheet.
- 2 Start by giving the group a few minutes to consider previous experiences and allowing each person to write down at least one experience.
- 3 Where possible begin with Nostalgia, moving to trauma.
- 4 Allow participants to reflect on nostalgias and traumas and turn them into hopes and fears.
- 5 Focus on new hopes and fears.

Keep the chart accessible and visible during ideation or reflection moments of the pattern language application workshops.

FRAMING CONDITIONS

Overview

This tool is aimed at businesses. Policy, regulation and financial instruments can be extremely complex and difficult to navigate for anyone attempting to deal with urban manufacturing. Whether it be a business wanting to develop their site, a planner exploring the potential for a neighbourhood or a public authority interested in supporting manufacturing, important opportunities and constraints due to planning regulations and financial instruments are often encountered only after work has been done or significant decisions have been made. This is particularly a challenge to businesses that have limited time or budgets to explore ways to adapt their sites or need to weigh up the benefits of moving. Often decisions involve trade-offs, which should be discussed openly with public authorities to build business that provide clear benefits for the city. There may also exist incentives or financial instruments used to attract manufacturers to change or adapt their businesses, yet such incentives may not be evident to businesses.

Description

The framing conditions canvas can be used in two ways: firstly, to understand benefits or constraints for development, and secondly it can be used to evaluate a business' strengths or weaknesses due to planning and financial instruments. The canvas is split into two columns.



Fig 6. Source: lisa Nakhlé & Adrian Vickery Hill

Spatial conditions refer to planning, architecture and the functionality of a space.

- ***Logistics & Mobility** refers to the accessibility of large vehicles and the ease by which goods can be easily moved from vehicles into buildings.*
- ***Neighbourhood** refers to ambitions that may be set at the neighbourhood level through a masterplanning instrument which may provide a business leverage for negotiation with a public authority. Zoning at a neighbourhood scale may also be a weakness if it is subject to change. This can affect businesses that need to make long-term investments.*
- ***Building** refers to architectural regulation associated with fire, load bearing, noise, natural light and other standards which may impact the design of a building. It may also relate to building heights, access points from the street and setbacks from the front boundary.*
- ***Environment & Externalities** refers to limitations or constraints imposed on a site due to proximity to neighbours, due to sensitive ecosystems or due to potential flooding or fire issues.*

Financial instruments, there are a range of financial tools that public authorities often employ to influence or manage development.

- ***Taxes** are generally a cost. They can range from taxes for equipment, levies for parking spaces, operating licences, workforce taxes, land use taxes, sales taxes and so on.*
- ***Subsidies** may be provided to improve competitiveness, adapt to new regulation (such as carbon emissions) or change business models (such as to become more circular).*
- ***Training & skills** can be provided or subsidised by the government to develop a workforce or improve productivity. While this may not provide direct cash incentives, a choice of well-trained workers certainly can be a very useful stimulant for businesses to remain in urban areas.*
- ***Research & development (R&D)** can be useful for both established businesses that are exploring new materials or technology or universities or research organisations that are specialised in R&D. Some cities can use R&D as a successful export in itself.*

Application

Ensure there is someone to represent various perspectives, particularly individuals that can represent the financial tools, the planning instruments and the social context.

- 1 If planning conditions are performance oriented, use examples of different business types to test how they may react (such as a bakery, a metal recycling plant, a biotech lab, a printer...).
- 2 Look for connections between the themes. For example taxes may be imposed on the amount of floorspace occupied.

THE PROJECT-ENVIRONMENT CANVAS

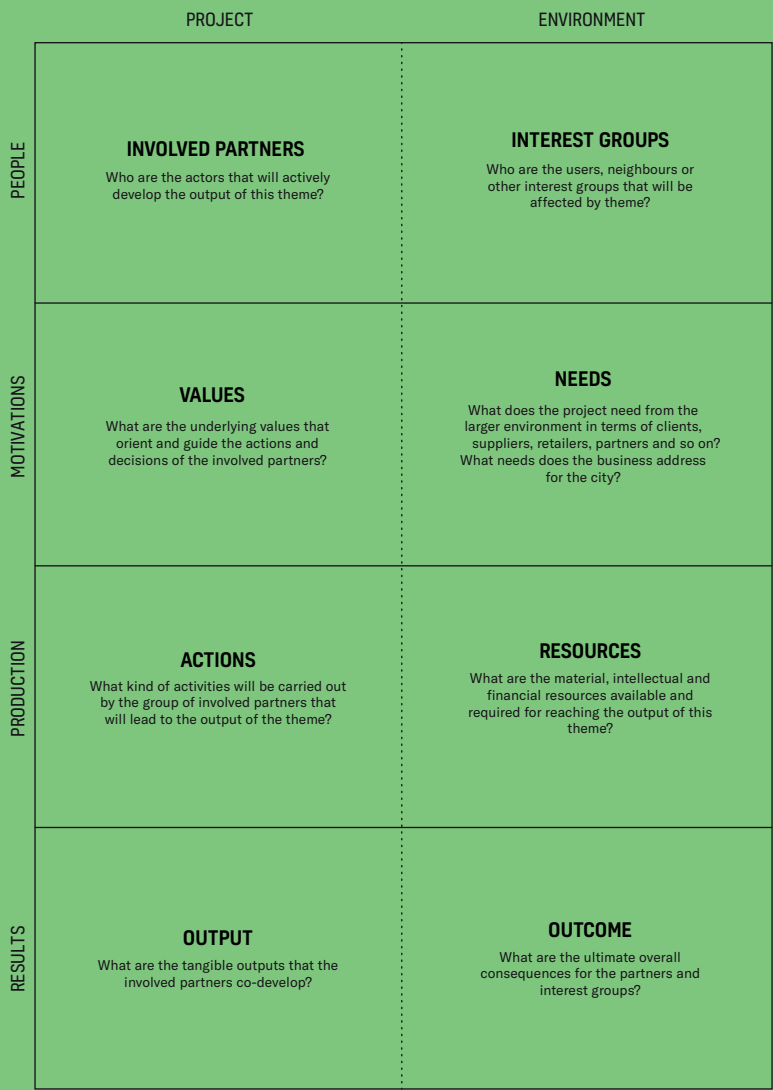


FIG 7. Source: Osmos

PROJECT-ENVIRONMENT

Overview

As described throughout this book, urban manufacturing should be well aligned with the needs of the city or take advantage of specialist skills or resources available in the city. What this means in practice will fall into the hands of policy makers and regulation. Businesses that are very city oriented may expect to benefit from incentives such as business support, tax breaks, financing for new equipment or training for staff.

Description

The project environment canvas helps to quickly map out how a manufacturer relates to its context. It can be used for existing manufacturers, new ones or to help out the type of organisation that may be necessary to complement other manufacturers. There are four layers of information relating to the project (essentially the business or proposed business) and the environment (which could be a neighbourhood or the city itself).

- ***People:*** *The involved partners or those directly involved in the business itself (such as type of staff) or those helping the business (through technical services, financing a or suppliers). Interest groups are those that may have a concern for the business to produce a certain product or because the business may impact their lives in some way (work, knowledge, environmental issues and so on).*
- ***Motivations:*** *The business will project have certain values of what its product or service offers, which can be both perceived values or the company values. These may address certain needs from the community or city, or may have certain needs from the city.*
- ***Production:*** *The business will perform certain actions in terms of transforming materials or creating goods. The manufacturer will depend on certain resources which could be supplied locally or beyond.*
- ***Results:*** *The production process will result in certain forms of output, such as bread or wooden cabinets. The outcome for society of the production process could be much broader such as providing food and furniture or recycling local resources.*

Application

This exercise can be a quick brainstorming tool that can be pre-filled by the organisation itself, or someone that knows the organisation. Once completed it can be discussed in a larger group, particularly with people that have relatively little working knowledge of the business. Use the canvas to compare businesses or design an ideal business.

Ensure the group can represent a range of perspectives such as business, sales, the community and users or clients.

- 1 If developing the exercise in a group, use post-its to allow the canvas to be easily populated and adjusted.
- 2 There is no specific order to fill in the canvas and it can be easiest to start from the output or the values.



Planners and designers instinctively start by trying to solve problems and define solutions before really understanding the complexity of a project or site. During the analysis phase, the patterns can be treated at the very least as a kind of checklist to systematically review issues which may not be apparent. The analysis stage should be used to help define the scope of a project, while investigating potentials and challenges. By running this exercise in a group, particularly with a wide range of experts or interest groups, it is possible to use the patterns as the basis for discussion and to prioritise issues.

Suggested steps:

- 1 For neighbourhoods or project areas, map out stakeholders (Figure 4, p214) to survey interests.
- 2 For established businesses, complete a project-environment canvas (Figure 7, p220).
- 3 Lay out the full list of patterns, pick out a shortlist and then prioritise the most relevant ones based on the current situation.
- 4 Consider trends, plans and foreseeable projects. What patterns would be relevant with five or ten years?
- 5 How are the patterns relevant for the current situation compared with the foreseeable future? If changes have occurred, define why. If there are various scenarios, compare them. If necessary plot the patterns on a SWOT analysis (strengths, weaknesses, opportunities and threats) to compare them.

VISIONING

Visioning is about looking for opportunities and ways to integrate the needs of different stakeholders, before a concrete project or action plan has been developed. Visioning should involve stakeholders to reach at least the following two outcomes. Firstly, through co-creation, stakeholders should help improve the quality of a project by contributing to different forms of knowledge and experiences. Secondly, by involving stakeholders early in the conception of a project, visions and ambitions can be aligned, helping to avoid conflict in the long-term while also developing cooperation and investment. Visioning can be carried out by organisations (public authorities or businesses), to explore their position in relation to a larger dynamic. In this way a vision should remain relatively abstract and allow specific details to be developed over time. This will provide space for flexibility and innovation. The pattern language helps to make the vision more explicit and helps focus on specific action areas.

Suggested steps:

- 1 Each actor or stakeholder receives the full pattern language and chooses the relevant patterns to address their needs.
- 2 In smaller thematic groups, discuss a specific topic (such as logistics or circular resource management). Debate the prioritisation of individual ambitions and distinguish them according to responsibilities.
- 3 In a discussion with the large group, assess the compatibilities and possible synergies with other patterns and identify possible conflicts. Otherwise refer to the suggested connections related to each pattern regarding synergies and possible conflicts.
- 4 Conflicting patterns should be discussed to decide how these issues should be dealt with in the future and how said conflicts can be managed.



A WORKSHOP EXPLORING VISION OF AN INDUSTRIAL AREA IN LONDON / © B CROXFORD

The agreed final pattern set becomes the vision for the site or company. To establish a starting point, prioritise actions such as writing a design brief. Alternatively define deadlines for objectives to be met.

DESIGNING

Design, for either a site or a business, will generally start after a brief has been written. This could be built on a larger vision for the site or area. Design could involve various aspects such as space, processes or a larger system. This means that the application of the pattern language for design can include operational aspects, like financing or technology, that are relevant to successfully develop a manufacturing project. As urban manufacturing often involves a limited amount of available space, it is important that designs are carefully dimensioned and can be realistically integrated into the urban context.

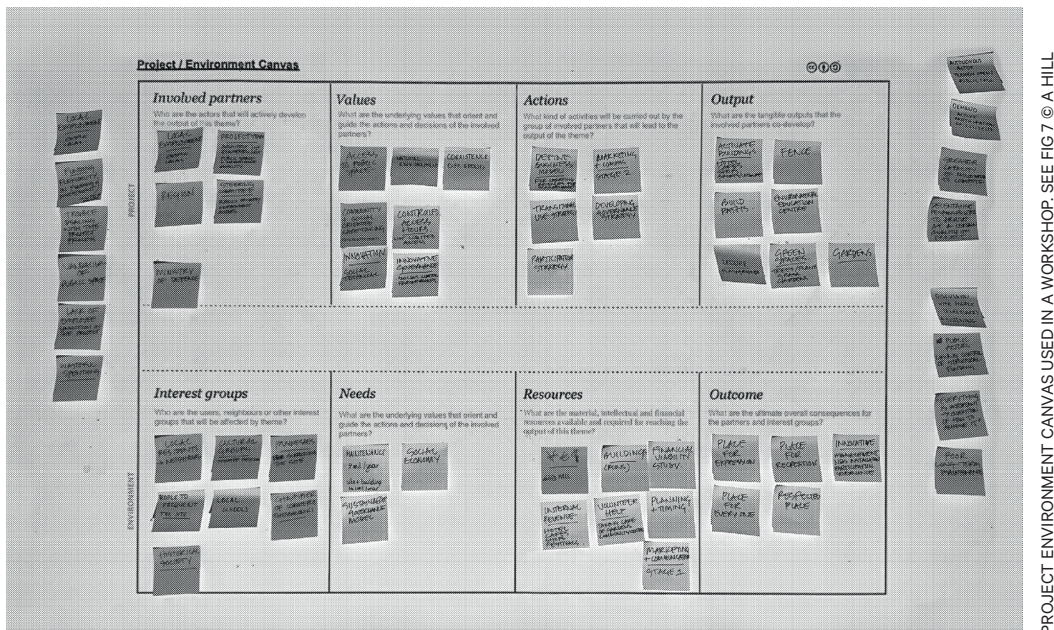
Designers and planners are necessary to link the ambitions of the programme with the potential of the site. This requires that the design team has appropriate expertise to adapt and improve the production process. For example user centred designers can help develop space for innovation and efficient working environments. Specialist engineers will be required to assess the capacity for co-location or vertical manufacturing, for acoustics and technical networks. Planners may be required for efficient logistics spaces, spaces for waste management and so forth. The patterns should be used to improve the collaboration process between these experts.

Suggested steps:

- 1 Based on the vision or the brief, the designer or planner assembles a limited set of patterns (4-8), that have greatest priority.
- 2 In a first evaluation step, individually, the team members assess if they consider the chosen patterns as relevant and indicate if they are missing a pattern which can be added from the rest of the pattern language.
- 3 In a debate with the other team members, the outcome of the first round of discussion is presented to the larger group to allow the group to debate priorities. The prioritised patterns must find their way into the design project. The set is adapted after this phase to review other priorities.
- 4 The map of the project site can then be analysed with the help of the urban designer or planner to discuss the viability or application of the prioritised patterns and discuss possible missing patterns or a list of secondary patterns.
- 5 With a full list of prioritised patterns, the designer can sketch out possible translations of the patterns into a design on the site map. This can lead to another round of review of the viability or priority of the patterns.

MONITORING

The pattern language can be used to monitor general performance or impact of development. In the case of changes, being spatial, organisational, administrative or technical,



the effects of the development can be evaluated. Possible effects of development in neighbouring areas could also impact mobility, or parts of a business' operation could be affected due to the loss of a supplier or key partner. At the same, time socio-technical development or costs of materials might alter a production process and have unexpected knock-on effects. Through monitoring, it can become clearer how sites or neighbourhoods change and identify opportunities for new projects.

Monitoring can be carried out by different actors such as public authorities, the local area manager or a curator (R.3) but it is useful to have a multi-disciplinary stakeholder group (ideally representing logistics, spatial planning, environmental management, human resources and skills, sales, resource management and so on) to review what is monitored and how it is monitored. Monitoring can be expensive and time consuming, so it is important to focus on the most relevant indicators.

Suggested steps for selecting indicators:

- 1 Allow stakeholders to individually select relevant patterns and to prioritise their selection.
- 2 In a group, allow the stakeholders to lay out their selected patterns according to priority. If patterns were previously identified in a visioning or design phase, include these in the list. Select a limited set of prioritised patterns, more than 10-15 patterns can become difficult to manage. The selection can be done informally or through voting (allowing each person a limited number of votes, such as five). Review the shortlisted patterns to ensure that they cover a range of relevant topics.
- 3 Translate patterns into indicators, which can be quantitative and/or qualitative. Patterns may result in various forms of indicators (particularly training and skills such as *P.7 Spaces for Development & Education*).

- 4 Define the monitoring responsibilities and the amount of time and resources to invest in monitoring. Will monitoring be done only by a public authority or will businesses or the neighbourhood manager be responsible? Help incentivise businesses to collect data and if necessary (such as ***R.10 Place-based Financial Levers*** or ***R.12 Material Database***).
- 5 Define who will be responsible to follow up monitoring and how the quality and privacy of the data collection can be guaranteed. Define who has access to the data and under what conditions (can it be shared?).
- 6 Define the reporting period (such as every three months, half year, year or so on).
- 7 Set expected forecasts for certain indicators based on the impact of interventions, subsidies, development or changes in technology and resources.

Suggested steps for using monitoring data:

- 1 Review data to identify if any noticeable changes have occurred from previous review periods.
- 2 Identify causes and effects for any deviations in the data. Use the patterns as a reference. Consider changes in the larger context (neighbourhood or city scale) which could include suppliers, land use changes, development projects, new taxes or regulation.
- 3 Review if the indicators remain relevant and/or if other issues should be monitored. Follow the indicator suggestion process above.
- 4 Review expected forecasts for certain indicators based on the impact of interventions, subsidies, development or changes in technology and resources for the following period(s).

FROM DATA TO WISDOM

As proclaimed by astronomer Clifford Stoll, 'data is not wisdom'. Translating data into information, knowledge and even wisdom is done through tools and visualisations. Professions often grow around particular communications tools and attach weight and meaning to their respective tools. Multi-disciplinary collaboration will inevitably result in the convergence of a range of such communications tools which can make collaboration both richer and more complex. Spatial thinkers, like architects and engineers, depend on maps, designs and visualisations. Analytical thinkers like economists or sociologists use graphs or texts. Scenario planners may write stories and create visual montages. The patterns attempt to converge both analytical and synthetic forms of thinking. To ensure that the patterns are used effectively, it is imperative to be prepared with relevant base material that can be interpreted by a multi-disciplinary group.

SPATIAL INFORMATION

Spatial information is generally represented by mapping. All forms of mapping are nuanced and can only communicate a limited amount of information. Increasingly interactive mapping can superimpose layers of information. The following are some forms of spatial information that can support the use of patterns in a workshop setting.

- *Topographic maps can be useful for issues such as flooding but also where the landscape may be useful for accessibility, noise attenuation or visual impact.*
- *Land ownership maps help to identify the main interest groups and decision makers.*
- *Zoning maps and relevant land use regulation is useful to understand permitted land uses, building scale and possible interface with neighbouring areas. These maps can be difficult to interpret as they require not only an understanding of the regulation behind the zoning but also how flexible it is to changes or adaptation.*
- *Political boundaries and an indication of political persuasion of the elected officials which will be linked to a formal or informal economic vision.*
- *GIS analysis can be the most effective way of converging spatial and analytical information. This can include heatmaps, dot maps, cartograms, network flow maps and a vast range of infographics type mapping. It is important to treat this kind of mapping with caution as the source of data is not always easy to validate.*
- *Schematic maps are an abstract interpretation of a system and can be used to illustrate the production process. Such maps can be easily spatialised and used to show how people interact with technology or move around a space.*
- *Mobility maps and plans can show the roads accessible to certain sized vehicles (such as lorries or semi-trailers), they can show the volume of vehicle movement according to a certain period and issues related to congestion.*
- *Visions and designs are generally developed by designers, architects and planners to help describe a desirable future. These can include plans, maps, schemes and visualisations like photomontages.*

DATA AND ANALYTICAL INFORMATION

There is an extensive amount of relevant non-spatialised data and analytical information, covering a range of perspectives and expertise such as sociology, geography, anthropology, economics, finance, resource management and so forth. Due to the breadth of data and analytical information, it is difficult to prioritise their importance or relevance.

Likewise, it can be hard to translate ideas or knowledge into spatial terms which can make it challenging to embed them into a project. Regardless, the following are examples of different types of data and how they are interpreted.

Quantitative data:

- *Demographic and population data can be useful to understand the context of a site or neighbourhood. Information related to age, income, sex, education level and so on, can provide insight into how a neighbourhood may relate to a certain business or if the neighbourhood contains a source of workers or clients. It can often be sourced from municipalities or even open databases. Such data is generally communicated through graphs. Some of this data requires interpretation, such as employment and skills levels, as statistics may not have been correctly completed.*
- *Production and business data is very useful for understanding production chains, skills and measuring value added.*
- *Material flow data, often depicted with Sankey diagrams, is very useful to understand the flow of materials and to explore ways to improve production efficiencies, increase output or to take advantage of a waste stream. Material flow diagrams are often an approximation as data is typically a calculation, extrapolation or estimation. Some material streams are very valuable, while others may not be able to be treated within cities (such as steel). It is necessary to have an expert that can translate practical on the ground knowledge with an interpretation of material flow diagrams.*

Qualitative data:

- *Stakeholder mapping can involve interpreting the types of interest groups, decision making power and values of concerned stakeholders. Refer to the Penta-helix stakeholder mapping tool (Figure 4, p214).*
- *Interviews and questionnaires are important sources of information that can help to expose values and opinions from workers, clients or neighbours. It could involve anthropological research to understand how businesses operate or how space is used. Rarely will such information result in clear solutions. Therefore it requires an interpretation of how the results can be used to improve products, production processes and urban planning.*
- *History and storytelling can be based on archival research and interviews. It can be related to certain events or experiences which analyses collective memory and values. It can also include material that complements qualitative interviews through synthesis of the material.*

LIMITATIONS AND FURTHER CONSIDERATIONS

In researching material for this book, we often found data and planning information to be misleading and sometimes outright incorrect. Where data, maps and plans were available, it was not uncommon to find evident errors or miss-representations of reality which misconstrued the perception of how industrial neighbourhoods work and the health of the manufacturing sector in general. Examples are diverse and prove that any knowledge available must be treated with some level of scepticism. Available mapping should particularly be heavily scrutinised since what is noted on plans does not necessarily correspond with reality. Zoned industrial areas can contain vast amounts of other functions which have little to do with manufacturing. It is not uncommon to find retail, recreation and social activities (such as places of worship) in industrial areas which are located on such sites due to rental prices.

Data from sources like the European NACE database and derivations of them are very useful to gain a regional or national picture on employment conditions, material flows and economic conditions. But this data has serious accounting limitations when applying it closer to the ground. For example, most statistics are connected to a business' headquarters, which can be located far away from the place(s) of production. This and other workforce related data do not provide a clear picture of the role of freelance workers. Material flows remain estimations or pegged to NACE codes. Another issue is in identifying how sites are used when shared by a number of companies. All of this has resulted in assumptions being made about the manufacturing sector which can be misleading but difficult to refute due to a lack of alternative data. Seeking more realistic statistical insights can be an expensive and time-consuming exercise.

Site surveys can provide a much more realistic insight into businesses and their local conditions than statistical data. It is very useful to survey the actual activities that occur not only on blocks but also in the public streetscape, such as loading and deliveries. While this can require an investment of time, the knowledge produced is much richer while contact with business owners can be important to grow working relationships. Care should be taken in how to approach businesses as they can be apprehensive about sharing too much internal data for fear of losing intellectual property or exposing business secrets.

KEY IDEAS

The patterns can be translated into a place specific pattern language. Process oriented planning and design are increasingly imperative for dealing with complex place-based problems such as urban manufacturing. Practitioners need to adopt human centred tools to supplement the design process and to learn how to work within multi-disciplinary stakeholder groups or teams. Collaboration is key to ensure that problems are dealt with efficiently and to avoid conflict or confusion. The patterns presented in this book aim to be used as a tool for multi-disciplinary collaboration and can be applied in a range of ways according to the development process: from analysing and vision creation, to design and monitoring. To ensure that the patterns are relevant to the context, it is important that suitable base information is available, and that it can be easily understood across a multi-disciplinary group. Such information includes mapping, graphics representing quantitative data and qualitative data.

MANIFESTO

A MANIFESTO FOR 21ST CENTURY SUSTAINABLE URBAN MANUFACTURING

Manufacturing has evolved dramatically over the last century, yet there remains much work for it to become a vital part of 21st century cities. Where is the best place to start? The first three chapters helped to define the history, opportunities and challenges for urban manufacturing, which proves that it is a complex arena yet highly valuable asset for cities. This chapter outlines a manifesto for urban manufacturing, laying out twelve core actions that any city can start with. Each of these manifesto points can be traced back to the patterns in the previous chapters. This chapter does not intend to be exhaustive or prescriptive, yet provides a diverse enough range of points for departure. Each manifesto point is accompanied by a suggested list of patterns that can be used to get started.



A SIMPLE OPEN SPACE WITH NATURAL LIGHT, SUITABLE FOR A RANGE OF FUNCTIONS (LONDON) © T DOMENECH - R.5, B.4 & P.3

MANIFESTO POINTS

1 PROTECTION

Establish a suite of approaches to protect manufacturing spaces, allowing a variety of sized spaces distributed across the city.

Industrial land is rapidly disappearing or being replaced with non-manufacturing activities. Urban manufacturing needs a clear and robust protection system that supports manufacturing spaces while encouraging owners to make their spaces available to manufacturers. Clearer and stricter approaches are particularly needed to deal with real estate speculation. Furthermore, strategies must be customised to fit the context. Mixed use areas and transition zones need guidance from an area manager or curator to enforce both soft and hard development tools. The curator can help establishing a suitable mix of businesses while looking for ways to avoid real estate speculation. Furthermore, protection should not simply be limited to the manufacturing space, but also ensuring that a suitable variety of spaces are available. Protection is also required for traditional manufacturers that are important for the city but do not attract the attention of younger high-tech businesses.

Refer to patterns: R.3 Curator, R.9 Assured Security of Space, C.1 Microzoning, C.3 Balance Between Public and Private Land, C.4 Diverse Tenure Models, C.5 Varying Unit Sizes, C.9 Concentration of Noisy Making Along Infrastructure, C.10 Transition Zones, N.1 Taking Advantage of Place Conditions, N.3 Mixing Complementary Making & Related Services, N.4 Clustering Similar Making, N.9 Making Touches Making, N.10 Making Along High Streets, N.11 Back of The High Street, B.1 Making Around Courtyards, B.5 Enabling Vertical Making, P.4 Meanwhile Spaces & Transitional Uses, P.5 The Work Home.

2 FINANCING

Create investment packages to support manufacturers to be more competitive, more efficient, better integrated and more relevant to the city's needs.

Public investment is needed to boost competitiveness, support the adoption of new technologies, help companies adhere to environmental policy, gain access to space, improve production processes and to ensure manufacturing is benefitting the city. Investment can include funding research, developing buildings, creating incubation facilities or purchasing real estate, providing in-kind support for business development, offering accessible loans, providing training and so forth. Manufacturing can be mission oriented and respond to certain ambitions set at a metropolitan scale, for example waste reduction or developing excellence in bio-technology.

Refer to patterns: R.2 Transparent Making, R.6 Sustainable Product Cycles, R.10 Place-Based Financial Levers, R.11 Incentives for Research & Development, C.3 Balance

Between Public & Private Land, C.4 Diverse Tenure Models, N.2 Re-use of Materials & Energy Flows, N.7 Local Design & Prototyping, P.2 Shared Technology & Making Spaces, P.3 Flexible Spaces for Making, P.4 Meanwhile Spaces & Transitional Uses, P.7 Spaces for Development & Education, P.8 Community Hub in Making Locations

3 SPATIAL FRAMEWORK

Strengthen the structure or zoning plan of the urban region to regulate suitable spatial conditions for urban manufacturing.

Cities need variety: from places that are highly mixed to those areas that concentrate on a very specific activity. At a metropolitan scale, a structure plan can guide the distribution of mixed use areas across the city. Explore ways to accommodate mixed use zones and manufacturing into high streets. Protect manufacturing in fringe zones, particularly those areas protected by infrastructure or waterways, that support larger scale manufacturing and can house activities that produce odours, dust and noise. This helps by providing choice of locations to achieve the right mix of functions. The structure plan should build on existing centralities (for mixed use) and fringes (for industrial zones). New development near manufacturing areas should help increase opportunities for mixed use development and build good transition spaces towards mono-functional areas. This helps to avoid piecemeal development while strengthening a compatible mix of land uses at the right places across the city.

Refer to patterns: R.9 Assured Security of Space, C.1 Microzoning, C.5 Varying Unit Sizes, C.6 Strategic Access to Multimodal Mobility, C.7 Links to Transport Infrastructure, C.9 Concentrating Messy Making Along Infrastructure, C.10 Transition Zones, N.1 Taking Advantage of Place Conditions, N.4 Clustering Similar Making, N.6 Centralised Logistics Zone, N.9 Making Touches Making, N.10 Making Along High Streets, N.11 Back of the High Street

4 GOOD NEIGHBOURS

Design mixed use areas to avoid long-term conflicts and find complementarities between all occupants.

Industrial co-location is seen as a viable solution to pack a range of different activities into an area or even a building. Many neighbourhoods were traditionally mixed, but due to legislation (such as noise and fire) and due to developer's business models (few developers know how to create suitable mixed use projects), co-location policies have trouble being interpreted. Buildings are designed without suitable insulation, logistics access or flexibility in the design. Furthermore, housing developers often attach retail rates to the industrial spaces, which simply makes them unaffordable for many manufacturers. These issues can be solved through supporting developers during the design process (see **chapter 5**), developing spaces that are useful for manufacturers, that will not create tension between the industrial and residential occupants, ensuring developers' business models are realistic and where possible determining that a public or community facing organisation (such as a cooperative or NGO) takes ultimate control of the management of the manufacturing spaces. Mixed use areas can be complementary to all uses, allowing housing, cafés, gyms, corner shops, repair shops and others to be used by all occupants.

Refer to patterns: R.3 Curator, C.1 Microzoning, C.2 Negotiated Qualities & Environmental Criteria, C.4 Diverse Tenure Models, C.5 Varying Unit Sizes, C.9 Concentrating Messy Making Along Infrastructure, C.10 Transition Zones, N.1 Taking Advantage of Place Conditions, N.3 Complementary Making & Related Services, N.4 Clustering Similar Making, N.8 Quality Urban Environment in Making Areas, N.9 Making Touches Making, B.1 Making Around Courtyards, B.2 Yard for Logistics, B.3 Public Face, B.5 Enabling Vertical Making, B.9 Large Openings, P.1 Productive Rooftops, P.4 Meanwhile Spaces & Transitional Uses, P.5 The Work Home, P.7 Spaces for Development & Education, P.8 Community Hub in Making Locations.

5 ACCESS

Provide suitable low-carbon transport infrastructure for reliable flows of materials, personnel and goods.

For manufacturers to function effectively, they need clear and reliable supply chains and accessibility for staff, clients and partners. Manufacturers can thrive in dense inner-city areas if mobility and supply networks are available. Co-location between manufacturing and consumption activities can contribute to reduction of transport burdens. Improving air quality in cities (such as developing low-carbon zones) should consider suitable alternatives such as intermodal logistics hubs for inner-city logistics. This may require investment in current infrastructure, habilitation of water ways, introduction of electric mobility logistic networks and optimisation of logistic activities. Buildings also require sensible solutions that allow vehicles to move goods without affecting the general public.

Refer to patterns: R.6 Sustainable Product Cycles, R.7 Multi-scalar Circular Infrastructure, R.8 Moving Things Efficiently, R.10 Place-Based Financial Levers, R.12 Material Database, C.6 Strategic Access to Multimodal Mobility, C.7 Links to Transport Infrastructure, C.8 Accessible Material Recovery Facilities, C.9 Concentrating Messy Making Along Infrastructure, N.1 Taking Advantage of Place Conditions, N.6 Centralised Logistics Zone, B.2 Yard for Logistics, B.5 Enabling Vertical Making, B.6 Easy Loading & Unloading, B.7 Access to Technical Networks & Services, B.8 Space for Storage.

6 SUPPORT

Nurture the role of the curator to connect actors, improve the visibility of manufacturers, identify local needs, boost innovation and create business opportunities.

Businesses are more isolated than ever, particularly well established and less conspicuous businesses that are not making hip consumer products. Manufacturers lack a clear voice and struggle to connect manufacturing to their local contexts. This role could be taken on by a bridging actor, such as a curator, a park manager, facilitator or community agent. They can perform a vast range of competencies from identifying common issues, defining infrastructure needs, perform matchmaking services, help with business development, identify new spaces for manufacturing, connect interest groups and help with the integration of manufacturing activities in communities. This role can focus on a building, a neighbourhood or cover the extent of the city.

Refer to patterns: R.1 Making Making Visible, R.2 Transparent Making, R.3 Curator, R.7

Multi-scalar Circular Infrastructure, R.10 Place-Based Financial Levers, R.11 Incentives for Research & Development, R.12 Material Database, C.2 Negotiated Qualities & Environmental Criteria, C.10 Transition Zones, N.2 Re-use of Materials & Energy Flows, N.3 Mixing Complementary Making & Related Services, N.4 Clustering Similar Making, N.7 Local Design & Prototyping, N.8 Quality Urban Environment in Making Areas, N.9 Making Touches Making, B.3 Public Face, P.2 Shared Technology & Making Spaces, P.3 Flexible Spaces for Making, P.4 Meanwhile Spaces & Transitional Uses, P.8 Community Hub in Making Locations

7 EXCHANGE

Develop informal spaces for knowledge exchange and capacity building to drive mission based challenges.

Communities of manufacturers should build on collective strengths to create quality exports. Building informal relationships between manufacturers can help find complementaries and symbiosis. Connecting makers to designers, researchers, financiers and distributors can help turn ideas into products to solve problems or develop income. Community hubs can also provide platforms of exchange with the local population, providing additional visibility, hosting local capacity building and increase acceptance of working and living in proximity.

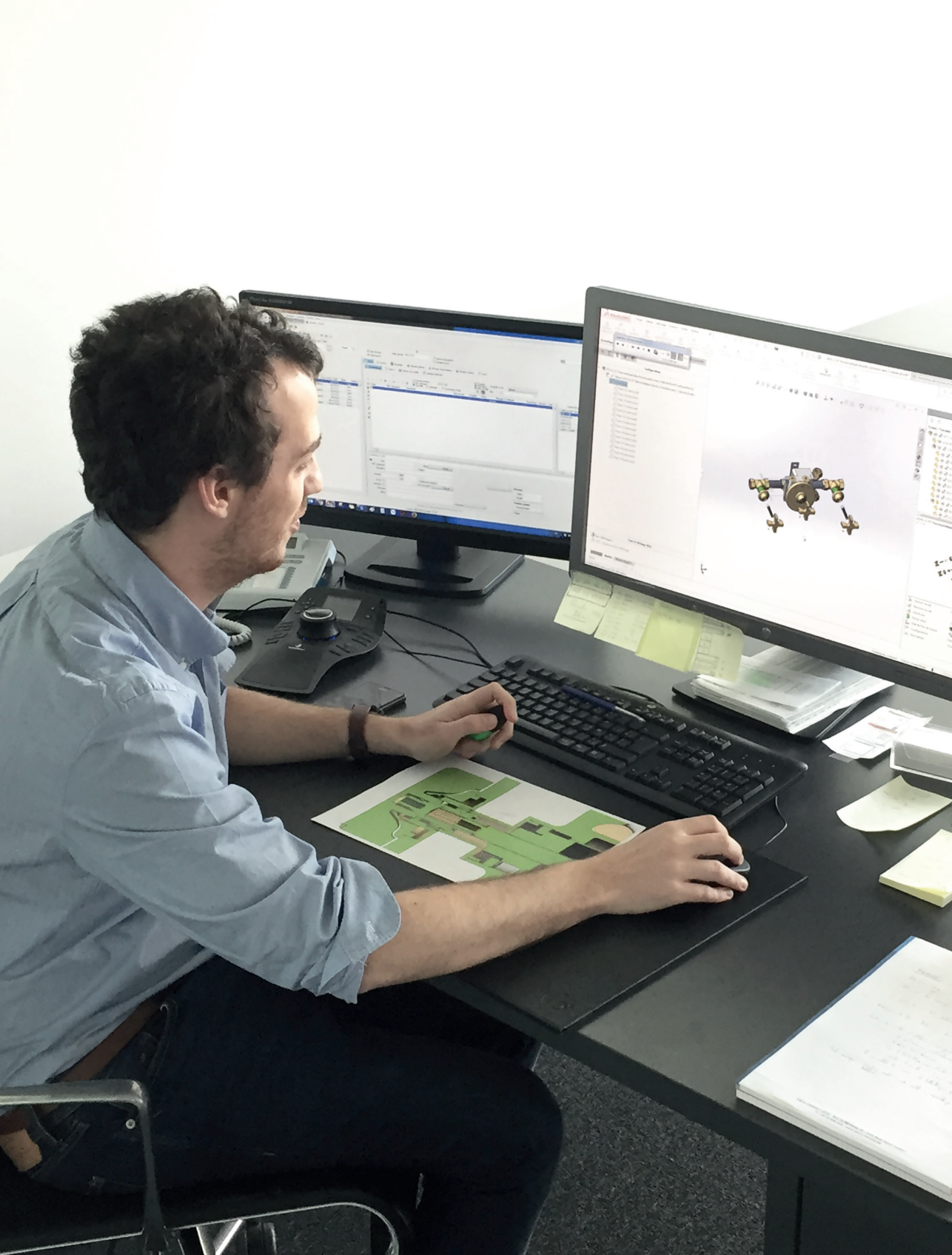
Refer to patterns: *R.1 Making Making Visible, R.2 Transparent Making, R.3 Curator, R.11 Incentives for Research & Development, N.3 Mixing Complementary Making & Related Services, N.7 Local Design & Prototyping, P.2 Shared Technology & Making Spaces, P.7 Spaces for Development & Education, P.8 Community Hub in Making Locations*

8 CIRCULARITY

Build resource efficient and circular manufacturing through public leadership, suitable available space, effective infrastructure, by promoting symbiotic relationships across businesses and between business and the city.

Manufacturing plays a crucial role in the transition to the circular economy to optimise resource flows, manage waste and take advantage of local materials. Manufacturers can be a vital asset for improved circularity. Industrial waste streams are a major opportunity for circularity, but manufacturers often lack the capacity, technology or space to effectively close cycles. Improved use of technology and resources can help local businesses. Yet they will unlikely have a significant impact without public support through moderating resource management and transferring the waste of one business into the feedstock of another. This requires storage, sorting yards, processing units, distribution chains and the necessary data systems to facilitate the process. Public authorities also play a key role in providing the infrastructure for the efficient use of heat produced by manufacturing processes.

Refer to patterns: *R.2 Transparent Making, R.3 Curator, R.6 Sustainable Product Cycles, R.7 Multi-scalar Circular Infrastructure, R.8 Moving Things Efficiently, R.10 Place-Based Financial Levers, R.11 Incentives for Research & Development, R.12 Material Database, C.1 Microzoning, C.7 Links to Transport Infrastructure, C.8 Accessible Material Recovery Facilities, C.9 Concentrating Messy Making Along Infrastructure, N.2 Re-use of Materials & Energy Flows, N.3 Mixing Complementary Making & Related Services, N.4 Clustering Similar Making, N.5 Local Collection Points of*



Segregated Waste, N.7 Local Design & Prototyping, B.2 Yard for Logistics, P.1 Productive Rooftops, P.6 Re-use & Repair Centres, P.8 Community Hub in Making Locations.

9 SHARED FACILITIES

Provide access to technology, space for risk-taking, incubate start-ups and nurture foundational forms of manufacturing with shared facilities.

Manufacturers, particularly foundational types of manufacturing (such as food production, construction, repair and resource management), are struggling to afford space, access high quality facilities and technology. This means established businesses are pushed to make a profit while younger businesses have limited access to the market. Furthermore, businesses are less likely to take risks, to test new products, to prototype, to push new products into the market and retain or attract talent. Public support and corporate philanthropy can facilitate access to shared resources. This can lead to clustering certain activities and strengthening local networks or makers.

Refer to patterns: R.2 Transparent Making, R.3 Curator, R.11 Incentives for Research & Development, C.1 Microzoning, N.3 Mixing Complementary Making & Related Services, N.4 Clustering Similar Making, N.7 Local Design & Prototyping, B.1 Making Around Courtyards, P.2 Shared Technology & Making Spaces, P.3 Flexible Spaces for Making, P.4 Meanwhile Spaces & Transitional Uses, P.7 Spaces for Development & Education, P.8 Community Hub in Making Locations.

10 SKILLS & KNOWLEDGE

Harness facilities for training and development of knowledge to address existing and future staffing needs.

Many businesses struggle to find suitable skilled staff that have the interest and drive to work in manufacturing. Youth are being channelled into cleaner, services oriented vocations and have less interest in technical skills or messy workplaces. Furthermore, workplaces employing new technology require hybrid skills, where workers have both technical and theoretical competencies. Training therefore must be shaped around forward looking employment opportunities and robust career pathways. Education should offer a gateway to manufacturing and minimise any barriers of entry (sex, race, wealth or background). Training should balance the needs for staff today with the desired future for the city's urban manufacturing in the coming decades. This may require new forms of incremental and adaptive education, whereby institutions provide basic skills and competency training which can be nourished by life-long learning tracks. Schemes supporting training on the job provide opportunities for better collaboration between city stakeholders to harness skills and capacity for the city.

Refer to patterns: R.2 Transparent Making, R.4 Availability of Diverse Jobs, R.5 Fair Work Conditions, R.10 Place-based Financial Levers, N.7 Local Design & Prototyping, P.2 Shared Technology & Making Spaces, P.6 Re-use & Repair Centres, P.7 Spaces for Development & Education, P.8 Community Hub in Making Locations

11 NETWORKS

Embed local manufacturing networks within the local economy through policy, urban planning and decision making.

Little is known about how urban manufacturers relate to their suppliers, their clients and how they depend on sources of technical expertise. Urban planning is increasingly complex and often manufacturers are affected negatively when development plans are rolled out. The impact of removing industrial land to gain space for housing or public space may only be visible many years after the initial development plans are tabled and approved. To avoid poor planning decisions and unintended consequences, source detailed information on how businesses operate, where they source materials, where staff are trained, where staff live, where waste is stored and where products are sold in order to allow for suitable evidence based decision making. By contrast, healthy manufacturing networks may need support to remain competitive or to develop new goods and services. By studying local networks, public support can benefit the aspect in most need or with greatest returns on investment.

Refer to patterns: R.1 Making Making Visible, R.2 Transparent Making, R.3 Curator, R.4 Availability of Diverse Jobs, R.5 Fair Work Conditions, R.6 Sustainable Product Cycles, R.7 Multi-scalar Circular Infrastructure, R.8 Moving Things Efficiently, R.9 Assured Security of Space, R.10 Place-based Financial Levers, R.12 Material Database, C.3 balance Between Public & Private Land, C.4 Diverse Tenure Models, C.5 Varying Unit Sizes, C.6 Strategic Access to Multimodal Mobility, C.7 Links to Transport Infrastructure, C.8 Accessible Material Recovery Facilities, N.2 Re-use of Materials & EnergyFlows, B.7 Access to Technical Networks & Services.

12 COMMUNICATION

Drive strong local communication to show the value of manufacturing.

Very few residents know what is made locally and what manufacturers do for the city. Public communication campaigns, open door days and festivals for locally made goods are excellent ways to connect manufacturers and the wider public while also helping to sustain the local economy. Such initiatives should be well founded within a larger economic vision which is also connected to research and development policies. Businesses themselves can provide greater levels of transparency by providing an insight into their products or production processes through public façades, communication material and windows connected to workshop spaces.

Refer to patterns: R.1 Making Making Visible, R.2 Transparent Making, R.3 Curator, N.7 Local Design & Prototyping, N.8 Quality Urban Environment in Making Areas, B.3 Public Face, P.2 Shared Technology & Making Spaces, P.4 Meanwhile Spaces & Transitional Uses, P.8 Community Hub in Making Locations.



MAKING IS MADE ON MAKING, A TRADITIONAL CANAL ZONE NOW HOUSES SPACE FOR FURNITURE MAKERS / © V SANZ - C.9, N.1, N.4 & N.9



meubelmakerij



SOME MANUFACTURING, LIKE WASTE MANAGEMENT, MUST BE CLOSE TO THE CITY BUT AWAY FROM HOUSING (BRUSSELS) / © A HILL - C.9, N.2 & N.4









ILIFFE YARD (LONDON), BUILT IN 1870, REMAINS A MODEL FOR WORK-LIVE SPACE BUILT AROUND A SHARED ROAD / © V SANZ - B.1, B.2 & B.3



INTRODUCTION

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CHAPTER 1

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CHAPTER 4

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CHAPTER 5

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- 2 The Ideo Foundation's design kit has an extensive range of design-based collaboration tools: www.designkit.org
- 3 The business model canvas is one of the easiest tools for analysing and communicating a business' motivations and structure but is complemented by a range of other tools: www.bmtoolbox.net

CHAPTER 3

- 1 For more information on the fieldwork and research behind this chapter, refer to www.citiesofmaking.com/category/results/report
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- 5 Josef Manner & Comp AG, Vienna: www.manner.com
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ABOUT THE BOOK

This book is the result of the Cities of Making project, a two and a half year JPI Urban Europe co-funded research project exploring the future of urban manufacturing in Europe. The project focused on three case study cities: Brussels, London and Rotterdam.

The project involved seven organisations: Latitude Platform for Urban Research and Design (project coordination), Brussels Enterprises Commerce and Industry, Technical University of Delft, The RSA, l'Université libre de Bruxelles, University College London, Vrije Universiteit Brussel.



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Despite the odds, manufacturing is not in terminal decay in western cities. On the contrary, it is at the opening of a new chapter. Urban manufacturing can help cities to be more innovative, circular, inclusive and resilient.

Since the 1970s, cities world-wide have been witness to radical de-industrialisation. Manufacturing was considered incompatible with urban life and was actively pushed out. As economies have grown, public officials and developers have instinctively shifted their priorities to short-term, high-yielding land uses such as offices, retail space and housing. Inner-city growth from New York to London and even Seoul have generally come at the expense of land uses such as manufacturing or logistics.

More recently, with increasing interest in the circular economy, with cleaner and more compact technology, with more progressive building codes for mixed use, with increasing awareness of the impacts of social inequality and with a clearer understanding of the value chains between the trade of material and immaterial goods, cities across the world are realising that manufacturing has an important place in the 21st century urban economy.

While both enthusiasm for making is increasing and the value of manufacturing is becoming increasingly evident in cities, the topic remains extremely complex and challenging to manage. This book attempts to shed light on the ways manufacturing can address urban challenges, it exposes constraints for the manufacturing sector and provides fifty patterns for working with urban manufacturing. This book has been written to help politicians, public authorities, planners, designers and community organisations to be able to plan, discuss and collaborate by developing more productive urban manufacturing.

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