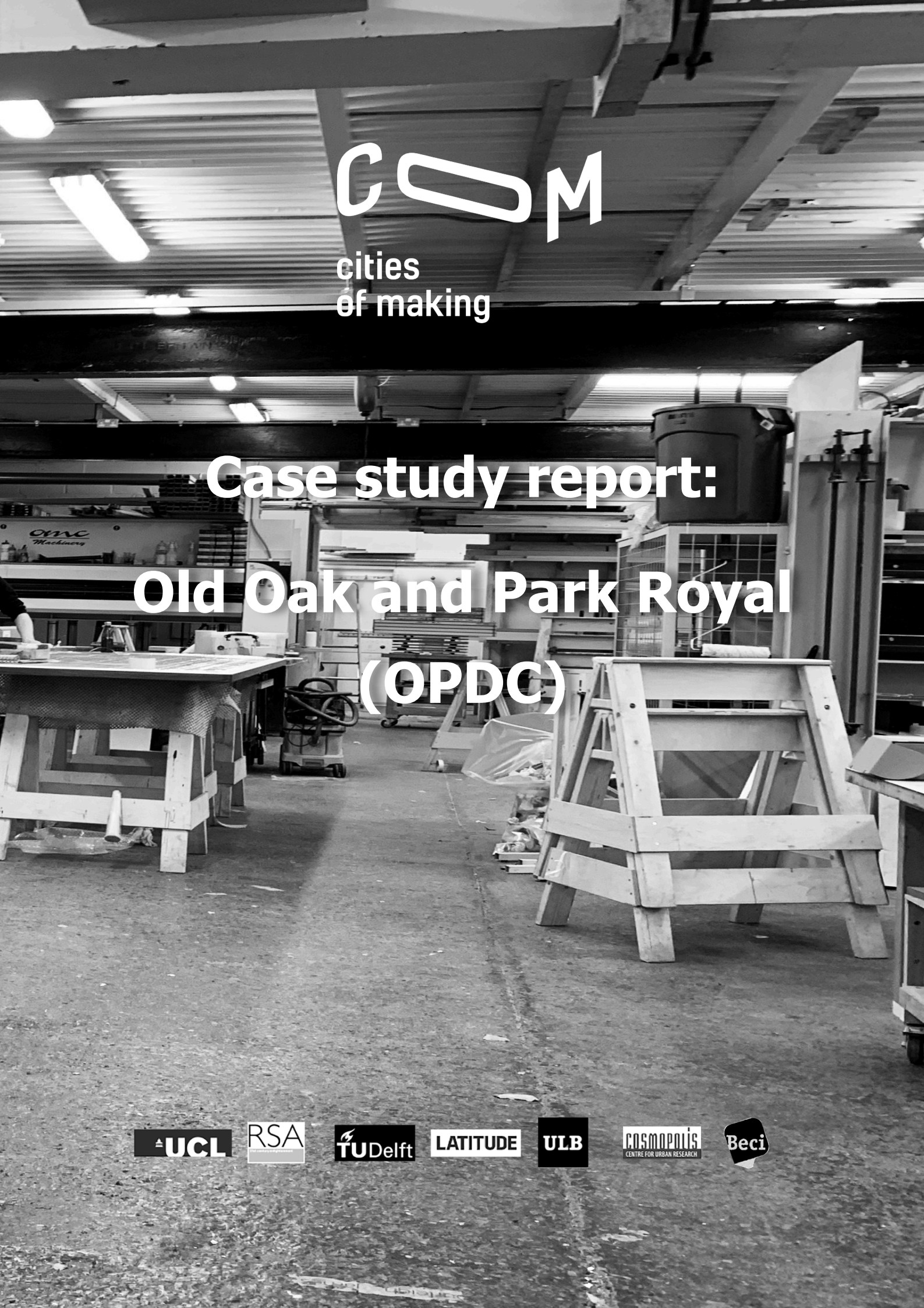

cities
of making

Case study report:

Old Oak and Park Royal (OPDC)

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Cities of Making Report

Case study: Old Oak and Park Royal (OPDC)

Sustainable Urban Manufacturing report

Cities of Making (CoM) explores the future of urban based manufacturing in European cities in terms of technology, resources, place, and application. CoM uses a combination of strategic and action research resulting in concrete projects. Our ambition is to identify what works in supporting a resilient and innovative industrial base and to test those solutions in a real-world setting.

The team: The project brings together a dynamic, multidisciplinary team from Brussels (BECI, Latitude, ULB and the VUB), London (UCL and the RSA) and Rotterdam (TU Delft) – which gather a breadth of competencies in resource and technology, industrial ecology, circular economy, urban planning, governance, strategy, social dynamics and more.

Acknowledgements:

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London, UK, June 2020

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1. Introduction

1.1 Objective

Cities of Making aims to explore the role of urban based manufacturing in European cities in the 21st century. Using a combination of strategic and action research, our ambition is to identify what works in supporting a resilient and innovative industrial base, and to test those solutions in a real-world setting. We will learn from experiences in London, Rotterdam and Brussels – each with a distinct industrial heritage. By the end of the project we will have developed ideas, practices and policies focusing on public authorities (and many other relevant stakeholders) that may drive a new age of urban manufacturing embedded in place, people and locally available resources.

1.2 Research objectives, project goals and planned results

We aim to define the key leverage points that public services in Europe can use to re-industrialise urban areas. This is focused on three main research streams: materials and technology, spatial conditions and transition planning strategies. While find these themes to be significant leverage points, we also recognise and will respond to broader drivers/inhibitors of re-industrialisation, such as: infrastructure, skills, taxation and macroeconomic conditions. Our research base focuses on three European cities; however, we aim to describe findings that can be scaled up across Europe and beyond. The transferability will further be tested inviting also current project partners of related EU projects of the main partners, as H2020 "Repair", to the Wp3 workshops. We will ensure the project remains relevant through ongoing stakeholder engagement (based on successful methods developed within the team), public outreach/communications and regular interaction within the team (face-to-face knowledge exchange). Examples of stakeholders range from local authority planning officers, development organisations, regeneration groups, councillors and elected officials, waste management officials, educators within higher and further education, architects and urban planners, waste management teams, and private-public sector business groups (such as project partner BECI in Brussels).

City level diagnosis for re-industrialisation. Using three cities (Brussels, London and Rotterdam) we firstly aim to have a better understanding of existing urban industry, local policy priorities, a scan of public actors operating in this space, data on available materials, urban capacity to deal with new industry and the development of innovative new projects. We will produce reports (for the three cities and a global trend analysis) for comparative analysis and foundation for the rest of the project.

1.3 Leverage points for re-industrialisation.

Focusing on three key research tracks (governance, materials and technology, and buildings and space) we aim to dig deeper into the building blocks that could catalyse change. Although this will be orientated to the needs of the three cities, the results will offer the foundation for many other European cities. The outcomes will include both applied research and practical Resource Kits. The Resource Kits are a synthesis of the applied research using common language, diagrams and tools to facilitate the discussion on the re-industrialisation process and is aimed at both public services policy makers and practitioners.

The institutional capacity. We will apply the knowledge learnt about the cities and test the Resource Kits on a site in each of the three cities, selected with stakeholders (see letters of support) at an earlier stage. We will explore the structure of the organisation administering the public services which may include established public authorities, a public-private partnership or a development agency. The circumstances can depend on many variables, so we will apply knowledge to three specific sites and produce transition plans as a first practical step. A range of stakeholders will be included in the milestone workshops.

A manifesto for new urban industry. We aim to reduce barriers in re-industrialising urban areas. As industry has developed a negative stigma, we will show how a vast range of technology can be in urban areas by compiling the results of the research into a manifesto. This summarises the outcomes while focusing on scalable opportunities.

1.4 Approach.

The work will be founded in applied research while engaging regular stakeholder co-creation (e.g. through local Question Time-style events, consultation and workshops). Research will be based on empirical city level data while exploring innovative approaches to governance in public services planning policy. We will produce relevant research for academic journals while synthesising results to foster multi-disciplinary stakeholder focused discussions. The project will involve regular engagement, feedback and updates within the group and also stakeholder outreach and communications, ensuring the research results are relevant while the outcomes are spread across the project for public discussion. We will focus on industry that draws upon and feeds back into a city's assets – its workforce, communities, culture and public services.

1.5 Innovation.

This project brings together three critical aspects associated with re-industrialisation. Firstly, while extensive work has been done on industry, it remains unclear what materials (particularly waste) and which technologies are most relevant to re-industrialisation within the European context. Therefore, we aim to clearly describe the state-of-the-art relating to both. Secondly, as old industry has been largely pushed out of cities, more amenable new

technologies are being developed. Yet it remains unclear where innovative industries can be accommodated, so we will explore various suitable urban typologies. Finally, future public services relating to a complex topic such as re-industrialisation require new governance capacities and transition strategies which we will research and apply in three cases.

1.6 London as a case study

London is a highly successful global city. It is the seat of national government and a core part of the UK economy. In 2014, it accounted for more than one fifth of the UK's total GVA output. On a comparable basis, the city's economy is larger than that of many European countries, including Belgium, Sweden and Norway. The region governed by the Greater London Authority (GLA) covers 1579km².

London has a large population of almost nine million, much higher than other UK cities, and this is set to grow to around 10 million in the next decade as migrants are attracted from across the UK and further afield. This is a diverse population, the most diverse in the UK, with a wealth of culture and communities. It is a well-educated population too, with the city topping European tables for levels of tertiary education attainment amongst its residents. Today the city faces the challenge of adapting to continued population growth and accommodating both people and industries. It must also address significant inequality amongst its citizens. Despite its economic success, these fruits are not evenly distributed: a Londoner in the top 10 percent has 295 times the wealth of a Londoner in the bottom 10 percent, and 27 percent of the city's residents live in poverty (after deducting housing costs). If its citizens of tomorrow are to live happy and healthy lives then London must also improve its relationship with the environment, from tackling its serious air pollution breaches to dealing with its waste.

Manufacturing has played a role in the city's economy and society throughout history. Like other UK cities London underwent deindustrialisation in the late twentieth century, but unlike many others it thrived in this new environment and has established itself as a leading global financial services centre. The story of manufacturing in London is far from over, however, and new technologies look set to shape a new chapter.

The London report, published in Dec 2017, and available at: www.citiesofmaking.com, provided an overview of urban manufacturing in London and insights on key trends shaping the sector. The next phase of our research aims to go a step further to provide actionable tools and leverage points for promoting sustainable urban manufacturing in London. The study departs from an in-depth study of three case study areas in London: 1) OPDC; 2) Hackney makers' mile and 3) Tottenham to define an integrative framework which considers three key interacting dimensions: 1) spatial considerations; 2) socio-economic factors and 3) materials and technologies. This report covers the analysis of the work undertaken at OPDC.

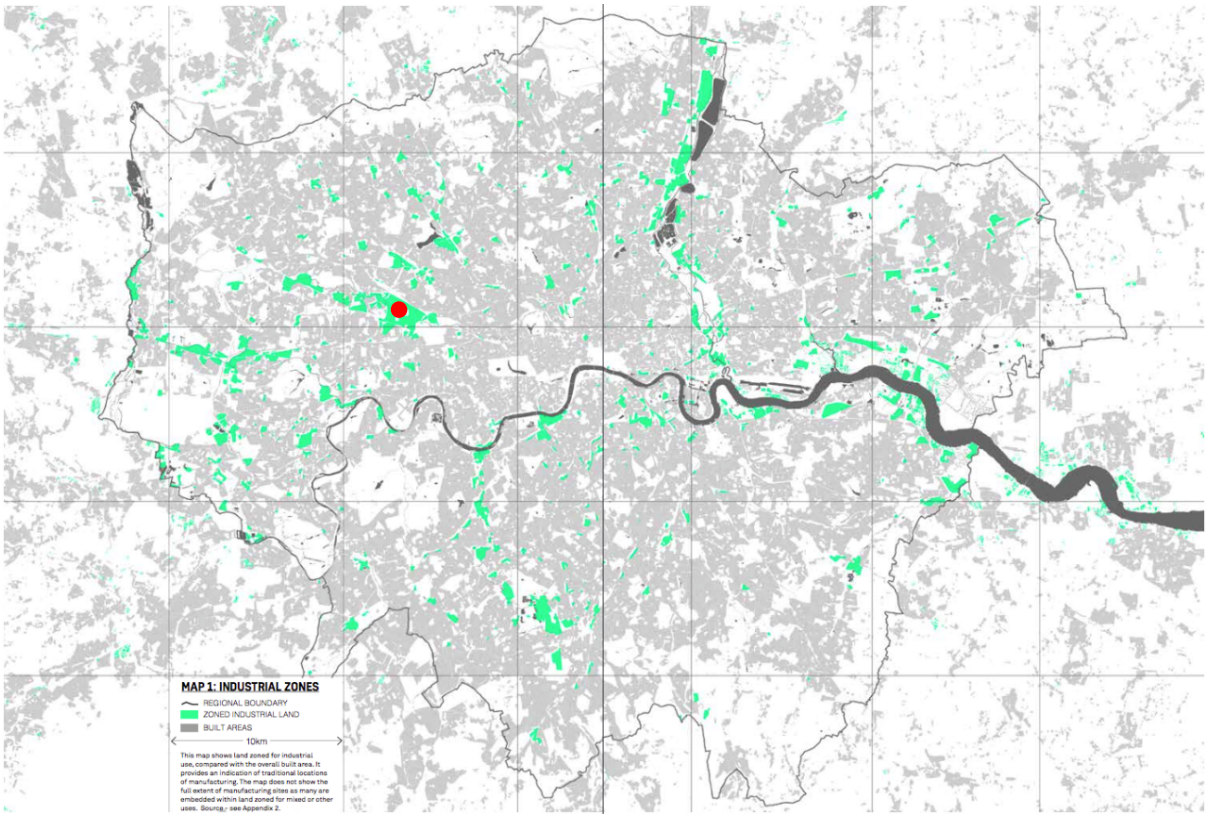


Figure 1.1 Map highlighting the industrial zones of London (in green) and the location of the OPDC (in red)

2. Overview of the research area

2.1 History of Old Oak and Park Royal from 19th century to today

According to the Park Royal Atlas the study area was not urbanised until the 1870s and was composed primarily of open fields crossed by major rail infrastructure (GLA, 2014). By the beginning of the 20th century few housing clusters appeared in the area which was later used for the construction of munition factories during WWI. At that point the industrial character of the area was established, and factories of various productive sectors started appearing as the industrialisation was ramping up. Indeed, by 1932, 73 factories employing an active workforce of 13.500 workers were located in what is now Old Oak and Park Royal a number that rose to more than 45.000 employees by the 1960s as the area was spared from the extensive London bombings of WWII (OPDC, 2016). However, the following decades would see the start of the decline of the industrial sector and with it a large number of factories shut down except fror the larger companies such as Heinz and Guinness which survived temporarily survived yet relocated or closed by the early 2000s. Today, only few of the historical large manufactories remain but interestingly a renewed interest has emerged for Old Oak and Park Royal. Medium to small companies have invested the old industrial sites following several subdivisions of land and buildings. Effectively, the contemporary landscape is composed

majorly by small and medium sized industrial units among an archipelago of larger ones. Still, Park Royal is one of Europe's largest industrial estates, if not the largest. It has been home to household names such as McVities and Heinz, and it is thriving today with over 30,000 people working there in over 2,000 businesses.

The site has very low vacancy rates and demand for space is high. As a key industrial site, Park Royal is one of the city's Strategic Industrial Locations (SILs), and the OPDC plans to retain and improve the area's industrial capacity.

2.1.1 Old Oak and Park Royal Development Corporation and location of OPDC area

In 2015, the Old Oak and Park Royal Development Corporation (hereafter OPDC) was established in tandem to what could be considered the biggest event in the contemporary transformation of the area: the arrival of the High Speed 2 and Crossrail Station planned for 2026 as well as the planned Elisabeth Line. The OPDC was created to amplify the foreseen benefits from these projects by regenerating 650 hectares of land that include the Old Oak Common and the industrial site of Park Royal (OPDC, 2016). The Mayor of London formed the OPDC to manage the development which is only the second corporation of this kind in London, the first being the London Legacy Development Corporation managing the transformation of the former Olympic site in East London. Additionally, it is worth noting that the OPDC is a local planning authority, meaning that they develop a Local Plan for the area and manage planning decisions based on that policy. Within Old Oak, the corporation plans to add 24.000 new homes and 55.000 new jobs as well as enhancing the overall urban tissue by carving new roads, parks and other necessary infrastructure. It has also pledged to conserve the industrial character and function of Park Royal by protecting the existing Strategic Industrial Locations (SILs) and promoting a mixed-use type of regeneration that would combine productive and non-productive land uses in a comprehensive plan (OPDC, 2016).

2.2 Location

As previously mentioned, the area targeted by this regeneration is today (see map XX) one of the largest active industrial zones of London and Europe located within the three Boroughs of Brent Ealing and Hammersmith and Fulham in West London. It is extremely well connected both to Central London and to the rest of the country as the area is served by National Rail, Overground and Tube lines, the North Circular (A406) and Western Avenue (A40). As it becomes clear during this study, the existence of this transportation infrastructure and specifically that of the road network is vital for the optimal operation of the area.

On the flip side however, these massive infrastructures work also as strong boundaries the clearly separate the area from its immediate surroundings. Within the area, the transportation network is composed primarily of a smaller, almost capillary, network of streets that are less well connected to the major transportation infrastructure as they are designed to serve

primarily the manufacturing processes of the area. They were optimised for the productive processes of the first businesses that settled in the area and as such are not optimal for the contemporary mixed-use activity of Old Oak and Park Royal. Many of these streets are indeed very narrow, several end up in dead ends while other have limited accessibility. Furthermore, the very few access points into (see map XX) coupled to the very heavy transportation flows – mainly goods transportation and commuting – traversing the OPDC area result in strong congestion problems both on the outskirts and within the area.

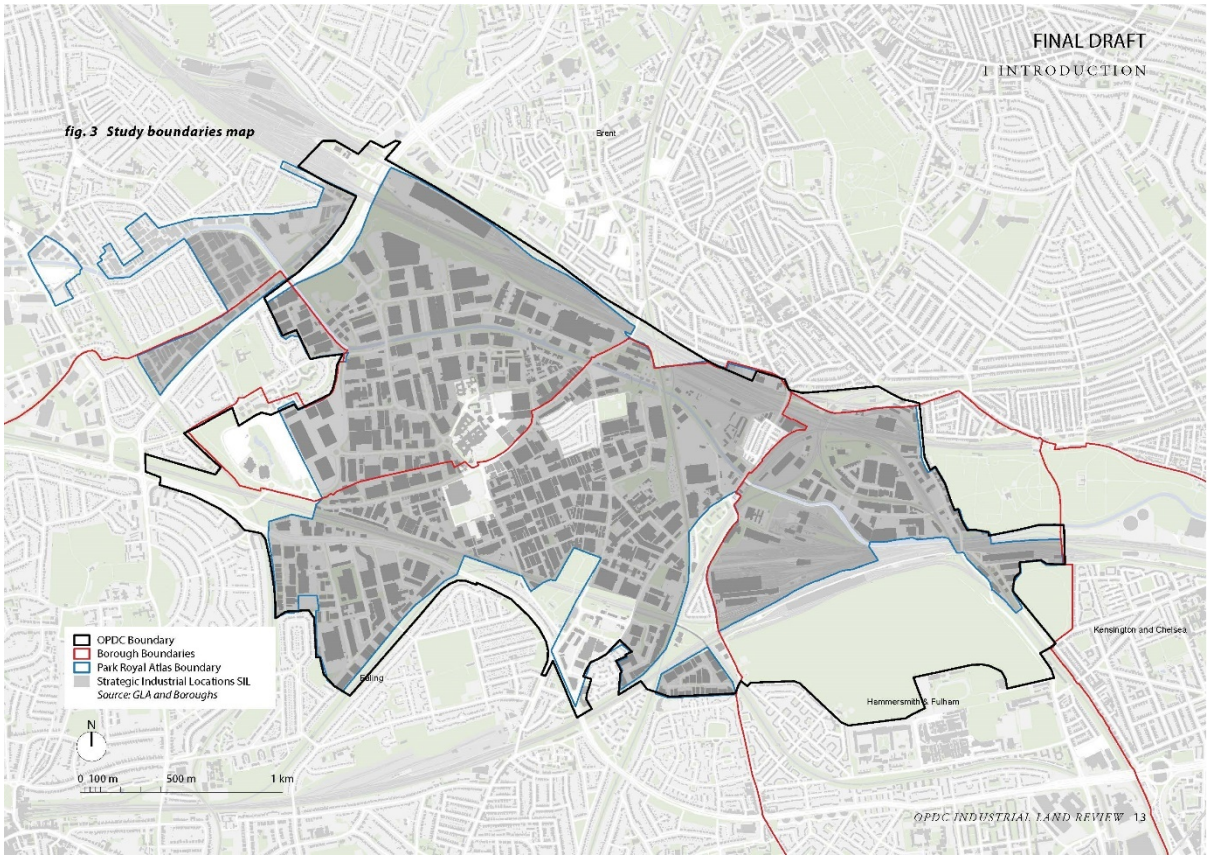


Figure 2.1 Map of OPDC boundaries (Source: OPDC, 2016)

2.3 Building typologies

Aside from the industrial land use a few non-productive clusters exist in the OPDC area including a hospital, houses, supermarkets and a park resulting in a very diversified built environment although predominantly industrial. Indeed, observational work crossed with the accounts from the OPDC (2016) show that only 25% of buildings are not of an industrial type (i.e. hotel and offices, residential, business, vacant land, etc.) whereas the remaining 75% accounts for four major building typologies: standalone warehouses, industrial estates, light industrial buildings, and business centres. Although these types will be extensively looked at during the later parts of this study it is worth to succinctly mention at this point their major characteristics and relation to the built environment.

2.3.1 Standalone warehouses

Standalone warehouses are essentially large industrial spaces that are highly flexible and thus can be fitted to a large array of activities from industrial and manufacturing processes, to storage, distribution centres or transport depots. They are usually invested by a single company (contrary to industrial estates) and maintain their own access, internal routes and office spaces. Furthermore, they are typically implanted within a larger fenced open yard that serves for either parking space or additional storage. This peculiar morphology translates into a porous yet very impermeable built environment where large open areas dominate yet movement is constrained by barriers and fences.

2.3.2 Industrial estates

Industrial estates take various forms from terraced warehouses to clustered small industrial units. Regardless of their morphology however industrial estates are one of the predominant typologies present in the OPDC area as they offer higher density of companies. Similar to standalone warehouses, industrial estates occupy a larger open yard which in this case serves for parking and access to the different industrial units. These units are typically smaller than standalone warehouses and are thus invested by smaller-size companies. Finally, while the boundary between the estates and public space is in most cases clear, access to the inner yard is rarely restricted resulting in a more permeable typology.

2.3.3 Light industrial buildings

Light industrial buildings are either the result of the subdivision of larger warehouses and factories or are single buildings densely packed together along a main street (i.e. Disraeli Road). In contrast to standalone warehouses and industrial estates, this typology does not possess any type of yard for parking or storage which results into using the public space for these functions. The activities located in these buildings are of medium to small-scale light industrial, manufacturing, garages and transportation. From a morphological standpoint this typology is very well embedded in the built environment and does not constrain movement aside from the possible congestion problems it may occasionally generate.

2.3.4 Business centres

Business centres are much larger structures (although some single-storey buildings of this category exist) often older factories and warehouses, subdivided into smaller units and shared among numerous businesses. They are similar to the light industrial buildings in the sense that they do not own yard space and to the industrial estates given the variety of businesses they host. However, their impact on the built environment is much different from either as they work as massive facades along main roads.

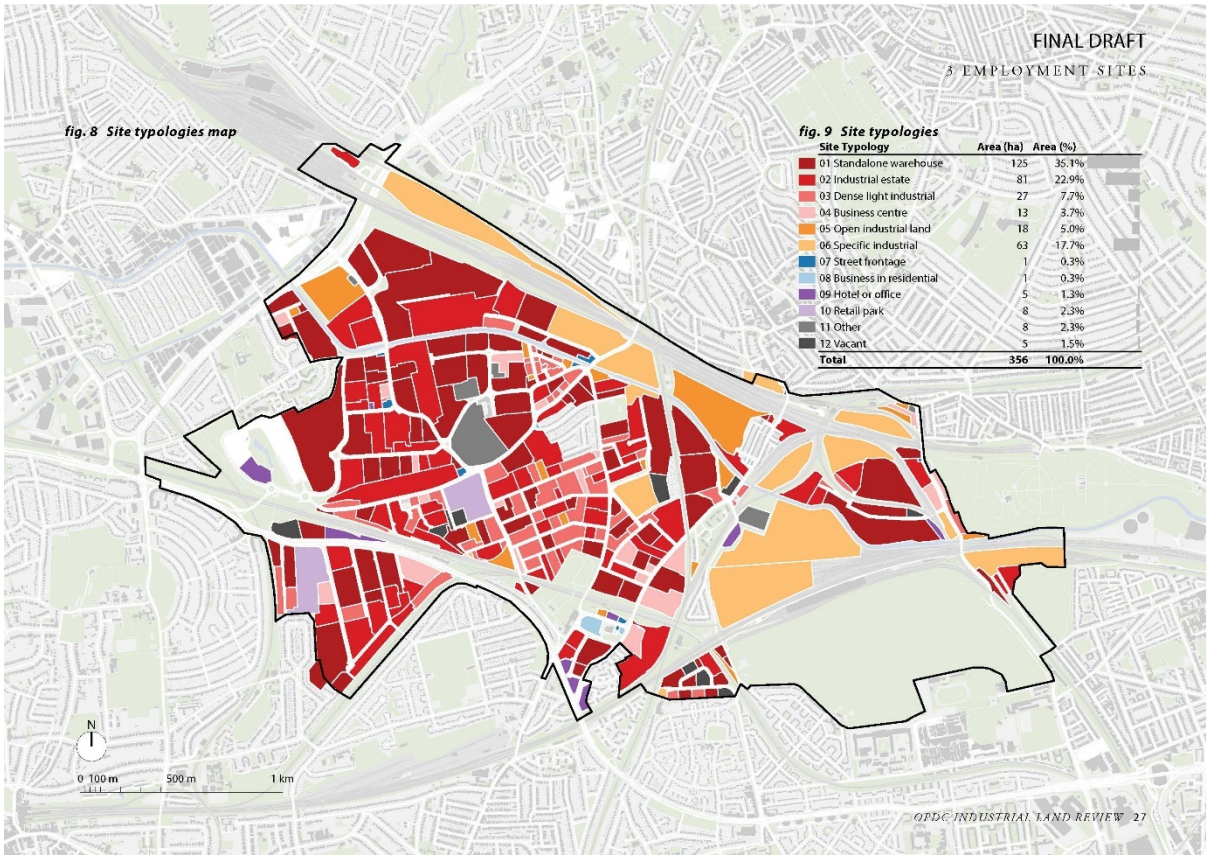


Figure 2.2 Map of typology of buildings existing in OPDC (Source: OPDC, 2016)

2.4 Industrial trades and activities

As it can be expected the range of activities located in the OPDC area are as diverse as its morphology and spread across multiple sectors. Following the thorough investigation of activities, this study has grouped them into 9 key sectors as follows: food and drink; building associated manufacturing; chemicals; clothes and textiles; electronics; wood, carpentry and furniture; printing; transport equipment and lastly, other manufacturing. As the map XX shows (OPDC, 2016) activities and sectors are spread unevenly throughout the area and without any apparent clustering logic. They occupy all the aforementioned building typologies and while some patterns appear to exist, the choice of location seems to be primarily directed by the size of the company rather than the appropriateness of space.

2.5 Census statistics and economic profile

Aside from the interest of its urban form, the Old Oak and Park Royal area is also fascinating when it comes to its social and economic profile. According the OPDC (2016) the study area is employing around 36.000 people among 1.500 businesses that cover its 2.100.000 m2 of employment sites. It is a crucial nucleus of activity in West London that provides jobs to the surrounding boroughs while offering services to the entire Greater London Area. Interviews and census statistics (OPDC, 2016) indeed showcase that while the workers of the OPDC area

live across London the vast majority of them live locally and in close proximity to the area. While this might appear trivial at this stage, it is of great importance when considering the area as part of the broader urban, social and productive networks that compose the city and is a recurring theme of this study.

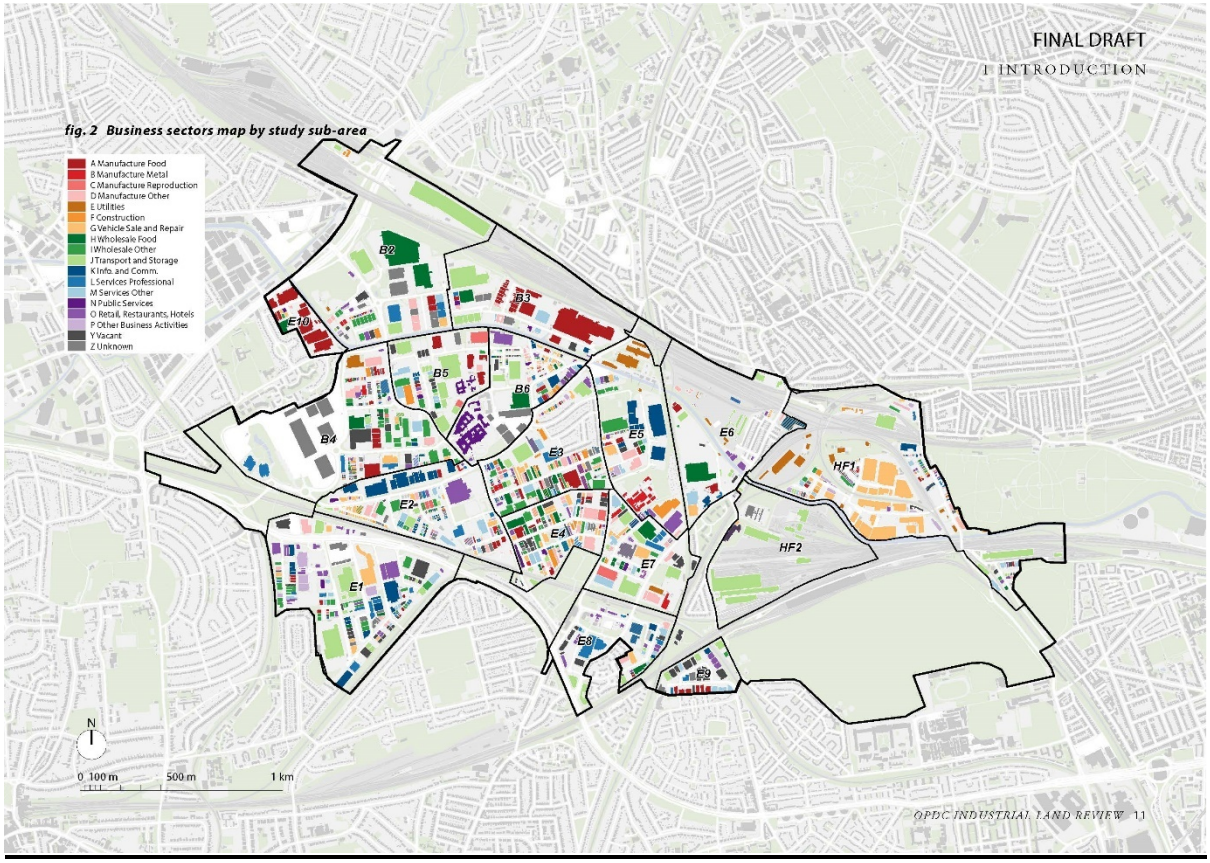


Figure 2.3 Map of business sectors within OPDC area (Source: OPDC, 2016)

3. Study Methodology

This project used a mixed-method approach to obtain primary data and to analyse both primary and secondary data. Primary data was obtained through questionnaires to key relevant stakeholders, i.e. companies' owners, directors or staff. Secondary data was obtained from literature review, online databases, site visits to industrial focus areas, and aerial imaging. The analysis of primary and secondary data was conducted through thematic analysis, network analysis, spatial analysis, material flow analysis (MFA), and strengths-weaknesses-opportunities-threats (SWOT) analysis.

3.1 Secondary data collection: FAME database

Secondary data was collected from the FAME database which allowed to obtain an aggregate of all companies existing in the research area based on their NACE codes (Nomenclature des Activités Économiques dans la Communauté Européenne), a European industry standard

classification system for business activities. First, were extracted all the businesses housed in the NW10 area where the OPDC area is located regardless of their activity. In that sample 7,311 companies were identified. Then, this database was filtered to show the businesses located within the precise postcodes that related solely to the research area; reducing the sample to 3078 companies. Lastly, the database was reduced to show only the companies related to the manufacturing sector based on their respective NACE codes. At this stage were also added the companies found through fieldwork for a total of 253 companies divided into manufacturing sectors as pictured in the table below.

Food and drink		Building associated manufacturing		Chemicals		Clothes and textiles		Electronics		Wood Carpentry Furniture		Printing		Transportation equipment		Other Manufacturing		Total
70		34		6		19		25		28		20		8		43		253
28%		13%		2%		8%		10%		11%		8%		3%		17%		
Alcoholic beverages	4	Concrete	1	Soap and detergents	3	Carpets and rugs	1	Consummer products	2	Carpentry	1	Binding	1	Automotive	3	Extraction / quarring	4	
Bread / Patisserie	13	Electronics	1	Rubber and plastic	2	Clothes	12	Lighting	3	Fitted	1	Book publishing	3	Repair	5	Professional equipment / Machining	4	
Cocoa and chocolate	4	Glass	5	Pharmaceutical	1	Finishing	5	Media	3	Home furnishing	1	Pre-press	1			Jewellery	2	
Condiments and seasonings	2	Marble	2			Weaving	1	Printing	2	Kitchen	3	Printing	11			Musical instruments	1	
Dairy	6	Metal	17					Professional equipment	4	Mattresses	2	Other	4			Toys	1	
Fish	1	Repair	1					Repair	8	Office / shop	6					Repair	11	
Meat	6	Stone	3					Sound production	2	Repair	1					Tobacco	2	
Packaging	1	Windows and dorrs	4					Other	1	Joinery	6					Waste management	8	
Preserving	8									Other	7					Other Manufacturing	10	
Ready meals	3																	
Soft Drinks	4																	
Vegetables	3																	
Other	15																	
	70		34		6		19		25		28		20		8		43	253

3.2 Analysis of secondary data

Secondary data was analysed through the production of maps to identify the potential clusters and location patterns within the research area; network analysis to recognize the connections among industrial trades and industrial activities in the analysed companies; Material Flow Analysis (MFA) to assess the material flows per industrial focus area and per industrial trade; and finally, strengths-weaknesses-opportunities-threats (SWOT) analysis to identify practical and policy recommendations.

Analysis of secondary data included the creation of various diagrams and mappings describing the main inputs and outputs of manufacturing activities as well as the existing or potential relations between companies and/or sectors. This included identification of the main supply chains across local, regional, national and international scales; the description of main waste streams produced by companies of the research area and the management of these flows; and finally, through the investigation of linkages across companies and sectors was explore the potential for realising industrial symbiosis and circular economy opportunities.

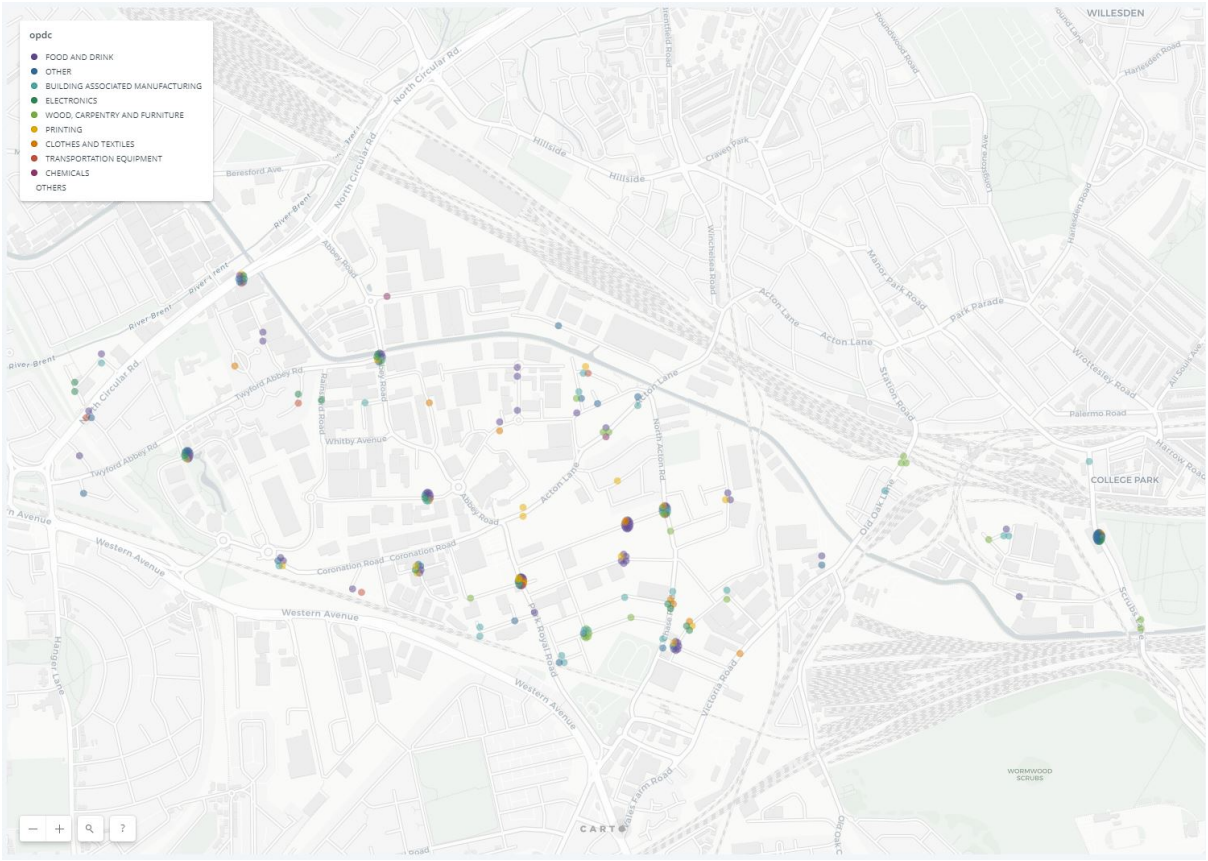


Figure 3.1 showing the location of all manufacture activities in the OPDC area

3.3 Primary data collection: observation, selection of companies and in-depth interviews

The selection of primary data included several site visits, two of which are pictured below. This fieldwork was instrumental in gathering first person information about the area and allowed to interact with the local scale and the finer grained aspects of the case study that were not apparent through the initial secondary data collection. During these visits, informal discussions and photographs were taken to document the reality of the studied area.

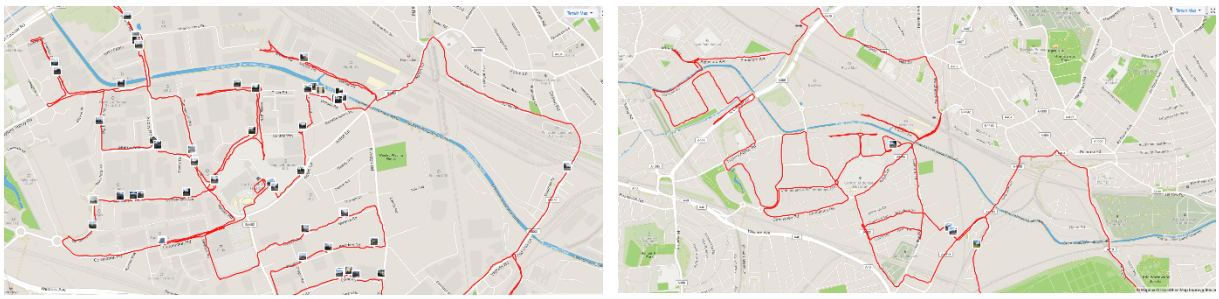


Figure 3.2 showing two site visits recorded using the STRAVA app

Interviews were an inherent process in the research to obtain contextual information. Out of the full sample of identified companies, the aim was to include the widest possible spectrum

of manufacturing sectors present in the area. As such, the amount of companies interviewed per sector was tentatively relative to the size of said sectors.

In total, 17 interviews were conducted as shown in the table below. Companies were either pre-selected and contacted in advance or based on information drawn from the FAME database or from personal research on the field. Through three rounds of emails and phone calls were conducted and 27 companies were contacted in total. Of those, one company agreed to be interviewed. The remaining 16 interviews were unscheduled and conducted during fieldwork without appointment.

FOOD MANUFACTURING

Madame Gautier	Ready meals
Sweet and Tart	Tarts
OREXIS Foods	Dips
Lola's Cupcakes	Cupcakes

WOOD / FURNITURE

James Burleigh	Modern furniture
Bespoke Furniture	Furniture
Zenn Interiors	Curtains
AZCO Interiors	Design furniture
Inspired Elements	Chipwood furniture
La Maison London	Antiques

METAL MANUFACTURING

Porfan Metalworks	Staircases, balustrades, ornaments, railings, etc.
Promet Technology	- Structural steel for new and existing buildings (Offices, Flats, Hotels and Houses) - Large portal frames including mezzanine floors and cladding (Industrial Warehouses, Offices and Workshops) - Trusses - Tubular Structures - Architectural/Feature steel
Big Ferro	Gates and railings

GLASS LAMINATION

Toughglaze Lamination Plant	Glass lamination

STONE	
GMQ Marble	Stone and marble cutting

CREATIVE INDUSTRIES	
APEX House	Various art related activities
Artists' Studios	Art Installations

Interviews covered 7 major aspects of the businesses' condition. Their history; the manufacturing activity itself; space and location; organisation; materials, water and energy; technologies and innovation; and finally, elements of contextual importance (see appendix for the detailed survey). Interviews were informal conversations that lasted from 10 minutes up to 3 hours. The research project was succinctly presented to the interviewees and consent to record the interviews was sought. In the cases where it was not granted notes were taken on the spot.

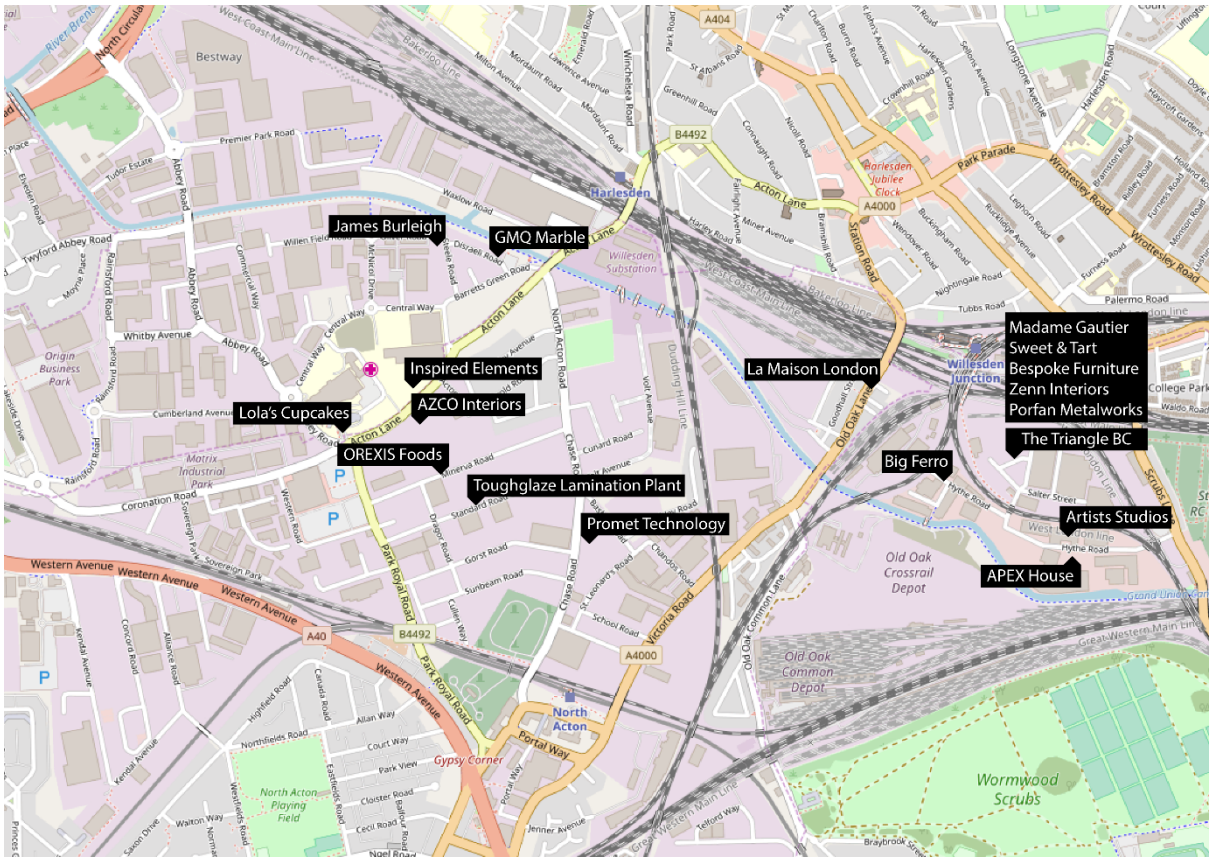


Fig 3.3 Map locating the interviewed companies in the OPDC area.

3.4 Analysis of primary data: interview transcription and thematic analysis

Recorded interviews were fully transcribed, and both transcripts and field notes were then fed into NVivo software to be analysed through thematic analysis. The aim of the thematic analysis was to search for patterns and common 'themes' present in the narratives of the interviewees. The themes were selected inductively before the analysis started and covered – in alphabetical order – architecture building style, context and cooperation, description of activity, employees, energy, history of activity, infrastructure and mobility, location in the city, market, materials, support, pressures and relocation, tech and innovation, waste and finally water.

Figure 3.4 Photographs of the manufacturing building typologies within the OPDC

4. Manufacturing

4.1 Key manufacturing sectors of activities within OPDC

Within the research area the key sectors of manufacturing activities identified are food and drink (28%), building associated manufacturing (13%), chemicals (2%), clothes and textiles (8%), electronics (10%), wood, carpentry and furniture (11%), printing services (8%), transportation equipment (3%), and other manufacturing (17%). Each of those sectors can be further broken down into specialised 'sub-sectors' as it can be seen in Fig 3.1.

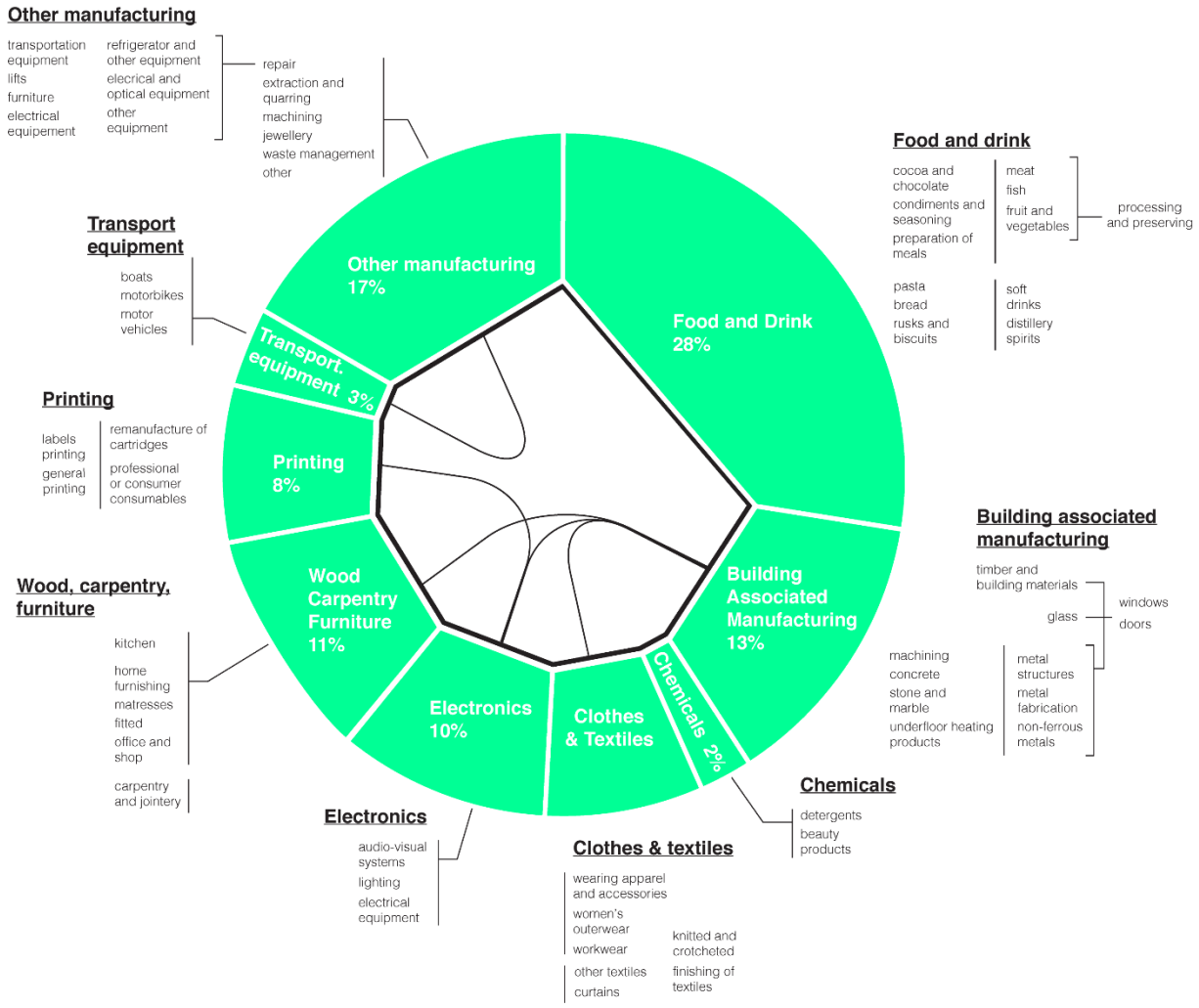


Figure 4.1 Diagram of the manufacturing activities in the OPDC area by sector.

4.1.1 Food and drink

The food and drink sector is the most prominent in the area (28%) and extremely varied. It ranges from very large multi-national companies such as Heinz, McVities, Kolak Snack Foods to big food manufacturers such as OREXIS, Lola's Cupcakes, Bighams, J.PAO & CO, and lastly medium and local producers such as Madame Gautier, Il Fornaio, or Pots and Co.

Consequently, the range of production varies tremendously from vegetables, meat and fish processing, dairy products, patisseries and bakeries, the production and packaging of ready meals, and many catering services. Accordingly, the geography of food manufacturing in OPDC/Park Royal is extremely diverse and ranges from locally sourced, to global supply chains.

Small-scale producers like French traiteur Madame Gautier (5-6 employees trained in house) make fresh ready-made meals sold at farmers' markets across London during the week and weekends. Sweet & Tart is another example of a small-scale artisan bakery (around 15 employees) who specialise in hand making sweet and savoury quiches and tarts. They are supplying to "fine shops", delis, and restaurants in London. On the other side of the spectrum, OREXIS food, a large food manufacturer located in the area for more than 30 years (65 employees from manufacturing to administrative positions) specialise in chilled ready to eat dips (i.e. humus, tarama, cheese creams etc). Their scale of production is massive compared to the smaller companies as they produce around 80 different products and around 16 tonnes of products per day. Lola's Cupcakes, another large food manufacturer operating since 2006 (80 employees) specialise in producing cupcakes and cakes for their retail and online stores.

Interestingly the OPDC area provides appropriate spaces for this very wide range of productive activities which is a key aspect for the success of the area that should be preserved as this promotes a healthier and diversified industrial ecosystem. From a building typology perspective, the large companies are predominantly located in large open floor warehouses where they have the possibility to develop a full line of production (processing, cooking, packaging). The smaller producers seem to be located in much smaller units but of the same open floor typology. Size of space is intrinsically related to the weight of production. However, regardless of size, the products are transported via the road network using refrigerated trucks and vans.

Figure 4.2 Photographs of units used for food manufacturing

4.1.2 Building associated manufacturing

The building associated manufacturing sector is the second largest sector present in OPDC (13%) and includes all activities that are related in any way with construction works. This comprises any types of timber and metal works, stone and marble cutting, as well as the production of architectural elements such as doors, fences, and windows. Interestingly, the geography of supply and market is contained within the UK and mostly in London with very few activities overseas. It is also noteworthy that this sector is the only requiring skilled

employees and all companies train their workers in house. Out of those, the metal manufacturing sector is the largest.

The metal manufacturing sector is the largest among the building associated companies and is composed of medium or large-scale businesses based on their output and market size (rather than the number of employees which revolves around 10-15). The medium size companies such as NSB Casements, Big Ferro or Porfan Metalworks (see interviews) seem to be geared mostly towards fabricating architectural elements like staircases, fences, window frames or balustrades and are active in new constructions as well as in renovation of buildings. On the other hand, larger companies such Promet Technologies however seem to be operating for larger projects and produce structural steel, beams, etc. for larger constructions such as stadiums.

Indeed, Porfan Metalworks established in 1997 and currently counting 14 skilled employees trained in house, started with manufacturing railing gates, small metalworks jobs and slowly we added bigger sizes to eventually specialise in building and restoring staircases, balustrades, and decorative elements. Similarly, Big Ferro a steel manufacturing company counting 10 skilled and trained employees specialises in gates, railings, metal structures, and sometimes we do bespoke metal if the customer wants like a bespoke table. They started in 2015. In the beginning they were doing furniture but later changed to do gates and railings because the market in London is much more geared towards those elements. They count 10 employees skilled or trained in house. Thus, medium-size companies either have the flexibility or are pushed to specialise as the market changes.

In contrast, Promet Technology, a large steel manufacturing company of 20 skilled employees has the spatial, economic and market advantages to specialise in large structural work. They make structural steel, beam work for commercial buildings, hotels, residential, anything that has to do with steel (specifically mild steel). Their work includes fabricating and erecting various forms of steel such as structural steel for new and existing buildings (offices, flats, hotels and houses), large portal frames including mezzanine floors and cladding (industrial warehouses, offices and workshops), trusses, tubular structures, and architectural and feature steel. Again, in contrast to smaller companies, they do not work with a client but instead with large main contractors who appoint an architect and engineer for a particular project. Promet Technology operates therefore more as a stage in the construction rather than on entire projects from start to finish.

Yet, regardless of size metal manufacturing companies are usually located in large to very large industrial sheds with very high ceilings to allow the handling of large and long pieces of metal material. In accordance to the overwhelming majority of businesses and sectors in the OPDC area, all products and materials are transported essentially via the road network on

trucks. This is perceived also spatially as companies tend to prefer buildings and areas with large open spaces in front of their workshops to allow trucks to manoeuvre with ease. From the observational work, the storing of materials seems to be an issue. Companies tend to not store large amounts of raw material within their workshops due to spatial constrains. The ones that did, tended to store metal structures under covered sheds outside their main unit.

Figure 4.3 Photographs of units used for building associated manufacturing

In more niche sectors, in the OPDC area one finds a tremendous array of very specialised companies such as the Toughglaze Lamination Plant. The Toughglaze Lamination Plant is part of Toughglaze (a very large glass manufacturer) and specialises in laminating glass produced by the main company. Laminated glass is a very specific type of safety glass that holds together in the event of breaking hold together by a chemical interlayer of polyvinyl butyral or ethylene-vinyl acetate and as such requires particular machinery and knowledge. In the Toughglaze Lamination Plant the glass goes into the wash first to clean it, then to the cold room where it is sandwiched to put the interlayer depending on customer needs. Then, it goes into the oven which will pre-heat it and then we put it on the trolley. The next day the trolley will put it in a machine to cook the glass over and the next day the glass is cleaned and made ready for the customer. It is thus of no surprise that the 13 employees of the plant are intensely trained in house to ensure the correct handling and processing of the materials.

Given the interdependence between the glass manufacturer and the lamination process, the plant is located in close proximity to the main company to ensure optimal production times.

The last surveyed company of the building related sector is GMQ Marble, a small manufacturing company specialising in cutting and selling various types of stone and marble. They have been in business for only 4 years and count 4-5 employees trained in house showcasing that the OPDC area is not reserved for long-established manufacturers and is still attractive to new companies that value the flexibility, connectivity and character of the area.

Figure 4.4 Photographs of the Toughglaze manufacturing unit

4.1.3 Wood, carpentry, furniture

The wood, carpentry and furniture sector is intrinsically related to the building manufacturing sector and as such shares several of its attributes regarding employees, location, supply and market. Due to its important size however (11%), it is worth a separate mention and a closer look. Within the wood manufacturing sector, furniture making seems to be the most prominent activity ranging from bespoke interior design elements such as chairs and table tops to entire fitted kitchens and bedrooms. Most of the sector's companies specialise in builders' joinery and carpentry followed by bespoke office and home furniture and lastly the manufacturing of fitted kitchens and bedrooms. The geography of supply for this sector is UK based (UK suppliers) but essentially global since most of the wood is not produced in the UK but rather in the US or East-Europe (see interviews). The market of this industry however seems to be once more located essentially in London.

James Burleigh is a prime example of this pattern. They is a medium-scale furniture maker counting 18 skilled and trained employees that specialises in stools, tables, and general office and indoors furniture. Similar to Promet Technology, James Burleigh get specified by architects who honour a project for a client with whom the company rarely deals. Because of this, the end clients are extremely diverse and include the public sector, education, universities, the creative industries, advertising companies, media companies, lots of financial

services, banks, corporations such as BP or COCA-COLA. The development of James Burleigh also illustrates the capacity of companies to adapt to the market and change and the increased possibility to do so in the OPDC area in contrast to other locations in London. The company initially started supplying retail customers who do not exist anymore and so they were pushed into the contract side of the market which is supplying commercial interiors to institutions, public bodies and private customers. According to Mr James Burleigh himself, they moved from the small premises in Kilburn to their current workshop in Park Royal in 2012 where they have the opportunity to expand. The move has given them the chance to employ a good and skilled workforce and invest in machinery as they are the owners of their building. According to our interview it was a necessity because rented premises do not allow to invest in machinery which can't be easily or at all moved.

Moving to much smaller cases, a similar case of relocating to the OPDC area is Zenn Interiors is a small-scale independent company of 4 employees specialising in high-end, handmade curtains. They started in 2006, in West Hampstead but moved to Old Oak in 2013 for economic reasons. They make 'make to order' curtains for clients in Central London and today following the OPDC development plans face one more eviction as their industrial estate is planned to be demolished. In the same industrial estate, Bespoke Furniture is a young small furniture maker of 2 workers located in the Triangle Business Estate in Old Oak that have been active for 2 years and create bespoke furniture such as wardrobes, desks and bookcases for private clients utilising very standard traditional manufacturing processes. In contrast, Inspired Elements are also a small-scale designers and manufacturers of bespoke interior wooden furniture counting 6 skilled employees but in contrast to Bespoke Furniture have automated their entire manufacturing process with CNC machines, laser cutters and informatic design. A feature which works both for productivity and marketing. Lastly, among smaller companies are also found very niche and specialised ones such as La Maison London. La Maison London is a small-scale furniture maker specialising in assembling and finishing tailor made furniture and antiques. They have been in business for 25 years (although they moved to Park Royal only in 2013) and unlike any other company interviewed, they work on a freelance type of employment model depending on the workload. As such their number of employees fluctuates from 2 to 10.

Hence, as it pertains from this overview of the wood, carpentry and furniture sector, company size varies but seems to be essentially of medium scale production. Workshops are therefore very similar regardless of the specialised activity and are occupying medium, single or two-story fitted buildings. It is common for wood workshops to have relatively high ceilings for the handling of their material like the metal manufacturing sector, although not as high. According to the interviews conducted as part of this study, space constraints do not seem to be a major issue for this sector, but observational work showed that the storage capacity of these units is relatively limited.

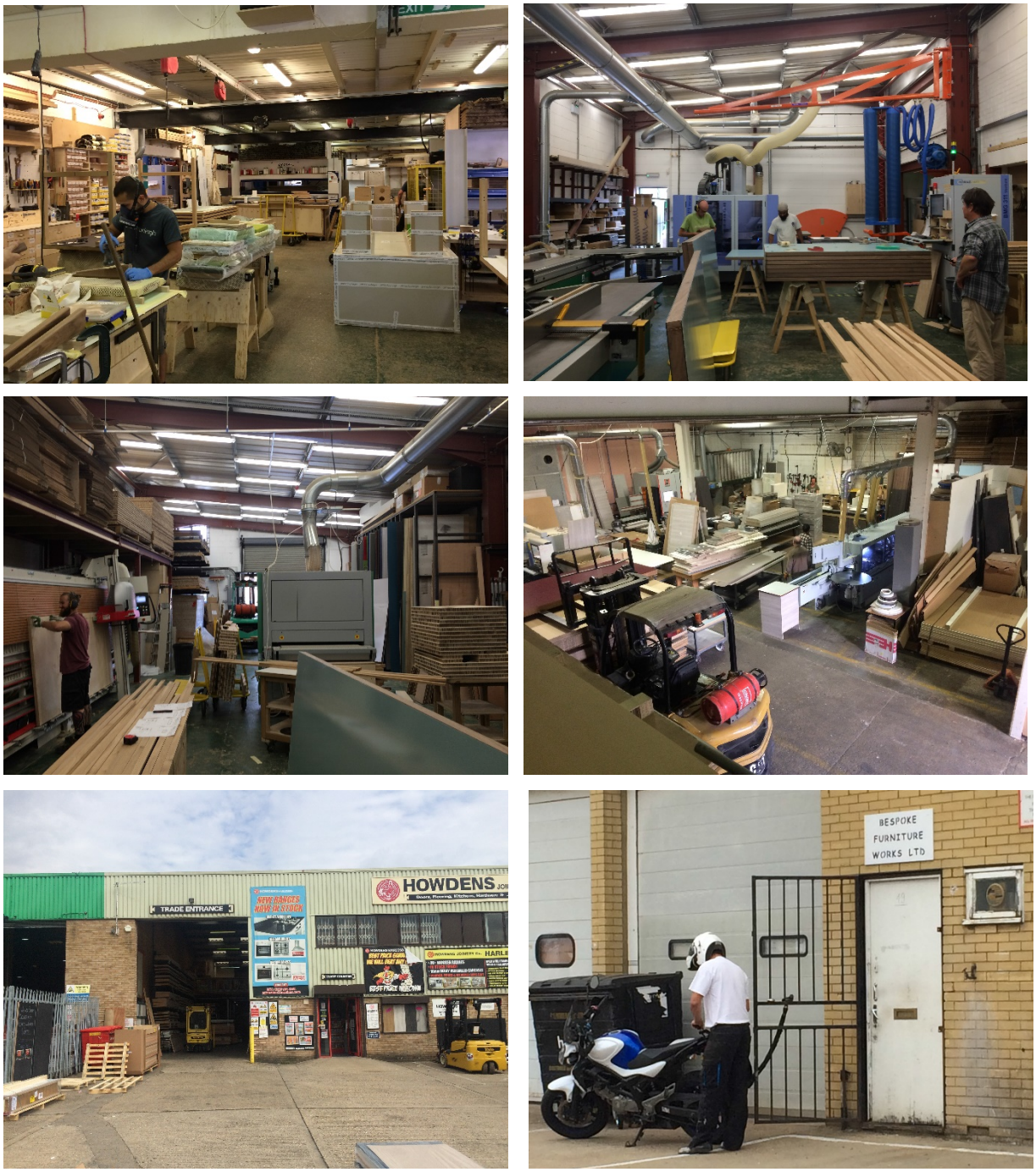


Figure 4.5 Photographs of units used for wood, carpentry and furniture manufacturing

4.1.4 Transport equipment

The 'transport equipment' sector is predominantly related to the repair of transportation vehicles. Although the FAME database did not show a high concentration of such companies in the OPDC area (3%), observational work however found quite an important clustering of such repair shops around Disraeli and Steele Roads – making it the only sector in the area that presented any type of clustering. Repair shops seemed to be specialised in one type of vehicle, either cars, vans, trucks or motorbikes.

These workshops are very well anchored in the area as they are of the oldest industrial units of the OPDC area, thus having a very strong impact on the urban morphology surrounding them. The building typologies tend to be large single-story industrial sheds where the appropriate machinery can fit while still leave enough free space for the manoeuvring and parking of vehicles. It is not uncommon for these companies to informally use the road in front of their businesses as an extension to their yard space for the parking of cars.

Figure 4.6 Photographs of units used for activities related to the transportation sector

4.1.5 Chemicals

The chemicals industry of OPDC seems to be axed towards the production of soap and detergents, pharmaceuticals or rubber and plastic products. It is the smallest manufacturing sector present in the area (2%) and is not especially visible. One reason for this might be that workshops do not need any connection with outside space and are much more flexible on the type of building.

4.1.6 Clothes and textiles

The clothes and textile sector is of medium importance in the area in terms of size (8%). In terms of manufacturing processes however it seems to be very small. Of these two categories (clothes and textiles) the clothing sector is the largest. But companies affiliated to clothes and fashion seem to be predominantly using their space as storage rather than to produce clothes. The textile industry however, albeit being relatively small, is much more extensively related to manufacturing and specifically to the production of household products such as carpets and curtains. Hence, there is a distinction to be made between these two as they are in effect unrelated. The supply geography of this sector is global as materials are supplied from international locations. The market however seems to be contained again within the regional scale of London and limited to the transportation network as goods are transported exclusively by vans.

Depending on the size of the clothing company, their units vary from small single-story units to large multi-building industrial sheds. Being less related to manufacturing per se, the clothing companies seem to be using their space also as a showroom to exhibit their collections. Surprisingly, the interface between their building and the public space does not seem to be especially valued or designed to attract customers. Conversely, the textile workshops are much more contained and located within smaller, fitted industrial units.

4.1.7 Electronics

The electronics sector is very minor in OPDC and related essentially to the manufacturing of professional equipment such as motors, generators, computer components, etc., or consumer products such as general electrical equipment. According to the analysed databases, in the area are located a considerable amount of companies focusing on the repair of electronic equipment (10%). Fieldwork however did not capture any activity related to this sector. Like the chemical companies this might be due to the inexistence of a public-private interface as companies are much more specialised and self-contained.

4.1.8 Printing

Albeit not clearly related to manufacturing, the printing sector is of medium importance in OPDC (8%) and thus worth mentioning. Printing companies specialise essentially in either book publishing or the general printing of products such as tags, adverts, packaging, labels, etc.

Figure 4.7 Photographs of units used for printing

4.1.9 Other manufacturing and artist studios

Other manufacturing as a category encompasses all other activities that constituted less than 1% of the total companies present in the area. Yet, when combined, these businesses add up to 17% of the total and hence are worth mentioning. This category includes activities related to extraction and quarrying, machining, jewellery, waste management, general repair, and other unspecified manufacturing. Of those, waste management is worth investigating further

as several major recycling plants are present within the OPDC area including POWERDAY and Gowing & Pursey and their future is uncertain following the OPDC's redevelopment plans.

Figure 4.8 Photographs of waste recycling

Less directly related to manufacturing, artists are present in the OPDC area and strongly value the more affordable rent compared to Central London and the availability of large studio spaces. Artist studios are the only 'sector' that shows a spatial clustering around Hythe Road. Indeed, APEX House Studios and Hythe Road Studios are two communities of artists operating in Hythe Road since at least 10 years and have seen multiple artists utilising the buildings workshop spaces.

Figure 4.8 Photographs of artists' studios

4.2 Clustering and linkages between sectors and activities

Geographically, there is no apparent clustering of sectors. Instead, companies are scattered within the industrial area and do not entertain any major linkages between them.

Cooperation among companies is extremely limited in all sectors. Only 4 out of the 17 interviewed companies (James Burleigh, APEX Art Studios, La Maison London and Lola's Cupcakes) expressed having some type cooperation with other businesses albeit very light. James Burleigh is working with a photography studio located in the area for advertisement purposes. Artists working in APEX Art Studios share tools and mutually help other artists in the building. La Maison London as a furniture maker cooperates with a specialised company making mattresses, FOAMTech. Lola's Cupcakes is using local car garages for vehicle repairs. To some extent related this, several companies expressed working with contractors especially in the metal manufacturing sector to obtain structures they are unable to construct themselves

But overall, the surveyed companies are self-sufficient and reluctant to rely on other businesses. This could be related to several factors. First, manufacturing businesses are not clustered per sector but instead scattered within the OPDC area and as such any type of cooperation would entail additional logistic costs. Second, could be due to a certain lack of innovation. Companies seem to "do what they were always good at doing" and as such do not have the need to reach out for alternative r new processes. Thirdly, companies are unique in their sector and in the case where they are not, other businesses are seen as competitors. Finally, there seems to be an important lack of establishments such as canteens, restaurants or cafes that would allow to "mix and match".

From the analysis of the secondary data however it is clear that potential linkages could be formed across several sectors with the exception of the food and drink sector which due to its nature remains independent. As fig XX shows and as it will further be explored in the next

section following the mapping of resources and materials used by the companies located in the OPDC area several possible synergies emerge. These include the textile with the wood, carpentry and furniture sectors; the electronics with the building associated manufacturing and the printing sectors; the building associated manufacturing with the wood, carpentry and furniture sectors; and lastly the transportation equipment sector with other manufacturing through the installation and operation of machinery.

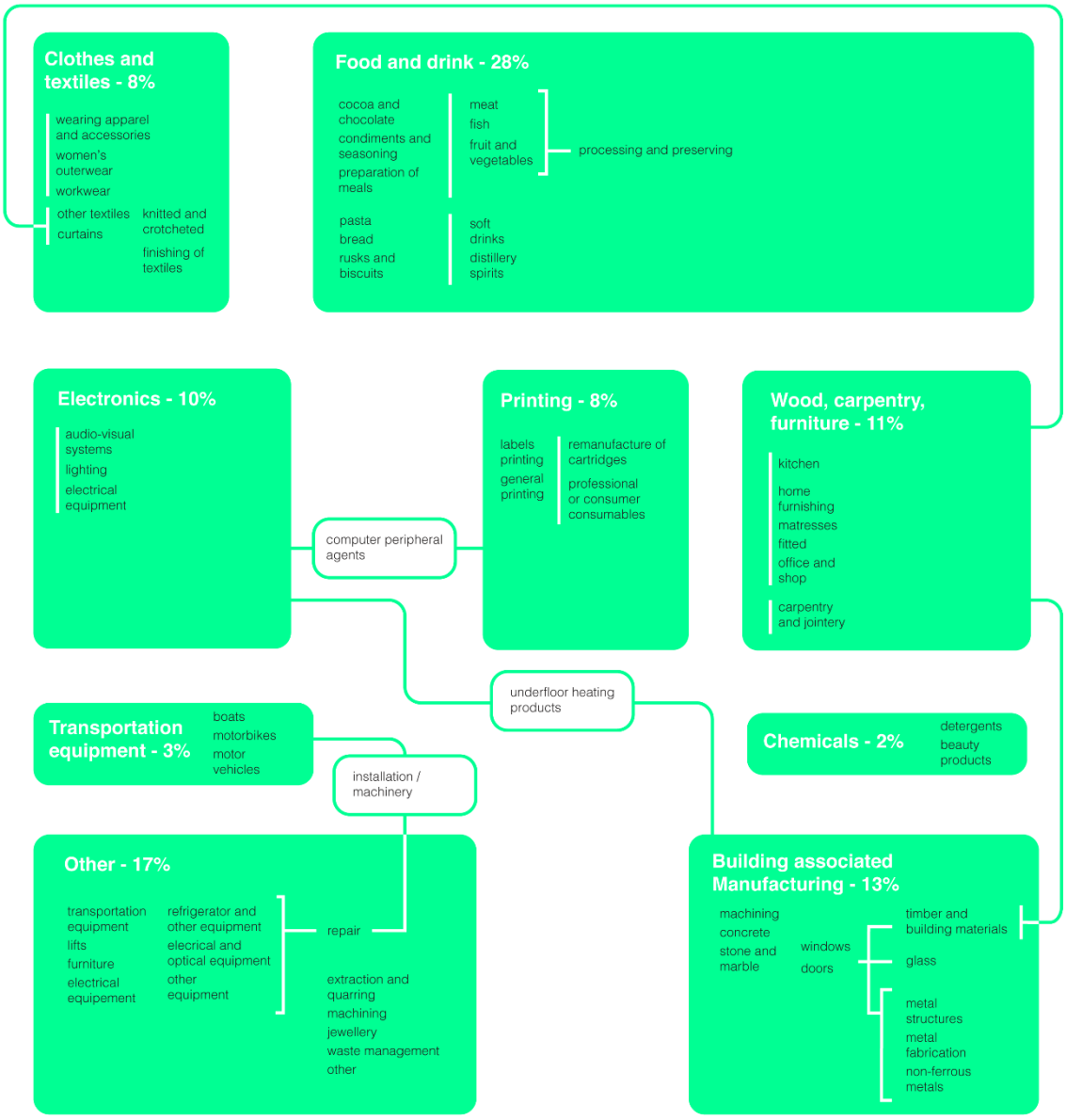


Figure 4.9 Diagram highlighting the potential synergies between the manufacturing sectors present in the OPDC area

5. Mapping of resources and materials

5.1 Location, building typology, infrastructure and mobility

5.1.1 Choice of location

The overwhelming majority of interviewed companies (65% when not counting the creative industries) stated that the choice of their location in the OPDC area was greatly influenced by the geographical proximity of the site to central London and the major road arteries that serve the area. Another key factor is related to the proximity to the interviewees' place of living. Other important factors mentioned were the price (compared to small workshops in central London) and the convenient public transportation network. Adequacy of space was also brought up. Lastly, the creative industries seemed to agree that the sense of community that has developed in and around their workshops is an additional positive factor.

5.1.2 Building typology

The type of buildings used differed greatly depending on the type and size of each company. The size of the industrial units seemed to be proportionate to the size of the company ranging from a few hundred square feet up to 60.000 square feet. Building types fluctuate from single-story low-rise units to large industrial sheds and fitted multi-story buildings.

30% of surveyed companies reported having fitted their spaces to their needs and 60% were content with the amount of space they had at their disposal. The companies that reported space issues were of two categories. On the one hand, the very large companies like OREXIS Food which in their process of expansion have reached maximum capacity or on the other hand manufactures that have to manage products of very large size such as the metal manufacturing businesses.

Lastly, storage space seems to be an issue of medium importance (25%). Companies tend to not store materials due to lack of space but have found ways to work around this issue by optimising their processes. Waste management and recycling is one aspect that some companies have issues dealing with due to the lack of storage space for waste.

5.1.3 Infrastructure and mobility

All companies reported using primarily the road network to transport their materials and goods. Preferred type of vehicle depended on the size of the materials and ranged from cars, vans and large lorries. 17% are using contracted courier companies. La Maison London reported shipping their products internationally through a large variety of modes including containers, boats and airfreight. No company is using the rail network.

Employees of all companies travel either by foot, bus, subway, train, bicycle, or car. No statistics were given but it is estimated that the majority of employees live relatively close to the OPDC area.

5.2 Supply chain and market (local, regional, national, international)

Supply chains of the interviewed companies vary from regional to international. No correlation has been found between the size of companies and the reach of their supply chain and market. Most companies (69%) however are supplying their materials from within the UK at a regional and national scale while 23% are supplying mostly from international sources (remaining 8% are N/A).

The market of the surveyed companies was predominantly UK based and specifically within London (suburbs and central) – 71%. 4 companies (James Burleigh, Porfan Metalworks, AZCO Interiors and La Maison London) are involved with international trade.

5.3 Main inputs consumed by manufacturing activities (including energy, water and materials)

Material inputs depend largely on the manufacturing sector with the only cross-sector input being plastic and cardboard packaging. A breakdown of material sources per sector can be seen below (refer to Analysis Table for details):

Sector	Material Input	Suppliers
Wood / Furniture	Timber, formaica, plywood, paper, textiles, resins, natural materials, metal, decorating materials	International and UK based
Food manufacturing	Fresh foods, frozen ingredients, packaging	Mainly UK for the small companies. International for the massive one (OREXIS)
Metal manufacturing	Steel of various sorts (high grade steel, stainless steel, cast iron)	Exclusively UK based
Glass lamination	PVB (polyvinyl butyral) and ethylene-vinyl acetate (EVA).	N/A
Stone	Stone, marble, natural and manmade	International
Textiles	Various types of textiles	UK based
Creative industries	Various materials, paint, plastics, wood, metal, etc…	N/A

The volumes of the material inputs vary greatly and in majority are not tracked or normalised. One characteristic fact of the metal manufacturing sector is that the total volume used per

week or month varies depending on the size of the ongoing projects. Mostly due to size constraints, metal manufactories do not store material in their workshops.

5.4 Main waste streams

Waste streams depend largely on the manufacture sector. They can be generalised as follows:

Sector	Waste stream
Wood / Furniture	Timber offcuts, wood dust, wood shavings, cardboard, general and factory waste
Food manufacturing	Minimal organic waste, mainly plastics and cardboards from packaging
Metal manufacturing	Metal scrap, offcuts, boards, general waste
Glass lamination	Chemical products (PVB and acetate), general waste
Stone	Stone offcuts
Textiles	Textile offcuts
Creative industries	Extremely varied. Paint, plastics, wood, tape, plaster, metal, etc.

Regarding waste management, companies are equally split between utilising private companies or the council waste management (ratio: 9 council to 8 private). Only two companies (Big Ferro and OREXIS) mentioned actively recycling waste. Big Ferro recycles scrap metals and OREXIS recycles cardboards from packaging. According to the interviewees, the reluctance to more widespread recycling initiatives is linked to high costs and low economic incentives. James Burleigh is currently recycling 1100 litres of cardboard every 2 weeks and is actively seeks companies to recycle their timber offcuts but is constrained by having limited storing capability.

5.5 Energy and water

Water in the manufacturing process is only used by the food manufacturing sector for cooking and by the stone sector which use water to contain the stone dust during the cutting process.

Energy-wise, electricity is predominant with 100% of companies using it, followed by gas either for metal welding, wood burning and cooking (35%) and air in the process of food production (5% - i.e. one company) as shown in the table below.

Company	Energy use
James Burleigh	Mainly electricity, gas, boiler, wood burning
APEX Art Studios	Electricity
Bespoke	Electricity
Madame Gautier	Electricity, gas
Sweet & Tart	Electricity, gas

Porfan Metalworks	Electricity
Zenn Interiors	Electricity
Promet Technology	Mainly electricity, gas (acetylene)
Toughglaze Lamination Plant	Electricity
Hythe Road Artists' Studios	Electricity
GMQ Marble	Electricity
AZCO Interiors	Electricity
Inspired Elements	Electricity
Big Ferro	Electricity, gas
La Maison London	N/A
OREXIS Foods	Electricity, gas, air
Lola's Cupcakes	Electricity

5.6 Technology and innovation

35% (6 out of 17) of the surveyed companies reported using some type of technologies in their manufacturing process. Technologies are used across the sectors of wood / furniture, creative industries, metal manufacturing, and food production. The use of technologies requires appropriate training of employees.

Sector	Technology
Wood / Furniture	CNC, laser cut, timber texturing, personally developed tools, automated cutters and indexing systems
Creative Industries	CNC machines, laser cutters, 3D print (not operated in house)
Metal Manufacturing	CNC, laser cut (not operated in house)
Food production	Metal particles detector, barcode tracking system

Out of all companies only Big Ferro reported planning on investing in new technologies in the future by purchasing a CNC machine. GMQ Marble argued that a CNC machine would be beneficial to the company, but the high costs make it impossible for the near future. Lola's Cupcakes although they do not plan on investing in technologies soon, they are excited by the potential of using drones for delivering their products.

Also noticeable was that 2 companies: Madame Gautier and Zenn Interiors (11%) preferred to retain a certain traditional manufacturing process and were not planning in investing in any type of technologies.

Of interest is that companies that cannot afford owning high-tech machines would subcontract external firms to do the jobs. These included Porfan Metalworks and Promet Technology which due to space constrains and the 'messiness' of metal fabrication cannot add high-tech machines such as CNC in their workshops. Artists reported a similar process but of more informal nature. CNC machines, laser cutters and 3D printing are technologies they use occasionally but through mutual contacts on a sharing-type of relation.

Lastly, OREXIS reported using a combination of metal particle detector and a tracking system to ensure their product was not contaminated during the manufacturing process. Traceability allows to take any product they make and have a complete image of where all the ingredients came from, when, where was it produced up to the supplier. Since they use blades that run at 6000reps per minute, there is a possibility that the blade breaks. Hence, all the products pass from metal detectors before the packaging. Everything is recorded, and every 30 minutes checks are conducted. In case traces of metal are found, the traceability comes into play, the batch it came from is identified and thrown away.

5.7 Support, pressures and relocation

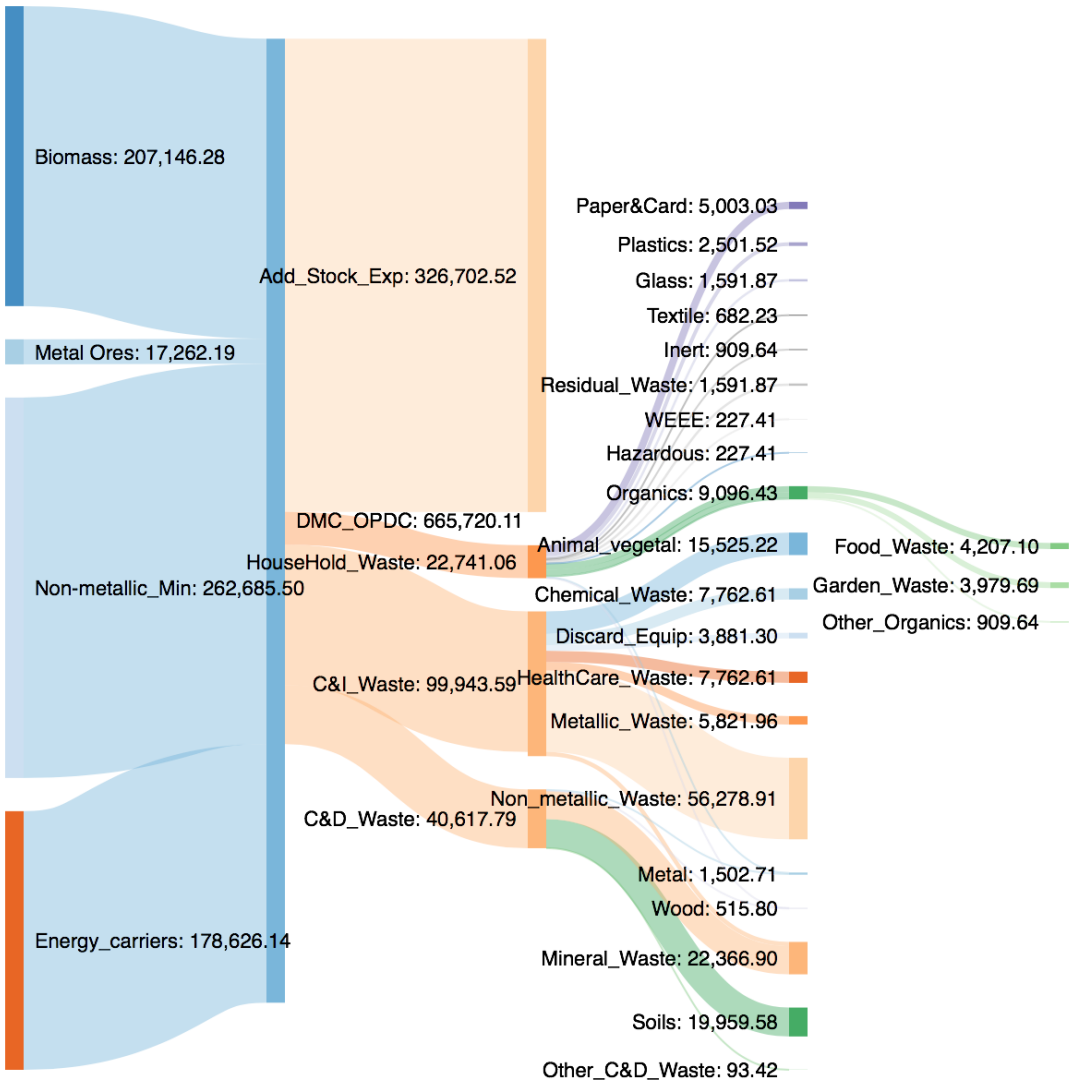
External pressures and fear of relocation was very high for the companies located in the Old Oak development site but null for the ones located broadly in Park Royal.

Company	Site	Pressures and conflicts
James Burleigh	Park Royal	No conflicts, no pressure to relocate. Only pressure is to reach the industry's standards (LEEDS BREAM, ISO 9001, FSC Accreditation)
APEX Art Studios	Old Oak	Constantly affected by the shutdown of artists' studios.
Bespoke	Old Oak	Not at the moment. Signed a five years lease in an area known to be redeveloped by OPDC
Madame Gautier	Old Oak	Pressures from the OPDC development. Would not be able to relocate due to very high costs. Do not take any action for the moment
Sweet & Tart	Old Oak	Aware of the OPDC development not
Porfan Metalworks	Old Oak	Aware of the OPDC development, they have to leave by 2022. They have another unit in Oxbridge where they will eventually relocate
Zenn Interiors	Old Oak	Aware of the OPDC development, very afraid of relocation. Has had to move several times so far.
Promet Technology	Park Royal	No pressures to relocate, no other challenges either regarding manufacturing
Toughglaze Lamination Plant	Park Royal	No pressures or issues

Hythe Road Artists' Studios	Old Oak	Aware of the OPDC plans but confused. They are not looking forward to relocating but don't know what will do yet.
GMQ Marble	Park Royal	No pressures; not affected by the OPDC plans
AZCO Interiors	Park Royal	N/A
Inspired Elements	Park Royal	N/A
Big Ferro	Park Royal	Nothing except manufacturing related challenges
La Maison London	Park Royal	Nothing in particular
OREXIS Foods	Park Royal	No pressures to relocate, BREXIT is affecting them very much on the personnel and the prices of goods
Lola's Cupcakes	Park Royal	No pressures to relocate, labour costs are a significant restriction to the business, no other specific constraints.

Finding staff was not an issue for most companies that replied to that question (63%). Finding skilled staff however was a concern. Madame Gautier was the only company which reportedly had a very big problem finding staff to meet their needs – specifically related to selling in the food markets.

5.8 Material Flow Analysis of OPDC



5.9 Opportunities for industrial symbiosis

Currently, only one company of the sample was aware of potential industrial symbiosis or CE possibilities. This research however argues that industrial symbiosis and CE initiatives could be very fruitful in the Old Oak and Park Royal area given the extreme diversity of manufacturing sectors.

5.10 Investment requirements and infrastructures (e.g. resource efficient and material recovery facilities)

Currently the OPDC area is a net importer of waste. The area concentrates currently seven waste facilities, including waste transfer station, metal reclamation and C&D waste treatment. Most of them are relatively small, with less than one hectare of land, with two main plans: Europe Metal Recycling (4.4 hectares) and Powerday (3.9 hectares). The developed area falls

into the boundaries of the Borough of Brent, Ealing, Hammersmith and Fulham and therefore the OPDC plan needs to ensure that the area complies with the apportionment targets (OPDC Local Plan, 2016). The Boroughs of Brent and Ealing fall into the West of London Waste Authority and they are part of the West of London Waste Authority (WLWA). The OPDC committed to comply with the WLW plan (WLWP) and safeguard two waste sites Twyford Waste Transfer Station; and Quattro, Victoria Road, two waste transfer stations. In the case of Quattro this is safeguarded under HS2 Safeguarding Direction and may only become available for waste management after 2024 (OPDC Local Plan, 2016). The rest of five waste facilities, a total of five, fall within the Hammersmith and Fulham Borough. The Borough's waste plan from 2015 specifies that waste apportionment targets can be met entirely by just one plant, POWERDAY, and therefore this is the only facility that will be preserved in the redeveloped area. The rest of the facilities will be relocated outside of the OPDC area, with Europe Metal Recycling being the first to be relocated to allow for the regeneration of the North part of OPDC.

Right now, this plant mainly treats C&D waste with a small share of C&I waste and MSW (see figure below). The Plan considers that POWERDAY could act as construction waste management facility during the redevelopment and then adapt to MSW, including provision of 'district scale' energy generation in the developed area (OPDC Local Plan, 2016). The overall licensed capacity is 1.6 mill tonnes per annum. However, yearly intakes are in the region of 350 thousand tonnes which means that the plan in operating substantially under capacity. This is partly due to the conditions of the license that specify that about 1/3 of the waste need to be transferred by rail and another 1/3 by the canal. The company is currently not exploiting any of these transport opportunities, with 100% of the waste being delivered by truck.

According to the MFA shown above, total yearly projected waste for the area is 160,391 tonnes. This includes three main types of waste streams: household waste; C&I waste and C&D waste. OPDC operational waste alone thus would be insufficient for maintaining activity at POWERDAY at current levels. However, as noted above, C&D waste by major infrastructural works in the area associated to HS2 and Crossrail and construction activity associated to the regeneration is projected to generate enough C&D waste to work close to full capacity during the construction phase of the project.

The waste plant currently segregates different waste fractions for recycling and produces Refuse Derived Fuel (RDF) from residual waste. RDF constitutes around 22% of the plant current outputs. RDF is a renewable fuel created by shredding and drying out combustible waste (Fang-Chih et al., 2013) with calorific value, which in the case of Powerday, is mainly made up of plastic film, paper, splinters of wood and cardboard. Current RDF produced in the Uk is mainly shipped to the North of Europe, mainly, Sweden, Germany and Holland, but there may be opportunities to use this more locally to generate energy in the future.

Plans for the area include the possible development of a gasification plant. Gasification technology operates in an oxygen-starved environment to produce heat for pyrolysis reactions resulting in the generation of syngas that can be sold or used to generate electricity in the reactor (Young, 2010). This technology is economically and environmentally appealing alternative to avoid landfill (Young, 2010) and has been implemented in other parts of London (Barnett, LSIP). Gasification plants can treat MSW, sorted or unsorted, to convert it into energy. The gasification plant in the OPDC development could work on two main types of feedstock: wood chips from West London and RDF from the waste plant. Combining 29,000 tonnes of wood and 72,218 tonnes produced of RDF generated in the area, the gasification plant could cover around 80% of the electricity demand of the developed area and generate surplus of heat. For this to be feasible, the plant will need to maintain a steady stream of wood waste from C&D fraction or import wood chips from other transfer stations in West London area and maintain its position as net waste importer. Similarly, the current 72,218 tonnes of RDF could represent over 45% of the total waste produced by the OPDC area and therefore would compete with the recycling fractions with calorific value (Plastics, cardboard, paper) which are also more suitable for recycling. Being a net importer of waste in such a densely populated area may create additional frictions, such as congestion and air pollution, especially is waste is delivered by trucks.

The use of composting technologies and Anaerobic Digestion (AD) to treat all organic waste streams in the area could also generate opportunities to recover nutrients and generate biogas and heat and electricity. Anaerobic digestion is a well-tested technology which includes the biological oxidation of organic matter to produce biogas and digestate (Tani et al., 2012). Examples of operative AD plants in London are multiple. The Riverside AD facility upgrades biogas to produce biomethane that is injected in the national grid. producing 550 Nm3 biogas/hr from 36,000 waste (NNFCC, 2016). Small scale AD has also been adopted as community projects in other parts of London. According to our own calculations, presented in the MFA diagram flow above, the OPDC area could be generating around 24 thousand tonnes of organic waste, combining organic fractions from household waste and C&I waste.

6. Recommendations

Based on the empirical work explored as part of this research in the OPDC area a series of recommendations emerge clearly and are categorised hereunder.

6.1 Spatial recommendations

- Preserve the possibility for a large range of activities and company sizes to remain in the same area.
- Do not over-densify

- Most companies need ground floor access and large working spaces
- Shared spaces would not work for the type of manufacturing located in the OPDC area
- Ensure stability of location
- A large variety of building typologies is needed to accommodate the large breadth of activities

6.2 Recommendations related to resource use

- Promote shared networks of supply
- Promote shared networks and clustering of waste
- Develop efficient waste management models and synergies

6.3 Market oriented recommendations

- Cluster activities to minimise transportation flows
- Promote new models of logistic organisation
- Use technologies and automation for the optimisation of market reach

6.4 Technology

- The use of technologies falls largely on the companies themselves
- Technologies should be envisaged however for the monitoring of space and anything not directly related to the manufacturing processes

6.5 General planning policy recommendations

- Promote the construction of clearer and more thorough databases regarding the manufacturing industry (companies, products, waste, etc.)
- Concentrate less on superficial infrastructure such as internet provision and enhance the core structure of the area and its transportation infrastructure
- Consider alternative means of transportation
- Promote the use of new technologies and provide companies with incentives to incorporate them. Companies are limited by their economic situation and are reluctant to invest given the perceived instability.

7. References

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